




Portfolio of Purposes, Methods, Tools and Content: Forming Digital Enablers of NBS

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Appendix 1

Digital Enablers: examples from cities all over the world and key features

Glossary for the present report

The glossary lists and defines key terms as applied in the present report. Due to the specialised topic, some of these terms fall outside the core set of terms applied in URBiNAT more generally. In principle, however, terms are defined in consistency with their meaning in the overall project.

Terms	Definitions
Ambient Intelligence	Relates to user experience, draws on user-centric design and depends on unobtrusive, user-friendly hardware, such as miniaturisation, nanotechnology, on smart devices, and human-centric computer interfaces.
Analogue communication	Data transferred from sender to receiver using analogue signalling, possessing continuous varying amplitude with time. Data such as voice, sound etc., can be transferred this way.
Artificial Intelligence (AI)	Machines capable of continuous learning and autonomous problem-solving, attaining intelligence of their own, in contrast to the “natural” intelligence displayed by humans and animals.
Attributes	A named quality or characteristic inherent in or ascribed to someone or something. Attributes can include personal qualities (e.g., age, gender, level of education, ethnic group), ambient information such as location, or certifications that serve as proof of a given capability.
Authentication and authorisation	Authentication refers to “who is on the other end of the line”, while authorisation refers to “who has “access” or “control” of digital communication.
Behavioural change	The source of issues affecting communities tends to be related to the attitudes and behaviours of people, as individuals and as groups. Solutions thus tend to imply a need of somehow instigating behavioural change.
Building blocks of digital enablers	The present report categorises the main building blocks of digital enablers by way of digital tools, methods, and content, devised for meeting with a particular purpose. These building blocks typically need to match each other/combine to achieve the objective of digital enablers, e.g., by overcoming hurdles or encouraging engagement by citizens and stakeholders.
Challenge-based approach	A central starting point when developing digital enablers is the challenges faced in URBiNAT neighbourhoods.
Citizens	Citizens refer to the individual human beings in this case residing or working in the city, or in the specific neighbourhoods selected for interventions.
Co-creation	Co-creation is a broad term denoting the active participation and engagement of citizens and stakeholders. The term incorporates more narrowly defined terms that characterise more specialised activities, such as co-diagnostic, co-design, co-implementation, and co-monitoring. Co-creation is broader also than co-production, which refers to participation in the creation or assembly of a product, i.e., a good or service.
Co-creation culture	Related to ethics, experiences, human relations, the way people act within a creative environment, process, codes and symbols, behavioural patterns, language and customs, as well as the way communities of practice interact and engage in the world around them.

Co-design	Co-design is about collaboratively establishing action strategies and discussing proposals. Through their facilitation of citizen engagement, digital enablers offer opportunities to enhance urban and NBS co-design.
Community	Refers to a group of individuals making up a collective, generally geographically or culturally co-located, which may be marked by diverse attributes and interests.
Community of interest (CoI)	Group of citizens and/or stakeholders that share a particular interest. In the present context, it refers to a group that may find opportunities to take that interest forward through a joint undertaking.
Community of Practice (CoP)	A CoP represents a framework for collaboration between citizens, stakeholders, partners, or cities, that serves to promote constructive sharing of experience and joint learning.
Content	Content is about turning data into structured meaning that can be framed for messages and interaction.
Cybercrime	Criminal activity either targets or makes use of a computer, a computer network, or a networked device, mostly for profit pursued by cybercriminals or hackers.
Deprived area	Here referring to a district, or sub-area of a city, which is marked by in some sense unfavourable social conditions for its citizens, typically resulting in lower incomes, levels of education, levels of wellness, levels of security, etc.
Digital divide	A persistent gap in the distribution of benefits from digitalisation.
Digital enablers	Usage of digital tools along with complementary methods and content, devised for addressing particular purposes, in support of engaging citizens in co-creation processes related to NBS and Healthy Corridors.
Digital networks	Examples of digital networks include the Internet.
Digital Participatory Platform (DPP)	An online platform developed for the objective to support citizens and government interactions such as co-creation, crowdfunding, participatory budgeting etc.
Digital tools	Digital tools include, e.g., apps, social media, websites, blogs, IoT, GIS, virtual reality, video consoles, and SMS-based services. For functionality, digital tools have to operate within a framework of digital infrastructure and with the support of Big Data, cybersecurity, privacy protection, and so forth.
Digitalisation	Also referred to as digital transformation, is the process of converting information into a digital format, in which the information is organised as bits, i.e., a series of numbers that can be used to describe a discrete set of points or samples (objects, images, sound, documents, etc.).
Disadvantaged group	A distinct group as defined by certain attributes, e.g., in regard to gender, age, ethnic group, level of education, profession, etc., resulting in less favourable conditions as measured by economic or social factors. A disadvantaged group may or may not coincide with a deprived area.
Disinformation	Information that is false and deliberately created to harm a person, social group, organisation, or country (cf., misinformation, misleading but not deliberately).
Diversity	Refers to the variation in attributes, in contrast to homogeneous (may apply among citizens or in a particular local community, or to another context).
Engagement	Physical or emotional involvement. When engagement is accompanied by action, we refer to active engagement, or participation.

Healthy Corridor	A “green and social articulation” in the urban environment, integrating and linking diverse areas using and combining several NBS in support of well-being and neighbourhood regeneration.
Governance	The word “governance” originates from the Greek, “ <i>kubernaein</i> ”, which means “to steer”, thus referring to the manner of steering or directing a group of people, typically referring to significant number and over an extended period of time. Governance is different from “Government”, leaving it open “who” steers, or to what degree control is exercised.
Industry 4.0	Based on IoT, Ai, machine-learning, and digitalisation more broadly, industry that keeps getting smarter and thereby continuously more efficient and productive.
Information and Communication Technologies (ICT)	Refers to all devices, networking components, applications and systems that combined allow people and organisations to interact in the digital world. ICT components include computers, telephones, smartphones, digital TVs and robots.
Internet of Things (IoT)	The Internet of Things refers to the applications of communicating chips and artificial intelligence leading to all kinds of goods and products being wired, i.e., connected to the Internet, and starting to interact more or less autonomously with other things, and with people.
Interoperability	The ability of disparate and diverse organisations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organisations via the business processes they support, by means of the exchange of data between their respective information and communication technology (ICT) systems.
Methods	Methods include, e.g., voting, surveys, competitions, games, interviews, motivational interviewing, rewards, photo-voice, etc.
Nano-surveillance	With increasingly pervasive and intrusive surveillance mechanisms, known as Nano-surveillance, utilizing invisible tags, sensors, and Radio Frequency Identity Chips (RFIDs,) r digital tools vastly improve their capacity to “listen in” on human communication and activity, raising issues of integrity and privacy.
NBS	URBiNAT’s catalogue integrates territorial and technological Nature Based Solutions, comprising products and infrastructures, but also participatory, social, and economic solutions, comprising processes and services, putting in dialogue the physical structure and the social dimensions of public space.
Network	Interconnected group of individuals or organisational unities that may not be geographically co-located but are digitally connected.
Network identity	Context-sensitive identity, attributes, rights, and entitlements, all maintained within a policy-based trusted network framework.
Online	The state of being “wired” and thus able to connect and communicate digitally with people, networks, systems, computers, subjects, or components in real time through the Internet and/or social media.
Organisational interoperability	The coordination of processes by which different organisations achieve technical and functional compatibility in ICT, e.g., to achieve service-related goals.
Participation	Refers to the active engagement of citizens and stakeholders in influencing or developing processes or decisions with a bearing on their neighbourhoods, implicating: i) a spatial dimension; ii) an actual impact (going beyond the mere provision of information); iii) interactivity (involving two-way exchange), and; iv) exchange that is structured in some sense (not just coincidental).

Participatory Geographic Information Systems (PGIS)	A participatory approach making use of geographic information systems, PGIS can be applied in spatial planning and information as well as in communication management of geographical areas.
Public Participatory Geographic Information Systems (PPGIS)	The term implies broad-based informed citizen participation in decision-making, using PGIS. PPGIS focus especially on inclusion and empowerment of marginalised populations with a limited voice in the public arena.
Platform economy	The rise of the platform economy implies connecting supply and demand on new terms using digital means, creating win-win through exchange that by-pass traditional middlemen with less transaction costs. Examples of platform economy applications include Uber, Spotify, and Airbnb.
Privacy-online	The right of an individual to control or influence what information related to him/her and appearing online, may be collected and stored, and to whom that information may be disclosed.
Purpose	Refers to the objective in terms of outstanding challenge or need that the NBS and Healthy Corridors intend to address.
Sharing economy	When assets or services are shared between private individuals, either free or for a fee, typically by means of the Internet. Examples of sharing economy applications include BlaBlaCar and Intervac HomeExchange.
Smart	The term "smart" in conjunction with "city" has been applied since 2008/2009, to denote the adoption of digital tools, sensors, etc., to arrive at solutions that are more relevant and efficient in the local context. "Smart" may also be used to refer to "citizens", "industry", "places", "buildings", "transport", and so forth. The concept of "smart city" may, however, be viewed as an extension of previous approaches to applying "modernism" in urban development, with ancient origins.
Stakeholders	An actor with an interest or concern in a particular subject, here referring to "others" than the citizens themselves, whose engagement one way or the other may influence what solutions can be achieved or maintained.
Strengths-based approach	Focus on the strengths of individuals, social and community networks rather than their deficits. A strength-based approach is typically holistic and multidisciplinary and works with the individual to promote wellbeing.
Surveillance	The observation of individuals, communities, or populations at large for the purpose of information gathering.
Tailoring	Adapting a solution to the specific situation, also referred to as "custom-making".
Virtual Community of Practice (vCoP)	A vCoP is a Community of Practice basically run by virtual communication.
Web platform	Web platforms support virtual interactions between multiple members of CoPs, or VCoPs (if entirely based on digital communication).
Web 5.0	Following the previous generations of the web, Web 5.0 is predicted as the (emotional) interaction between humans and computers.

Purpose of Deliverable

The present deliverable has been framed for the objective of collecting information, analysing and drawing conclusions on the role of “digital enablers” in urban regeneration, with focus on co-creation and participatory processes around Nature-Based Solution (NBS) and Healthy Corridors. The title has been slightly adjusted from the Grant Agreement, to appropriately reflect the properties of the structured framework we have arrived at.

Despite the advance of digitalisation, as observed in business, research, and the development of smart cities or eco-cities, societies and communities struggle to realise the potential benefits. Although the application of Information and Communication Technologies (ICT) does not by itself offer a solution, an important purpose of the report is to widen the perspective and examine what goes beyond the role of technology in shaping and realising the contribution of digital enablers linked to urban regeneration through NBS and Healthy Corridors. In this, the report distinguishes between mechanisms through which digital enablers can add value, compared to conventional participatory means. Further, it covers new ground in identifying and exploring the main building blocks and how they relate under varying circumstances, including through the various stages of co-creation.

The report further highlights the ongoing changes in actor roles and how they link to governance. Related to this, it examines the importance of data management allowing for effective monitoring, comparisons, and evaluation. Further, the report sets out to review and characterise the standing of digital enablers in the URBiNAT cities and to explore ways forward. The purpose includes covering risks and mitigation efforts, and a brief review of the situation brought about by COVID-19 and the associated lockdowns.

A major objective is to provide an overview and synthesis comprising the main impacts, building blocks, and examples of digital enablers, outlining a portfolio perspective on the range of possibilities at hand, and how they can be devised and combined. In this, the report aims to distil key patterns and guiding principles for the applications of digital enablers under varying conditions, as a means of providing guidance and inspiration of relevance to URBiNAT cities as well as more broadly in urban development. Finally, the report highlights the significance of complementarities and capturing synergies at various levels, while avoiding contradictions in effectuating digital enablers to promote participation and co-creation on terms capable of realising the range of potential benefits at hand.

Roles and Objectives in Relation to Other Work Packages

The report draws on several other already completed or ongoing URBiNAT activities. In Work Package 1 (WP1), the Handbook (D1.2), elaborating the theoretical and methodological foundations of URBiNAT, provided useful background. The report takes into account the local

diagnostic (WP2 and WP5), the nature of the NBS to be implemented in the Healthy Corridors (WP4) and how digital tools/applications can support participation at different stages of the co-creation process, drawing on WP2 and WP4, and conducted in coordination with WP5 on Data analysis and the URBiNAT Observatory. Meanwhile, the report forms an inherent part of WP3 and builds on the previous reports, D3.1 and D3.2. The conclusions will be taken forward for direct application in task 3.4, where specific digital enablers will be co-created, piloted, evaluated, and fine-tuned on the ground. From there on, a knowledge-based collaborative platform will take shape, with task 3.5 set to develop a participatory process toolkit for the Healthy Corridor. This will subsequently feed task 3.6 about the amplification of participatory solutions. Further, the results will be applied in the Living labs (WP2), supporting the uptake and benefits of NBS (WP4), be diffused (WP6) and further built upon in work on ways to support innovation and commercialisation, including through policy support (WP7).

Executive Summary

The present report reviews the nature of digital tools and associated elements making up what we define as digital enablers of the participatory processes to co-create NBS and Healthy Corridors. Initially, it reflects on the remarkable diffusion and impetus of Information and Communications Technology (ICT) on all strands of society, along with the reasons why possible benefits in many cases fail to materialise. In urban areas, despite the potential contributions of digitalisation as reflected in the flourishing of “smart” cities, planners continue to struggle with a range of challenges. These include fragmentation and polarisation, with worsening conditions in deprived neighbourhoods, and the exclusion of disadvantaged groups.

Successfully shaping digital enablers in response to outstanding issues requires an understanding from the start of the potential contribution, i.e., the basic rationale for applying them. These include exceptional reach, but also inclusion, targeting, flexibility, interactivity, linking, achieving trust, achieving sustainability of approach, and impacts of governance, depending on circumstances and context. After exploring their strengths and potential impacts, relative non-digital means of instigating participation, we reflect on the associated array of business models under development, including with a view to social innovation and other mechanisms for value-creation and sustainability.

Going beyond the technological aspects, the report considers four main building blocks of importance for shaping the orientation and properties of digital enablers. The *Purpose*, what participation ultimately aims to achieve, is fundamental. *Methods*, such as competition, games, rewards, and surveys, can help initiate as well as support sustainable engagement. *Content* plays a critical role in targeting and securing relevance, especially for disadvantaged groups, taking account of language, symbols and visuals as well as connecting all the elements for a tailored approach. The deployment of digital *Tools*, finally, is not merely a matter of technical specification but their ease-of-use and suitability for connecting citizens. The building blocks need to be framed and combined to match genuine needs and inspire socially relevant solutions in the specific case.

The report further highlights how the value-creation of digital enablers may vary along the stages of processing NBS and Healthy Corridors. The status of digital enablers in each of the URBiNAT cities and their selected neighbourhoods is further reviewed. Providing an overview and synthesis comprising the potential benefits, building blocks, and examples of digital enablers, a *portfolio*

perspective is elaborated, demonstrating the range of possibilities. In this, the report distils natural combinations, matching and synergetic patterns in the applications of digital enablers under varying conditions, as a means of guidance and inspiration for the URBiNAT cities and beyond.

Subsequently, ways forward for devising and applying digital enablers in URBiNAT cities are examined, including by developing and linking parallel Communities of Interest (CoI), drawing on a strengths-based or a needs-based approach. The presence of costs and downsides is reviewed as well, along with measures to overcome them. The agenda to promote citizen participation in support of NBS and Healthy Corridors in itself represents a significant rebalancing act relative the traditional tech-focus and expert dominance of the smart city agenda. Challenges of cyber insecurity, privacy, and data misuse, for instance, require awareness creation, with cities also in the position to foster capacity building through the provision of training and public service hubs promoting open source. The situation that has arisen with COVID-19 and societal lockdowns in 2020, of massive reliance on ICT to maintain communication and support adaptation and organisational change, underlines the need of addressing unwanted side-effects disproportionately damaging vulnerable groups.

In the final part, key take-aways are summed up. It is important to build capacity and frame digital enablers for participation where the needs as well as potential benefits are the greatest. Whether that amounts to using existing digital enablers or co-create new ones is a balancing act where the latter may be more costly but conducive to greater benefits of participation. However, the report stresses the importance of more work to explore the benefits at hand, and notably experimentation, capacity-building, and competence development benefiting from digital enablers, targeting the participation of prioritised groups while preparing for their role in realising Healthy Corridors in support of physical, mental, and social well-being. On a closing note, close attention needs to be paid also to the costs and downsides which may pertain to participation and digital enablers, and how they can be mitigated or overcome, to make room for genuine backing of participation and associated governance reform. The results feed the next stage of co-creation of NBS and the making of Healthy Corridors in the URBiNAT framework.

1. Rationale for Digital Enablers in Support of Engagement and Participation

The rapid development and diffusion of Information and Communications Technology (ICT) through basically all strands of society is widely viewed as one of the most salient aspects of our present-day world. The impacts have been multi-fold and tangible for years, as observed at the level of individuals, organisations, regions, and national states. Yet, the role that ICT plays is complex and the ultimate significance in terms of productivity, quality of life and societal progress, which have been the subject of numerous studies, remains evasive.

With the continued advance of the underlying technology as well as its applications, we have entered the stage referred to as “digitalisation”, typically associated with ubiquitous, seamless conversion of data into a digital format. Much of this development is private sector led and carries an intensive focus on mapping and shaping consumer behaviours for commercial purposes in a wide sense. Other forces exert a strong imprint too, however, including for instance a buoyant

effort by the health sector to make use of digital systems to influence patients and engage them in addressing health disorders. Yet another highly conspicuous manifestation of the digital revolution is the rise of “smart” cities (Angelidou, 2015), which has come to signify the extensive application of smart sensors, smart grids, big-data, IoT, and so forth, to transform the urban landscape through digitalisation.

A partly related agenda, sometimes blurred with that of the smart city, we may refer to as that of “green” cities, or “eco-cities”. Attaining a circular economy, infinite sources of renewable energy, sustainable transport, zero-carbon emissions, etc., have been signatories of this concept, often with reference to a reorientation of technical progress and innovation. Yet, ample of studies have pointed to tensions, with the smart city agenda viewed as dominated by commercial interest while sustainability concerns playing second fiddle. Despite common references to a people-centric approach, questions linger what weight is placed on human and social considerations.

The concept of Nature-Based-Solutions (NBS) sometimes fitted into this realm, but also evolved in parallel, as a practical approach to learn from and build on nature in working out solutions to outstanding problems and create amenities and sources of inspiration of great value to citizens and local communities. Expectations are for them to serve as an engine for sustainable growth, through both public goods and private sector development, through the delivery of high-quality nature-based products, services, and solutions.

For all these elements, however, no outcomes can be guaranteed. This is partly reflective of the profound diversity of technical tools and applications at hand. Beyond this, however, much depends on the quality and nature of people’s engagement, as well as by specific concerned parties, stakeholders, including who is involved and listened to, and who is not. This brings us to the key role of process, and governance, which critically frames the pre-conditions and outcomes of participation and co-creation.

ICT has been partly heralded and partly debated for many years, following the enormously increased reach and interactivity in communication that it brought about from early on. Its role in bringing about what has been referred to as the information – or knowledge – society, has clearly influenced the mainstream perception of what is meant by a democratic or open society. In the place of representative democracy as the predominant expression of influence by citizens, countries and societies around the world have come to embrace the participatory approach, based on the idea that citizens, unstable and diverse as they may be, have a direct role to play in contributing to the decisions and directions staked out for society. This is what has been referred to as e-democracy, as opposed to e-government, where the former has to do with direct participation, while the latter is about the provision of information, and of publicly devised services. Although various factors come into play and influence the actual outcome, the former may be viewed as fundamentally “bottom-up”, and the latter “top-down” (Schmidt, 2008; Lindner et al., 2010).

Given the continued momentum of new applications and rapidly enhanced functionality, digitalisation has gradually been called upon to decisively contribute to more favourable outcomes across multiple domains. This includes virtually any societal and economic sphere, the functionality of institutions, politics, and democratic systems themselves. As noted already, despite the evidence of favourable impacts in many respects, there is also ample despair about downsides, and plenty of uncertainty what to measure and how. In regard to governance systems themselves, sceptics argue that the empirical evidence of digitalisation having enhanced participatory processes and the influence of citizens is largely lacking. Many underline the

presence of risks and downsides, along the potential benefits (Townsend, 2013; Kleinhans et al., 2015).

The present report takes a step back to review the role and potential contribution of digital enablers, with focus placed notably on the co-creation of NBS and, by their extension, Healthy Corridors. Digital enablers can support NBS in several ways, being directly embedded with them or serving to structure and diffuse information on their use and uptake. Yet, their support of participatory processes strengthens the core - and spans much - of the mission to deploy NBS in support of urban regeneration.

In the remainder of this chapter, we next proceed by reviewing the background and context for the issues at stake. Following on from there, we review some of the key strengths of digital enablers, transforming into the rationale for applying them in the first place. Subsequently, we consider the rise of business models applicable to realise their contribution, after which we conclude by outlining the structure of the ensuing chapters.

1.1 Background and context: from technology to participation

The ongoing, technological revolution associated with ICT involves an unprecedented advance of continuous innovations that diffuse across sectoral and national boundaries and embrace new user categories more rapidly than anything we have seen before. Smartphones, for instance, represent the fastest adopted technology of all time (McGrath, 2013; Kemp 2020). ICT exerts a formidable impetus on nations, companies, and individuals, as is visible in institutional as well as behavioural change, along with economic renewal and restructuring occurring at local, national and global level.

As ICT is becoming ubiquitous, the Internet and mobile telephony converging, and also the advance of Big Data, the Internet of Things (IoT), Industry 4.0, and Ambient Intelligence, we have arrived at the state popularly referred to as “digitalisation”. Although narrowly defined as the process of converting information into a digital format, the term is widely used to imply the implementation of seamless digital applications throughout society, propelling massive change to the way data is collected, managed and accessed, implicating greatly enhanced diffusion, ease-of-use, reduced costs and, a changing person-to-machine interface (Kitchin and Dodge, 2011; Manovich, 2013).

Despite the speed with which ICT has spread and the pervasive nature of digitalisation as a general-purpose technology, the economic and societal impact has been far from straightforward and is partly contradictory (Solow, 1987; Van Est, 2014). The fact is, in contrast to previous technical revolutions, that rather than recording increased efficiency, overall productivity levels have been in decline through the ICT era, most notably at aggregate level but also with tempered impacts at industry and micro/company level (Gordon, 2000; OECD, 2019).

This situation has partly been explained by difficulties in measurement, as products and activities have changed so much that comparisons over time were distorted, indicating that ICT achieves enhanced (unmeasured) “quality” rather than what could be picked up in (measurable) “quantity” (OECD, 2020a). A remaining caveat, however, is the realisation that the impact of ICT is far from given, but crucially depends on the way ICT is implemented and used, including complementary effort in research, competency development, innovation, entrepreneurship, organisational change

and regulation (OECD, 2001). Specific issues are at hand with regards to the impact on jobs (Brynjolfsson et al., 2017), translation of technology to social and professional practice (Halford, 2015), income distribution (OECD, 2017), privacy, control, and misuse of data (Pariser, 2011; Roman et al., 2013; Goodman, 2015), the influence of technocrats and vested interests on planning, and also new means offered to populist leaders (Bekkers and Homburg, 2007; Berry, 2011; Kitchin et al., 2017).

Several of these aspects come together in the role of ICT as propelling an enduring, and potentially widening, “digital divide” (Norris, 2001; van Dijk and Hacker, 2003; van Dijk, 2005). The term captures lingering inequalities in the distribution of benefits from digitalisation, caused by differences in literacy, awareness, culture, and so forth. A related phenomenon is the emergence of a “mobile underclass” (Napoli and Obar, 2014). While phones have been credited with alleviating socioeconomic disparities, referring to affordability, safety, and service provision of particular relevance to the poor (Rice and Katz, 2003; Castells et al., 2007), the idea that improving access to ICT for disadvantaged groups by itself could serve as an equalizer fell more or less flat many years ago (Azari and Pick, 2005).

Similar to the impact of ICT more generally, the situation has been ascribed to the presence of confounding factors. Skills shortages among the vulnerable (Norris and Reddick, 2013; Napoli and Obar, 2014) blend with poverty, substandard education, and public as well as private disinvestment. Other performance objectives among experts and government officials coupled with barriers to policy coordination along with administrative hurdles tend to frustrate the development of countermeasures (Friedman, 1973; DiMaggio et al., 2004; Looker and Thiessen 2003; Burkhardt et al., 2014). The insight has grown that addressing the digital divide hinges on a fundamentally changed approach (Kvasny and Keil, 2006; Bertot et al., 2012; Kummitha and Crutzen, 2017). More needs to be done for ICT to be accompanied by strengthened education and training – professional working life relations (Hayden and Ball–Rokeach, 2007; Edwards and Fenwick, 2016; European Commission, 2016a; Patrinos, 2020). Basically, ICT needs to be part of a broader strategy, where a range of policies and measures are taken in tandem to address the root causes of income inequality and the digital divide.

Less salient aspects of ICT require consideration. While ICT and new software development have become integrated into daily life to an extent that makes its use more or less pervasive, i.e., a prerequisite for performing basic professional as well as personal and societal functions, challenges linger. A fundamental question has to do with the rationale for using ICT; what one is trying to achieve? Some of the issues are inherent to ICT, emanating from ease-of-use playing into the hands of commercial exploitation, misinformation, and manipulation (Fuchs, 2009; Halford, 2015; Stehling et al., 2018). Populations less familiar with ICT, and less protected against the downsides, risk becoming increasingly disadvantaged, unless digital infrastructure and/on their literacy can be improved, and the influence of vested interests meet with countervailing measures (Gilbert et al., 2008; Tapia et al., 2011; Lee et al., 2015; Vesnic Alujevic, et al., 2019).

Another prominent aspect has to do with its role in shrinking time and distance, as communication becomes possible in real-time with vast networks of users, irrespective of location. Paradoxically, the local and regional level is strongly impacted as well, due to virtually “everyone” becoming wired and able to access as well as diffuse information. By increasing transparency and facilitating two-way communication on issues in one’s immediate surroundings, ICT potentially invite dialogue in the search of new solutions to outstanding local issues, spurring innovation (Chadwick, 2009; Gelders et al., 2010; Kim and Lee, 2012; Höffken and Streich, 2013; Nambisan and Nambisan, 2013).

The concept of “smart” cities has been coined to reflect the ubiquitous usage of electronic devices in the urban environment to collect, synthesize, process and act upon the vast amounts of information made available in real-time, of relevance to the full spectrum of infrastructure and amenities shaping the city. This includes the daily behaviours and actions of inhabitants. Properly managed, such application of smart devices may widen the scope for identifying what issues are at hand as well as what solutions can be worked out, with implications for city administration, citizens and stakeholders (Brabham, 2009; GSMA, 2017; Brorström et al., 2018).

Typically, the smart city concept is described as reflective of efforts to create an environment that is more open to “[...] practicing user-driven innovation for experimenting and validating Future Internet-enabled services” (Schaffers et al., 2011, p 444). The massive penetration of the concept in city strategies has been clearly documented, including in Europe (Melville, 2013). Increasingly, however, as spelled out by Meijer and Bolívar (2016), the term is applied loosely, with multiple connotations to it. For instance, technologies, people, buildings, and transport may be termed “smart”. Lim and Maglio (2018) characterised twelve smart city tracks. OECD (2020b) presents various typologies for categorising smart cities, e.g., with regard to; i) level of economic growth; ii) stage of urban growth; iii) type of smart city (whether the focus is placed on technology, organisation, collaboration, or experimentation); iv) according to goal, and; types of spatial cluster. Bearing in mind the stark influence of cities’ visions and priorities, which in turn vary starkly, Albino et al., (2015) underline the importance of adopting “integrated approaches”, including both “hard” and “soft” elements.

It is commonly implied that “cities going smart” strengthens the capacity of management to enhance the well-being of citizens. The smaller distance between citizens and the management of cities and regions, compared to the national level (especially in large countries), opens for ICT to be guided by, and respond to, concrete issues and be put to more practical use. Realising this potential, however, is far from trivial (Helal, 2011). Among other things, it hinges on constructive interfaces between the key actors involved. Some speak of processes through which cities become playgrounds for “[...] counter-discourses through a wider discursive engagement of citizens in the development of the smart city” (Grossi and Pianezzi, 2017, p. 84).

Urban planning and development, and city governance more broadly, inevitably meet with a myriad of objectives, dealing with which requires a range of competencies. Often, technocrats and vested interests exert pervasive influence. Considerations to societal and behavioural aspects, on the other hand, may be fuzzy, and lack champions with clout. It may be claimed that citizens are in the “driving seat”, although in most cases the opportunities for being heard have been relegated to filling in a questionnaire or sitting in as a bystander on irrelevant meetings (Thomas et al., 2016; Sánchez-Teba and Bermúdez-González, 2018).

The concept of “smart” cities is sometimes confused with that of ecological or “green” cities. There is scope for strong connections and synergy, but the concepts are far from synonymous. The eco-city, by definition, puts sustainable development aspects at centre stage. In the context of the present report, where the focus is on the use of digital enablers to support citizens’ engagement in Nature-Based Solutions (NBS) and Healthy Corridors, the concepts draw closer. Yet, as we will see, the application of digital enablers for such purposes is not merely an extension of the smart city agenda. In focus here is whether and how the application of digital enablers can generate lasting value, and enhance well-being for citizens more broadly, in disadvantaged communities as well as elsewhere.

Years ago, it was observed that the complexity of cities, although human-made, carry strong features of natural ecosystems (Odum, 1975; Restrepo and Morales-Pinzón, 2018). More recently, the role that NBS may play in urban areas has become the object of serious attention in the context of fulfilling the Sustainable Development Goals (SDGs)¹, highlighting their potential for generating a range of environmental, economic, and social benefits (Faivre et al., 2017; Maes and Jacobs, 2017).

Green urban quality space and associated ecosystem services have been shown to favour both well-being and quality of life, e.g., by promoting physical activity, reducing stress, enriching our senses, providing the fabric for different generations or ethnical groups to share experience or spend time together in an amiable environment (Maes et al., 2013; Cooper, 2017; Kabisch et al., 2016; WHO, 2016; EEA, 2020). There is a common notion as well, that NBS can underpin social cohesion and counter income differences and inequality, including by helping to overcome long-standing problems of exclusion. In practice, whether this is so, is not a given. Empirical evidence suggests such impacts are unlikely to materialise within a given institutional frameworks. Interventions designed to ‘green’ cities may, on the contrary, lead to reduced equity and inclusion due to increased property prices, social pressures, and polarisation (Haase et al., 2017).

A related aspect requiring consideration is that of public space (van den Bosch and Sang, 2017). While NBS potentially enable improved access to green areas for all, for their effective servicing of a public good, their location within a city, especially in relation to vulnerable communities, matter. Additionally, cultural factors, of relevance to mindset, play a big part (Hunter, 2015). Attitudes and perception determine whether citizens experience that they are welcome and appreciated, in essence putting trust and a sense of belonging at the forefront of what is understood by “public space”.

Outcomes in such respects are inevitably influenced by the relationship between city government and citizens (Lombardi, 2011; Somarakis et al., 2019;). Commonly there is a “gap” between the two, in part populated by ‘experts’ – whether public or private sector, or academic, referring to planning as well as implementation (Healey, 1997; Hibbard and Lurie, 2000; Carp, 2004). Some observers refer to a deficit in “democratic rights” (Roberts, 2004), the overcoming of which requires adopting a “human rights-based approach” (Lettoun, 2018). On this basis, citizen participation becomes inter-linked with empowerment, allowing citizens to “have a say” and play a role in shaping their own environment and how they relate to it.

In the present context, however, we proceed further to explore participation as a means – to nail down what specific benefits may be anticipated, which is necessary to gauge the contribution of digital enablers in participation. Further, we attempt to build an understanding, with participation and digital enablers offering expectations of favourable outcomes, why it is that not more deployment is observed? May this be explained by the presence of costs and risks from their deployment, or are other factors at work?

A basic source of benefits from wielding greater influence for citizens emanates from the basic notion that granting them “a say” brings a potential for better outcomes. This is partly a consequence of the information that citizens who live their days in the city, or in a particular district, possess, granting potential value to having that mobilised and channelled into ideas, proposals, and actual city development. Another aspect has to do with the value of opening for better linking between people and places. A third source of benefits emanates from the role of

¹ <https://www.un.org/development/desa/disabilities/envision2030.html>

participation in shaping perceptions and thereby opening for greater appreciation of the outcomes achieved (Van Herzele 2004; Kahila and Kytta, 2009; Greenfield, 2013; Brown, 2015).

The notion of such benefits can be traced back to the Nordic “participatory design” (or “collaborative design”) approach, according to which the engagement of user experience provides valuable insight as well as commitment to the system by those who are to use it (many, at times conflicting, stakeholders enter the picture as well). On this basis, co-design evolved as an umbrella approach for combining the insight of the various actors who are affected by a particular problem (Bradwell and Marr, 2008). Over the years, however, sceptics pointed to lack of: i) empirical evidence that the approach works (Nicholson, 2005), or; ii) clarity when genuine participation actually works as well as when it may fail, as obstacles to nailing down the prerequisites for the approach to succeed (Mitchell et al., 2015; Kristensson and Magnusson, 2002).

Conventional methods to enact citizen participation arose in the 1960s, including a whole range of tools and tactics: referenda, public hearings, public surveys, conferences, town hall meetings, public advisory committees, and focus groups (Rowe and Frewer, 2000). The emphasis used to be placed on “public” participation”, referring mainly to administrative decisions (Creighton, 2005). Here, the concept of participation is applied more broadly to incorporate the overall framework of social and political influence, placing the focus on the ability of citizens and relevant stakeholders to exert an impact on their spatial context in the urban environment.² The term further presupposes two-way interaction and an actual process, although it may be formal or informal, going beyond coincidental exchanges.

Conventional approaches and methods to participation require citizens to be physically present at a particular time and place, raising various issues. Limitations of time and affordability may arise in under-representation, along with an experience of discomfort by some. In the absence of countermeasures, vulnerable citizens, including less articulate groups, may basically be left out (Seifert and Peterson, 2002; Irvin and Stansbury, 2004; Shipley and Utz, 2012).

While co-creation by citizens has always been natural and present in some sense, it has been granted much increased attention in recent years. There is now a notion that co-creation is key to attaining publicly valued outcomes, for instance by identifying and addressing the “real issues” and instigating behavioural change. This may particularly apply to marginalised groups, those who would otherwise stand the least chance of being consulted. At the same time, this implies that those citizens whose participation it may potentially be the most important to attract, are the ones that are the most difficult to engage. They may be willing to do so only under special conditions, motivated on terms that matter to them. They may also be willing to co-create only on specific subjects that are genuinely important to them, while also sensitive to making sure their effort is not wasted by administrators.

Achieving a diverse representation of citizens in urban development meets with challenges (Beebejaun, 2006). In parallel, avoiding or doing away with the dominating influences of specific messengers/experts, involve issues too, that are partly related (Carp, 2004). It must further be recognised that participation, co-creation, and the proliferation of impulses brought about by digitalisation do not come without costs (Bovaird and Loeffler, 2012; Hanna, 2020). Quite a few studies observe that participation can go astray, e.g., inflict administrative costs, open up for more of “me” instead of “us” mentality, counter instead of facilitating professional responsibilities,

² Compare with the concept of “extended peer community”, which is based on the notion that citizens should be involved when “stakes are high, values in dispute and facts uncertain” (Funtowich and Ravetz, 1990).

hinder constructive compromise, and lead to the neglect of more complex considerations, as intrinsic to achieving sustainability. This may in some sense reflect how digital technologies, including big data analytics, profoundly impact on training and professional life, happening across-the-board although with varying manifestations in different fields (Fenwick and Edwards, 2016). Notwithstanding such concerns, digital enablers, while disruptive and hardly superior to non-digital means in a general sense, do open for fundamental opportunities and amendments.

As for citizen engagement, experts cannot acquire insight by themselves in the same way as citizens into what is relevant on the ground. Further, how they relate to, build upon, and translate such considerations into concrete action create an intermediary and distortive layer (Burby, 2003; Laurian, 2003). The corporate world includes many examples how direct influence of customers open for radical improvements of product design and outputs (McKinsey, 2017). Separately, citizens' satisfaction with decisions made tends to be enhanced by their sense of influence (Brown and Chin, 2013). The involvement of citizens may further translate into a better understanding among the public, applying to urban planning as such but also of what is actually accomplished, including the value of nature and public space more broadly (Hawxwell et al., 2018). The resulting influences, when they work out successfully, may help build long-term community support, as future users "inherit" a sense of belonging to what has been co-created (Brody, et al., 2003; MirafTAB, 2003).

What counts is thus not the mere scope of cooperation, in technical terms, for citizens and other key actors to engage and take part, but what the benefits are, and it is worth it (O'Hara et al., 2014). A key question is where to prioritise, "for what purposes", with a view to realising participation capable of attaining results. Arriving at "better" decisions, processes and outcomes is eventually what counts (Patten, 2001).

Whether arising from the initiative of citizens themselves or instigated by authorities, sound participation should be crafted with a view to ensuring certain fundamentals. There is the task of achieving local relevance of an initiative from an early stage (Acedo et al., 2019), as well as to underpin long-lasting value-creation in harmony with local conditions.

Beyond a mandate to co-create, citizen participation, embracing diverse categories including those that may be viewed as disadvantaged, should help better define the issues and implement solutions. Success in this regard entails a shift in mindset, on all accounts, from being "part of the problem" to becoming "part of the solution".

1.2 Rationale for digital enablers

We now turn to revisiting the basic strengths of digital enablers in relation to the core task at hand. The rationale for their application emanates from inherent advantages, bringing various benefits depending on context.

Several possible virtues merit consideration, including reach, inclusion, and targeting. On the other hand, downsides and risks arise as well, taking various shapes. Engaging in participation and co-creation involves certain costs. The same applies to the introduction of digital enablers, as required technology along with competences and organisation inflict some costs that materialise upfront, while there are also indirect and less visible pitfalls.

Meanwhile, users may be negatively affected by information overload, fatigue, mismatches between technical requirements and user skills, and so forth (Picazo-Vela et al., 2012; Gordon and Mihailidis, 2016). For such reasons, digital enablers may not necessarily in themselves provide an answer to outstanding issues. Their application calls for preparatory diagnostic, clarifying the objective, strategy, deliberation of risks and mitigation, and assurance of the ability to execute. In some cases, it will be preferable to abstain from applying digital enablers in the first case, in others, their use may be blended with non-digital means (Castells, 2010).

Next, we proceed towards a framework for shaping digital enablers in support of participation. Extending from there, we review the nature of selected strengths underpinning their rationale.

1.2.1 Towards a framework for supporting participation

The EU eGovernment Action Plan puts emphasis on the opportunities to make use of digital enablers to enhance the quality and reach of public services (European Commission, 2016b). Of critical importance in this respect is to resonate, and plug in, with citizens' awareness and behaviours. CitizenCity, referring to the 'European Manifesto on Citizen Engagement', presents a framework for inspiration towards this end. Here, a Social Engagement Toolkit (SET) serves to guide cities in using digital tools to fulfil their objectives.

CitizenCity refers to advocacy and the promotion of inclusion (irrespective of gender-race-religion, and so forth) as well as the prospects of achieving innovative scalable and sustainable platforms.³ Three basic components of SET are illustrated in Figure 1. First, proper organisation is required. Second, assessment is a prerequisite for building an understanding of how to match issues and solutions. Third, appropriate tools, suitable for adding value, are adopted.

Several forward-looking cities may be viewed as having applied the building blocks of SET in their approach to engage citizens to resolve specific issues, with the help of digitalisation:



Figure 1: CitizenCity SET, toolkit for engagement (IP-SCC, 2019)

³ <https://eu-smartcities.eu/news/set-toolkit-engage-citizens-co-creating-their-cities>

- Drawing on an ambitious strategy for digital infrastructure, **Bristol** constructed tailored agendas to engage citizens and relevant stakeholders in the housing and health sectors, promoting new solutions to damp housing issues, implementing a spectrum of smart sensors and other mapping tools in support thereof. It further mobilised a cadre of volunteers who were trained to assist in working out new ways to deal with the problem (EIP-SCC, 2019).
- In **Helsinki**, citizens used to provide feedback to the government via email or phone calls. A policy was then adopted to develop a comprehensive framework capable of servicing citizens with tailored means how to foster interactive participation, “Plans-on-the-map” and “Tell-it-on-the-map” are two of the resulting digital enablers, devised for citizens to locate and design their own proposed solution in fictional space. The city government further invited citizens to take part in consultation processes via so-called “competition websites” (Saad-Sulonen, 2012).

These examples may serve to indicate how the various components in practice become interrelated and blurred, along with the wide spectrum of combinations that may arise. Having said that, the steps outlined by SET are generally applicable and feature in our framework as well. Part of the challenge is to frame the capacity and approach so as to pursue policies and initiatives that are consistent and capable of capturing synergies in response to major issues, not to be stuck with a compartmentalised and fragmented mode of operation. Depending on the way they are framed and applied, digital enablers may generate value based on their inherent strengths and as manifested through various mechanisms. Next, we briefly review some of the most important strengths, while bearing in mind that they may well be inter-related, perhaps synergetic but possibly also partly contradictory, or conflicting.

1.2.2 Reach and inclusion

Due to the widespread diffusion of ICT as well as the speed with which communication can be enacted, digital enablers have the potential to reach a greater number of citizens/users over a shorter period of time than is the case for other traditional means to promote participation. The proliferation of diverse communication channels, such as the Internet, cellular technology, social media, etc., blends with digital convergence in underpinning growing network effects. The greater the number of people who are interconnected and the lower the costs of access, processing, and diffusion, the greater the potential for widespread reach and inclusion. Increased numbers represent merely one aspect, however. It is critical to bear in mind the importance of value-added emanating from the quality of engagement.

Many applications operate not just at individual level, but target communities, or linkages, possibly between diverse sets of actors. For instance, “Smarticipate” exemplifies a digitally enabled service which brings together citizens, stakeholders, experts and decision-makers for balanced influence, using open source run on an inclusive digital platform. It has been applied in cities such as Hamburg, Rome, and also the Royal Borough of Kensington and Chelsea, London. Reportedly the results thus far have been highly beneficial, with a growing proportion of citizens engaged in sharing valuable ideas and actively participating in taking their neighbourhood forward (Smarticipate, 2019). Digidim⁴ offers another example, running on a digital platform using

⁴ <https://decidim.org/>

open source and devoted to bottom-up processes as a replacement for top-down technology-driven ‘fixes’, where community engagement is facilitated by local councillors.

As we have seen, social media networks as well as smartphones – and also simpler mobile telephones (now accompanied by numerous apps and other functions) – have come to combine a stunning reach among the world’s population with increasingly significant functionality and services attainable at prices that are affordable to most. This remarkable shift in accessibility is matched with a deepening “any-time, anywhere” user sentiment that has come to embrace growing number of people, adding to the scope for wide-ranging influences.

Yet, as noted, the diffusion and ability to make use of ICT is in itself subject to a significant divide. Due to pre-existing conditions, i.e., in regard to infrastructure, skill, technology, organisation, etc., ICT keeps being associated with an expanding gap in information and incomes. The need of explicit countermeasures has been acknowledged since decades (OECD, 2001*b*; Cantabrana et al., 2015). Clearly, reforms and initiatives focusing squarely on ICT do not, in themselves offer a solution. To make a difference, technology, by way of smart devices or manifested in other ways, must be accompanied by other elements.

1.2.3 Targeting, flexibility, and interactivity

Digital enablers may not only achieve massive reach and inclusion in general but feature great scope for targeting, flexibility and interactivity. They may help frame and effectuate communication that is tailored to individuals, or specific groups, identifying and responding to their interests. They may be devised so as to help motivating learning, deepening core skills, widening their perspective, or overcoming misunderstandings and sources of conflict.

The application of digital enablers further opens for gradual improvement and calibration, based on testing and evaluation in real time, of the best means to sharpen desired impacts. This may initially be applied in support of participation around individual NBS and, subsequently, their extension and combination in Healthy Corridors. The gradual adaptation of digital enablers through the different stages of a project may also be taken advantage of to focus attention on what critically ought to be resolved at each stage.

These advantages partly emanate from the low cost and ease with which the collection and processing of data can be continuously refined and adjusted. Flexibility is underpinned by the scope for experimental use and gradually improved practice. This is particularly important as the precise needs and issues of the greatest relevance for specific groups cannot be pre-determined or judged objectively *ex ante* based on any given criteria. What is deemed to matter most reflects subjective experience, with the norms and values of various communities taking on a life of their own. The fact that failure has been recorded for so many attempts to apply digital enablers to enact change, as well as also traditional means, should come as no surprise. Exerting an impact on user attitudes and behaviours has, in fact, proven inherently difficult (Wesselink et al., 2011).

Changing established norms through repetition within the framework of established daily routines, even when backed by significant incentives, seldom results in any lasting adjustment. Continuous development work and experimentation, however, notably in the health sector, has identified viable ways forward. Enacting change may well be possible by shifting the perceived context, for which digital enablers can be framed with relative ease (Karppinen et al., 2018). Of relevance here are so-called persuasive systems, which engage users in interactive processes for

the explicit purpose of changing attitudes or behaviour. A key vehicle for targeting in such systems, greatly enhanced through the application of digital enablers, is that of personalisation, through which functionality, content, and services are tailored to fit the needs and preferences of a particular user (see further Section 2.3).

While experience has been accumulated in the specific case of health applications, much work remains to arrive at a well-founded, structured understanding how to devise digital enablers capable of inducing constructive behaviours and societally beneficial outcomes. Mobile apps and social networks have jumped into new spheres of application, subject to intensive experimentation, how to achieve new targets and embrace new user categories. Some of these experiences have been highly fluid and transitory, evading easy measurement and documentation. The intensity with which new user responses and patterns are coming online, nevertheless underlines the potential impact at hand, and thus the importance of framing constructive driving forces for targeted participation.

Today, digital enablers have come to draw on exceptional interactivity much more broadly. Smart sensors, cameras, videos, drones, and digital platforms keep developing their capacity to feed huge volumes of data in various directions, including back to users creating engaging feedback loops. So-called Participatory Geographic Information Systems (PGIS) refer to participatory use of geographic information systems, propelling citizens to engage in spatial mapping backed by big data analysis and various computer services. Messaging using social media platforms and chat bots spur intensive interactivity among rapidly expanding numbers of users irrespective of geographical distance.

1.2.4 Accuracy and adjusting to context and stages

Achieving relevance is not merely a matter of communicating with individual citizens, or categories of citizens. Human interfaces and spatial organisation meet with inherent multi-dimensional challenges. In cities, this has long been reflected in concentration of resources and uneven provision of public service and living conditions (Myrdahl, 1944; Knox and Pinch, 2010). In one way or another, the local context tends to be troubled by conflicting interests, representing part of the root cause why problems persist, in turn mirroring the potential benefits of introducing or leveraging NBS and Healthy Corridors.

For such reasons, broad-based communication may be of limited use, with success dependent on accuracy in terms of targeting more broad-based patterns relevant to understanding and resolving the issues at hand in a particular context. Rather than addressing individual preoccupations, digital enablers may be applied to tackle several interrelated issues, while also bringing a range of diverse actors on board for constructive interface, and collaboration. This implies ensuring parallel relevance in regard to citizens and stakeholders with varying attributes, reflecting differences in their degree of readiness, interests and aspirations. Making this possible may well not be doable in “one go”, but the ability to demonstrate tangible results along the way. One approach is that of initially working with those that are relatively favourably inclined, and proceed from there to convince others, in a step-by-step fashion. Priority may also be given to cases where it is relatively straightforward to demonstrate direct, visible relations between input and output (Andersson and Björner, 2018).

The preparation and introduction of digital enablers in support of participation should typically be preceded by mapping and identifying which actors are most important to reach, why that is so,

and how they may most effectively become engaged in constructive co-creation of solutions. Digital enablers can contribute greatly to the various stages of identifying and addressing such subjects. At the outset, they allow for interactive mapping and analysis to distinguish different categories of citizens and their specific characteristics. This is of importance for determining how to frame digital enablers from the start. Measuring access to digital infrastructure, tools and skills is part of the picture. Digital tools can help gather, examine, and evaluate information on the basic prerequisites for value-creation. This does not merely come about through improved means of gaining insight into the issues and needs confronting citizens, but by realising the actual engagement and influence by the diverse perspectives represented by those who live in, and make up, the city and its neighbourhoods.

Where digital enablers have been tailored and applied with success, however, it does not follow that their use can be extended to other fields, or locations. Complacency in this respect can lead to applications where they do not belong.

Similarly, what works for a while, may not do so in the medium- to long-term, making it critical that monitoring and evaluation are arranged not in an *ad hoc*, static or piecemeal mode. Key is to be receptive to change, to recognize evolution, and also to take into account “the bigger picture”, i.e., to capture how individual projects relate and can either counter or strengthen each other, as is encapsulated in the notion of Healthy Corridors.

As for coping with changes over time, the application of games is a case in point, and devised games are known to have the potential to raise interest or even captivate many users in the initial stage. There is a tendency for the interest in games to wane, however, meaning that excessive or extended use of gamification is likely to make it a lot less effective. Once the game is known, boredom sets in, after which the game is abandoned. A strategy which incorporates strong game-based components therefore must bear this in mind from the start. There must be preparedness, and a way, for the use of games to evolve and renew itself, operating in tandem with the shifting sentiments of users, and also to be replaced altogether, with other means, once the time is ripe.

Open facilitation and stimulation of social processes in support of sustainability attracted special attention in this context (Loorbach et al., (2011). That citizens care more about the outcome if directly involved from early on, has implications for their willingness to engage in urban planning down the road. Citizens’ active engagement, via co-creation, in realising green urban infrastructure and NBS specifically, as well as their extension into Healthy Corridors, will be further motivated when relevance is achieved in tackling the wider issues of fragmentation and polarisation from the perspective of citizens.

1.2.5 Linking

Related to their reach, targeting, and interactivity, digital enablers carry great potential for increased linking between various actors, in multiple ways. On the other hand, online communication is known for being better suited to channelling exchanges between actors who already know each other, compared to establishing new relations. For this reason, enhanced linking between some, can come at the expense of others.

The benefits associated with linking partly materialise with a so-called Community of Practice (CoPs), as developed for URBiNAT, devised for the purpose of breeding exchange of experience and mutual learning. Within the consortium, Zoom and other digital enablers have been

indispensable for communication and coordination. A number of webinars connecting URBiNAT with EU sister projects have also been greatly facilitated this way.

When virtual platforms come to dominate, underpinning virtual CoPs (vCoPs), the means are at hand to manage exchanges with greater number of users, and with greater intensity. Time management becomes more demanding however, with risks of fatigue as well as pressures for conformity, which may lead to a loss of diversity and less inclusion.

The CoP prepared for URBiNAT has been specially devised and structured to promote knowledge-sharing and learning processes between highly diverse actors, reflecting the broad-based nature of the consortium, including its reach beyond Europe (Andersson et al., 2020). Digital enablers provide important functionality, with the introduction of the URBiNAT Observatory as a focal point in terms of managing data, with the capability to upload all kinds of files and operating via open systems. The purpose is to help fulfil the tasks of the project, creating the support environment by way of collecting, processing and making data available for all. Shunning unnecessary lock-in caused by proprietary technologies and/or specific vendors, the URBiNAT Observatory operates well-known open source software repositories. The latter implies active backing of collaborative work with programmes that are modifiable while also able to create and alter content without being constrained by particular tools and/or proprietary vendors (Ferilli et al., 2020).

While the set-up for the Observatory, and the URBiNAT CoP, is partly framed to facilitate sharing data and experience between the participating cities, including by connecting frontrunner cities with follower cities, its objectives reach beyond that, with a view to effective dissemination and diffusion to a range of diverse audiences.

1.2.6 Innovation and community development

Whether citizens and stakeholders are involved in developing new - or appropriately adapting existing - solutions, the task of responding to outstanding issues contains an element of “innovating”, i.e., to realise new ways of dealing with the issues at hand, while also succeeding in gaining sufficient support and acceptance by the relevant actors involved.

Numerous studies have underlined the impetus of ICT on innovation, mostly in the private sector. The ongoing strong uptake by business of data analytics, switch to cloud computing and use of digitalisation more broadly as a basis for transformative change are indicative of private sector lead (Deloitte, 2020). This is very much the case in the bulk of smart city development currently under way, where Nilssen (2019) and OECD (2020a) examine their role in innovation as a mainstay for success. Having said that, business may push for conditions that lean into dominating commercial interests.

The digital revolution makes a massive amount of information available at much greater speed than was previously thought possible, spanning technical options, customer preferences, competitors, external events, etc. Corporations of all kinds can take advantage, as well as academic institutions and civil society, linking to civic engagement or social entrepreneurship. Innovations may take various forms, including social and inclusive, with implications for social cohesion and social change. The source of innovation may likewise come from different directions, including partners and customers, or beyond the tech-commerce realm.

Various individuals and stakeholders may be inclined to impede or distort intended outcomes, as when not feeling “on board” – the so-called “not-invented-here-syndrome”. For instance, citizens in a neighbouring area that may or may not benefit from certain NBS, may adopt a positive stance if invited to comment and add ideas from early on. If not, they may just see risks of congestion or competition with their own facilities.

As expounded in the literature on development blocs, growth poles, regional innovation systems, synergies between different social spheres and complementary competences are of high importance for achieving competitiveness in a particular location (Marshall, 1890; Dahmén, 1988; Perroux, 1988; Audretsch, and Walshok, 2013). The advance of public-private partnership and the “Quadruple Helix” model point to the importance of inter-linkages between sectors as well as different kinds of actors (Carayannis and Campbell, 2009). Inherent to the nature of digital enablers is their potential to establish connections across any of the impeding borders, whether disciplinary, sectoral or national, and to enable participation by a broader range of actors – with a bearing on knowledge exchanges, innovation, value-creation and well-being.

1.2.7 Trust, overcoming bureaucracy and governance

As noted, traditional means of engagement meet with limitations and hindrances, including when it comes to reaching a diverse representation of citizens (Beebeejaun, 2006) and how to avoid arbitrary influence by messengers/experts (Carp, 2004). By helping to overcome such issues, digital enablers may importantly contribute to building trust, as observed in urban planning processes and outcomes (Burby, 2003; Laurian, 2003). By helping to disclose, document and diffuse information and lessons to diverse groups of citizens and stakeholders, digital enablers may increase transparency and, thereby, trust (Seebø et al., 2008; Prabham, 2009; Ertio, 2015).

Related to this, easy-to-use channels can open for citizens to provide feedback, pose questions, or communicate ideas, on a scale that is simply not attainable through non-digital means. The potential difference compared to status quo is likely to be the greatest in so-called deprived areas, and for disadvantaged groups.

Enhanced transparency can further forge trust by underpinning dialogue between actor categories otherwise at odds with one another (Kim and Lee, 2012; Brown, 2015). This may occur through the facilitation of co-assessment of outstanding issues, in the present case by local communities, “neighbours”, on terms that underpin a common identity “on the ground”. This has been observed to accomplish trust and achieve greater buy-in among citizens with the outcomes of urban planning (URBACT, 2019).⁵ Related to this, citizens may gain a greater sense of responsibility, become more motivated to familiarize themselves with the process of urban planning and more willing to accept trade-offs. Taken together, such factors can help build wider and more long-term buy-in and appreciation among local communities for, e.g., public space and joint facilities (Brody, et al., 2003; Mirafteb, 2003).

In the health sector, digitally enabled social innovations have similarly been observed to allow more voices to be heard, creating the confidence to help expose stifling bureaucracy (WHO et al., 2018). Given proper framing, digital enablers were also found to help grow greater receptiveness to divergent points of view, in part by detracting focus from the emitter to focus on the message, thus helping to overcome conflict and strike a deal.

⁵ For other examples how, digital enablers can support governance, by way of democracy, see https://www.rand.org/pubs/conf_proceedings/CF373.html

Trust is a complex concept however, with various underpinnings and issues associated with it. In interpersonal relations, trust is commonly associated with shared goals, loyalty, commitment, and effectiveness, translating into a sense of predictability (Nias et al., 1989). Authenticity, open sharing, like-mindedness, and mutual respect are other typical attributes of trust (Bista et al., 2012). Chen and Hung (2010) referred to “good intentions”, benevolence, competence, and reliability”. In these cases, trust emanates from “knowing your counterpart” which, however, may square poorly with digital communication. Besides, not all people feel comfortable connecting digitally, or possess the equipment and/or skills to do so without effort.

Paradoxically, inter-personal relations do not just fuel trust as indicated, but equally opens for the opposite, namely a sense of not being able to rely on your counterpart, resulting in “no trust”. At times, anonymity may serve as an asset, notably for those whose mere belonging to a certain group is likely to undercut their credibility. An example is that of female entrepreneurs in Southeast Asia, who have experienced a renaissance thanks to virtual connections providing avenues to overcome personalized barriers, spanning from access to skills, flexibility to shift time and place, and deepening customized relations without suffering the trauma of gender stereotypes (The Sasakwa Peace Foundation and Dalberg Global Development Advisors, 2017; GEM-report, 2017). This is a special case of a more general phenomenon widely observed as electronic commerce opening for greater focus on the properties of products, rather than features of the messenger, shifting perspective on the source of trust/distrust.

Conversely, however, failure of operations will undermine and potentially destroy trust. In a situation of crisis, if people are left to the mercy of automatic systems, without access to other people, or a personally trusted connection, the damage will grow further. Separately, the engagement of conflicting interests where they lack interest in compromise, or where some aim for outright derailment of the process, may destroy trust and undercut sound governance (Walker and Hurley, 2004, Elelman and Friedman, 2018). If digital communication paves the way for such mismanagement, again trust will suffer severely.

Whether digitalisation makes bureaucracy more efficient and, even more so, more reliable, is a controversial subject. E-government is often argued to open for a more transparent and rules-based administration (Cordella and Tempini, 2015). Less tied by a command-and-control system, managers may find more room for creative solutions (Goldsmith and Crawford, 2014). When introduced along with workplace organisational change, a shift towards more decentralised solutions has been observed, with problems identified and addressed faster (Fernandez and Moldogaziev, 2013). On the other hand, new rigidities have been observed as well. With reference to participatory processes where citizens engage via social media networks and smartphones, Seltzer and Mahmoudi (2013) observed an increased workload for government officials

Digital communication can help induce trust in other ways. The prospect of consumer complaints being instantly communicated to millions of users by electronic “word-of-mouth”, may account for a disciplining effect and underpin trust (Ismagilova et al., 2020). Conversely, whether ethical dimensions, privacy, security, and consumer protection are properly integrated, for instance in applications of AI, can be anticipated to have a strong bearing on the degree to which they earn trust at the end of the day, resulting in major implications for the digital strategy of developers (Mandal, 2019).

1.3 Business models, value generation and platform economy

The potential benefits of digital enablers require other mechanisms to be at work, which themselves may be upgraded by digital means. Business models and associated value generation are of high importance in this context. In this section we consider these aspects, while paying special attention to the platform economy.

From early on, the literature examining the significance and benefits of digitalisation, highlighted the key role played by software rather than hardware, and the use of ICT rather than the production (OECD, 2001a). Rather than a supply-push of technology and its applications for artificial purposes, gains emanate from demand pulling development efforts towards meeting with outstanding needs. On this basis, from the macro side, digitalisation potentially saves resources and raises efficiency. Digital enablers may help reduce the cost of collecting data and reduce transaction costs. Economies of scale and scope created by faster and more extensive roll-out may generate financial returns as well as socio-economic benefits. Realising the potential advantages may come with restructuring and organisational change, however. A favourable ecosystem, conducive to innovation, entrepreneurship as well as teamwork and synergies between complementary competences, is of high importance. The key business proposition of a new venture will have to match market openings and achieve a vibrant customer base. In the process, it needs to overcome competitors, fill in the "gaps" when it comes to weaknesses while leveraging an edge. It may also usefully take advantage of the knowledge that resides in clients, customers, and citizens.

What the ecosystem has on offer by way of financial instruments and mechanisms similarly matters greatly. Securing adequate financing is particularly challenging in early stages where capital requirements are modest but risks are high. Only idiosyncratic sources of funding (family, friends, and fools) are typically accessible at that point. The resulting so-called "Valley of death" for new ideas, especially potentially disruptive innovations, indicates a source of systemic failure in much of Europe as well as the wider world. In order for a start-up to evolve through subsequent growth phases, diverse sources of funding typically need to be mobilised along the way, including public seed funding, angel investment and private equity investment (Andersson and Napier, 2007). As risks gradually subside, bank lending and IPOs become available for scaling. In many cases, however, access to patient seed funding is too thin or so demanding that potential high-growth start-ups never reach such a situation. The lack of access to alternative sources of funding weakens the bargaining position even of many successful entrepreneurs, which may lead to potential high-growth companies being sold off prematurely, with not nearly enough in return.⁶

The ongoing advance of digitalisation impacts on innovation ecosystems in various ways. This includes the way businesses approach customers and progress their business propositions, or manage resources and risks (Bettiga and Ciccullo, 2019). Crowdfunding, fintech, blockchain, cryptocurrencies and new forms of banking, e.g., retail banking, signify the developments. Figure 2 provides a stylized illustration how crowdfunding and debt-based P2P (peer-to-peer) lending, propelled by digital enablers, may supplement traditional sources of equity funding in the innovation ecosystem. Here illustrated as green clouds at opposite ends of the capital-risk trade-off, they may either enable raising modest but highly engaged capital injections along a firm's

⁶ With the United States presiding over a more fluid financial system, backing both start-ups and growth, potential high-growth firms in other parts of the world are often acquired by US investors

growth-trajectory (linked to creating a client-base, in the case of crowdfunding), or enable access to significant loans from peers at an early stage by building strong business links.

The case for applying participatory methods in support of successful crowdsourcing online has been argued for years (Campbell and Marshall, 2000; Brabham, 2009). Having said that, challenges remain. In the case of Next Stop Design, for instance, Brabham (2013) found issues associated with the digital divide to hamper what success could be achieved. Drawing on the rapidly evolving service-provision over handsets, co-creation in smart app development, so-called m-participation, opens for attracting younger users typically excluded in other domains. Höffken and Streich (2013) takes stock of positive impacts on crowdsourcing, while stressing the importance of having the opportunities reflected in the mechanisms of mainstream innovation systems. In practice, “grassroots engagement” using social media as a tool for crowdsourcing linked to citizen-led urban regeneration, remains largely untapped relative to its potential as a complement to traditional data collection and funding practices (Seltzer and Mahmoudi, 2013; Stiver et al., 2015).

The degree to which the benefits of the digital economy are concentrated or diffused is not a given. The long-standing concern with a “digital divide” adding to already existing income differences, was discussed above. Early observations concluded that the introduction of ICT will not in itself diminish societal gaps in knowledge and access to information (OECD, 2001*b*). The fact is that, notably since the financial crisis in 2008-09, income differences have been rising within most countries, including by way of polarisation within cities, between districts.

While network effects create massive economies of scale for some organisations and solutions, there is also the flip side, i.e., opportunities arise for digital innovation at small scale, e.g., by start-ups and Small and Medium-sized Enterprises (SMEs). While facing challenges in R&D and specialised skills, such firms tend to be more flexible than larger ones and digitalisation can help them excel in narrow market niches, due to a proliferation of borderless knowledge networks and low-cost diffusion channels (OECD, 2017). Although, on average, SMEs are lagging in digital technologies, some highly innovative and specialised SMEs, keep advancing niche solutions as a basis for swift breakthrough in global markets. Many of the most successful tend to be acquired along the way by bigger more established players, especially in ICT, raising serious concerns about unhealthy market dominance and competition (OECD, 2020*a*). While the US and China lead the way, European-based high-tech start-ups have seen a recent surge in valuations “prematurely”, which may hamper industrial and technical dynamism (European Commission, 2009). Sectors strongly impacted in Europe include IT and life-sciences.⁷

Despite their potential for far-reaching environmental, social, and cultural benefits, it is similarly not a given that the introduction of NBS results in reduced income differences. The wider context and the nature of citizen involvement will matter greatly. Where the processes surrounding NBS are conducive to social innovation, social entrepreneurship and solidarity economy initiatives, chances are that outstanding societal needs will be addressed to a higher extent. Digitalisation can help spur social innovation from the stage of inception to dissemination and uptake by new users (West and Lakhani, 2008; Smith and McKeen, 2011). By exposing waste and the misallocation of resources, it may facilitate the replacement of outdated practices (Mailoni, 2016).

⁷ See, e.g., <https://www.information-age.com/value-of-european-tech-companies-soars-to-e618-billion-123492448/#:~:text=As%20of%20October%202020%2C%20a,.com%2C%20UiPath%20and%20Zalando>

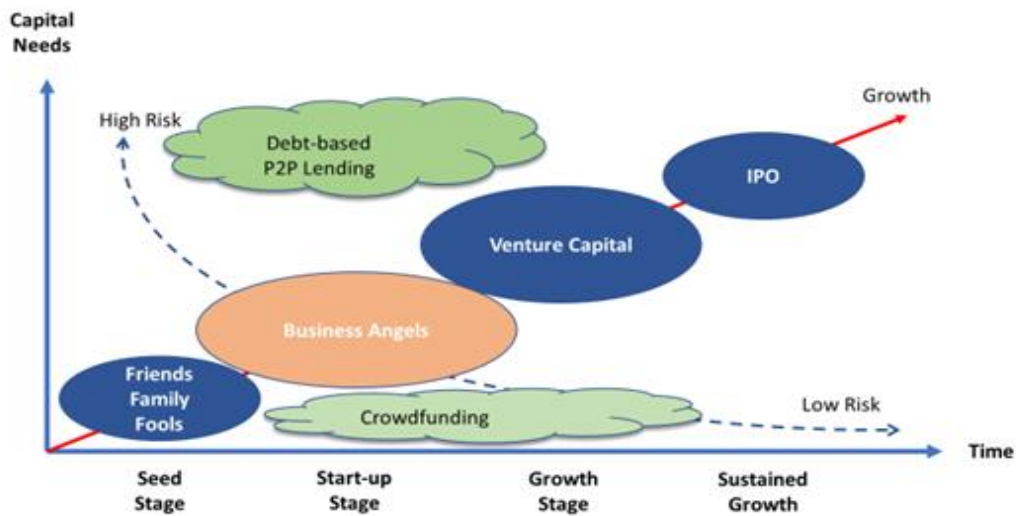


Figure 2: Diversified roles of funding (IKED, 2020)

Digital enablers may similarly support data provision as a basis for evaluation, feedback, and future policymaking. Improved means of integrating diverse data can help call attention to inefficiencies in resource use or to inequalities. This in turn may facilitate social and solidarity economy initiatives aimed at, e.g., poverty reduction or serving other societal or environmental purposes, such as climate mitigation, water and food security, or addressing air pollution. Properly packaged, such information may open new avenues for cutting waste, for instance by removing intermediary layers, and accessing funding for start-ups or business expansion. As indicated by Figure 2, linking crowdsourcing to building an organisation and a customer base may raise funding at diverse stages of business growth, while debt-based P2P funding, typically collected through a platform, may raise relatively large amounts already in early stages (Wang et al., 2020; Nevo and Kotlarsky, 2020).

The application of Artificial Intelligence (AI) and Machine learning using neural networks opens for autonomous learning processes, capable of spurring gradual adjustment in each local context, spanning social interactions and human behaviours. Examples feature in traffic control, safety, water and energy consumption, and air pollution mitigation. Polluting particles can be measured by air-quality sensors placed at strategic locations and communicated to the general public for citizens to be alerted, or for instance more efficiently map traffic to aid drivers in selecting preferable routes. Thus far, such applications tend to concentrate on logistical issues of mainstream importance to the urban environment.

In parallel, however, AI is used, notably by the private sector, to structure and evaluate information flows relating to a myriad of user actions, tracing, analysing and responding to communications, consumption, leisure activities, mobility patterns, and so forth. Cities increasingly apply AI to devise gamification tools for residents, e.g., to raise awareness of individual water consumption and incentivise users to regulate their water usage to cut costs and to protect the environment. Prospects of social benefits are tempered, however, by the skills needed to ensure their realisation and avoid unwanted side-effects. IoT may, for instance, place a premium on strategic skills and new kinds of privilege for insiders - “relational advantage” (Van Dijk and van Deursen, 2014) - while doing damage to those reluctant to deal with technology (Joss,

2018). Further, IoT infrastructure and data-driven diagnostics are associated with challenges of security, privacy, ethics, and accountability, as in the case of GPS based tracking data (Weber, 2010; Abosaq, 2019; Elmaghraby and Lovisa, 2014), specific health applications (Shao et al., 2015), and social networks broadly (Moustaka et al., 2018). These aspects are related to overriding issues of inadequate security and data protection that feed widespread malicious activities (Nemitz, 2018; Forum on Information and Democracy, 2020) at a scale that risks an erosion of trust in digitalisation, see further Chapter 5

Separately, digital enablers drawing on platform economy applications have risen in recent years as a means to link supply and demand more effectively, resulting in reduced transaction costs as traditional middlemen are bypassed or done away with. Whether gains materialise at both ends of the market, fuelling sustainable business growth and job creation, depends on the degree to which new innovations and entrepreneurial ventures seize on the opportunity. A particular category of platforms is taking shape in the jobs market, matching the demand and supply of work assignments, skills, or services. This is sometimes referred to as the "gig" economy, reflecting the tilt towards short term, flexible and also generally more uncertain job conditions.

The outcome of the platform economy ultimately depends on whether there will be better functioning markets, how they are structured, and how social values are protected (Kenney and Zysman, 2016). Mainstream platform economy applications include giant international companies such as Uber, Spotify, Airbnb and BlaBlaCar. The two last ones relate to the concept of "sharing" economy, implying more efficient resource use. Other such applications can be found in various sectors, including finance (as noted), retailing, transport, offices and house renting, and service, jobs, and talent sharing. Job-platforms, matching needs and supplies in nursing care, or by mobilising and making accessible a reserve of doctors and other specialised health experts as in the face of advancing pandemics. In URBiNAT, several apps are under consideration, for linking seekers and providers or relevant services, as well as connecting farmers with citizens looking out for eco-food and local specialities. Further avenues will be evaluated for mobilising platform economy mechanisms where citizens define a priority.

The gains achieved through the platform economy are sometimes marred by conflict, e.g., with those intermediaries whose services are made obsolete. It may also be that the functionality put in place enters domains where regulatory frameworks and market conditions are deficient, resulting in new forms of "rent-seeking" and exploitation. Realising sustainable platforms in support of NBS through digital enablers, strongly depends on the scope for business model development on terms that help align conflicting interests, and achieve win-win, without elements of unsustainable exploitation of some actors.

Alternative currencies represent another approach made possible by digital technologies (smartphones, encryption, electronic peer-to-peer systems, blockchains, etc.) to cut transaction costs for secure interactions. Several examples of such currencies have surfaced, backing locally inspired, environmentally sustainable urban regeneration initiatives. Other new models are under way, including with connection to participatory methods and co-creation by citizens.

1.4 Outline of the report

A mere listing of digital enablers and their potential virtues is bound to be of limited operational use. In the present report, we aim to go further, by casting light on - and structure - the underlying factors, or building blocks, that shape their functionality. In Chapter 2, we thus open up the "black

box” and highlight the key elements inside, going beyond the notion of a digital “toolkit” to examine also other ingredients which contribute to forging their functionality. Related to this, we review some examples of urban programmes, from around the world, and in what sense the identified elements of digital enablers appear to be at work.

Applying this framework in Chapter 3, various conditions affecting the way digital enablers play out, are examined. This includes features of the local context, such as the status of digital infrastructure and participatory culture, which play a role in shaping the study areas as well as each city more broadly. Subsequently, the attention shifts to the role of digital enablers through the stages of co-creation, notably co-diagnostics, co-selection, co-design, co-implementation, and co-monitoring of NBS and Healthy Corridors.

Moving closer to the URBiNAT cities, Chapter 4 initially takes note of the lessons thus far of local diagnostics. After distinguishing between key actors, it reviews the key role of governance in determining whether digital enablers are applied to diffuse information or lay the basis for citizens’ active engagement and empowerment. This is followed by consideration of data management, highlighting the importance of integrating key aspects of the infrastructure, collection, and analysis of data, with the URBiNAT Observatory established to provide continuous support for coordinated experimentation and joint learning. The last examines the readiness and also actual experience of applying digital enablers in each of the URBiNAT cities specifically.

In Chapter 5, consideration is paid to the way forward in applying digital enablers in URBiNAT. Outlining a framework and *portfolio* of digital enablers, their development and use under varying conditions is reflected on. Based on the lessons thus far, and with a view to the situation confronting each of the URBiNAT cities, ways forward are outlined. Outstanding challenges and risks with digital enablers, along with the need of countermeasures and mitigation, are taken into account. Finally, we turn to implications of COVID-19, including the impact on the URBiNAT cities and project activities.

Finally, in Chapter 6, the main findings and conclusions are summarised, how digital enablers can help breed participation and co-creation of NBS and Healthy Corridors in the urban environment, with high attention paid to issues of inclusion. Key take-aways are outlined for the relevant stakeholders, by way of practical steps to underpin participation in support of NBS and Healthy Corridors by use of digital enablers.

2. Framework for Digital Enablers

In this chapter, we introduce a framework for structuring digital enablers that can be effectively applied in the URBiNAT context, while also of sufficiently broad applicability to facilitate generic analysis and conclusions.

In framing our approach, we have taken inspiration from various strands of literature, including those referred to in Chapter 1, reviewing the role and impact of ICT under varying conditions, and also additional research exploring the complementarity between ICT and other factors. The latter include organisational change (Bocquet et al., 2007; Brynjolfsson et al., 2013), skills and workplace development (Miller and March, 2016), communication and marketing (Kumar et al., 2016), and the structure and dynamic of networks and CoPs (Gilsing et al., 2008; Ahuja et al., 2012; Badar et

al., 2015). Additionally, the digital divide literature and that on the intricacies of participation have been taken into account. We further build on the empirical experience of digital enablers in various cities around the world. Finally, we benefit from cross-fertilisation with work in other URBiNAT activities ongoing in parallel.

2.1 Components of the framework

As noted, digital enablers are not necessarily preferable to traditional means of participation, nor usefully suitable to replace them (Hasler, 2017). The two may be complementary, although in some cases one may be strictly preferable, or represent the only option at hand. Although similar issues may arise whether participation is propelled through digital or non-digital means (IAP, 2017), as we have seen, the strength and pervasiveness of the former bring a range of possibilities.

Despite that the rapidly increasing capacity of digital tools takes centre stage in digitalisation, the key to successful development work and implementation has less to do with technology than with people, adoption, and how the results will be put to use.

An extensive literature has elaborated on kinds of factors that influence the quality of sharing and learning in a network, typically summed up as (Andersson et al., 2020): i) leadership; ii) social (community features and user attributes); iii) information-quality related (e.g., content that is evidence-based, up-to-date and pertinent), and; iv) systemic factors, e.g., system reliability, software compatibility, access-related, and user-friendliness (Pratte et. al., 2018). Beyond such considerations of immediate relevance, a broader range of factors come into play, influencing what kind of participation is feasible and can be attained.

With a view to arriving at a framework that can be operationalised, we structure the building blocks for digital enablers. Beyond mainstream challenges of “leadership”, new requirements and opportunities arise from digitalisation by way of spread, engaging teams, setting directions as well as bringing on board diverse perspectives and competences (Fontaine, 2001; Bourhis et al., 2005; McKinsey, 2017). We thus devise our starting point as *Purpose*, in essence what participation, or co-creation, aims to achieve. Meanwhile, the notion of “social” relates to what has sometimes been referred to as “transition management”, by many viewed as the key to enacting societal change (Kemp et al., 2007). Others have aired scepticism referring to dangerous tendencies of meta-governance, opening for authorities to manipulate social arrangements (Shove and Wallace, 2007). Here, we apply *Methods*, the means of encouraging a process of meaningful participation. As for “information quality”, we refer to *Content* as the substance that is devised, codified, and packaged, relating to the purpose and tailored to the target audience (with the help of methods and tools). Finally, for the “systems aspect”, we highlight digital *Tools*, encompassing a broad set of instruments. Although this fourth aspect refers to the “technical” aspect, in order to be applicable, it crucially needs to match with accessibility for the user, including ability, skills and willingness to use.

These building blocks should naturally be devised and structured so as to be mutually reinforcing in the support of the participatory processes surrounding NBS and Healthy corridors. Figure 3 illustrates the set-up, with purposes featuring at the top. Methods appear on the left-hand side, tools on the right and content in between. Alongside experts, citizens - and stakeholders - may importantly engage in shaping digital enablers, operating through any of the building blocks. When devising and applying digital enablers, all these aspects should be considered in tandem.

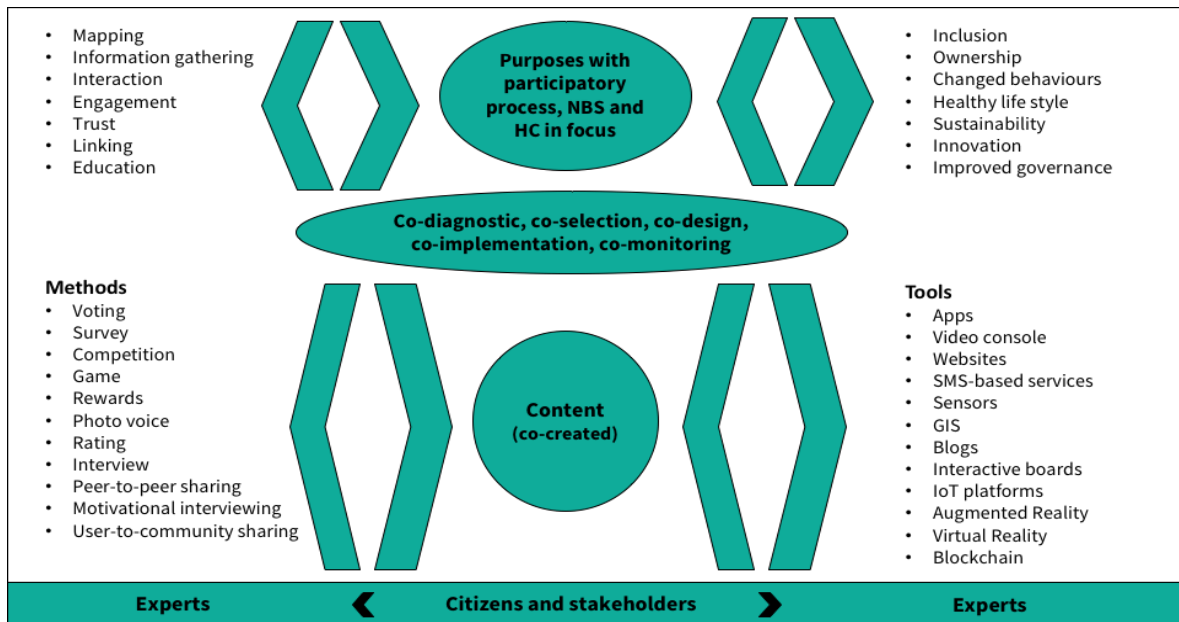


Figure 3: Schematic framework for the building blocks of digital enablers (IKED, 2020)

No clear-cut universally applicable hierarchical relations exist between the identified components, but various relations and combinations are tenable. In one sense, all have to do with purpose, the objective of participation, while ensuring that methods, content, and tools follow suit. Alternatively, a method may be devised based on the opportunity created by certain digital tools, and then utilized with the help of content achieving a match with user sentiments (e.g., Nantes developing surveys to utilise an online portal, and then make it relevant with content, or Reykjavik introducing methods complemented by content to engage citizens using competition and recognition, while taking advantage of users’ existing Facebook activity).

Or, a method may be devised in tandem with suitable content, with the resulting combinations operationalised by suitable digital tools (Queenspark London a case in point). In the following, each category of building blocks is considered, along with further observations of the possible linkages between them, and how they may take shape in different situations.

2.2 Purpose

Various conditions influence not just whether participation is feasible but where it will lead. Compare with Figure 4, where “enablers” are depicted as propped up by the “pillars” of digital infrastructure, investment, skills, e-leadership and entrepreneurial culture. In this illustration, each of these relates to activities that, in turn, are integrated by digital technologies and also mirrored by a community of IT start-ups, along with outputs.

All of this taken together has a bearing on what works and what does not work. Defining an effective and relevant strategy for digital enablers therefore requires taking account of various relevant functions. Ultimately, the rationale for engagement flows from what a digital enabler can achieve, i.e., what value it brings. Why is an outstanding issue unaddressed in the first place, and what does it take for it to be straightened out with the application of digital enablers, through a process entailing the constructive engagement of citizens and stakeholders, where they become part of the planning and implementation of NBS?

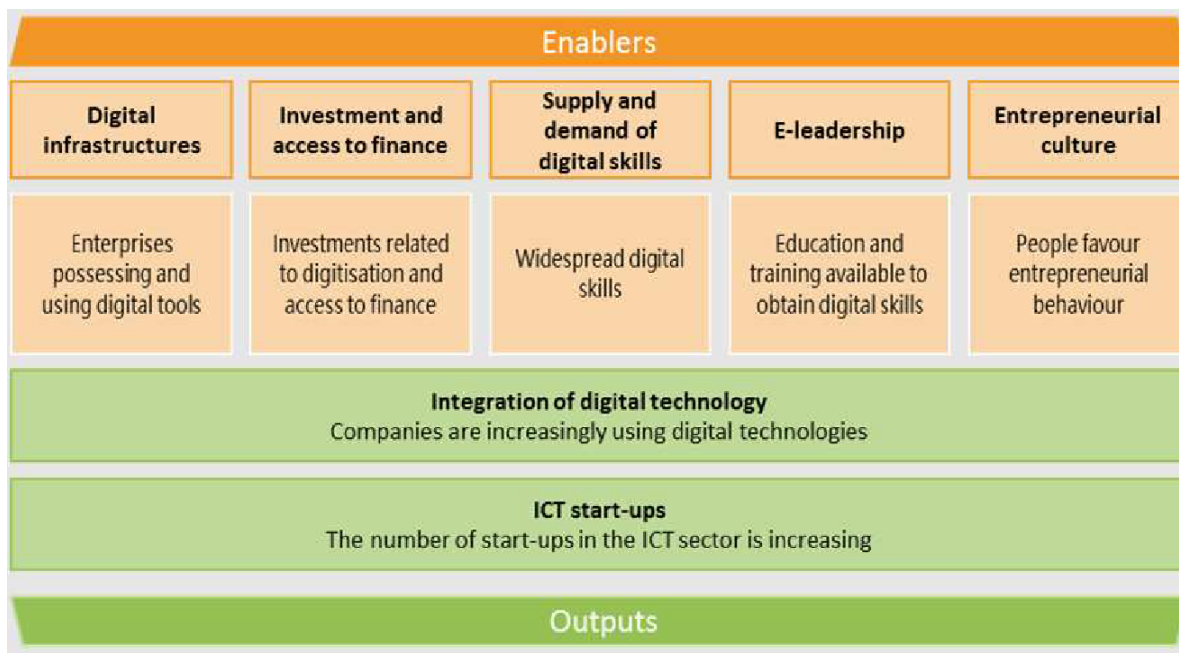


Figure 4: Concept of enablers built up by digital fabric (EIP-SCC, 2019)

In determining the purpose for action, public objectives play a prominent role, including those of municipalities. Their strategic objectives such as supporting health, wellbeing, social inclusion and cohesion, increased accessibility, safety, security in the public space, and job-creation, represent the natural starting point. Tackling climate change mitigation and adaptation, and sustainable development more broadly, cuts across a range of critical and challenging fields. These may span water-related issues, food, energy, and the restoration of ecosystems. With this calling for a “systemic” approach, inspiration by “nature”, including the application of NBS, has evolved as a means to respond. Yet, the role of people, by way of user engagement and active participation, forms an integral part of any viable strategy.

In many cases, however, narrow interests related to special competencies or access to finance, exert a strong influence. With citizens naturally occupied by other priorities, they may not necessarily engage spontaneously. Having said that, some user categories are becoming increasingly pro-active, making intensive use of digitalisation and associated engagement in paving the way for innovation to resolve outstanding issues. Open source, open data, opportunities to linking disparate data in novel ways applying user-friendly digital platforms, coupled with new business models and community-based funding tools (see further below), all contribute to new space in this regard.

Additionally, citizens are in the front seat when it comes to feeling the downsides when investments and opportunities bypass them, and outstanding issues remain unresolved. Their active engagement, in parallel to that of business and other stakeholders, without propelling increased bureaucracy, stands at the core of the purpose for digital enablers in the present context. This means shifting to a situation where issues and objectives are formulated and interpreted with citizens at the core of the process. Leveraging CoI, through which citizens engage with each other driven by joint interests, can be of great use in this context.

The task to examine, interpret, structure, and convey specific needs and requirements of citizens and stakeholders requires their active participation. In determining rationale for action, it has proven important to involve the targeted actors themselves. In the present case, the purpose

encapsulates mechanisms for engagement, including innovation by diverse categories of citizens. In this way, their status is shifted from an apparent camp of passive spectators, or from that of helpless victims, to potentially active and creative drivers of change (cf. Nambisan and Nambisan, 2013). Such a change does not occur in isolation but bears on the organisation and governance of city planning. It also connects with the relationship of individuals with their networks, including social networks (O'Hara et al., 2014).

The notion of the innovation ecosystem is of high relevance in this context. Conditions for restructuring, industrial renewal, new enterprise development and the update of new solutions by clients, customers and citizens, matter strongly. A mindset which is conducive to curiosity, a favourable attitude to what is new, a sense of generosity rather than jealousy when confronted with success, may appear as a subtle and imprecise set of qualities. It is hard to exaggerate its importance, however, for whether citizen engagement along with innovation and entrepreneurship have a chance will outdo other, more tangible influences. Hence, what level of involvement by a particular actor may be anticipated, and with what results, will vary enormously between individuals and by communities, bearing on mindset and attitudes. Communication and dissemination methods should be shaped with this in mind. Interventions exercised through physical, online, or behavioural means may serve different purposes (Andersson et al., 2020).

Rather than adopting social engineering, the task at hand is to unleash and unify momentum for a broadened collaboration in response to unresolved issues, by engaging fragmented interests in a structured joint effort. This, in turn, requires identifying common interests and mutually viable solutions (March and Olson, 1995). Network dynamics, leveraged by digital enablers, have an important role to play in making this possible. A successful approach is bound to be transdisciplinary, based on multi-stakeholder engagement and experimental in nature, with little interest in defining a blueprint or silver-bullet of universal relevance.

An important subject in this context is that of public space. Traditional approaches analysing public space place great weight on people's presence, as an indicator demonstrating whether public space is in demand, typically reflected in the number of people present in, e.g., streets, parks or squares (Gehl and Svarre, 2013; Sadik-Kahn and Solomonow, 2017). A related measure is the time people spend, as when lingering in 'sticky streets' (Toderian 2014), or the frequency or intensity of use. Indicators of such behaviours may serve to estimate revenue flows, commercial rents and other kinds of land use (Ryus et al., 2014; Hankey and Marshall, 2017). Extending from there, more in-depth considerations may be merited to arrive at an understanding of when men are more likely than women to venture outside, or visa-versa? Or, what will enable public space to resonate with the needs of the elderly, the young, or with specific ethnic groups? Further, what is required for public space to be shared productively across the boundary lines of such groups? Specifically, how can digital enablers best support co-creating NBS and Healthy Corridors so to underpin "high-quality" inclusive public space, as experimented with in the cities and city districts that engage in URBiNAT?

The degree to which citizen engagement is sought, and with what results, can be depicted using a tool such as Arnstein's ladder (Arnstein, 1969), outlining a spectrum that stretches from mere input to empowerment. It can also help evaluate the goal of community empowerment, with results measured with reference to the way changes were achieved and the level of engagement at hand. Mere inputs may be measured by expression of appreciation and buy-in. At higher levels, quality feedback and two-way influences become important. D1.2 Genuine sense of control, accountability, connectedness, vision, etc., can be applied to verify empowerment.

Some studies bundle complementary evaluation methods, with the aim of arriving at holistic evaluations for citizen participation (Simonofski et al., 2020). Varying levels of engagement, including empowerment and creativity, can be characterised in other ways too, as in the case of user control of their digital identities or their involvement in mobile apps development.

2.3 Methods supporting citizen participation

Here we exemplify methods in support of digital participatory enablers. Each method draws on the particular rationale, range of applicability, points of strength, and weaknesses.

Methodologies for digital enablers framing participation partly depends on the specific task, e.g.:

1. Mapping of municipal facilities and infrastructures, identifying “hot zones” where it is necessary to intervene, and what type of information we need to collect from each area.
2. Identifying “resource persons”, ambassadors or project promoters and promotion groups, well placed to back and boost a participatory process at various stages of a project.
3. Continuous monitoring and evaluation of online social networks.

Examples of methods include voting, survey, competition, game, interview, motivational interviewing, rewards, photovoice, walk through, scorecards, idea bank, time banks, peer-to-peer sharing, rating, and peer-to-community sharing. Various methods, such as calls for proposals, the creation of an idea-bank, a competition or voting, are applicable for inspiring bottom-up idea-generation and engagement. Digital enablers provide potential leverage through increased reach, speed, flexibility, cost, room for interactivity, and so forth.

Citizen engagement may further be enhanced through digital games like “Urban City Players” where neighbours get together with the aim of designing parts of the urban environment, and to open their minds as to what can be accomplished. Another example is Superbarrio, applied in URBiNAT as returned to below. Evidence shows such games can be effective in creating initial interest and bring diverse groups together, although not all will be equally attracted. Their role and impact are likely to be temporary rather than permanent, however.

Rewards represent an important method, closely related to culture, and to content. Of importance for the relevance of rewards, especially when the objective has to do with awareness creation and behavioural change, are the time span between action and reward delivery, as well as the reward itself and to what extent it generates value in terms that are relevant for participants. Studies of behavioural change have demonstrated that achieving lasting impacts requires going beyond the mere objectives of citizens, or merely attempting to change habits within a given framework. Rather, targeted action is required, possibly capable of bringing about a perceived change of context (Marteau et al., 2013; Teyhen et al., 2014).

In persuasive systems, explicitly aimed at changing attitudes or behaviour, Fogg (2009) identified three key methods: motivation, ability, and triggers. Based on experience what works and what does not, most web-based enablers fine-tune methodology by way of tunnelling (guidance to tasks) and reduction (simplification), which help define and narrow the target behaviours in focus (Kelders et al., 2012). Self-monitoring is a common feature in all health- and lifestyle apps, for the purpose of tracking and self-disciplining behaviours (Bakker et al., 2016). In this case, however, users are already aware of issues to be addressed. The prime methodology applied in digital enablers targeting health problems, however, is that of personalisation, which involves tailoring

functionality, content, and services to fit the needs and preferences of individual users (Almutari and Orji, 2019).

While some persuasive systems, such as Social facilitation strategy, are not inherently digital, use of video, camera or apps have added great value notably by providing the means for discerning how others in the target group perform (Harjumaa and Oinas-Kukkonen, 2009). Connected people can keep track of each other and followers can see the activities of those they are following. Digital tools particularly make it possible to scale peer-to-peer sharing and user-to-community functionality, so as to involve many more members of a community in a structured exchange tailored to coaching and supporting individual users, in effect extending from individual to group benefits. Most persuasive strategies run via apps place great weight on positive rewards, including praise mobilised via social interactions (Orji et al., 2014).

Digital enablers, which bring a host of opportunities in this respect, have been intensively engaged in selected areas, notably health-related, for enacting such change. A key aspect is the translation of traditional behavioural-change methodologies to digital space coupled with a process of targeting and tailoring for maximum impact in the special case at hand. Self-monitoring, personalisation, and reminders exemplify three driving forces that have been picked up and operationalised in digital enablers developed by the health sector, generating important lessons how to enact changes in attitudes and behaviours (Wood et al., 2005; Price et al., 2016; Alqahtani et al., 2019; Almutari and Orji, 2019).

LearnforLife (Lfl) in the URBiNAT NBS catalogue, is a methodology that frames rewards as a means for incentivising individuals, both in relation to different target audiences and expected outcomes (Andersson and Björner, 2018). Efficient reward design resonates with local culture, e.g., when it comes to the desirability of visibility and recognition. For example, the Bella Mossa programme in Bologna is a digital enabler pioneering rewards as a means to incentivise changes in behaviour in support of fewer cars with single occupancy and reduced CO₂ emissions (Appendix 1).

Time banks and social currencies are essentially methods that may be leveraged with the help of digital enablers, underpinning citizen cooperation, civic contributions and community building. This can help pave the way for a sharing and solidarity economy, along with new services development and matching of employment and jobs through a platform economy.

Methods may be interrelated with specific tools. Photovoice has become widely used as a participatory method linked to a smartphone camera, but also to web portals with data management functions. FixMyStreet (www.fixmystreet.com) exemplifies a digital enabler using such methodology for the purpose of encouraging citizens to document and report on neighbourhood issues. The mapping platform MyMaps - fed with data generated through the ArcGis programme - was applied in URBiNAT diagnostics for the purpose of visualising the results of photovoice and walkthrough performed in elementary schools.

Reporting websites include www.walkscore.com which invite stakeholders to rate cities based on the extent to which neighbourhoods offer enjoyable conditions for walking, as well as regarding proximity and the accessibility of services within the reach of attractive walkways.

Voting is often combined with other methods, such as “suggestion box” and competition. An example of a successful digital enabler using that combination is offered by Reykjavik, i.e., <https://betrireykjavik.is> (meaning a “Better Reykjavik”). Ideas that are posted to the website can be reviewed by individuals living in the city, voted on in favour or against, or be subjected to

participatory budgeting. The municipality of Reykjavik uses this platform for enabling widespread feedback on their broader policy agenda as well as on specific political programs, in effect providing a “citizen generated” policy.

More subtle methods for shifting decision-making and influence from governments or experts to citizens include the (already mentioned) methodology by way of LfL and Urban Acupuncture (Apostolou, 2015). Both of these focus on devising a flow of interventions that slightly modify those elements that affect daily life. Gentle interventions stimulate step-by-step adjustment in behaviours, leading to real improvements for individual citizens, as well as for groups and for society in its entirety.

Especially young people use digital means of communication in a seamless way, in particular by smartphone, in their everyday life while older people mostly apply them intensively in more limited respects. The health sector offers illustrative examples of this pattern. Use of digital enablers for general information purposes are on the rise more or less across the board. When it comes to when, where and how patients proceed to attain specialised assistance, however, there is huge variation. See Pratt et al. (2018) for structuring supportive methodologies, which include consideration to integrity and security. Empirical studies find evidence of favourable outcomes of digital enablers in terms of more timely treatment and also when it comes to effectuating changed treatment, although the nature of the health condition and aims of treatment pose remaining challenges. Psychological support in times of distress and complementarity by way of reminders, etc., in regard to appointments, represent other niches managed well by digital enablers. At the same time, a common deficit indicated in the literature has to do with openings for co-design, with weaknesses in methods to help facilitate a shared understanding of what matters and can be achieved in stressful situations. Led by digital enablers, especially younger people may take initiatives that run contrary to the view of physicians (Greenhalgh et al., 2015).

Methodologies to make it possible for digital enablers to realise benefits of personal engagement are in high demand. So-called “introductory post methodology” may be applied to allow new members of a vCOP to introduce themselves to the group on terms that facilitate rapid acceptance. Various variants may be applied as well for web platforms to facilitate the speedy identification of particularly relevant subjects/messages:

1. A system of traffic light colour coding, devised by a “knowledge broker” to fine tune the level of evidence supporting a post (i.e., green for practices proven effective, yellow for those with uncertain effects, red for those proven to be ineffective).
2. A “thumbs up” feature similar to the “Like” feature on Facebook, made available to all CoP participants to indicate when a post is of special interest.
3. A search function facilitating for users to locate relevant posts.

Meanwhile, vCoP activities may be monitored with the help of: (1) monthly emails summarizing recent vCoP activity (e.g., news related to thematic weeks, recently added resources) and (2) the possibility for users to subscribe to email notifications when new content is added to a thread or subsection. User guides should be introduced with care for the purpose of describing key features of the platform.

Other lessons concern usage of cross-sectional surveys in early stages of vCoP development, followed by semi-structured interviews later on, at regular intervals.

Participatory budgeting is a method which has been practiced through non-digital means for many years, aiming to make citizens more aware of how public funding works and take active part in resolving trade-offs with a view to using scarce resources in the best possible way, can help increase citizens' support for long-term maintenance, e.g., of public parks, sports facilities, or other public facilities. Digital enablers were thus far deployed mainly for partial or indirect support, for instance through visualisation, when it comes to presenting users with projects to choose from. The "Urban Meadow" and "Common Benches" project in Warsaw (Maksymiuk and Kimic, 2016)), where removal of concrete pavement combined with artificial planters and flower beds in support of attractive development work by users, includes such elements. In some cases, innovative enablers are applied for the purpose of setting out new directions in citizens' involvement - leading from participation to co-creation. An example is the Empatia project, which runs participatory budgeting using a digital test platform, applying a role-playing game and participation simulator, Empaville, which allows for experimentation with alternative specifications in a safe environment. Empaville integrates in-person deliberation with digital voting, exposing participants to critical issues common to the participatory budgeting and generating lessons in both methodological and practical terms.

Finally, it should be underlined that digital enablers can draw upon, and combine, a range of different methods, synthesised in a way so as to tailor specific conditions. For instance, rewards may be combined with competition and collaboration, co-petition, debriefing via peer engagement and gradual progression, personalised in terms of timing, with help of interactive digital communication. This approach is practiced by URBINAT to coach behavioural adjustment, guiding the most effective participation around NBS and Healthy Corridors.

2.4 Creating content

Content is a broad term for information that has been structured so as to cover a particular substantive theme and usually with a view to have it contain meaning for a given recipient audience. The task of creating content that is valuable and manageable needs to take account of the endlessly expanding flows of data that surround people and organisations in the digital world. The ability to take advantage of unstructured data and turn it into content that can be used for meaningful interaction between relevant actors and competences, including customers, has evolved into a major source of value-creation (Schubmehl and Vesset, 2014).

Content matters in all sectors and actors, organisations, and individuals. It may have a factual side to it, but subjectivity may be just as important, as exemplified by art and fiction. It may concern what is concrete, or it may be wholly abstract. It may come across as positive, or negative.

Activities devoted to the collection of information, such as local diagnostics, should help provide directions for content development. In the early stages of a co-creation process, awareness creation, mapping of participatory culture and the identification of relevant stakeholders are of high importance. In later stages, content will be devised for more targeted purposes, e.g., in support of specific NBS, their update by various user categories, maintaining relevance and an interest, learning, and taking home lessons. With co-diagnostics, citizens are in the position to prioritise content that centres on the issues confronting them. Further, citizen involvement may contribute greatly to finetuning content, with the precise calibration decisive for triggering a response from key groups of citizens or stakeholders.

Content suitable for communication to the broader community may be devised with a view how to raise general interest. When targeting a specific community, or category of users, by contrast, effort needs to go into determining commonalities in interest. A nascent CoI may show up as a possible leverage factor. Narrowing in on marginalised communities, mobile phones rather than computers should typically be in focus, along with social networking, rather than the mere provision of public information (van Deursen and van Dijk, 2014), when devising mechanisms and content suitable for co-creation.

Big Questioning Kortrijk⁸, launched to promote citizen participation in decision-making, exemplifies this kind of approach. Plans to make the city “bicycle-friendly” were shared with all to inspire idea creation and the provision of suggestions how to resolve specific obstacles and issues. Meanwhile, space was made available for citizens at the city website, for display of videos created by citizens themselves, encouraging them to work out and communicate their ideas by creating and getting recognition for own content. The procedure was introduced and communicated so as to instil trust, underpin effective diffusion and achieve quick results. The functionality of the platform was made user-friendly so citizens can easily provide their input without requiring high skills.

In Winnipeg, a historical meeting point “The Forks” is a famous place for gatherings of around 6,000 people each year. The government decided to redevelop the area by engaging citizens in a development project “The Forks Urban Revitalization”. People were encouraged to participate in the process by the distribution of brochures, pamphlets, public meetings, newspaper advertisements, and radio call-in programmes. A complete set of objectives/project plans were communicated to people about the redevelopment of the Fork i.e., Public Food Market, All-Season Leisure Centre, and a few others. Further, the public opinion was sought at different stages by raising questions of particular relevance to each phase.

While operating in tandem with methodologies and tools, content features particular ability to tailor digital enablers with relative ease. This applies to matching with such varying issues across, as well as within, URBiNAT cities, along with needs of variation to achieve relevance for users with diverse attributes. In some cases, content may be devised as a basis for communicating with narrow groups, such as specific linguistic groups, those who engage in bee-hiving, or families with an autistic child. Content may also hold the key, however, to reach broad audiences with specific messages, for instance by relating them to universal human values or concerns. When linked to wide-ranging digital networks, tailored content development opens for highly effective alerting or influencing of huge numbers of users (counted in millions, or even billions).⁹ Using big data and machine-learning, the enormous amount of private data collected by Google, Facebook, YouTube, etc., is constantly channelled to specialised marketing campaigns across a range of sectors and societal spheres. It has also been used intensively in support of populism to produce fake news (Applebaum, 2018; European Parliament, 2019).

In the present context, of feeding participatory processes around NBS and Healthy Corridors, tailored content development opens for shaping messages to fit with a range of purposes. It may do so on terms that underpin learning, collaboration, trust, innovation, or entrepreneurial efforts, by drawing on opportunities based on new business models. Stakeholders meet with messages that can help motivate them to assume a constructive stance. As engagement further evolves

⁸ <https://www.citizenlab.co/case-studies-en/kortrijk>

⁹ More than 4.5 billion people are wired with the internet as of 2020, with the number of social media users worldwide exceeding 3.8 billion and the number of people with handsets at around 5.2 billion (Kemp, 2020).

through stages of co-creation, spanning from co-diagnostic to co-monitoring, content may adjust along the way to sustain or reignite users' interest and trust.

Relative to the opportunities at hand, limited attention has so far been paid to ways that content can be applied in support of user engagement (Bonsón et al., 2015). On the other hand, today, much emphasis is placed on content devised to facilitate constructive interactivity. Continued development work is staged to embrace a wider spectrum of target audiences and purposes. In the context of digital enablers, content development will have to match method(s) as well as tool(s) in relation to the fulfilment of a particular purpose, and context. In deprived areas, and vulnerable groups, m-participation using either existing apps or new apps-development, offers a unique entry point for the engagement of many young adults left out of traditional participatory community schemes. Success in this respect, however, will require highly specialised and customizable content that, in effect, takes on a role as “soft architecture”. The same applies to content devised on top of, e.g., behaviour-change methodology, including games, rewards, and motivational interviewing techniques. Those may have broad applicability but lack substantial effect for a particular category of users unless complemented with tailored content fine-tuned through real-time interaction with individual users.

Successful content development typically requires involving several kinds of expertise, able to foster behavioural responses at individual- as well as group level. Content must similarly match the multi-dimensional nature and complexity of NBS. Further, there is the need to generate responses that meet with the requirements of the relevant planning- and decision-making processes. Examples of cities where arrangements suitable for citizen engagement, backed by content devised and operationalised through digital enablers, include Stockholm and Helsinki.¹⁰ Examples of Innovative content developed bottom-up by self-organising urban groups and movements can further be found in the local organic-food community of Aarhus, or the evolving ecology of digital tools illustrated by Saad-Sulonen and Horelli (2017).

In some cases, digitalisation may turn into a vehicle for exercising physical laziness, isolation from nature, and a preference for staying indoors. Recreation and social activities linked to NBS are known to generate health benefits and foster well-being. Content development is critical for motivating and realising user activity in this regard, in part by stimulating social connections and joint initiatives.

2.5 Digital tools - shapes and examples

Digital tools represent the technical aspect, or building block, of digital enablers. Traditional models for participation require citizens to be physically present at a given time and place, giving rise to a range of practical problems and limitations of time and costs. The difficulties tend to be particularly compounded for disadvantaged and less articulate groups (Nunes and Caitana, 2018; Ertiö, 2015).

By contrast, the combined advance of affordable smartphones, broadband and social networks have made it possible to achieve unprecedented levels of connectivity throughout society, opening up new avenues for citizens and communities to engage actively in shaping their environment, including through urban planning. Computers, phones, tablets, sensors, apps, SMS-

¹⁰ https://www.nordregio.org/sustainable_cities/maptionnaire-map-based-questionnaire-service/

based services, social media (Instagram, Snapchat, Facebook, LinkedIn, WeChat, Twitter, Telegram, WhatsApp and Messenger), websites, blogs, GIS, virtual reality, and video consoles, matter in various ways. In this section we comment on a few of the most important along with factors influencing what role they play.

Geographical Information Systems (GIS) store and manage spatial data as a basis for complex analysis, which may enter into social, economic, cultural or governance aspects. Remote Sensing (RS), meanwhile, opens for complementary preparation of landscape projects. Together with Live 3D, Virtual reality maps, and energy management systems measuring efficiency, such tools offer a range of opportunities for innovative representation of, and engagement in, spatial processes and phenomena (Sieber, 2006). A proliferation of so-called “Public” Participation Geographic Information Systems (PPGIS) has opened for broad-based informed citizen participation in decision-making using these tools. Imaginative geo-visualisation interfaces such as Google Maps and Open Street Map — underpinned by Web 2.0 technologies — make it possible for almost any citizen with an Internet connection to generate and publicize their own maps and geographic information (Adams, 2013). Smartphones using GPS technologies further apply ‘geo-tagging’ by way of physical objects or online content, along with location-aware information. Individuals using geo-visualisation interfaces to disseminate data further generate Volunteered Geographic Information (VGI) (Goodchild, 2007; Sui et al., 2013).

In recent years, the rapid diffusion of social media has greatly impacted the creation and proliferation of virtual networks. Facebook, Twitter, Google+, Instagram, YouTube, BlogSpot and other social media have spurred a demand for new forms of self-organising governance by citizens. Unlike with many conventional methods, many citizens are keen on using social media, offering handy tools for planners and citizens to engage (Williamson and Parolin, 2012; Evans-Cowley, 2010). In fact, many governments tend to use various social media channels, in particular Facebook, as a means to inform citizens. However, the impact of making use of these channels is under-investigated and make governments rely on channels which do not respect personal integrity issues (Medaglia, et al., 2018).¹¹

With usage extending well beyond desktop computers with Internet connections, social media are more easily accessible from smartphones than from traditional desktops. Barriers to access dwindle with the “online whenever wherever” principle and allow participation “on the go” (Ertio, 2015). Mobile participation, i.e., the mobile form of e-participation, is defined as “the use of mobile devices to broaden the participation of citizens and other stakeholders by enabling them to connect with each other, generate and share information). They bring an attraction especially for youths and young adults who are difficult to engage in public affairs or participation schemes (Clark et al., 2013). Other categories, e.g., some older citizens, may lose access, however.

Mobiles, which increasingly take the form of “smartphones”, have diffused rapidly over the last decades to become far more prevalent than computers on the global scene, applying particularly to poor and minority communities (Castells et al., 2007). Their rise has been propelled by plenty of advantages (Höffken and Streich, 2013): escape from dependency on fixed-broadband; flexibility and usability, e.g., easy-to-handle-touchscreens; multi-functional, combining phones, cameras, email, etc.; enabling multi-channel communication through instant messaging or social networks; small and portable (mobility); their functionalities can be extended with apps; and, also, users can program new apps to spur wider innovative services (user-driven innovation). In short, phones are

¹¹ https://publications.jrc.ec.europa.eu/repository/bitstream/JRC115008/futurgov_web_lq_v2.pdf

no longer devices used for placing calls but readily available hand-held computers. The ‘rush towards mobile’ has been best observed in services, initially built for desktop computers, now in mobile version with accompanying native apps.

Mainly due to the rise of smartphones, more than half of the world’s population is now connected to the Internet (Kemp, 2020; Internet World Stats, 2019). Of particular importance in the present study, and a contentious subject for researchers, is the degree to which mobile telephony serves the interest of disadvantaged groups. In fact, a discrepancy observed in Internet access and use between those who connect by phone and those who do so by computer has been referred to as the “device divide” (Pearce and Rice, 2013). Some speak of mobile “dependency” among low-income and minority users (Napoli and Obar, 2014; Smith, 2015). Arguments regarding affordability, device dependency coupled with lack of reliability, discrepancies in kinds of use depending on skills and socio-economic factors such as age and gender, convey the need of taking a blend of factors into account when considering what applies in a specific case (Marler, 2018).

Specific niche products, such as digital visioning techniques coupled with gaming strategies, present opportunities for catching the attention and engaging specific groups that would be very difficult to use via mainstream communication channels. With PGIS as a kind of predecessor, computer aided design, virtual environments, and digital games now offer development-oriented user ‘immersion’ in a sensory and imaginative way. Second Life serves to explore how various niche groups perceive of challenges facing their city and what responses they turn to when confronted with them in an engaging way (Jones et al., 2015; Evans-Cowley and Hollander, 2010).

We are obviously in a situation of rapid technical progress, which encapsulates growing capacity, evolving functionality as well as increased user friendliness. We have come a long way from the days of having to learn how to operate programming languages such as Fortran or APL, less than 40 years ago, as a prerequisite to programming a computer. Having said this, technicians and professionals specialised in digitalisation remain of high importance. Cities and other public sector institutions are mostly reliant on “importing” required competencies without the ability to judge and enact proper balance in perspectives with a view to matching societal issues.

Thanks to extraordinary network effects, digital tools are now able to link up millions of users in continuous interactive communication flows, entailing humans, institutions, and all sorts of machines and devices. While the resulting connectivity is not exactly equivalent to what is achieved through non-digital personal contact, digital communication increasingly incorporates elements that resemble real-world interface. At the same time, it may offer other specific kinds of functionality, on-demand, including a chosen degree of privacy, anonymity, security, traceability of verifiability. Web platforms driving a virtual Community of Practice (vCoP), recognised since the early 1990s (Lave and Wenger, 1991), may now apply such servicing for their members.

Figure 5 illustrates the interlinkages surrounding a digital platform, placed on the left-hand side along with supportive infrastructure as well as city management systems. The part in the middle features the layers of data sourcing that feed the digital platform with information, spanning the web and mobile apps, geospatial information, data collection and sharing, AI and big data. While AI represents an increasingly prominent source of data, much of the system for sourcing data remains an intermediary level relative to the senses of humans (hearing, sight, smell, taste and touch), located on the right-hand side in the figure.

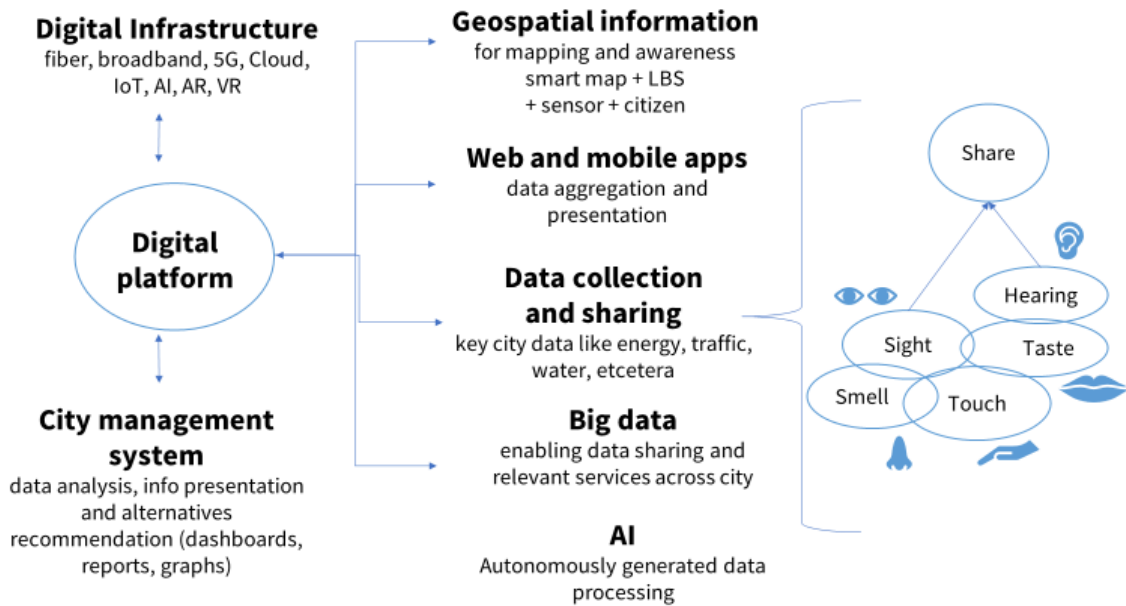


Figure 5: Digital platform and communication channels powered by sources of data (IKED, 2020)

A development under way is that of “participatory sensing apps”, i.e., mobile devices forming interactive sensor networks enabling users to gather and share local knowledge (Burke et al., 2006). Using tools that citizens are already familiar with, is obviously the least demanding. Sensors are now commonly built into smartphones, typically connected to GPS-functions, the camera, microphone, or accelerometer. WideNoise uses the microphone to collect and monitor sound, the accelerometer-sensor helps monitor road conditions while auxiliary sensors analyse air quality. Yet, engaging users in identifying or advancing new tools may lend important support to the overall objective of co-creation.

Saad-Sulonen and Horelli (2017) discuss “digital artefact ecologies” of self-organised communities that rely on the use of freely available, familiar mundane technologies like Facebook, Google Drive, Dropbox, and Doodle. Such groups may be caught, however, between commercial platforms (mainly Facebook and Google) and their own platforms, for instance those using open systems, thus avoiding dependency on proprietary vendors. The latter may require substantive effort, investment, and development work, including support by experts in ICT, in the short term. On the other hand, it will leave users and the community less vulnerable to commercial exploitation, more independent and with greater development potential.

Although cloud computing is widely applied, security concerns have more recently induced a partial return to storage in secure servers. Data exchanges over the Internet need encryption and other mechanisms for trusted transmissions. A central data-processing entity is typically required, especially in the case of a platform for high-value added services and functions, for which a “smart brain” is required for orchestrating the ecosystem. With the help of AI, machine-learning can adapt the system autonomously to human responses, as transmitted through, e.g., “front-end” sensors, mobile phones and watches devised for smooth user-interface. This accounts for human experience platforms, adaptable to evolve in conjunction with user competencies, convenience, and cost (Deloitte, 2020).

Various application systems naturally connect different functions in one. “Maptionnaire”¹², for instance, offers access to GIS-based systems on terms that aim for maximum flexibility and accessibility. Still, it features inherent complexity, with any application dependent on multiple elements, including hardware and software as well as regulatory and governance frameworks.

Similarly, As examined by O'Hara et al., (2014), the individual's engagement with social media cannot be separated from how it is perceived by, and acted upon, by society. This brings into focus the need of balance, e.g., between surveillance vs. privacy, or control vs. empowerment, differentiating between; the individual, society, and the market; big data and open data.

As a sort of hybrid, Block-by-Block exemplifies an existing platform that allows citizens to create and design parts of their city simulating their solution in a 3D environment, in essence taking part in identifying and developing new ways to realise public space. Another example is GeoJSON, a platform for collaborative mapping using open source technology to allow users to map, add properties and information, and share their maps and ideas with others. Other open source platforms include Crowdgaugue, Crowdmap, Map Server, and Shareabouts.

A particular aspect of digital tools has to do with their usefulness in offering a fit with people's experience and sentiments. While technological in nature, the digital tools form what amounts to the critical interface with users. They may be said to form part of a broader toolkit at hand for supporting participation, including through non-digital means. Various studies have, as noted, observed that digital tools have drawbacks, and that their use should be selective, with that of digital enablers viewed as complementary to traditional support of participation (Hasler, 2017). Where the boundary lines between digital and non-digital run, or what combination is most effective and useful in enabling desired outcomes, depends on circumstances. When selecting digital tools in support of inclusion of disadvantaged groups and deprived areas, again, consideration is required of their specific challenges, e.g., regarding infrastructure, access to, and familiarity with technology among the target audiences.

2.6 Inspiring examples of digital enablers

A wealth of experience is available when it comes to digital enablers, applied internationally, nationally and locally. Most have developed where there are solid ICT digital infrastructure and supportive frameworks. An example of such a context is offered by Estonia, which pioneered a holistic approach to electronic services, referred to as e-Estonia.¹³ As part of the set-up, a secure digital identity card, utilising blockchain-based infrastructure as backend, serves as a basis for service provision spanning health, finance, emergency response, transportation, taxes, voting, digital signatures, etc. Other countries with similarly advanced systems include Japan and Israel.

Mainstream e-government policy typically engages a broad set of technical and administrative competencies, with a varying degree of focus placed on achieving quality service and societal relevance. Meanwhile, quite specialised tech-savvy smart cities have arisen over the past two decades, entailing heavy investment in digital infrastructure with a view to digitalising a number of city functions. The technically most advanced, such as Songdo in South Korea (Shwayri 2013; Albino et al., 2015), pursue advanced procurement strategies to promote strong private sector engagement, often by way of public-private partnership. Following the financial crisis, however,

¹² <https://maptionnaire.com/>

¹³ <https://e-estonia.com/tallinn-smart-capital-digital-nation/>

many smart city projects found themselves overstretched, generally requiring public re-engagement, along with a slow-down and efforts of diversification that are still ongoing.

Despite the challenges encountered, the smart city agenda carries broad-based appeal. In fact, most large and medium-sized cities in developed countries have devised strategies for big data collection using smart sensors, cameras, maps, etc., along with platforms for data processing in support of service provision. Public data collection is increasingly organised with a view to the potential benefits of stimulating end-users to look for new solutions, along with public-private partnerships, innovation and entrepreneurship. The city government of Melbourne, for instance, collects pedestrian movement data and feeds it to an entrepreneurial community to stimulate its creative engagement in city planning¹⁴.

The EU is working towards common digital infrastructure and inter-linked data management systems, with major progress achieved in priority areas such as security and border crossings. Major European Research and Innovation projects, such as URBiNAT, link up consortia of cities, companies, universities and research institutes in joint development agendas, devoted to work out new concepts and applications capable of propelling value-creation, applying to smart cities as well as eco-cities and diverse means of urban regeneration.

In the following, we review selected examples from some of the cities with the most advanced and relevant empirical experience. Taking stock of key features, we briefly reflect on their fit with the framework outlined above. In this we include a consideration of the various stages of co-creation noted above, and further examined in Chapter 3, i.e., spanning from co-diagnostic to co-monitoring.

On this basis, for the purpose of highlighting how the identified building blocks of digital enablers can play out in practice, we review examples of their application across six selected cities, in support of participatory processes. Some of these demonstrate a clear-cut link to NBS and Healthy Corridors. The cases are:

- 1) “Queen Elisabeth Olympic Smart Park” (London, UK), applies a range of smart sensors and associated information services to deliver integrated sustainability solutions, spanning resource efficient buildings, energy systems, and future living¹⁵. Microclimate sensors, air quality sensors, and bat sensors coupled with advanced data management support identifying and trialling innovative solutions.
- 2) “My Neighbourhood” (Reykjavik, Iceland)¹⁶ inspires citizens to present ideas which are then subjected to participatory budgeting and public voting. The scheme is conscientiously co-created, with the “Citizens Foundation” writing the software and the City of Reykjavík running the election. The National Registry authenticates voters. More than 600 ideas have been approved since 2012, with thousands of citizens exerting a genuine influence on their urban environment.

¹⁴ <https://www.architecture.com/-/media/gathercontent/designing-with-data/additional-documents/designingwithdatashapingourfuturecitiespdf.pdf>

¹⁵ <https://www.queenelizabetholympicpark.co.uk/our-story/how-we-work/sustainability/smart-sustainable-districts>

¹⁶ https://www.citizens.is/portfolio_page/my-neighbourhood/

- 3) The “Big Questioning” (Kortrijk, Belgium)¹⁷ induces citizens and communities to develop and present ideas and take part in community voting. Participation was encouraged from the start by confronting citizens with highly engaging questions for how to shape the future of the city, presented on the city’s online platform. Continued platform use and online voting have further intensified participation and co-creation of the urban environment. Co-created video clips have further leveraged engagement along with publication of project news on local as well as social media. The resulting momentum has led to the local government web page being frequently visited by citizens accessing a range of services.
- 4) “Blijstroom” (Rotterdam, Netherlands)¹⁸ was initiated by volunteers with an innovative idea to make use of urban rooftops to create green energy while also generating income. Introducing a digital platform, it became widely known over a short period and developed into a cooperative project aiming to generate 100 percent green energy for the city of Rotterdam. A novel element is its approach to collective investment and effort in support of co-creation and ownership by all participants.
- 5) “Schiedammers make the city” (Schiedam, Netherlands)¹⁹ draws on a citizen participation platform launched by the city government. An area-based approach helped motivate citizens to pin their idea on a map (Pin je Plek in Schiedams Midden). The so-called CitizenLab platform has been engineered to underpin gradual learning and to help mature citizen engagement. A channel has arisen for the authorities to consult citizens on new ideas, and the other way around. Design tools such as mapping apps facilitate for citizens to develop and share new ideas. Other social media tools such as Facebook are also used to present and test proposals. The purpose is to help structure citizen engagement as a productive co-creation process.
- 6) “Ride Together” (Milan, Italy)²⁰ started 2018 with the aim to make Milan bicycle friendly and facilitate cycling as a means for commuting. The project adopted a user-driven approach, targeting citizens who use a bicycle, especially women. A digital city map was developed by drawing directly on people’s experience, marking out cycle routes, as well as safe and unsafe areas for biking. “Bike Bell” was introduced as a device to notify safe vs. unsafe areas, and link to emergency services. A mobile app, also called “Ride Together”, notifies cyclists when another cyclist using the device passes by, creating a sense of community. The approach is blended with physical elements, such as the “upcycle café”. Data is generated for municipality officials via a digital dashboard, thereby aiding city planning, e.g., where to build new cycling routes.

Table 1 provides a stylized mapping and illustration of aspects in which digital enablers, and their building blocks, feature in framing the special nature of each case. All projects noted herein engage citizens in co-creation processes. Further, in various ways, they signal a shift in the way e-government and citizen engagement play put, as returned to in Chapter 4.

¹⁷ <https://www.citizenlab.co/case-studies-en/kortrijk>

¹⁸ <https://blijstroom.nl/>

¹⁹ <https://www.citizenlab.co/case-studies/schiedam-en>

²⁰ <https://marlenneescalante.com/portfolios/ride-together/>

Project	NBS	Digital Enablers of co-creation in which stage					Strongly applied to support participation			Healthy Corridor
		Co-Diagnostic	Co-Selection	Co-Design	Co-Implementation	Co-Monitoring	Tools	Methods	Content	
Queen Elisabeth Olympic Smart Park	Yes	✓	✓	✓	✓	✓	✓		✓	Yes
My neighbourhood		✓	✓	✓			✓	✓	✓	Yes
Big Questioning Kortrijk	Yes	✓	✓	✓			✓	✓	✓	Yes
Rotterdam Blijstroom	Yes	✓	✓	✓	✓	✓		✓	✓	
CitizenLab Schiedammers make the City			✓	✓			✓	✓		Yes
Ride together	Yes	✓	✓	✓	✓	✓	✓	✓	✓	Yes

Table 1: MATRIX - coverage by digital enablers in selected cases, key dimensions (IKED, 2020)

Queen Elisabeth Olympic “Smart Park” engages authorities, stakeholders, and citizens from the co-diagnostic stage onwards. While digital enablers have been actively deployed through all stages of the process, face-to-face gathering played its part as well, especially in the early stages. Park mapping, sensors, and smart district data infrastructure combined in structuring a basis for various activities. Monitoring and evaluations in real time allow for experimentation and testing how to gradually increase benefits. Interactive content development inspires participation of relevance to both NBS and Healthy corridors.

My Neighbourhood Reykjavik and **Big Questioning Kortrijk** both apply online portals while adopting methodology by way of voting and competition to engage citizens in project co-selection and co-design. Smart and effectively tailored content serve to entice participation by a broad range of citizens. While NBS are not explicitly in focus, My Neighbourhood Reykjavik features a notion of Healthy Corridors while, in Big Questioning Kortrijk, both NBS and Healthy Corridors appear among the areas prioritised by citizens.

In **Rotterdam Blijstroom**, the different stakeholders engage using a digital platform enabling them to engage in a seamless communication on issues at hand and exchange ideas on their resolution (van Genuchten et al., 2019). In this case, participation was powered notably by the innovative methodology and content of the digital enablers, developed and applied to propel co-creation through all project stages. While the project is closely associated with NBS, the concept of Healthy Corridors is less applicable.

In the CitizenLab **Schiedammers make the city**, digital enablers support co-creation through all stages. A range of tools along with methods such as geographical mapping and participatory budgeting incite citizens to present new ideas and follow through by taking part in their implementation. The targeted objectives include “beauty, cleanliness, safety and health”, meaning that NBS nor Healthy Corridors may gain indirect support.

Ride together features a combination of innovative tools, methods and content to shape digital enablers promoting participation by cyclists specifically, through the stages of co-selection, co-design, co-implementation, and co-monitoring. The case is highly relevant for both NBS and Healthy Corridors.

These intriguing cases indicate ways in which digital enablers can and do play a highly potent role in effectuating co-creation by citizens and other stakeholders, drawing on their underlying building blocks. While the engagement process often entails both digital and non-digital elements, continued rapid technical progress along with evolving societal challenges, including the onset of COVID-19 in 2020, have clearly served to intensify the use of digital enablers in co-creation. Much remains to be done, however, to nail down how to devise the most effective and useful contribution of digital enablers under varying conditions.

3. Digital Enablers under Varying Conditions

In this chapter, focus is placed on the noteworthy diversity of potential usage for digital enablers, as well as the richness of opportunities in devising and applying them accordingly. Our point of departure is the local context, notably when it comes to areas that meet with particular challenges and where city parts are disjoint and polarised. Conditions requiring attention include the status of infrastructure and culture, and their implications for specific actor categories. We then proceed to distinguish the stages of the participatory process.

No single formula holds the key for how to make use of digital enablers under different circumstances, and in the context of each city or specific situation. The experience and perceptions of citizens form part of the context requiring unique responses. Instigating motivation and inspiration for genuine participation has to happen on the ground, based on what matters for citizens as well as with a view to other key stakeholders in each case. Digital enablers have important contributions to offer in making this possible.

A general compilation of the many digital enablers actually put to use in cities around the world with a view to, in one way or the other, supporting the participation of citizens and stakeholders, would result in a very long list. A sub-set of cases relevant in the present context can be found in Appendix 1. Here, each digital enabler is characterized by a way of purpose, a stage of NBS development that is particularly relevant, and also identified prominent tools, methods and content. The final column additionally takes note of issues that require consideration in each case. As we proceed through varying situations and stages of application, we will make some reference to these cases, where fitting, so as to complement or help illustrate the points made. Some of them show up as well, in the mapping of the digital enablers’ portfolio elaborated in Chapter 5.

3.1 Addressing the neighbourhood

3.1.1 The context for digital enablers

The literature has underlined that the quality of sharing and learning in a network depends on numerous factors (Bourhis et al., 2005; Pratte et al., 2018). Examples include: i) leadership; ii) social (community and user attributes); iii) information-quality related (e.g., evidence-based content, up-to-date, and pertinent content), and; iv) system-quality related (e.g., reliability, software compatibility, accessibility, user-friendliness, and security). Each of these is of relevance for the application of digital enablers in a particular location.

As for leadership, fickleness and fragile relations between leaders and followers often give rise to problems on how to identify, evaluate and communicate relevant issues and information (Alvesson and Spicer, 2012). On the other hand, leadership is understood to have access to multiple tools to achieve results (Vansina and Cobbaert, 2008) and, through their inherent strengths, digital enablers may help change the momentum. The information society has itself brought to the forefront the potential for value-creation through knowledge co-creation, brought about by multifarious interactions and advances among diverse competencies (Brugnach and Ingram, 2012). Allowing others than the usual suspects to have a say in setting priorities, URBiNAT explores approaches for co-creation of content from early on, in the stage of local diagnostics. Additionally, URBiNAT's approach is inherently systemic, applying a broad-based approach to NBS, and with their extension to Healthy Corridors placing strong focus on interlinkages and how to prepare for and realise synergies as a basis for aggregate benefits, in turn requiring consideration to the wider context for urban planning.

A breakthrough for citizen participation in urban planning came about with the arrival of GIS which, today, is commonly utilised in the planning of urban green infrastructure. By offering location-based service apps and volunteered geographic information via social media, public participation has been made highly inclusive, while also triggering interaction between citizens, public authorities, and stakeholders. This reflects a broader evolution from citizens being invited to raise ideas or comment on plans as individuals, to the rise of, forums for their direct involvement in the shaping of spatial processes (Shiffer, 1999; Craig, et al., 2002). San Francisco and Melbourne exemplify cities setting out to frame explicit influence by citizens on urban planning and governance, by embracing place-based knowledge exchanges (Möller and Olafsson, 2018).

The diffusion and active use of digital enablers opens for enhanced measurement and characterisation of all aspects of the urban development. This may span the general state of infrastructure, public service provision to citizens, social and environmental issues, and so forth. Some of the attention will be to what is inherently local, applying to specific districts and communities, including deprived areas. Others related to the city, including mobility patterns and relations between its parts. The official statistics most readily available may not necessarily provide what is needed. The following exemplify some of the data that should be collected, where feasible:

1. The status of digital infrastructure, broadly referring to Internet access, including speed and affordability, typically the availability of broadband (fixed or wireless), 4G and/or 5G networks;

2. The rate of penetration by digital tools along with the usage of various networks. Examples of the former include smartphones/mobiles/laptops/tablets, etc. The latter may feature social media channels serviced by vendors such as Facebook and Twitter. Measurement may apply per household/per capita, or to particular kinds of users;
3. Digital literacy level of specific groups of citizens, measured indirectly through digital tools penetration or as user patterns. Local diagnostics collecting socio-economic data and also mapping attitudes and behaviours can help establish benchmarks and underpin an in-depth understanding of the relevant context;
4. Relations between communities in URBiNAT neighbourhoods and other parts of the cities, including actual relations and communications, as well as perceptions and attitudes with implications for actual behaviours, such as openings for enjoying common public space or responding to joint projects.

This is not to claim that such factual information necessarily allows for an exhaustive characterisation of the conditions for participation and how digital enabler can make a difference. Enormous discrepancy exists between individuals and households, contributing to the complexity of the local context. Additionally, any neighbourhood forms part of a wider city landscape of mutually interlinked entities. Having said this, various means are available to allow for meaningful examination and characterisation of conditions on the ground. This may be exemplified in URBiNAT by the planned analysis of citizens' social media traffic, or the use of geospatial data to spot patterns of movement. The data collected through such methods can help patch together valuable insight on what matters to citizens with various attributes and how they may respond to interventions. This in turn may help guide the use of digital enablers in support of participatory processes.

3.1.2 Culture and mindset taken into account

Culture is a multi-faceted concept of high relevance for understanding the behaviours of individuals, groups, and institutions. Culture may or may not promote openness and tolerance. Corporate culture, for instance, may serve to defend entrenched positions, lock in privilege, and separate insiders from outsiders. On this basis, various aspects of culture and mindset exert major influencing on the terms under which participation may unfold in each city, as well as locally. Mapping of participatory culture coupled with complementary analysis of actors and interests involved in the special case, may thus convey information of high significance for devising and applying digital enablers of relevance in the local context.

In many cultures, personal contact is valued strongly, and is basically a prerequisite for loyalty and trust to be established. Online communication may then merely allow for exchange of factual information, not for overcoming disparate perspectives and interests. Some cultures will accept critical reflection and cross-fertilisation of ideas with ease, while others will react defensively and give rise to increased tension and less scope for flexibility. Stark differences in such respects are often observable across as well as within cities, where polarisation may lead to entrenched positions and attitudes. In disadvantaged areas, where digital infrastructure and access to digital tools go together with low rates of digital literacy, low self-confidence and lack of trust in authorities tend to be prevalent as well.

Culture is not static, however, but subject to change. Certain methods can play a role in injecting change, e.g., by instigating more favourable attitudes towards cultural bridging and exchange (Andersson et al., 2020). Digital enablers can be made effective in this respect by picking up on

strengths, curiosity, and a natural interest by targeted citizens, or as pointers to weaknesses based on a notion that what is presently lacking can be put in place (see further Chapter 4). Digital enablers have been deployed for such purposes since more than a decade, often linked to social innovations. Bridging between members of different ethnical groups may be achieved by opening for their joint participation in activities of joint interest, such as physical activity, cooking, or training (Redecker et al., 2010). In Appendix 1, “Online contest for 15 vacant lots” exemplifies a digital enabler - in this case from Nantes, one of the URBiNAT cities - which applies digital enablers for overcoming cultural issues, while achieving other complementary purposes too.

The handling of inter-cultural relations significantly influences to what degree an ethnically diverse environment, e.g., with a strong presence of immigrants, will struggle with discrimination and exclusion, or if countervailing forces supporting bridging will make headway. Related concerns arise when it comes to managing human rights and gender, whose inclusion in a culturally and ethnically diverse set-up tends to meet with challenges. Digital enablers can again be applied as part of a response, building awareness step-by-step through a gradual process, and strengthen skills selectively to counter digital divides (van Deursen et al., 2011). By establishing non-conventional communication channels, they may run into fewer problems with vested interests and resistance from entrenched social relations.

3.1.3 Respecting different attributes

In order to meet with a particular purpose in the urban context, a critical aspect often has to do with the challenge of overcoming conflicting views and interests. An important step is that of fostering inclusion among groups that are presently left on the side-lines (Holz, 2018). The task often requires reaching several target audiences with different characteristics. Attributes of high relevance for the applicability and reach of digital enablers include reading/writing; digital skills and competencies, interest in and readiness to use tools, and experience of participation via digital means. Additionally, mainstream socio-economic factors such as education, profession, gender, age, civil status, and ethnical belonging play a role in determining behaviour and receptiveness to change (Andersson, 2018). The effective engagement of specific citizens or stakeholders using digital enablers, basically hinges on the ability to shape a scheme that matches with what these groups are familiar with and interested in. One operationally noteworthy aspect is whether users belong to any particular Col, which then provides a basis for common interest and links with others. Such Cols may be in place, or could evolve, with a focus on various expressions of sports, music, entertainment, food, nature, and so forth. Methodology and content may often be crafted with a view to building on and leveraging inspiration of such kinds, while the suitability of tools may be relatively more influenced by infrastructure and existing user patterns while also taking account age groups and digital literacy.

Disadvantaged groups generally have access to a fewer number of tools per household, calling for the arrangement of accessible and attractive complementary facilities such as community centres, libraries, etc., offering relevant complementary entry points. Content in the language of targeted ethnical minorities obviously matters a great deal. Icons and visuals are of generally high importance, but with different connotations and attractors for different kinds of users. For those who lack education and are unfamiliar with or not interested in books or abstract communication, a strategy of reaching out needs to be shaped with consideration to their diminished motivation. Easily recognisable symbols and emotionally convincing arguments, of immediate personal relevance, may be devised in this case.

The availability of data on the communication of microblogging online using Twitter, has proven easier to access, including with differentiation of users across specific city areas. Although Twitter clearly has fewer active users in the study areas of URBiNAT cities, compared to the mainstream social media channels, Twitter has been usefully applied in previous evaluations of user sentiments, e.g., transit services (Collings et al., 2013; Schweitzer, 2014). Its coverage is likely to allow for valuable comparison and analysis of selected themes, linking to NBS. This opens for novel approaches to evaluate, for instance, what content and incentives mostly stimulate user responses.

3.1.4 Stakeholders

Besides government and citizens, a range of stakeholders is intrinsically involved in various aspects of digitalisation. The private sector, or “business”, naturally takes centre stage in many cases, being the prime source of R&D and investment in developing new or adapting existing digital solutions. Academia, including universities, represent a major other source of research and carry the main responsibilities, as part of the educational system, for training and skills upgrading, although much training and “life-long learning” is ongoing throughout society. Non-government organisations and civil societies, spanning a wealth of diverse often community-driven organisations active in a realm of societal spheres, such as culture, sports, other leisure activities, environmental protection, and so forth, represent another sub-set.

Inadequate strategies regarding stakeholders may, for several reasons, serve as the source of failure in urban development projects. Most obviously, this may be due to the exclusion of relevant parties, which may therefore be misinformed, adopt a negative stance, or simply ignore a project that would have benefited from their active engagement (Kitchin, 2014). Projects may also fail, however, because the actual involvement of parties with conflicting interests prevent constructive agreement on mutually beneficial outcomes (Fischer, 2014; Elelman and Friedman, 2018). The way purposes and processes are framed, is of critical importance for what outcomes are achieved, with strong implications for what difference digital enablers can make. On the other hand, far from all cases are advanced in ways that underpin constructive participation. In many instances, digitalisation is driven by incumbents, with a view to ensuring support for mainstream solutions, from the perspective of businesses, technocrats, or vested interests of various kinds. The result may be a steamrolling, entailed supply-push of high-tech applications with user and citizen interests playing second fiddle. Plenty of observers argue that participatory processes keep losing out in mainstream urban planning or end up influencing merely subjects of modest significance.

Meanwhile, corporate sector surveys, such as that of Solis and Littleton (2017), find that most businesses struggle with digitalisation and how to accommodate and take advantage when it comes to organisational, technical and skills aspects. Private sector investment tends to be short-term and cost-minimizing, rather than strategic and long-term oriented. Risk-aversion and a lack of strategic leadership commonly mean that digital renewal often is left to be dominated by technical considerations and the scope for apparent marginal efficiency gains, meaning that opportunities to identify and pursue higher-order benefits in organisational motives, and capacity of driving forces to making better decisions are foregone. The potential damage of such limitations has been reflected in many years’ evaluation of ICT-benefits in the corporate sector, that investment in ICT for narrow purposes, without accompanying measures for skills improvement and organisational change, risk to undo the most important benefits and can be outright counterproductive (OECD, 2001*b*; Strassman, 2004; Melville, 2004). With the continued

advance of ICT in recent years, businesses clearly are in the process of placing digitalisation much closer to its strategic core (Deloitte, 2020).

Besides the public and private sectors, NGOs and civil society more broadly, increasingly turn to digital enablers as an instrument to attain reach and more targeted communication in support of behavioural change to achieve various results. While this is again partly motivated by the advances of ICT, evolving objectives and organisational change of such bodies matter strongly. Part of the motivation has to do with the shifting mode towards knowledge development and exchange “anywhere, anytime”.

Some may set out to impede progress or distort the outcomes, especially if not appropriately involved. For instance, citizens in a neighbouring area that will be affected through the introduction of certain new NBS-facilities, perhaps because their transport routes will be impacted through congestion or just because they will experience a sense of competing ideas, should have the option to raise questions and make suggestions with a chance of being heard and also to contribute. Again, how this is arranged is critical, making it mandatory for a city administration that is serious about digital enablers, to possess organisational competency capable of differentiating between processes that promote obstruction and derailment and those that facilitate constructive compromise and joint buy-in, in support of better outcomes (Shipley and Utz, 2012; Hanna, 2020).

Stakeholder relations and how they are managed exert an impact on all societal fabric and influence what can be achieved across-the-board. Even in the event particular projects focus squarely on a particular district or user category, “others” not granted opportunities as a perceived consequence thereof, may raise resistance, radiate a dismissive attitude and, in various ways, undo tangible results. Groups not in the driving seat may charge “not invented here” and their alienation towards deepen rather than diminish. Stakeholder engagement will therefore inevitably matter and must be tackled one way or the other. A strategy to this effect should weigh in the objective and the potential contribution of stakeholders, bearing in mind the following aspects:

- 1) Which stakeholder categories are key depending on context? Those who actively liaise with citizens in the targeted neighbourhoods, and who may play a role in influencing their participation, are obvious candidates. Social workers, workers in community centres or other public institutions, schoolteachers, vendors but also community leaders, formal or informal, may matter. Which category deserves attention varies, however, depending on the targeted group of citizens, such as the elderly, the unemployed, single mothers, or teenagers. In another context, the focus may be on urban planners, city officials, elected politicians, a category of experts, landscape architects, those responsible for energy, water, or other utilities of relevance to NBS, hospital workers, teachers, parents, or social workers. Yet other categories of importance for furthering the value of NBS are made up of local business, the private sector more broadly, entrepreneurs, financiers, and civil society leaders. In a specific case, green entrepreneurs or social innovators may be key.
- 2) The purpose may be to collect information that is helpful for local diagnostics or framing the strategy for participation. By surveying stakeholders, digital enablers can be used to identify which ones are most important to engage, and through which mechanisms. In each stage of co-creation, digital enablers carry the potential to facilitate measurement and analysis. Monitoring using social media may identify facilitators or champions as well as novel communities of interest. Digital enablers may track and specify what motivations

pertain to various stakeholder categories. By tagging stakeholders to their interests, digital enablers may provide direction for each to receive relevant information.

Of the cases in Appendix 1, Air Quality Mapping and Lande provide examples of schemes that include impacting on different stakeholders as an important objective. Each situation is unique, and the question is how to effectuate a dynamic that keeps forging stakeholder relations that are favourable and constructive in working with others to identify and resolve the issues that matter. In order to promote such stakeholder engagement, instead of undercutting it, people, and social relations must take centre stage. Technology, irrespective of its form, should add value and realise that expectations are met, without being allowed to dominate and take on its own life.

3.1.5 Minorities, equality, and gender

At an overriding level, digitalisation is widely viewed as having contributed to diffused opportunities for economic and social development, lifting hundreds of millions around the world out of absolute poverty (Sharafat and Lehr, 2017). Further, in some cases, digitalisation has been shown to underpin resilience in vulnerable communities, by offering improved prevention, signal detection, and damage containment. At the same time, however, risks have arisen by way of dismantlement of social relations and support structures, critical infrastructure breakdowns, and a worsening digital divide (OECD, 2001*b*).

Questions have gradually arisen regarding the way that specific vulnerable groups are impacted. Some of the issues centre on minorities, such as those marginalised by their ethnical or religious origins and belongings. Citizens with specificities refer to a broad range of sub-groups, some affected by disease or handicap which may account for exceptional vulnerability. Sub-groups such as children, young generations, or the elderly, represent major parts of society, while at the same time, finding themselves in a minority position in some respects. For all there is the question whether ICT leads towards “inclusion”, and whether they evolve towards a position of enjoying more, rather than less, “equality” on terms relevant to their situation. These concerns are of high relevance also with reference to gender, not because men or women would find themselves in a minority position as such, but because of serious conditions of systematic discrimination and loss of opportunity for individuals, solely caused by their belonging to a particular gender.

The topics referred to here have been high on the agenda on the EU for more than a decade, partly reflecting their high relevance for building an open and integrated single market while supporting social cohesion (European Commission, 2020ab). The presence of systemic discrepancies in opportunities and outcomes feeds bad sentiments, sows conflict, creates uncertainty that prevents investment, leads to poor allocation of resources, and runs counter to human rights and a dignified society. While these aspects are of high general significance, as noted in Chapter 1, what ways and means can be worked out to resolve outstanding issues and realise a better environment and quality of life, may be intrinsic to a particular societal context.

As has been observed through history, minorities run a high risk of being at the losing end in any given society or societal context. For one, they may be exploited by populist leaders as scapegoats for outstanding problems. Not all minorities are easy prey in such respects. The burden generally falls on groups that are less informed, have less influence, and are less organised. At times, however, minorities may be targeted because their success make them victims of jealousy. Typical examples of weak categories are newly arrived migrant communities, but also children and young adolescents. In some cases, women, the elderly, or members of certain professions viewed as less

deserving in a particular socio-economic context, are discriminated against. It has long been known that countervailing forces, such as the division of power, and community development at local level coupled with adherence to traditional value systems, may be required to defend the common good against the “tyranny of the majority” (de Tocqueville, 1835).

Although digital enablers greatly facilitate diffusion and reach to a myriad of diverse users, a digital divide persists and may, depending on the application of ICT, serve to enhance rather than counter discrepancies in access to information, opportunity, and wealth. Mobile telephony is of high significance in this respect, given its role in wiring - and bringing online - expanded categories of users, including in the many poor societies around the world (ITU, 2018).

Overcoming the limitations of fixed broadband, the expansion of cellular technology has brought tangible gains to many otherwise disadvantaged areas. Meanwhile, digital disparities related to affordability have clearly diminished (Castells et al., 2007; Rice and Katz, 2003). Remote access to information, goods, and jobs, as well as “quick-time coordination of personal or household activities”, have been seen to benefit the population at large (Rice and Katz, 2003, p. 603). Mobiles further favour safety, being “far superior to the Internet and the regular telephone” in alerting authorities of personal threats or emergencies (Rice and Katz, 2003, p. 603).

Yet, some have pointed to downsides. At their time of introduction, advanced digital technologies tend to be priced out of range, and be less accessible, for disadvantaged populations, although the time of catch-up is diminishing (Donner, 2015; Napoli and Obar, 2014). Meanwhile, low-income and minority teens are often charged more for Internet access via mobile platforms (Brown et al., 2011). Low-income populations typically experience regular loss of service, hardware dysfunction, and device theft. They may suffer periodic disconnection and lost service due to inability to pay their bill, or because mobile phones are lost, broken, or stolen in their socio-economic environment. Social support networks, of importance for mitigating such threats, tend to be less prevalent for the most vulnerable (Sampson et al., 1997).

Important questions emanate from observations of differences in use. Napoli and Obar (2014) argued that mobile phones are technologically limited in ways that lead to less productive Internet use. Further, socio-cultural factors underlie differences in the ends pursued through technology, with cultural and social imperatives shaping engagements with mobile phones (Horst and Miller, 2005; Donner, 2008; Ureta, 2008; Sey, 2011; de Souza e Silva et al., 2011; Shrum et al., 2011).

The question of whether mobile phones expand, constrict, or in other ways alter social networks is the subject of a growing body of research (Campbell, 2015). Its importance can be seen from the way that linking to close confidants promotes health and the ability to cope with adverse events (Cohen, 2004; Dickens et al., 2004; Hurlbert et al., 2000; Klinenberg, 2003). For instance, parental status, and also an urban location, have been found to link with more productive social use (Park, 2015).

Social stratification persists in mobile phone use. Individuals with higher incomes tend to access the Internet for “information-based” and “transaction-based” activities, while lower incomes rather are accompanied by social and entertainment uses (Zillien and Hargittai, 2009). Teens of higher socioeconomic status who had enhanced mobile access tended to use their mobile phones in ways associated with greater social and civic engagement. Differences among those that pursue social or entertainment versus civic ends through their mobile phones emerge from habits and motivations that associate with social class (Bourdieu, 1984).

In practice, patterns of use are complex, reflecting a multitude of user attributes. Park (2015) found female and minority teens to be highly capable but also diverse in their mobile engagements. Older teens appeared to engage in more mobile activities. Teens who had higher skills in content production and who turned to their phones more often to accomplish particular tasks were more likely to be civically engaged, such as volunteering in the community or debating politics with family and friends.

Phone sharing, a means to increase reach to the disadvantaged, has been found to be gendered, with men more often in the position of owning and lending phones than women (Blumenstock and Eagle, 2010; Burrell, 2010). The phenomenon of phone sharing links to the subject of affordability as a barrier to access for portions of the global poor (ITU, 2016). The continued presence of a digital divide, including within the urban environment, typically bears on discrepancies in skills, education, and socio-economic factors, rather than technologies.

Having said this, a wealth of opportunities has arisen and can be made use of to counter exclusion and the issues facing disadvantaged groups. In the case of urban planning, GIS is well suited linking and integrating diverse communities in co-creation (Harris and Weiner, 1998; Shiffer, 1999; Craig et al., 2002). Community mapping using various digital tools may clarify critical aspects of exclusion, including through a digital divide, such as those related to culture and behaviours (Crampton and Stewart, 2004).

In health sciences, extensive research along with clinical practice have led to a rapidly growing literature how to devise digital enablers in support of inducing constructive amendments in damaging behaviours. The resulting insights have generated lessons that have disseminated into mobile apps and social networks aimed at diverse kinds of usage, directed at a wide spectrum of user categories. Many developments have been fluid and transitory, evading easy measurement and documentation. The intensity with which various campaigns and user responses have unfolded, nevertheless underlines the potential impact at stake.

While commercially and/or politically driven objectives tend to dominate, power relations, human rights, considerations of ethnicity, gender, or citizens with specificities, etc., have gained traction (Okolloh, 2009; Goolsby, 2010). As for their varying characteristics, immigrant groups and the young often display high IT-skills but may be excluded from networks that serve to maintain entrenched power structures. Groups with specificities are generally excluded in the absence of tools or other features earmarked to facilitate their engagement. Digital enablers may be constructed in multiple ways to address and overcome adverse attitudes and conflicts, see for instance the two cases of Mijn in Amsterdam and Womenability, in Appendix 1. Special needs, reflecting local conditions, may also be addressed. A safety-feature which can be triggered in moments of crisis as a means to reach a help-centre, Shakti, has been introduced in cities in India to protect women from crime.²¹

Groups may become disadvantaged for numerous reasons, resulting in various kinds of subordination, oppression, and discrimination, thus linking to digitalisation and digital enablers in multiple ways as well. Ample studies have examined the impact of digital communication, including Internet use and mobile telephony on the well-being of children (Livingstone 2016). The expansion of social media among users of increasingly early age, moving beyond Facebook to encapsulate, e.g., Instagram and Snapchat, is accompanied by changing use patterns and motivations (Marwick and Boyd, 2014; Wang et al., 2018; Jagannathan, 2019). Others have

²¹ <http://shakti.jhpolice.gov.in/en/>

examined how digital enablers can be applied to address the issues confronting various vulnerable communities, including the elderly, citizens with special conditions, or children. These studies point to plenty of challenges, but also to a range of opportunities for constructive resolution of outstanding issues (Frauenberger, 2011).

To set the stage for constructive participation, it is important to pursue diagnostics of what kind of patterns can be discerned. Which are the key dividing lines, and what are the implications, especially when it comes to influencing the means through which digital enablers can realise inclusion and co-creation? Relevant aspects should be given due consideration from early on, with implications for all the main building blocks of digital enablers, including purpose, methods, content, and tools.

Digital communication influences such conditions in other ways too. While online impersonality generally is viewed as a drawback, making it hard to establish personal trust, the flip side is the availability of “protective space”. Given traits that serve as a disadvantage in a particular social context, whether related to age, gender, race, or whatever, digital communication may offer a remedy. An example is that of women-owned businesses in Asian countries, across industries where they may thereby escape prejudice and discrimination. This is as online interfaces may shift the focus onto products, prices, and so forth, rather than the gender, age, or skin colour of the counterpart. International goods trade, where the reliability and competitiveness of business offers can be assured on-line through other means than personal trust, have benefited. Additionally, however, a broader spectrum of entrepreneurs has been able to gain support for innovative services and business ideas, without the limitations of personal bonds. For such reasons, by removing visibility and transparency in some respects, digital enablers in some cases place members of otherwise disadvantaged groups in a better place to circumvent prevailing impediments, serving a source of neutralisation, giving more room for substantive capabilities.

Again, however, the downsides tend to be disproportionately taxing for vulnerable groups, such as women and children, which thereby risk meeting with even more hurdles. Lack of transparency can “invite” fraud, exploitation, and violence. Again, increased digital literacy, the adoption of secure practices, and so on, is of high importance to allow the advantages to play out, and counter the risks and downsides.

3.2 Stages of engagement

As already discussed, and illustrated in Figures 6 and 7, in the context of URBiNAT co-creation is referred to in a broad sense, which may mask tangible differences in the way participation works out in varying situations. In this section we elaborate on the implications for digital enablers arising through stages of engagement, such as those of preparing, implementing, and making use of NBS and Healthy Corridors. After considering “co-creation”, in each of the ensuing sub-sections, we turn to the more narrowly defined states of co-diagnostic, co-selection, co-design, co-implementation and co-monitoring.

3.2.1 Co-creation

Co-creation tends to be discussed with general reference to different parties coming together in one or more stages of an innovation process. The term co-creation is used in URBiNAT with reference to the specific case of citizens and stakeholders contributing actively to urban

regeneration, as associated with NBS and Healthy Corridors. It is not limited to the action of “jointly creating” but also includes a freedom of choice to interact with residents, companies, organisations, etc. and together create solutions such as products, services and/or concepts (Mateus et al., 2018). One can further distinguish between co-creation of new ideas and the co-production/delivery of public services. Co-creation may further generate new domains of collective activity (Trischler et al., 2017).

The role digital enablers play may vary depending on the co-creation referred to.²² In URBiNAT, co-creation serves as an umbrella term for the more specific components we associate with the stages surrounding NBS, notably co-diagnostics, co-selection, co-design, co-implementation, and co-monitoring. Figure 6 illustrates how these components may relate to each other in propelling a cyclical flow of preparation, action, response, and follow-up.

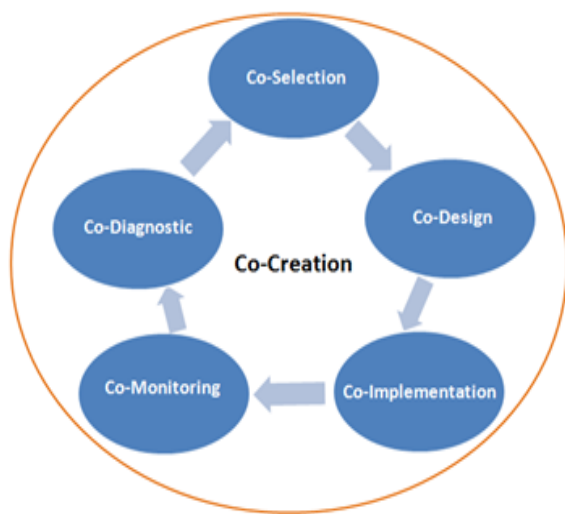


Figure 6: Process and dynamic of co-creation building blocks (IKED, 2019).

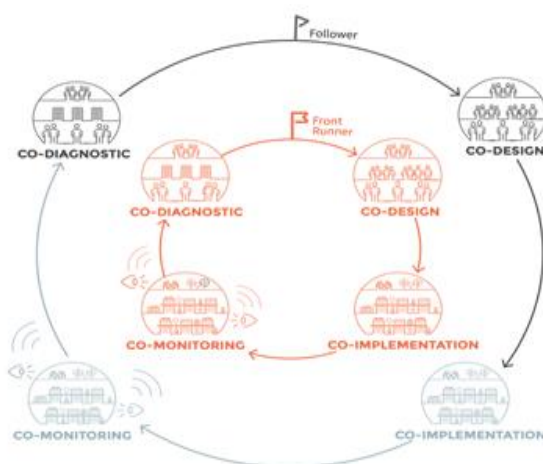


Figure 7: Co-creation elements in URBiNAT front-runner and follower cities (Nunes et al., 2019).

²² See URBiNAT D3.1 (Hilding-Hamann et al., 2019) on strategic designs and usage of participatory solutions and relevant digital tools in support of NBS uptake.

Figure 7, meanwhile, depicts the stages of co-creation in a more minimalistic way, with co-selection treated as part of the co-design stage. Here, moreover, the three front-runner cities are seen to operate at the core of the project, with the follower cities in the outer circle, moving a step behind, drawing on the front-runner experiences.

The extent to which citizens can be effectively involved matters greatly in relation to their sense of relevance and, hence, motivation. In this context, it may be interesting to apply a module-based approach motivating engagement at different stages of a project. In the early stage, mapping tools may be applied to design a new avenue while addressing community concerns through dialogue among different stakeholders. The act of engagement may continue through pre-application consultations, planning submission, approval, and monitoring. Another platform, “City Swipe”²³, provides people with engagement functionality using simple means to obtain their opinion about a proposal. The app has been developed to allow use of visuals of different urban planning topics and achieving public participation, as it applies a feedback mechanism pattern including YES or NO and LIKE or DISLIKE. The City Swipe platform further presents a series of visual slides on city-planning.

In the following, we further consider the implications of applying digital enablers through the envisaged stages of co-creation.

3.2.2 Co-diagnostics

Insufficient awareness among citizens represents a major weakness for NBS in urban development. While there are many kinds of NBS, which display varying potentials, as outlined in URBiNAT’s NBS catalogue, citizens naturally would not be aware of the spectrum of opportunities that may follow, spanning physical amenities, public space, social functions and also new enterprises and job. For co-diagnostic to be directly relevant to NBS, there is a need of awareness-creation and some process of knowledge generation as a basis for building motivation and inspiration among citizens, while linking to experts and decision-makers. In Singapore, a platform tool called Natural Capital²⁴, illustrates, explains and builds understanding of relations between ecosystem services and societal issues (UnaLAB, 2018).

Having said this, digital enablers blended with non-digital or traditional means, can be deployed to catalyse and stimulate the active involvement of citizens in defining issues, interests and motivations, leading on from there to shape participatory processes around NBS. Co-diagnostics is related to gaining insight and structure an understanding of the local context, as well as incorporating the inputs of citizens and stakeholders from the very start. The purpose is partly to arrive at a relevant action-oriented framework and partly to underpin trust.

Examples of cities that have used digital enablers in this vein include Mexico City in Mexico and Kibera in Kenya (Brown et al., 2016). While it is less straightforward to identify European cities that have made clear-cut advances in this respect, the use of digital enablers features in co-diagnostics related to specific kinds of institutions, such as schools and libraries, commonly located in neighbourhoods that meet with particular challenges. Connections with existing NBS, such as urban gardening, as well as ideas and proposals for advancing new ones, may form part of the

²³ <https://www.dtsmcityswipe.com>

²⁴ <http://www.naturalcapital.sg/>

picture, although this has not been evaluated systematically. Sweden is a case in point where digital games are applied for such purposes (Schelin et al., 2017).

The following are a few examples of uses of digital enablers to engage citizens directly in co-diagnostics and related processes:

1. Online citizen participation through a platform, web page or blog enabling citizens to post proposals, ideas, and opinions online, by selecting areas and indicating the most pressing problems in their environment that need resolving.
2. Channels of communication opened for citizens to require information and be better informed on substantive subjects or initiatives under way. Various digital entry points can be deployed to reach out and tease out an interest among citizens and provide highly accessible entry points.
3. "Topic-based" forums for bringing together citizens and stakeholders through virtual means to confront and discuss sets of issues in demand of solutions, opening for co-diagnostics coupled with community-building.

Examples of digital enablers suited for co-diagnostics include Big Questioning Kortrijk, Ride together, Lande (showing vacant land), Mijn in Amsterdam, and online content for 15 vacant lots ("15 lieux", Nantes), outlined in Table 1 and Appendix 1. Another example that attempts to attain great reach in blending awareness creation with co-diagnostics is that of Agora, set up by the Food and Agriculture Organisation of the United Nations (FAO) as an accessible, user-friendly, and engaging digital library collection in the fields of food, agriculture, and environmental sciences.

Of high importance, as underlined by URBiNAT, is the collection of inputs from different categories of citizens, including diverse stakeholders. Digital enablers can help developing and fine-tuning an approach that is able to connect with - and raise the interest of - different groups, including those disadvantaged in certain respects. This can help clarify in what instances co-creation should importantly aim to catalyse dialogue and idea-generation within the local community, or through linkages with "neighbours" (URBACT, 2019).

Co-diagnostics matters greatly for framing practices and procedures that are adapted to, and comparative with, local culture. Manifestations of culture may draw on values, norms, beliefs, community stories, relationships, and a shared sense of place (Duxbury, 2018). A "perceptual map" may be forged, spanning the needs and positions of various actors and stakeholders. Such a "canvas" may expose key priorities, relationships, linkages, challenges, risks, and so forth. It can be deployed from early on to guide further diagnostics, while also generating insights of use for further framing of digital enablers, in sync with participatory culture (Ferreira, 2018).

3.2.3 Co-selection

The term co-selection is here used in the narrow sense that refers to effective consultations and shared decisions regarding which NBS to select in a particular situation. URBiNAT does not make any extensive use of this term, as the stages of co-selection and co-design are viewed as inherently interrelated within the project (cf. Figures 6 and 7). The rationale is that no NBS should be taken as given, but an element of adjustment and tailoring to fit the specific context is always required and must be taken into account. Consequently, in URBiNAT, the selection of NBS is treated as part of the design stage.

Having said this, in practice, specific NBS may nevertheless be selected through a process that is independent of design and not subject to proper consultations with those most concerned. This may reflect the presence of vested interests pushing certain ways of working, and also solutions, which suit them at the expense of others. Depending on the specific content, it may be the influence of specific commercial groups, professions, experts, and also representatives of scientific disciplines or other academic territories that hijack the agenda and manage to boost outcomes that for some reason fit their agendas.

It is inevitable that such factors are at work, and it may not necessarily be a “bad” thing. Whether we are referring to a majority or certain minority having it their way in a particular situation, they may be losing out in other situations. What risks becoming markedly detrimental, is having a systematic bias, due to “hidden agendas” and one set of interests regularly coming out on top. Several studies argue that whatever citizen participation digital enablers have managed to boost, the interest of established mainstream (political/commercial) interests tend to remain dominant and resist any major disruptions to their agendas (Walker and Hurley, 2004; Zachrisson and Beland Lindahl, 2013; Raco, 2013).

When it comes to framing the co-selection of NBS, urban planners are not necessarily well placed to adopt a proper approach. According to Greenfield (2013), neither urban planners nor civil society have taken much initiative on such matters while, on the other hand, for-profit companies have a well-developed practice in place to sponsor events and pursue smart marketing of their preferred solutions. A number of observers view technological aspects as generally too dominating, not necessarily by treating citizen considerations as irrelevant, but leaving them to impact symbolic points rather than shape the actual outcomes (Greenfield, 2013). It is commonly observed that technocrats push both smart and eco-city agendas in terms that strengthen their own standing and established line of thought.

The credibility of the entire process surrounding NBS, ranging from planning to monitoring and the implementation and use/monitoring, may most critically hinge on the way the co-selection stage is handled. Opportunities for taking part should generally be announced to wide audiences, with the support of appropriate digital enablers, taking advantage of their reach as well as scope for interactivity and means for tailoring. Similarly, where possible, digital enablers should engineer an organic process, creating a level playing field and underpin open selection without inferring any pre-determined influence of limited technical and political nature.

Contrary to the case of enabling general engagement, the issues confronted by URBiNAT through participatory processes involve a serious effort to develop and apply methodologies and content for the purpose of triggering responses by targeted communities. Further, the focus is on the implications for how to spur value-creation through specific interlinkages, countering polarisation and the well-known problems with sense of exclusion and fragmentation.

In this vein, co-selection of NBS should draw on local diagnostics, in support of effective targeting and, when appropriate, an understanding of how digital enablers can add value. Approaching co-selection not merely with reference to the selection of NBS, but with emphasis on their design based on the active involvement of otherwise under-represented citizens and stakeholders, URBiNAT has applied a particular enabler, Superbarrio, to integrate communication, motivation, selection, and design functions. While, from the outset, Superbarrio included both digital and non-digital elements, due to the onset of the pandemic and its associated limitations on social gatherings, the approach has been adjusted, with almost total reliance on digital execution. With digital enablers still applicable where physical meetings face severe constraints, their importance

for realising quality processing and outcomes of co-selection has, if anything, thereby further increased.

3.2.4 Co-design

Co-design is about collaboratively establishing purpose and “reason why”, put in place action strategies and arrive at viable proposals. Participation is encouraged in the design of NBS, through co-design. As noted above, this may incorporate co-selection of which NBS to apply. For co-design, an interactive process, devised for the combined selection, adaptation and design of NBS, is generally preferable. With the help of digital enablers, there is enhanced scope for co-creation in this regard.

An issue in this context is whether citizens and stakeholders should utilise existing platforms or introduce new ones. To save costs in development work, Falco and Kleinhans (2018) advocates choosing among already existing digital platforms.²⁵ On the other hand, (existing) digital enablers may require certain technical skills as well as linguistic skills. Offering citizens to take active part in co-creating new digital enablers opens for specific opportunities. Depending on circumstances, however, one may build on certain building blocks already be in place, with co-creation by way of finetuning or adding elements to achieve a particular purpose. Low threshold technologies may be utilised for simplified co-design. Granting citizens an active role through co-design one way or the other can help instil a sense of ownership, increasing the probability that they will remain actively involved. This resonates with observations such as those by Ertio (2018), on the abilities of many users to create their own apps. Established social media platforms similarly launch development functions aimed to strengthen the buy-in of users and followers.

Using open source, Block-by-Block exemplifies a platform that allows citizens to create and design parts of their city environment and space in a 3D virtual world based on the game Minecraft. It has been applied in various parts of the world, and especially in distressed areas such as Haiti, Palestine and Kosovo, for example for the design of a city market, a skate park, and to upgrade a transport hub (Falco and Kleinhans, 2018).

In URBiNAT, as mentioned, the initial exercises with co-design have applied Superbarrio, a game that helps motivate and engage citizens in the formulation of ideas to design their neighbourhood, exemplifying a specific digital enabler devised for operating in this space. As described in previous reports, notably in WP2 and D3.2 (Nunes et al., 2019), Superbarrio allows citizens to observe, measure and compare (score) the anticipated benefits of each NBS, as well as contemplate how they may be leveraged through specific design. Thus far tested and explored in Nantes, the method is currently being reviewed for adaptation to restrictions that have followed from the pandemic crisis, as reliance on online interface has become even more pronounced.

In the game applied by Superbarrio, 3D objects serve as focal points for content development. For instance, how many trees may be planted in a given space, pedestrian passages be arranged, or parks be devised? What can be achieved by the installation of lights when adding benches in a particular location? Superbarrio goes beyond the mere application of a digital tool to present citizens with user-friendly methods as well as inspiring content. This kind of digital enabler may

²⁵ Not only will development work be saved but an already established DPP has been through numerous test and validation rounds, meaning that time, resources and energy are saved compared to setting up a new platform for digital engagement or collaboration.

further help structure citizens' perceptions and suggestions from early on, in support of effective monitoring and evaluation later on.

In each city, specific methods can be applied and leveraged in the co-design phase with the help of digital enablers for the purpose of reaching and taking on board inputs from a broader range of citizens, notably as a basis for framing NBS and Healthy Corridors for better match with local needs. Examples include Delphi method (Linstone and Turoff, 2002) and Triz method (Altshuller, 1984), focusing on co-identifying proposals, arguments and solutions consensus through open peer validation, prioritizing and feedback. Depending on the local situation, their integration and use can be managed through, for instance, apps, websites, SMS-based services, blogs, interactive boards, or polls. At the same time, excessive reliance on such means may lead to complications and stall progress, as has recently been demonstrated in connection with COVID-19, see further Section 5.4.

In URBiNAT, the original plan was to arrange most workshops related to the co-design phase face-to-face. Due to COVID-19, envisaged physical workshops have mostly been shifted online, enabling their realisation but not without challenges.

3.2.5 Co-implementation

According to Brand and Peters (2019), a “measure is being co-implemented if representatives of the city and civic actors are involved in its delivery in a complementary and non-commercial way”. In URBiNAT, co-implementation centres on participation by way of citizen involvement and co-creation in the implementation of NBS.

Co-implementation refers to the stage in which the ideas and advances in the earlier stages are brought to fruition for actual realisation. The situation will naturally differ depending on what NBS have been selected and how they have been co-designed. The actual challenges and requirements of implementation may motivate different combinations of building blocks. Possible methods to use at the out-set of this phase include games, rewards and motivational interviewing. In contrast to the previous stages, however, co-implementation generally needs to be considered with a view to impetus for the long-term. Here, participation is not merely about temporary action, but the very purpose is to bring about a lasting change in perception, mindset, and behaviours, possibly implicating increased self-confidence, a sense of “can-do”, that can lead on to follow-up initiative. A plethora of digital enablers has already arisen to help realise life-saving changes in behaviours, adding distinct value to traditional means of treatment (Kelders et al., 2012; Stephens and Allen, 2013). Much less effort has gone into achieving such outcomes in the present context, despite the potential benefits. Suitable digital tools include apps, websites, SMS-based services, blogs, interactive boards, etc. The key, however, has to do with methodology and content matching the current situation, including the community and the individuals at stake. Linked to this, the implementation stage calls for rethinking how combinations of professional management and execution can operate in tandem with citizen engagement.

Certain aspects of the implementation stage are of practical nature and may have a strong physical anchor to them, e.g., the procurement of materials, the plantation of trees, or construction activities. Digital enablers in support of co-creation by citizens should naturally be devised with a view to what can be operationalised effectively that way. As seen during the pandemic of 2020, increasing reliance on digital enablers does not result in a general preference for dismissing physical work or contacts by going online. Having said that, the impediments to the

latter creates a need for innovation in online activities, such as taking part in visualisation, providing feed-back in real time, and new forms of service-delivery, reaching many more citizens than would otherwise be possible.

ConSensus exemplifies an alternative approach devised for enabling effective participation in the implementation stage (Edelman, 2020). Based on observations of mere lip service to citizens' actual influence, coupled with the challenges raised by balancing perspectives in handling inherently complex challenges, this approach assigns citizens' a role as watchdog. It may be viewed as a form of representative democracy, or instituting downward accountability (see below), creating a potent channel for citizens to exercise influence through a control function. The approach is particularly suitable for addressing inherently complex environmental problems that require considerations extending beyond the local context. On this basis, it features judging elements of science and institutional relations requiring the involvement of relevant expertise.

The relationship between citizens and scientists/experts requires further reflection for additional reasons. The inherent complexity, uncertainty, and systems aspects, pertaining to sustainability, frequently call conventional distinctions between facts, values and politics into question (Healy, 1999). Funtowicz and Ravetz (1990*ab*) referred to "systems uncertainties" and "decision stakes" as attributes undermining traditional methodologies for collecting and evaluating factual information as a basis for decision-making. Under such circumstances, the quality assurance of scientific inputs to policy requires an 'extended peer community', with all those with a stake awarded a voice and a way of exerting influence.

A note should be made of the scope for digital enablers to support the implementation of, for instance, crowdsourcing, or crowdfunding. As previously discussed, such instruments bring important opportunities to help raise broad-based funding for projects of high relevance to activities with community-wide impetus where social change is interrelated with behavioural change in support of health, security, and well-being. Based on open calls that help both diffuse information on proposals and ideas, and collect new ones, crowdsourcing enables reaching out to a broader community of actors that, to the extent that they opt to join as financiers, clients, and stakeholders, make them inherently part of the implementation process. Evidence how this influences the delivery and take-up of services at community level is paramount, for instance, in the health sector (WHO et al., 2018). Digital enablers support the implementation of other related mechanisms too, such as digitally enabling local currencies, as returned to in Chapter 4.

3.2.6 Co-monitoring

Co-monitoring denotes the joint work undertaken once NBS have been implemented. The term "monitoring" should be interpreted in a broad sense. Depending on the nature of the NBS and the social context, it may denote a loose form of engagement, yet with some sort of defined role to stay observant and report on results. It may also refer to actual use and value-generation from associated add-on activities. These may take the form of service provision or social innovation that in turn creates new demand, spin-offs and further knowledge-generation. Such effects are likely to grow stronger the more productive and meaningful the sharing of ideas and efforts between individuals, groups, competences, and stakeholders that would not otherwise have connected or worked together.

In framing co-monitoring, attention should thus be paid to who can be actively involved, but also who can at least assume some sort of connectivity, and thus remain on board. It is important to

move away from a conflicting situation in regard to inclusion vs. exclusion. Digital enablers open for instituting differentiated tracks of co-creation, offering citizens a menu of possibilities when it comes to what level of time and effort to put in, and yet stay involved constructively. Co-monitoring may also include a kind of informal reporting on changes in citizens' everyday life. It should draw on the interests, perceptions and experience of diverse user categories as well as multiple stakeholders, and thus be infused with different perspectives and points of view.

Traditionally, co-monitoring has relied mostly on interviews and surveys. Today, various digital tools are frequently applied, for instance, sensors and GIS, interactive boards, blogs, websites, etc. When coupled with appropriate methodologies and content, enabling comparisons between cities, the monitoring activity will support associated exchange through URBiNAT's CoP and Observatory. On this basis, decision makers and neighbourhoods will enjoy easy access to each other's results and analyses, feeding structured comparisons, conclusions and mutual learning.

The abilities of digital enablers are currently in a state of further upgrade following from the advance of IoT, semantic webs, big data, and AI. These technologies are set to add value in various ways, some of which are easier to foresee than other. While the precise outcomes are impossible to foresee today, the need of bridging between data-driven diagnostics and human accountability is likely to grow in importance, raising organisational, ethical, and legal issues (Jaradat et al., 2013; Greenhalgh et al., 2014; Ruppert et al., 2015).

Thus far, big data generated algorithms, machine learning, and AI have been driven mainly by commercial objectives, notably for the purpose of predicting and stimulating consumer interest in particular e-commerce. Private sector progress is uneven, however, with many firms lacking the awareness, resources or vision to respond to the potential opportunities (Attaran and Attaran, 2019). Relatively few of these technologies have so far been deployed in support of citizen engagement and co-creation of NBS. Realising the opportunities ahead will likely require further strengthening of access to open data and use of open systems, within a framework of fruitful cross-sectoral and cross-disciplinary collaboration, in support of genuine responsiveness to the actual engagement of targeted citizens and stakeholders in local development.

4. Towards Digital Enablers in URBiNAT Cities

The URBiNAT project brings together nine cities with varying experience of enacting NBS and a shared, strong ambition to upgrade and strengthen the role of NBS in their continued city planning and development with a strong emphasis on citizen engagement. Three of the cities, Nantes, Porto and Sofia, already have extensive experience of NBS and assume the role as frontrunners in the project, inferring that they are spearheading new approaches in the various activities, including participatory methods, and preparing for their further linking in Healthy Corridors. The follower cities of Brussels, Høje-Taastrup, Nova Gorica, and Siena take active part in the exchange and are obliged to prepare plans for how to advance NBS and Healthy Corridors. The non-EU cities, Khorramabad and Shenyang, assume observer status, with scope for intensive engagement and own initiatives depending on what level of ambition they opt to apply.

The engagement of these nine cities in URBINAT reflects their already strong awareness of the opportunities and needs at stake. At the same time, they are all looking to step up their engagement in participatory processes, co-creation and paving the way for Healthy Corridors. While currently involved in selecting and designing NBS, drawing on URBiNAT's catalogue, spanning territorial, technological, social and solidarity economy, and participatory NBS, they have met with the new hurdles arising with the onset of COVID-19. Innovative approaches are therefore more required than ever, for the cities and the project to tease out the aspired citizen engagement and active participation by those most concerned. In this, as we have seen, digital enablers offer a range of advantage.

In a way, the URBiNAT cities have already readied themselves for placing emphasis on the deployment of digital enablers to propel co-creation by citizens. Having said that, the cities are at different levels, and carry with them varying experience, in applying digital enablers. In this case, it is not necessarily the frontrunner cities that are at the forefront. What has already been achieved, and what readiness each city displays for making use of new approaches and means, is a mixed bag. Generally, however, limited structured experience and insight is available on how to devise and apply digital enablers so as to fulfil various objectives through value-enhancing mechanisms. Further, governance models and systems for translating lessons into action differ in nature and are generally not devised for addressing the agenda at hand.

In advancing our understanding of how to help realise the potential supportive role of digital enablers in the context of the URBiNAT cities, next we proceed to reviewing digital enablers and stakeholder relations. Advancing from there, we reflect on the changing role of digital enablers, shifting from an emphasis on information diffusion to that of genuine engagement and empowerment. From there we proceed to data management in a broad sense. While the discussion thus far draws not just on URBiNAT cities which, after all, display only a small subset of the experiences around, we then turn to reviewing the actual experience of and approach to digital enablers in the URBiNAT cities specifically.

4.1 Digital enablers and stakeholder relations

Many digital enablers are put in place by regional authorities and/or municipalities. An important goal is then the offering and reach of public services. The application of digital tools combined with suitable methods and content may offer more avenues for governments to reach and inform the public and entice their engagement in specific projects.

Even with solid policymaking on the part of national governments, as well as authorities at regional and municipality level, the condition and evolution of communities increasingly reflect the combined influence of multiple stakeholders. The agendas, competencies and strategies of established business weigh heavily on the supply-side, while NGOs and civil society have been viewed as rather operating via the demand side.

Gradually, however, the increasingly pervasive nature of ICT, with strong interactive features, has shifted ICT applications to become more closely associated with innovation, building, and deepening the customer interface, and also moving to the core of business strategy, where the two sides blend and evolve in tandem. Further, the important role that high-impact start-ups and high growth SMEs play in fostering digital innovation and industrial restructuring attracts significant interest. The role of SMEs in challenging incumbent providers and market dominance, entering up new niches, underpin competitiveness, promoting skills upgrading, and generating

new jobs, is of high importance for local communities. Meanwhile, private enterprises as well as other organisations inevitably vary in their use of ICT, as well as the way they are impacted. Some lean towards defensive and inward-looking practices, while others are open and inclusive. The former direction tends to promote the proliferation of existing positions and vested interest, while the latter naturally tends to be more conducive to cross-fertilisation between complementary competences, innovation, and customer value (Effing and Growth, 2016; Schubmehl, 2014).

In regard to co-creation involving citizens and other key actor categories, a number of studies have pointed to the need of further examination before any definite conclusions can be drawn on the consequence and benefits (Clark et al., 2013; Meijer, 2011; Linders, 2012). A schematic overview of potentially relevant actors in reaction to the potential role of digital enablers is provided in Table 2, picking up on themes observed to be of direct relevance in the URBiNAT cities. Policy makers, city administration, citizens, and other stakeholders are listed. As for city administration, we have already noted observations in the literature of e-governance opening for higher efficiency and other benefits, but costs and downsides appear as well, and the balance act remains an issue. For citizens, depending on their purpose and orientation, digital enablers may help diffuse information more broadly or be targeted towards specific groups. They may serve to create awareness of outstanding issues; help define relevant objectives and enable citizens to take centre stage in coming up with solutions. In effect, digital enablers may both build capacity for citizens to engage and be at the forefront of shaping incentives/motivation for their involvement. Other stakeholders (e.g., organisations, businesses, NGOs, informal groups), meanwhile, may assume varying roles based on e.g., interest, purpose, resistance, tools, methods, content and/or data.

Access to information importantly has a bearing on the degree to which conflicting interests arise or can be overcome. There is variation with regard to the diffusion of information, as well as the provision of “voice” for disadvantaged groups. The following are examples of digital enablers, under development in URBiNAT, that offer means of remediation in this context:

1. Urban mapping addressing targeted workgroups (such as children, families, or elderly citizens); GIS schemes facilitate navigation in regard to identifying, locating and visiting certain places of specific interest and need for target groups, e.g., playgrounds or suitable routes for exercising.
2. Engaging stakeholder groups; Associations, interest groups, sub-communities, etc. Mobile applications often service specific CoIs in a targeted manner. Agendas set out to co-create even more tailored digital applications can help propel new linkages and the engagement of additional actors, including other CoIs with which potential synergies are at hand.
3. Citizen engagement through social media; A wide array of communication channels can be utilised by neighbours to signal their needs in novel ways, so as to be better understood by all relevant parties.

In URBiNAT, the ambition is for the engaged cities to collaborate in applying digital enablers to help framing experimentation as well as structured learning and better diffusion of resulting insights. An important aspect is the consideration of how to focus the encouragement and enactment of participation to where it matters most. Additionally, with the concept of the Healthy Corridor, URBiNAT pinpoints the opportunities for linking areas and communities and how to shape a sustainable urban environment at the systems level.

Relevant actors	Implications related to digital enablers
Policy makers	<ul style="list-style-type: none"> • Opening for inclusion earlier in the policy, redefining “purposes”. • Deepening the dialogue to achieve learning; interact rather than just listen. • Discern the advantages of a more balanced role between ‘decision makers’ and citizens with the latter as a more ‘equal partner’. • Accepting and looking for design processes that can encompass both the “representative” and the “interactive” arena. • Organisational improvement linking competencies and supporting positive feedback-loops.
City administration	<ul style="list-style-type: none"> • Shift from sole emphasis on public expertise and rule-setter, to provider of public services facilitating public actions and consumption as well as collaboration between key actors. • Training and recruitment/organisation featuring diverse competencies. • The municipality’s strategy is subjected to increased transparency and enhanced demands from the public. • Enhanced ability to differentiate between situations, judging where to play a significant role, where to play a minor role or none at all, depending on phase, purpose, type of NBS, segment of citizens, etc.
Citizens	<ul style="list-style-type: none"> • The agenda to become known more widely, with the purpose better anchored among citizens. • Helping to define challenges as relevant for citizens. • Inspire and enable citizen engagement in their neighbourhoods and NBS. • Breeding creativity, own capacity and underpinning innovation. • Move towards community and “we appreciation”.
Other stakeholders (e.g., organisations, businesses, NGOs, informal groups)	<ul style="list-style-type: none"> • Inspiration for positive engagement, overcoming conflicts and yet managing to make informed decision sound for the long-term. • Mobilise for innovation and an environment more conducive to growth. • Can be targeted in varying ways, based on their position in regard to: <ul style="list-style-type: none"> ○ Relevant “purposes”; ○ The development of “tools” and/or “methods”; ○ Sourcing of data and content; ○ Special interests; ○ Resistance, derailment, vested interests, “me only” focus.

Table 2: Relevant actors and the role of digital enablers (IKED and DTI, 2020)

4.2 Digital enablers and changing actor roles

While showing up broadly in societal affairs, the role of citizens is subject to an ongoing transformation that complements representative democracy, from one where citizens elect their government, to one in which they exert direct influence through “participation”. This implies a changing role as well relative to other actors in city development. Digitalisation, and the information economy, no doubt contributed greatly to this change of guards (Linders, 2012). Today, in various ways, digital enablers offer designated vehicles in support of such processes. Their contribution may be staged through several means: by creating awareness and reaching out broadly; through targeting of specific areas and groups; introducing co-creation and co-production of models; offering citizen-centred services and engagement platforms; scoping innovation, commercial as well as social, and so forth.

A common main theme in all this is the scope for digital enablers to promote participation and co-creation, partly as a basis for local initiatives and partly by opening for a stake in decision-making. Either way, those living and acting in the city stand, one way or the other, to gain new means of shaping their environment. Any society, however, features a diversity of actors and a multitude of conflicting interests. The business sector for one, spans a combination of incumbent and mature actors, on the one hand, and newcomers which tend to be more prone to innovation and transformative change, on the other. Citizens bring diverse ideas and perspectives. Realising solutions to outstanding issues requires an ability to cooperate (Bowles and Gintis, 2013). It has been argued, in this context, that citizen participation may lead to a proliferation of conflict, due to an unwillingness of many to compromise (Bodin, 2017). Citizens with varying backgrounds, interests, and language further face hurdles to establishing trust (Raab et al., 2015). Additionally, many outstanding issues require weighing in considerations that go beyond the local context, including scientific and expert advice (Zachrisson and Beland Lindahl, 2013; Fischer, 2014; Elelman and Friedman, 2018). Mere participation may not be sufficient to work out a middle ground on existing issues and may in fact cause complications of its own (Walker and Hurley, 2004).

While these various concerns deserve merit, digital enablers possess strengths and functionality to deal with them. Observations of increased government efficiency include lower costs for consultation and for building efficient policy-citizen interface (Huang and Yu 2019). The tension between individualistic interests and striking a deal for the common good is a case in point. A shift in perspective from “what is in it for me” to “what is in it for us” can be assisted by a guiding process, spanning from curiosity to bonding. Digital enablers can be effectively devised to achieve such maturing, with affirmation by the group staged by timely interventions and rewards. “LearnForLife”, in the URBiNAT NBS catalogue, incorporates methodology devised for this purpose (Andersson, 2018).

The concept of Healthy Corridor, championed by URBiNAT, recognises physical, mental and social wellbeing as three main pillars of health, to be distinguished from “absence of disease” (WHO, 1947). While the three are related, they span from “physical” being primarily about the individual to “social” having to do with the group, while “mental” is in between. At the stage of the inception of digital enablers, in the late 1990s, the solution architecture initiated personalisation and tunnelling. In the early apps, detailed profiling aimed for bonding with the user. In 2007, with the release of the first I-Phone, interactive apps took off, advancing hand-in-hand with 3G, then 4G and, more recently, 5G. In parallel, the importance of strengthening social skills was recognised (Jenkins et al., 2009), with group dynamics a powerful instrument for engagement, using peers and community linkages to generate kickbacks. On this basis, digital enablers have arisen as a potent means to mature participatory culture, shifting mindset from preoccupation with individual expression to appreciation for community involvement. In Table 4, strengthening of community aspects indeed features in the Portfolio of digital enablers, including the categories of Reach, Inclusion, Interactivity, Initialisation, Sustainability, Linking and Trust.

A related aspect has to do with the importance of enabling lasting impacts. As noted, many occurrences and influences conveyed online may be of transitory nature. On the other hand, certain digital enablers, or features thereof, may shift a myopic mindset to caring for the long term. Adequately implemented, peer support may succeed in underpinning commitment to lasting change, often the key for successful implementation, and also of high relevance in stages of monitoring and maintenance of what has been accomplished. For new users, it tends to take time before any affective commitment to a given community falls into place, and even more so online (Lehto and Oinas-Kukkonen, 2011). Social support can typically speed the process, but is

often difficult to organise, especially when participants are geographically dispersed, or when travelling and physical meetings are impeded for other reasons, such as the pandemic in 2020.

The way digital enablers impact on actor roles is influenced by the purpose they are deployed for. Which actors and perspectives dominate and set the agenda is naturally of critical importance. Who takes the lead, for instance, the public sector lead, business interests, academia, or a combination of these? To what extent is academia and the science community effective in provide relevant inputs, and listened to/trusted by decision-makers and/or by the public? And what is the attitude to civil society and local community engagement exerting a tangible influence? What mandates, ambitions and strategies mark those individuals who exert key influence, and their readiness to welcome “bottom-up” initiatives?

Bottom-up and top-down approaches to decision-making can appear in diverse ways. A case in point is co-governance applying “public-private people partnerships” to support the digital needs of self-organising groups. On the other hand, self-organisation by citizens around issues of common concern can serve as a type of participation in urban planning that is neither initiated, nor orchestrated, by planners or officials, but advanced by citizens on their own initiative (Saad-Sulonen and Horelli, 2017).

Informal processes fuelled by digital enablers may critically enable overcoming institutional, social and cultural barriers. Animated interactions evolving in experimental exercises may tease out new waves of powerful informal social linkages, leading on to fuel collective actions. The relationship with social planners is fraught with both risks and opportunities. Relations may turn antagonistic but urban planners may also take advantage to use such movements to navigate challenges of culture and politics (Hou and Kanoshita, 2007). Favourable outcomes critically hinge on strategy and governance.

Instigating learning processes that cut across likeminded cities, while also engaging various facets of the science community, can be of great use. In URBINAT, preparations are under way to extend from the cities’ dialogue to examine which CoIs across the front and follower cities can most usefully be linked and leveraged through an appropriately devised and applied digital enabler. A strong candidate is that of community gardening, which has been recognised as a common denominator in several of the study areas. An important objective is to broaden the spectrum of citizens involved, as many are seen to carry a latent interest without thus far being actively engaged. The citizens who live in the neighbourhoods put high priority on realising an agenda that centres on features that are practical, useful and concrete. This focus no doubt reflects the hurdles and issues that the local communities have been confronted with during the pandemic.

External factors influence the scope for success with each model, including existing institutions and cultural factors. This in turn has implications for the scope of collective learning, self-organisation and participation by people and local stakeholders, including the private sector, civil society and grassroots organisations (Jabareen, 2013).

As illustrated in Figure 8, digital enablers can be used for varying purposes. When leading towards the functions placed in the left part, ICT is applied primarily as an instrument for the provision of information, in effect handed by governments to citizens. Moving rightward, functionality shifts in the direction of enabling citizens to communicate issues and needs, and increasingly be part of, or contribute to, solutions. In this realm, public authorities adopt means to consult citizens, for instance, on proposed urban plans or projects. Moving to the far right, ICT is interrelated with governance models that embrace citizens’ active involvement, empowerment, and ownership.

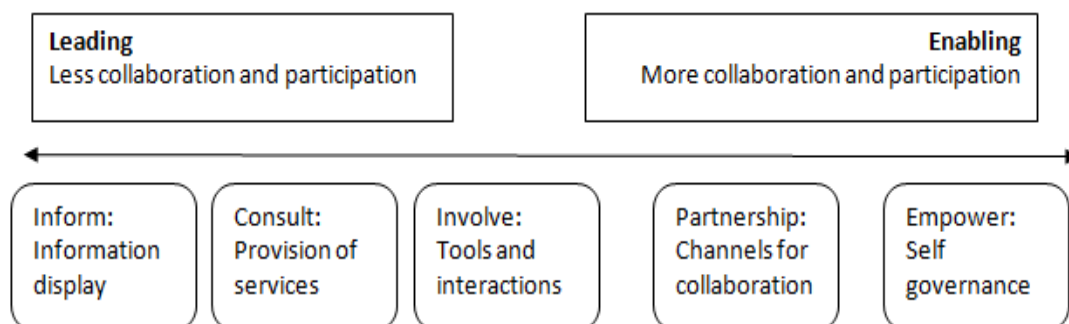


Figure 8: Where the influence of digital enablers is heading (adapted from Möller and Olafsson, 2018)

Digital enablers may be developed by citizens themselves and are applied to run projects independently of government. A practical example is “FallingFruit.org”, through which different kinds of fruits and food can be collected by citizens from various local sources with the help of location-based digital enablers (Möller and Olafsson, 2018). Separately, MegaCities-ShortDocs – Films4SustainableWorld, which identifies short documentaries raising awareness about the challenges of mega-cities and associated existing social and environmental issues and solutions.

A related dichotomy of relevance in this context is that between upward and downward accountability, here interpreted as whether decision makers are influenced by citizens or whether they will have to answer to them when making decisions. Analysis of e-platform use demonstrate a potential for both, with the capacity of officials and policymakers particularly decisive for upward accountability, resulting in citizens attaining increased clout in influencing decisions regarding various kinds of service delivery. E-platforms are also proving conducive to downward accountability, however. While less easily brought about, the latter tends to demonstrate the highest potential for instituting reform, resulting in greater capacity of city authorities to place citizen participation at the core of decision making. For this to work out effectively though, additional requirements need to fall in place, such as public disclosure of feedback coupled with active civic engagement. Without such elements, the civic muscle to hold senior policymakers, experts and service providers accountable, is likely to be lacking (Peixoto and Fox, 2016).

Engagement modalities thus vary from basic provision of information, representing a weak form of engagement, to full co-production, as well as various accountability models. The Dutch organisation Cordaid²⁶, for instance, created processes that squarely involve the local community while refraining from accepting any outside interference in decision-making, only outside inputs and support. The implication is that the community itself is in control of risk assessment and mapping, while supported by Cordaid trained professionals.

Unprecedented levels of connectivity, penetrating society at all levels, have resulted from the rapid diffusion of smartphones at increasingly affordable prices, broadband, and social networks. The combination of social media, social networking channels and mobile apps leads towards increasingly potent channels for citizens and communities to engage in co-creation.

In mobile telephony, Ertio, 2018) categorises “communication strategies” on the basis of: i) representation; ii) networking with the public, and; iii) citizen engagement. Representation implies a static functionality, a way of ensuring that certain perspectives are represented. Networking has to do with exchange by way of dialogue, i.e., two-way (or multi-party) exchanges. Ertiö (2015)

²⁶ <https://www.cordaid.org/en/wp-content/uploads/sites/11/2018/02/Cordaid-Annual-Report-2016.pdf>

classifies mobile instruments with a view to degree and qualities of participation, in regard to: i) type of data collected; ii) information flow, and; iii) citizen empowerment. Creative and multifaceted data collection is enabled by sensors such as cameras, GPS, audio, and voice recognition. Interpretation and measurement of quality in the surroundings are facilitated by auxiliary sensors, creating “the real-time city” (Townsend, 2000 and 2013). Further, various kinds of “participatory planning apps”, enable higher levels of participation, empowerment and progression in exerting an impact. Ertiö contends that the impact of planning apps has been modest thus far, but the potential ahead is substantive.

All this is emblematic of an ongoing shift in approach by public authorities, away from providing information to largely passive recipients towards citizens becoming encouraged to determine the issues as well as address them (OECD, 2020b; Vesnic-Alujevic, 2020). This we may conceive of as interwoven with a wave of “democratic innovation”, referring to the successful rise of citizen-led initiatives (Newton and Geissel, 2012). How cities handle this journey may be referred to as “transition” management, leading to “reflexive” governance. Having said that, it remains unclear under what conditions favourable adjustments occur. Distinguishing between six kinds of impacts, Fung et al. (2013) find stronger empirical evidence of technology contributing incrementally to policy reform, compared to truly transformative change.

Figure 9 outlines and indicates the relations between some of the concepts that emerged in recent decades, of relevance to interpreting and understanding the underpinnings of the smart city. Some of the specific contributions to this landscape are marked out in parenthesis. Ambient Intelligence draws on a range of technologies capable of sourcing and transferring digital data (broadband, clouds, smartphones, smart sensors, IoT, etc). Advanced software applications and ubiquitous computing account for deeper penetration of digitalisation in the city environment.

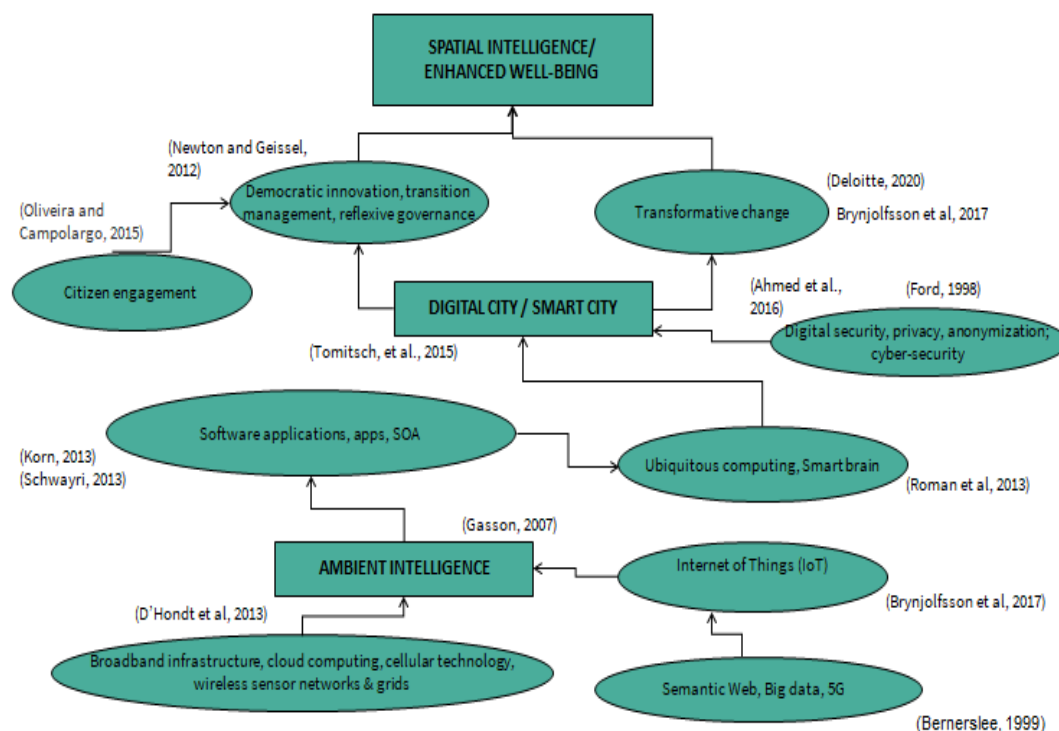


Figure 9: The urban information and intelligence agenda (IKED, 2020)

Smart grids, automated systems and IoT keep underpinning interactivity in everyday life. Despite extensive research and investment in making the infrastructure safe and secure, inherently fluid and essentially unresolved issues reside in the combination of authentication, authorisation, management and control of data, leaving systems, functionality and users at risk (Ford, 1998; Andersson, 2008; Ahmed et al., 2016; Baig et al., 2017), as returned to in Chapter 5.

The presence of several kinds of rationale/sources of benefits from applying digital enablers was introduced in Chapter 1. In focus here, is the potential for realising quality participation, and notably the engagement of individuals or groups which tend to be weakly represented when traditional means of engagement are deployed (Beebeejaun, 2006; Carp, 2004). In this, digital enablers should preferably not operate in isolation. Upgraded or reformed public service provision, infrastructure enhancement, or educational opportunities, may all have a role to play (Nelson and Servon, 2001). Such considerations underline the importance of *how* digital enablers may be applied and relate to a broader spectrum of circumstances and actions.

Regarding the role of mobile devices specifically, the subject of affordability needs to be paired with contemplation of reliability, service provision, the consequences of sharing phones, user motivation and kinds of use, and how these factors play out for different groups (Marler, 2018). In deprived areas, whether and how to identify constructive target groups is an important consideration that may be key to what results can be achieved. Candidates may be teenage girls, single household men, unemployed, persons with weak health, and “unusual suspects” (i.e., individuals who rarely take active part in community activities) are among the target audiences awarded special attention. In relation to these issues, lessons can be drawn from the EU funded Erasmus+ project COMENSI, focusing on community engagement for social inclusion and the development of methods for the activation of citizens at risk of exclusion.²⁷

Partly with a view to their particular weight in regard to disadvantaged groups, Ertiö (2018) suggests the following as greatly important for promoting participatory processes:

- i) Listen and respond – provide feedback channels and encourage broad participation;
- ii) Connect to the policy framework – safeguard the status of citizens’ contributions in decision-making;
- iii) Make co-creation fun and easy – motivate citizens to collaborate and compete with each other and design micro-tasks;
- iv) Build a community – enable users to communicate among themselves, not only citizen to public servant communication channels but also commenting and expanding on peer ideas.

For use of mobiles specifically:

- v) Expand usage – encourage users to learn how to use mobile phones for “serious” participation, rather than entertainment;
- vi) Situate engagement – make use of the ubiquity and portability of phones to reflect “on-site”;
- vii) Utilize sensor data – collect and analyse geo-referenced data captured by the phone’s sensors.

Critical pointers for how to realise a fruitful agenda here have to do with *who* stands to deliver on the outcomes of participation, *when* and *how*, including what connection there will be to actual decision-making. In focus here is the municipality “engine” – how to practice transparency, commitment, and accountability in governance. We may speak of the “backstage” requirements

²⁷ <http://www.tesseract.eu/project/comensi/>

both for digital and in-person participation, which may be hard to communicate clearly or to rein in. Yet, the associated issues will need to be managed in an environment opting for co-creation as a means to achieve real results.

Effective participation is supported by educational elements and training that help both bring out the best of urban planners whom, it should be stressed, have a key role to play and with valuable competences which should be utilised in the best way possible, and also to help underpin constructive citizen engagement based on a willingness to appreciate diversity and confront conflicting interest. A well-executed plan may require: a) Mindset evolution on the part of urban planners, in support of inclusion; b) The assessment of issues and problems beyond the limited scope of the municipality or vested interests; c) Room for candid and creative input from the relevant local stakeholders and neighbours; d) A sense of involvement and belonging, strengthening the identity and building new linkages and a sense of community among all, and; e) Genuine value-enhancement from the participation of executed plans.

4.3 Data management in URBiNAT

URBiNAT is partly framed for advancing structured collaboration and exchange of experience between cities that assume different roles. Based on their experience and established position, the *front-runners* select and devise specific NBS for linking up in Healthy Corridors. The *followers* are tasked with preparing plans. The *observers* take part in the learning process and may pursue their own initiatives in connection with the project. In focus are the issues of “in-city” fragmentation and polarisation, and how to engage citizens in disadvantaged city districts. The fundamental issues at stake are, in a sense, shared between the various cities, and also of more or less universal relevance to urban areas anywhere. Yet, the way they play out - and can most effectively be resolved - in the specific case, is deeply dependent on context-specific and idiosyncratic factors. In each case, URBiNAT sets out to examine and draw lessons from the pioneering of new approaches to participatory processes, with the aim to gain an understanding of what relates to the specific context versus what brings lessons of general validity.

The coordinated application of digital enablers in the different cities facilitates comparative approaches and assessments, e.g., by making it easier (and less costly) to examine what makes a difference in achieving favourable results and draw lessons thereof. The aim is for the parallel city studies to help build a more systematic understanding how citizens and stakeholders can be engaged in co-creation, spanning NBS and Healthy Corridors, each taking account of variation in the attributes of citizens, in the issues they are confronted with, in the presence of confounding factors, and so forth.

Meanwhile, comparability requires consideration to the issues raised by the varying features of NBS, including their implication for matching with local conditions as well as comparability, of relevance for the application of digital enablers in support of co-creation. As already discussed, the application of NBS reflects a holistic approach to urban development, with the recognition of diversity in relevant interests and perspectives, along with the richness in natural processes as a basis for means and insights to support sustainability. At the same time, human beings and social fabric need to take centre stage. While the technological and territorial NBS are often more material in character, and participatory as well as social and solidarity economy NBS more immaterial, the different categories are interrelated. Irrespective of whether material or immaterial aspects dominate, the focus is on ways to inspire co-creation in realising value-enhancing solutions, taking advantage of physical and social dimensions of public space.

Digital elements, meanwhile, are an integral part of many NBS, including those represented in the URBiNAT NBS catalogue. In the technological category, the “Mobile urban garden” is based on an augmented reality app while, as described above, Superbarrio relies much on a digital game. Territorial NBS show high propensity to make use of digital tools such as sensors, GIS platforms, etc. Social and Solidarity Economy NBS include Solidarity Fairs/Markets, Farmers Market Network, Bread Houses, and Social Currencies, each of which incorporate digital features. Among participatory NBS, Behavioural Mapping, Women’s Footprints Map, Photovoice, Motivational Interviewing, and Learn for Life, gains increased leverage through digital means. Whether digital enablers are part of a specific NBS or not, however, there is general scope for applying them as part of preparations, selection, design, etc., generating value through the mechanisms, and rationale, outlined in Chapter 1, ultimately for the purpose of encouraging citizens to get acquainted with, inspired by, and engaged in using them.

In characterising and measuring the impact of NBS, URBiNAT introduced *scorecards* to outline their respective profile, i.e., with a view to the envisaged impact on nature, wellbeing, health, mobility, and the economy. The scoring is meant to feed citizens with a minimum of comparable information on possible pros and cons of each NBS, as inputs to the co-selection and co-design stages. As should be underlined, however, it is not possible to define static, universally applicable impacts following automatically from the deployment of any NBS. The impact will be strongly influenced by people’s engagement, their expectations and approach, whether there is a matching between the issues at stake and what the NBS can achieve, and how different NBS combine and go together in Healthy Corridors.

The nature of this agenda places high demands on URBiNAT to manage a broad range of methods to collect, link and apply relevant data, to help build an understanding of outstanding issues, how to devise solutions and overcome prevailing conflicts and hindrances to their collaboration, and also to monitor and evaluate impacts in support of learning (ICLEI, 2015). Due to the costs of collecting data, time constraints and, at the end of the day, the prevalence of gaps in the availability of data, priorities inevitably need to be made and trade-offs resolved in order to determine which data to collect, process, integrate, communicate, visualise, and so forth (Observatorio del Derecho a la Vivienda, 2015).

The use of quantitative data typically facilitates structured comparisons and statistical evaluation. Qualitative data may capture what cannot be quantified, and allow for a more in-depth understanding of, for example, the behaviours, motivations and feelings of residents and stakeholders. Experimental work has been carried out as part of the local diagnostics of the frontrunner cities, with regard to both quantitative and qualitative data. Community mapping of various relevant aspects, including cultural and behavioural factors, represents an example. Another is the application of a well-being survey, collecting hard as well as soft data on aspects with a bearing on the physical, social and mental status of citizens. Qualitative data collection has been applied not least to reflect outputs generated by workshops, and also from the deployment of participatory NBS, such as Walkthrough, Photovoice and Motivational interviewing.

As noted, however, limited information resulted from the local diagnostics of the frontrunner cities when it comes to the digital infrastructure, access to digital tools and their use in the study areas. The preparations of local diagnostic to be undertaken in the follower cities, currently in progress, take lessons in this regard and will aim to fill out the gaps. Ways of underpinning comparisons and thus facilitating learning between the cities, are examined. Analysis of similar social media channels/platforms offers opportunities in this respect. Twitter traffic, which is available from all

the participating cities as well as each specific study area, has been identified as a viable option. Expressions of individual and community attitudes and behaviours, and how they correspond to user attributes (age, income, gender, employment, immigrant status, etc.), may thereby be compared in-depth, in niche areas. By extension, new insights may be gained into what influences, in each case, have a bearing on the processes surrounding NBS and Healthy Corridors. While the usefulness of the Twitter data in the present context remains to be determined, the focus is on working out informative ways to gauge the responses of and consequences for citizens and their communities, applying specifically to the study areas, or with a view to impacts on structures and relations within the city, related to the Healthy Corridors.

Meanwhile, ample experience points to the opportunities brought by mobile applications (apps), for engaging disadvantaged and vulnerable communities (Goolsby, 2010; Nash, 2010; Okolloh, 2009). In the US, cell phone use, mobile Internet use, and cell phone app use have become greater among African Americans and English-speaking Latinos than among whites (Smith, 2010). Following an array of user-friendly applications, my-participation, i.e., the advance of co-creation using mobile telephony and smartphones, is increasingly capable of catering for the special interests of niche groups. Not only that, the practice of engaging users in the actual co-creation of the digital enablers themselves, with a user-friendly app at centre-stage, is evolving.

Some concrete examples demonstrate the opportunities for taking the task of producing, accessing and processing big data in-real time closer to citizens, translating into impetus for decision-making where citizens have a role to play. Wellington (New Zealand)²⁸ exemplifies a city that has made active use of IoT to ensure that data collected by field staff is shared with constituents to engage them in developing solutions to meet with citizens' needs. The aim includes working effectively across sectoral and institutional barriers in delivering real results. In the EU, joint task forces have been set up to link the work of different EU projects, involving a range of cities, in support of cooperation on indicator development, to promote comparability and support sharing of lessons from implementation processes (URBiNAT, 2020).

The URBiNAT Observatory, meanwhile, accounts for a digital ecosystem, spanning all stages of the project, from the collection of data (WP5) using multiple sources, including regular statistical databases, remote sensors and interactive apps operated via smartphones, to the sharing and use. Co-monitoring is facilitated by associated services, worked out and further developed by the partners in collaboration, linking as well to the sharing of experience and learning that is ongoing within URBiNAT's CoP (Andersson et al., 2020).

To facilitate two-way feedback loops in the study areas, the observatory is inter-linked with URBiNAT's website, and also to social networks. Its toolkit further spans AI Analysis, Statistical Analysis, Qualitative Analysis, Social Network Analysis and Data Visualisation. Serving as a fast and scalable data processor, the Observatory will be applicable to both search and dissemination. Security and authorisation can be managed using a preferred choice of access rights along with conditions for sharing, based on a menu offering seven different levels of permission. Other services include geographical representation, timelines with structuring according to calendar, content combined with web-site arrangements and structured interface with the outside world. The Open Archive Initiative Protocol for Metadata Handling (OAI-PMH) is a standard increasingly used to exchange structured metadata (Devarakonda, 2010).

²⁸ See further: <https://iotalliance.org.nz/wp-content/uploads/sites/4/2018/09/Accelerating-a-Connected-New-Zealand-eBOOK.pdf>

The Observatory is meant to service all partners and actors directly engaged in URBiNAT, using open systems where experts and practitioners can work together while respectful of privacy and security. Where possible, open source is applied in order to avoid lock-in with individual software and vendors. For scientific analysis, specialised commercial software is likely to be required, depending on the purpose, but not on terms that promote or enforce its use more broadly.

The value added by digital enablers to the collection, processing and dissemination of data will, at the end of the day, hinge on the competencies and governance propelling actual use of the results. A key aspect is the scope for collaboration between technicians, urban planners, and social and behavioural scientists (Edwards and Fenwick, 2016). Required infrastructure and administrative capacity needs to operate in tandem with the providers of suitable methodology in order to plan, organise, evaluate and act upon citizens' inputs and responses. As part of the picture, there is always a risk that citizen and stakeholder engagement run off course, resulting in sharpening conflict rather than dialogue. The availability of diverse competences capable of mediation may then be critical. According to Forester (2006), mediated participation techniques can help redirect conflict into joint inquiry and search of solutions rather than escalate conflicting demands, and thus achieve practical ends aiding diverse interests. For coordination and mutual learning between the URBiNAT cities, again the Observatory needs to provide continuous support.

4.4 Readiness for digital enablers in URBiNAT cities

While the nine URBiNAT cities fall into the categories of front-runners, followers and observers, that does not translate into a corresponding hierarchy in terms of experience from applying digital enablers. The cities taking part in the project represent a mixed bag in this respect. Their active engagement in URBiNAT's CoP, however, currently engages them in actively sharing, concerns, experiences, plans and ideas how to go forward. For digital enablers, exposure to the vast, multifaceted experience that resides among multiple cities around the world, is essential (cf. Annex 1). Here, URBiNAT facilitates taking inspiration from any relevant, e.g., how to handle issues pertaining to deprived or disjoint areas, engage citizens on terms that promote innovation, and how to apply them while overcoming any accompanying downsides and risks.

In the spring of 2020, representatives from all URBiNAT cities took part in exchanges on digital enablers with a focus on carving out their most effective role in promoting citizen engagement. This work remains ongoing and will continue in subsequent phases, e.g., task 3.4. In these webinars and meetings, the following subjects were addressed: i) Frameworks for mapping, developing and implementing digital enablers; ii) Their building blocks, namely Purpose/needs, Methods, Tools, and Content; iii) Examples of digital enablers, such as Better Reykjavik, FixMyStreet, and BikeMi, along with lessons learned, and; iv) connections to URBiNAT's CoP.

The preconditions and strategies of the URBiNAT cities regarding digital enablers varied considerably before the project's start, however, and have continued to do so since then. Table 3 presents an overview of some relevant aspects, along with actual digital enablers visible in each city. Partially drawing on the local diagnostics, the columns to the left highlight the state of digital infrastructure in the study areas, covering Internet connection, access to digital tools and level of digital literacy, influencing the preconditions for applying digital enablers. The column in the middle presents an overview of digital enablers, in this case covering each city generally, while the right-hand column presents digital enablers developed in response to COVID-19 specifically.

	Digital infrastructure (in the study areas)			Digital enablers used (general)	Response to COVID-19 (general)
	Internet connection	Access to digital tools	Level of digital literacy	Apps, digital/online city platforms, etc.	Digital enablers developed as a response to COVID-19
Porto	Fibre optic network available	In the study area, access to digital tools is limited to mobile phones and smartphones	Considerable generational Divide, where the younger have a higher level of digital literacy	GameON Omniiled SiosLife EYEParking Cresce e Aparece Design the Future My Green App	City Café switched to online with monthly more accessible format Specific website on COVID issues on the city platform Educational sessions available on YouTube Tech4Covid, 3D-Videos https://tech4covid19.org/ UPFit - online gym
Nantes	Good coverage	Smartphones are common except for the older generation Fewer laptops and tablets	Good level of smartphone use among younger population Socio-economic and educational gaps	Online city platform: “Dialogue Citoyen” Digital tools to support citizen participation	App for volunteers to engage in delivering food for the elderly
Sofia	Sufficient bandwidth Lower affordability	Many have smartphones, fewer laptops and tablets	Relatively low digital literacy; Generational gap in use of digital enablers	Municipal single contact point for information https://call.sofia.bg Sofproject: web-GIS https://sofiaplan.bg/en/portfolio/municipal-development-plan/ District of Nadezhda, official web page: http://www.sonadejda.com/	All ordinances, announcements, and information on COVID-19 https://www.sofia.bg/covid-19 (Sofia municipality) https://srzi.bg/bg (Regional health inspectorate)
Høje Taastrup	Good access	Good access	Medium	Online platform Innosite Piggy-back on other Facebook pages	Change of participatory activities and events
Siena	Civic network accessible wireless Francigena WIFI available for citizens, tourists and pilgrims	Easy to access and consult web pages. Siena comunica.it has a user-friendly interface connected to social media platforms	Good level of digital literacy among citizens, and a willingness to experiment with new solutions	www.sienacomunica.it URBiNAPP (not yet ready to be downloaded)	Launched website “Siena restart together”

Nova Gorica	Broadband access plus Hot Spots with free WIFI at multiple locations	Smartphones are common and most families have at least one laptop	Digital literacy level is relatively high, but generation gap exists	City has website but is lacking interactive format City's Facebook page is utilised for quick informal updates to citizens	
Brussels	Broadband and Fibre Access throughout the city	Smartphones are common and most households have access to laptop or tablet, including at Community centres free of charge	Digital literacy is basic and generational gap prevails, but citizens are positive to use of digital tools	A number of web portals and apps are available for use by the citizens https://www.fairebruxelles.be/ https://fixmystreet.brussels/	Swift collection of laptops and other digital tools by volunteering activities as COVID-19 restrictions demanded online work and schooling while many households were faced with a shortage of tools https://www.impactdays.co/en/brussels/helps/ https://www.helpify.community/ https://www.hoplr.com/ https://brusurf.wordpress.com/2020/04/01/quelques-liens-utiles-en-cette-periode-de-confinement/ https://www.bruxelles.be/museumathome Open source platform "BOSA" to be implemented in the coming months

Table 2: Digital enablers in URBiNAT cities (IKED, 2020)

The reason for Table 3 to display digital enablers for each city as a whole, is basically that hardly any have been developed for the study areas specifically. As regards the status of infrastructure, it may be noted that, in principle all the URBiNAT cities, offer acceptable Internet access, broadband capacity including 4G and fibre optics, to most citizens, across all areas. On the other hand, due to socio-economic factors, citizens display highly varying access to personal digital tools. Most cities provide community centres offering access to digital tools free of charge, and generally also training or coaching. Gaps in digital literacy are universally present, generally with the more educated and the young more capable to manage on their own.

Most digital enablers deployed by the URBiNAT cities have aimed at supporting public service provision broadly, with little attention devoted to participation, or the study areas specifically. A partial exception is the use of social media platforms, mainly Facebook, in Høje Taastrup, in support of co-creation. In response to the pandemic, certain measures focused on capacity building in the study areas, such as the provision of hardware, in Brussels. Digital enablers in Nantes addressing the food sector, are similarly of high relevance for deprived areas. As for the general picture, however, hopes that digital enablers would provide straightforward answers how to assist badly hit deprived areas, have not been met. Table 3 demonstrates the limited scope of initiatives pursued, of direct relevance to URBiNAT's study areas, as well as to co-creation.

A clear-cut need has thus become evident of further strategic and development work by the URBiNAT cities, to devise and apply digital enablers where most needed. Again, URBiNAT offers a framework for taking this forward. In the following, we proceed to with further observations on the context for each city.

4.4.1 Porto

Porto is served by well-developed networks, one for fixed communications and another for mobile. While a forerunner city of URBiNAT, marked by rich experience in NBS, Porto's use of digital enablers is less pronounced, especially in deprived areas. Table 3 lists existing enablers promoted by the municipality, of which few are actually targeting, or tailored for specific relevance to, the selected neighbourhoods. Although many of them are clearly relevant to those areas, it is not yet clear to what degree they are accessed there. Limited access to digital tools in those areas coupled with demographic and socio-economic factors has so far acted as an impediment to digital enablers in the deprived areas. The Reboot programme, which entails recycling and sharing computers in support of underprivileged students, is an initiative aimed to improve conditions for vulnerable groups, with implications for both access to tools and learning. Digital enablers have been applied in selective areas since a decade but in a cautious manner.

A common preference for face-to-face contact is prevalent among many citizens. Step-by-step introduction of digital enablers, and having them co-exist with traditional participatory processes, is viewed as important to avoid a backlash. A start-up community, Porto Digital, is used to spearhead more ambitious applications. It has been engaged in developing smartphone applications, of which several are linked to NBS. One of the most successful examples is the application that can be used by citizens with the aim of reducing electricity consumption.

During COVID-19, the authorities have faced strong challenges how to keep reaching and involving citizens in participatory activities. Digital enablers were quickly approached as a panacea to overcome the impediments that arose to physical meetings. Results were not as expected though but, in a range of situations, met with resistance, including in deprived areas. Considering alternative avenues, representatives of Porto promoted personal phone calls as a means to reach out and inspire people to participate in various activities, some of them online. The plan was partly to locate "ambassadors" who can act locally by being in direct contact with citizens. Further, looking for other means to catch attention, 3D videos for presentation have been identified as an entry point to raising citizen interest. A particular method has been tested, where a 3D presentation made online, after which citizens are first divided into different Zoom meetings. From there on, citizens divide themselves up to take part in different rooms, taking account of locals involved in the video. Through URBiNAT, this experiment is shared with the other participating cities, in order to broaden the perspective and help draw lessons.

In this vein, an intensive search has unfolded to work out more engaging means, than what can be offered through traditional reliance on online communication. This is partly to overcome a general resistance which has appeared in the face of attempts to make extensive use of digital enablers, and partly so as not to alienate those citizens that are the least familiar with digital communication, and who also are the ones in the greatest need.

4.4.2 Nantes

Nantes has developed a specific governance model directed to the engagement of citizens in the preparations and implementation of projects, with high ambitions and strict practice for providing citizens with feedback on ideas they have brought forward. Issues arise with inclusion, however, which is a common challenge with traditional methods, as discussed in previous sections. Thus far, digital enablers have not been applied in this model. An electronic survey has been distributed during the pandemic, however, collecting information from citizens and engaging them in

producing ideas for how the municipality should respond. The Nantes approach puts strong emphasis on working out the means for realising effective citizen participation, providing the breeding ground for co-created digital enablers (Hilding-Hamann et al., 2019).

Nantes Metropole has used digital enablers in support of citizen participation since 2014. Through the platform “Dialogue Citoyen”, citizens are invited to initiate project ideas that are subsequently assessed and advanced to workshops. A swift and well-structured process leads from ideation to verification, i.e., project approval or rejection, providing an impressive contrast with regular bureaucratic procedures. Specific digital tools have further been introduced by the municipality to support the participation of citizens from the whole territory in addressing major societal topics. Examples include energy transition, reconnecting the city to the river Loire, and how to adapt the city to the longevity of its inhabitants, with projects selected through online voting contests.

In the era of COVID-19, Nantes has accelerated the development of an open-data platform (data.nantesmetropole.fr), which offers access to data collected by sensors, such as traffic camera data. For instance, this information can then be used to optimize energy supply within cities by centralising data in one server updated frequently and automatically, which enables a real time response to sudden changes, e.g., caused by natural disasters, outbreaks of pandemics, or traffic accidents. On this basis, resource use can be made more efficient, time can be saved and lives too due to faster signalling and more effective responses to various calamities.

The development of apps and other tools has been supported by CityLab, one of the first schemes of its kind to be set up in France, that offers concrete means to foster innovation at the service of residents. Examples of successful applications include the instalment of equipment to inform citizens about air quality and pollution levels. The aim is for this to serve as the starting point of a global experiment on air quality measurement, to be deployed until 2021. Another example is Farmbot, designed for an autonomous vegetable garden.

Faced with worsening social issues during the lock-down, an urgent need arose to find a way to support citizens. An identified particular task was that of making the most of a 1-hour opening to go outside. Walkthrough, here using a video broadcast in a bus, was applied to reach people not able to walk long distances, or with limited time. The video was arranged to match with the walking loop, connecting the green spaces of the Healthy Corridor²⁹. Further, ongoing discussions aimed to determine the best way for citizens to co-design the green areas in Nantes-Nord, have naturally shifted to placing greater attention to what digital enablers can achieve. Photovoice, or apps which can be readily applied to take pictures and share them online, are applicable. A blend of digital and non-digital seems to be gaining ground though. Suggestions under consideration include providing citizens with stickers displaying various NBSs such as herbal gardening, family exercise equipment, compost boxes, etc., that they can post on a 3-D map made available in the recently inaugurated citizens’ bus; la Mobil ´O Project.³⁰

Nantes ranks close to the top among provincial cities in France by way of most attractive ecosystems for start-ups. Since the French Tech label was awarded in November 2014, between 180 and 200 companies and around 22,000 jobs have been created on this basis. In 2016, Rob Spiro, a famous entrepreneur from Silicon Valley, left San Francisco to unpack his bags in Nantes and launch a start-up incubator with an international dimension. The city offers many coworking areas (the Terrace, the Cordée, the Prairie...), unmissable events such as the Web2Day (12th

²⁹ Video of the walking loop <https://vimeo.com/461432240/9845b804e4>

³⁰ <https://urbinat.eu/cities/nantes/>

edition should have taken place in 2020) or the Nantes Digital Week (7th year in 2020), not to mention the many networking opportunities. Nantes also has more than 10 incubators: the Centrale-Audencia-ensa school incubator, the Startup Palace, Atlanpole, the Company Campus, etc., and 9 start-up accelerators.

4.4.3 Sofia

In Sofia, the general status of digital infrastructure is satisfactory, with sufficient bandwidth, affordable access and the penetration of smartphones and other digital tools at a level which is comparable to many other major European cities. In disadvantaged neighbourhoods, however, digital literacy is fairly weak, and laptops and tablets have a low penetration rate. Low-income levels account for low affordability as the costs of connectivity attain a significant share of household expenses. In the specific case of the Nadezhda urban district, Internet connection and bandwidth capacity are provided by about 10 operators. Costs related to Internet services as well as for digital tools are nevertheless viewed as an impediment by citizens in the neighbourhood, which contrasts with other parts of the city.

Sofia is at an early stage when it comes to application of digital enablers as a means of engaging citizens. The municipality has a web-platform where citizens can write comments on ongoing projects or suggest new projects. The process from idea to comment is not well organised. Interviews among start-ups applying smart and green solutions display disappointment and criticism against the municipality for lack of support and counterproductive policies. In the Nadezhda neighbourhood several of the NGOs are using existing social media channels such as Facebook and Instagram for the initial engagement of community members.

In the Nadezhda neighbourhood, using Walkthrough along with workshops, citizens have identified an area with many fruit trees, to be revamped using digital enablers. Thus far, most fruits were mishandled due to lack of organisation/knowledge, with many picked prematurely by youngsters for throwing and playing. A few months later fruits are over-ripe, fall to the ground and become a nuisance for pedestrians and cyclists. Citizens are looking for a solution to build awareness and create shared interests in the usefulness of the trees and their fruits. An interactive digital map of the trees, run via GPS and supported by sensors, has been proposed by the citizens to signal when fruits mature, and to help launch exercises of joint collection along with the production of juices, marmalades, compotes, etc. The digital enablers should be easy-to-use, including via simple smartphones. If successful, the plan is for the application to be scaled for Sofia as a whole, similar to the German website www.mundraub.org which displays locations where individuals can pick vegetables and fruits for free.

4.4.4 Brussels

The city of Brussels has invested extensively in digital infrastructure in order to provide reliable and efficient Internet access for all citizens. Free WIFI is available in almost all public spaces and at local community centres (district houses) located in each neighbourhood. These facilities offer space similar to an Internet café and free of charge for citizens. On household level, a number of service providers are offering packages for home-based Internet connections at a relatively low cost. Meanwhile, many citizens, especially in less affluent neighbourhoods, opt for packages linked to their smartphone purchases in favour of paying monthly subscriptions for household Internet arrangements.

In order to support vulnerable citizens, Brussels has moved to equip each community centre within the city with stationary computers and Internet access, while also having personnel available for training and instructions how to make use of municipality applications. The services provided include location-specific information in regard to logistics and collective transport. WIFI access is free of charge and open also for personal use by all citizens living in the city of Brussels.

Opening for citizens to take active part in further service development, the municipal website is equipped with specific features encouraging feedback and further idea generation. Means of enabling further improved interface with citizens, and also to empower them to develop new initiatives, are in high demand. A special agenda has been introduced, opening up digital domains for citizens to develop new communities based on their private interests. Currently, however, most such activities are unfolding on commercial social media platforms such as Facebook, where user data is unprotected and open to exploitation by proprietary interest.

Highlighting the importance of user perspective in the development of new digital tools and applications, taking account of mobile platform complexities and challenges in Brussels, Walravens (2015) pointed to opportunities of leapfrogging in mobile service development by using the city as a local innovation platform built on open data. For approximately two years, the City of Brussels has been working on the development of a new open source citizens' platform, BOSA, as a vehicle for propelling active citizen participation. BOSA is expected to be launched at the end of 2020.

When COVID-19 affected the city and the lock-down restrictions were implemented it was quickly understood that this would put the digital infrastructure under pressure. With thousands of people working from home, school children and students engaging in online classes from their home bases, the need for upgraded services was evident. High discrepancy in access to laptops as well as high-speed Internet contributes to sharp divides between city areas already marked by unequal fortunes and opportunities. The city reacted quickly and launched a campaign to collect tools i.e., computers, laptops, printers from private as well as public organisations which had a surplus of tools not in use. The municipality managed the collection, reprogramming, disinfection and distribution of the tools. This action provided an important facilitation for all citizens, young and old, to not to be left out during the restrictions imposed by the pandemic. It also improved digital literacy because of access to tools and the lack of alternative activities such as outdoor exercises.

In the URBiNAT study area even the engagement with the council of citizens moved to online and after some training on the online tool, in this case Zoom, all council members (17 council members) were able to connect.

4.4.5 Høje Taastrup

In Høje Taastrup, many local communities have their own Facebook pages. The municipality piggybacks on the existing Facebook pages in order to spread information and communicate with residents. Høje Taastrup has also used an online platform called Innosite, to allow residents to provide feedback on the development of a park and urban space in a neighbouring district. Innosite is developed by Realdania, a very large Danish philanthropist investment fund. Young people represent an important target group for this and other initiatives. The municipality tries to attract young people to events in the neighbourhood, such as the yearly festival, by bringing in elements of interest to a younger crowd, including music and entertainment. So far, digital

enablers and social media form only the top layer, as the focus largely is on creating infrastructure, getting people involved and encouraging them to take ownership.

With the pandemic, a major shift has happened, with previously physical meetings mostly organised online. Having said that, where possible, physical workshops have been arranged as a supplement to online meetings. Personal calls have also been made in large numbers to individuals enrolled in social activities. The city further spent increased resources on communicating about COVID-19 in multiple languages, including those spoken by immigrant minorities. This has contributed to an increased number of people interacting online, compared to when meetings were primarily physical. Yet, the strong impact of culture, by way of those who manage applicable digital tools, seems to determine who connects online, underlining the importance of complementary communication channels, including through traditional phone calls.

Five apps offer this kind of functionality for birds specifically, for insects, plants, trees etc. and in registering certain sightings the user is also adding to knowledge of biodiversity in specific areas. At school level such apps can further be introduced via treasure hunts or special events. In these COVID-19 times, for countries where residents have been allowed to go for walks in nature, it has become popular to explore nature using such apps. Some can be applied in nature clubs, in schools for projects and by scouts and other organisations, or simply by people who like to walk around and explore nature in their neighbourhood.

The arrival of COVID-19, however, has had implications casting light on digital literacy aspects in the study area. As Danish schools closed and teaching went from face-to-face to online, students from disadvantaged groups faced severe challenges, both when it came to following classes online and regarding the submission of assignments online. As commented on earlier, the social context and varying levels of support and engagement in the home environment, were expected to play a major role. In the case of Høje-Taastrup, the local government deemed the risk of long-time consequences, by way of the weakest students slipping further behind related to suffering other psychological damage in the meantime, as unacceptable. Those experiencing evident difficulties were thus allowed to return to the classic school environment, and thus to be re-engaged by traditional education methodologies in a controlled environment. Hence, this demonstrates the need of monitoring and of being able to take selective remedial action, with consideration to individual capabilities and other issues affecting ease of use.

4.4.6 Siena

In Siena, a current project involves AI and a robot, enabling people with serious diseases to visit a museum (Santa Maria della Scala). Furthermore, the “URBiNAPP” was created in preparation of the project meeting planned in Siena for March 2020, before it was postponed due to COVID-19. The app has been devised to share information about events, tours and experiences in Siena, and also includes digital vouchers of various sorts. In times of COVID-19, Siena launched the web page “Siena restart together”, to inspire looking ahead (see further below). In February 2020, focus groups were formed targeting engagement of key stakeholders from the selected neighbourhood (associations, priest, doctors, and schoolteachers) who spread the word to other people. According to the local team, teenagers may represent the most difficult group to reach. Consequently, new specific approaches will be developed to involve them.

The pandemic called for a rapid uptick in digital communication. It became apparent early on, however, that digital communication meets with hurdles in reaching new audiences. Gradually, challenges to remain relevant and engaging have caught attention. Meanwhile, public green areas have emerged as a central asset for citizens hamstrung by fear of the pandemic along with suffering from lockdowns and even curfews. Additionally, Siena is reaching out to citizens offering them alternative contact points and communication channels, that they can use freely, based on their preferences. On this basis, several online forums and groups are developing. Initiatives by citizens, e.g., to provide community support and speed access to aid for those in need, are facilitated by the municipality. During the taxing period of “lockdown”, structured two-way interaction has been initiated drawing on the URBiNAT project, for awareness-creation and to inspire creative and innovative communication flows. URBAN TREKKING 2020 has been devised as a digital enabler applied to increase knowledge and inspire citizens to engage in city planning remotely.

4.4.7 Nova Gorica

Regarding digital infrastructure, Nova Gorica is well equipped with WIFI hotspots placed strategically around the city to allow easy access and good connectivity, providing the WIFI for free and without access code. Most citizens have a positive attitude to using digital tools and a big part of the younger generation is in possession of smartphones and laptops. The city website (<https://www.nova-gorica.si/>) offering full communication in Slovene, resumes in English and Italian language, and provides almost all needed info to citizens and visitors. However, the website is not interactive, and effective channels for input and feedback from citizens are lacking.

A Facebook account is at present the main online interactive tool for immediate feedback. Some neighbourhoods have set up local Facebook pages allowing citizens to comment and provide feedback and ideas, often in connection to various events and specific activities. The readiness of citizens to embrace digital enablers provides a potential for Nova Gorica to engage them in co-creating and developing a range of user-centric solutions, which could include apps in support of public transport, health services, entertainment, and more. In addition to that, the city is undergoing the evaluation process to become Culture Capital 2025 for Slovenia and is including numerous art and culture activities based on digital solutions that will probably enhance the city users experience in all forms.

4.4.8 Non-EU observers

In both non-EU countries with observer cities, China and Iran, progressing digital infrastructure, tools and applications are of high priority in public service, economic development and for security purposes. Especially in China, high priority is placed on smart cities and rapid advancement of digital solutions in urban planning and development. Assuming a leading position in big data processing and AI, however, the approach thus far has been mainly top-down and engineered through public investment. Strengthened infrastructure, e-government and addressing a range of sectoral development needs attain high focus. Limited attention has been paid, however, to the application of digital enablers in support of participatory processes and citizen engagement, including in the context of polarisation and addressing conditions that confront disadvantaged groups.

Of the non-EU observer cities, Shenyang resembles other Chinese cities in this respect. Here as well as on the part of the Chinese project partner, NSCJL, and also in other Chinese cities that are

now linked and exposed to the URBiNAT experience, URBiNAT's approach now attracts high attention and is expected to result in follow-up and experimental learning with potential for wider diffusion. Given the highly advanced stage of digital infrastructure in many Chinese cities, from a technical and physical viewpoint, there is strong readiness to take this forward with multiple applications. In Khorramabad, as in most other Iranian cities with the exception of the capital, Tehran, and the major regional centres, digital infrastructure poses greater challenges. Although Khorramabad has limited experience of digital enablers of direct relevance to the URBiNAT project, various other digital applications are around and can be built upon. The strong commitment by multiple stakeholders to realise URBiNAT's agenda, as is also the case in the national organisations involved, underlines the opportunities at hand.

As for a few more observations of the national context for digital enablers in urban development, in most of China, apart from the very young and old, digital services now represent an inherent part of people's everyday life. This applies to apps, websites, social media, Virtual Reality, digital technology frameworks, assessment models for agile communities, and more. Home-grown solutions flourish and are strongly connected with local culture, while most international digital platforms have no presence. The mechanisms for diffusing and disseminating information are very strong which means that spontaneously developed new ideas and messaging could evolve with tremendous speed, potentially engaging many millions of people in considering a new subject, when resonating with wider interests. Public authorities follow such traffic closely and may intervene with censorship or influencing directions. While interactive communication and smart solutions are thus commonplace, digital enablers are much used for instigating participatory processes aimed to identify outstanding issues and co-create innovative solutions.

In Iran, digital tools and applications are equally diffused in big cities. For instance, *MyTehran* is a well-developed website and application, offering citizens in Tehran access to various urban services, enabling reporting of outstanding structural problems and facilitating participation in surveys, etc. This and other related digital tools and enablers are not that much developed in smaller cities, such as Khorramabad. Similarly, digital infrastructure is not fully developed in deprived city areas and connectivity may be poor. Substantive investment has gone into the development of new networks, however, securing broadband capacity more widely. On the other hand, issues may arise with network access, quality of service or security risks, leading many citizens to limit or adjust their use. Further, digital literacy is generally weak among the elderly outside the big cities. Nevertheless, there are large numbers of tech savvy individuals, especially in the younger cohorts. Technology and engineering are held in high regard and large parts of the Iranian population take great interest in making use of the latest digital enablers available, again generally home-grown due to the presence of US sanctions against Iran. Snapp (an online platform for taxi services), the Iranian counterpart of Uber, developed by students at Sharif University of Technology, is hugely popular. Many other digital enablers have been similarly adopted by engaging in reverse engineering practices. Therefore, most of the young, urban Iranian citizens are daily users of existing apps and ready to apply new ones (UNCTAD 2016).

4.4.9 Local currencies in URBiNAT cities

Examples of other, related areas in which digital enablers are actively used include so-called “alternative currencies”. Such currencies are local in nature and may tie in with various URBiNAT activities. The NBS catalogue even includes a particular NBS, “Social currencies”, which can be created and managed by a community. The purpose is to promote the local economy, with special focus on areas of economic, environmental and/or social vulnerability and opportunity.

Of the seven URBiNAT cities, Nantes, Porto and Brussels have experimented with local currencies on a city-wide scale. It is worth briefly considering their respective approach and links to the project activities.

Launched in April 2015, the SoNantes is a Nantes-based, entirely digitized currency set up to promote shorter supply chains, notably in the food sector, along with sustainable urban development more broadly. Use is limited to local transactions and any speculation or hoarding of the currency is actively countered. The initiative is run by a local association. Five years after its launch, the interest from local businesses and users remains insufficient, and the sustainability of the model is in doubt. The URBiNAT project will take stock of the issues as a basis for drawing lessons, while considering whether SoNantes can be associated with revitalized purposes related to the introduction of NBS in the district of Nantes Nord, as a complementary digital enabler.

In Porto, circulation of the virtual currency EcoSol was initiated in 2014 to help develop a solidarity economy. The objective connects with that of growing the food network emerging from Porto's post-crisis context, engaging and linking producers, distributors and consumers on a regular basis. The set-up is conducive to transparency and based on trust and commitment by its participants. It aims to contribute to meeting basic needs (food, clothing, health, education, etc.) and thus safeguard quality of life (Moreira and Morell, 2020).

In Brussels, the new “Zinne”, launched in March 2019, is a combined paper and digital currency set up to support local entrepreneurs who nurture the local economic fabric, and whose activities contribute to a form of local economic development that is respectful of people and the environment. The objective of the Zinne is to strengthen these projects and local transactions. It was launched as an alternative to traditional economic models perceived to have had a detrimental effect on local economies as they tend to concentrate wealth, distort social ties and destroy the environment. While the implementation of this new currency is still in its infancy, URBiNAT will be monitoring how the Zinne evolves, considering it as a “complementary” digital enabler whose use may be adjusted for special purposes in the districts of Versailles and Neder-over-Heembeek where the project is being implemented.

The experience with digital currencies thus far, in effect amounts to a series of experiments on how to put in place practical and flexible support for local communities to innovate in strengthening their local environment and livelihoods. On this basis, ways are sought for utilising these instruments, or linking to them, in support of the participatory processes around NBS and Healthy Corridors. More work is warranted, however, to comprehend the underlying incentives and future possibilities. This concerns for instance, the mechanisms for how to earn a local currency and how to spend it. There is also the question how it can be digitally attuned for highest functionality in support of fulfilling desired objectives.

4.5 Concluding remarks

Selected observations have been made above on the use by URBiNAT cities of digital enablers, including brief comments on what they try to achieve as well as indications of hindering or missing factors. In going forward, it is important to bear in mind the huge diversity at play, applying both to the criteria and to the determinants of success. Various factors may assume a key role, such as the category of citizens put in focus, the stage of NBS development, and also the kind of NBS to be adopted along with its fit into Healthy Corridors. This is natural, given the complexity and strong presence of context-specific factors in urban development, including in regard to the role that various stakeholders and citizens play, do not play, or aspire to play.

While such differences underline that each city, city district and structure of city dynamics are unique, there is also commonality and great scope for comparability. For instance, relevant considerations for all include how to reach beyond “the usual suspects”. Typical issues arise as well with regard to ICT infrastructure and the readiness of vulnerable citizens to apply digital enablers, in turn presenting shared challenges on how to achieve inclusion. In an area such as digital currencies, several cities have entered a stage of experimentation, creating an opportunity to compare lessons how such schemes may support the wider objectives at hand.

URBiNAT’s CoP has been devised to structure joint learning processes, in part by collecting comparable data while applying common indicators, thereby allowing for effective sharing of experience. Coordinated experimentation with citizen participation using digital enablers, will be orchestrated by the Observatory across the URBiNAT cities. The objective includes jointly assessing how different NBS are used and combined in Healthy Corridors, as well as increase understanding how to apply the NBS catalogue and make it more operational. An objective already in the short term, is to advance digital enablers of citizens’ co-creation of solutions that help remedy the critical challenges brought onto local communities by the arrival of COVID-19. Specific challenges include engaging an increased number of citizens and target groups, raising the effectiveness of co-design and co-governance, and strengthening the ecosystem for innovation and NBS businesses.

5. Applying Digital Enablers: Process, Opportunities and Challenges

In this chapter, we outline the way forward in the application of digital enablers. Moving to the next step, attention will be paid to what guidance can be obtained from local diagnostics, including mapping of participatory culture, linked to the key objectives of NBS within the context of Healthy Corridors. It is further outlined how, within URBiNAT, there can be structured and coordinated advance of experimentation with digital enablers, in support of comparability, sharing and learning within its Community of Practice (CoP), in turn enhanced through the appropriate application of digital enablers.

To briefly recapitulate the position of digital enablers within URBiNAT’s structure, we consider their contribution in determining what issues arise in adapting to the local context, relating to co-

diagnostics (WP2 and WP5), the nature of the NBS to be co-implemented (WP4) and how digital enablers can support participation at different stages of the process (drawing on WP2 and conducted in coordination with WP5 on Data analysis). The conclusions will be taken forward for direct application in Task 3.4, where selected digital enablers will be piloted, evaluated and fine-tuned on the ground. From there on, they will feed into the knowledge-based collaborative platform for the co-creation of Healthy Corridors and NBS, in the scope of Task 3.5, as well as into the Observatory (WP5). Further, the results will be applied in the Living labs (WP2), support the uptake and benefits of NBS (WP4), be diffused (WP6) and further built upon in work on ways to support innovation and commercialisation, including through policy support (WP7). While the participating cities have reached different stages, and thus advance along different trajectories, they all assume specific roles and play their part in holding together and progressing the CoP.

5.1 Portfolio of digital enablers

Based on the findings of our report thus far, in this section we introduce a structured framework, and stylised mapping, for the development and application of digital enablers, with the aim to provide guidance for their use in promoting participation in response to varying purposes and goals. The building blocks, presented in Chapter 2, (purpose, methods, content, and tools), are listed horizontally at the top of Table 4. Meanwhile, the vertical column to the left features the main strengths and sources of rationale for digital enablers, corresponding to the set-up in Chapter 1, featuring: i) reach; ii) inclusion; iii) targeting; iv) flexibility; v) interactivity; vi) accuracy; vii) initialisation; viii) sustainability; ix) linking; x) innovation; xi) trust; xii) overcome bureaucratic barriers, and; xiii) governance. Meanwhile, the column farthest to the right exemplifies specific digital enablers that match the combinations in each row, i.e., the rationale/impact coupled with observed combinations of building blocks.

The table may be used for various reflections. Viewed from one angle, it may be applied for consideration how the different kinds of rationales (green left-column) can be made use of to fulfil specific purposes (2nd column), while achieving a functional matching with methods, content, and tools (3rd to 5th columns), with examples of digital enablers observed to match such set-up (6th column). One may also, in the columns denoting the building blocks, search for ideas and guidance how to conceive of and work around the best solution for each, when other specific elements are in place.

It should be stressed that no singular or fixed one-to-one relation exists between the considered elements. Different combinations of building blocks and impacts are possible, where the best matching may depend on conditions that are unique to the specific case. The examination of relevant experience, coupled with the inherent functionality of the options at hand, however, can be built upon for arguing the case what may work, or not work, under varying conditions. By demonstrating how various elements tend to relate to one another, Table 4 arrives at a landscape, or portfolio, of possibilities how digital enablers can be composed for effective delivery. For this purpose, we have drawn on the broad coverage contemplated in this report, rather than rely on a narrow selection of what has been directly observed in urban regeneration by co-creating NBS and Healthy Corridors per se. This is as we discern enough commonality for the broader spectrum of experience and considerations to generate lessons of relevance to our realm of core interest.

At all levels, there is the need of relating to people/citizens, and also stakeholders. Mirroring the report's position in URBiNAT as a whole, the portfolio will be taken into account in upcoming devising and applications of digital enablers to match the issues in URBiNAT cities, on the ground.

The purpose is not to limit the choices of the cities and the citizens, but to help inform and enrich the process based on examples and observations what combinations are effective and applicable under varying circumstances. URBiNAT is set to enable instructive comparisons and joint learning in this respect across the participating cities.

The purpose further extends to inspire experimentation and exchanges more broadly between cities faced with related issues in the present context. Naturally, the caveats pointed to in earlier sections, need to be kept in mind, such as participatory processes not always being “a good thing”, and also that digital enablers may not be preferable to non-digital traditional means in a given setting. Nevertheless, we argue that the potentials brought about by an informed approach to digital enablers, including how they can be devised and earmarked for a particular situation, task, and category, opens for tangible opportunities to overcome many of the issues previously raised in the literature.

The proposed matching depicted in Table 4 does not make claim to being definite or complete in any way but should be viewed as preliminary, based on the experience and observations at hand along with derived insights. We envisage this mapping to progress, as a “living subject collection”, based on the continued collection of relevant experience and the experimentation and evaluations under way in URBiNAT. Having said that, the multifunctional nature of digital enablers accounts for such a rich and diverse set of instruments, with opportunities for value-added at hand through various intermixed mechanisms, that no single framework can hope to exhaust or depict the constituents in full. The mapping further calls attention to the importance of synergies between complementary components and measures. Meanwhile, however, the developmental aspects follow certain patterns. The early phase of a participatory process typically needs to help bring awareness, motivation and the ability to identify and mobilise specific profiles and skills. The application of games or simple rewards is a case in point and can do the job for *initialisation*. In phases with great subsequent opportunities, other desired impacts will be selected and prioritised for example *linking* impacts will play a significant role when the objective is to co-create a common space where seekers and providers can meet and exchange in several contexts referred to as platform creation. In other cases of digital enablers, for example, such connected to NBS solutions, *accuracy* might be the priority and here tools such as GIS and sensors will play an important role.

The risk of running into trade-offs, due to conflicting objectives and impacts, should be noted. *Reach* and *inclusion* need to be separated from *targeting*, for instance. They may also run counter to *trust* and *linking*, which may occur most effectively within more limited communities. Similarly, flexibility may run counter to accuracy, and achieving sustainable long-term engagement may go against innovation.

The aim is for enhanced interactivity to go together with linking and building trust. Related to this, the building blocks of digital enablers need to be devised so as to be complementary, in sync, and mutually reinforcing. Table 4 indicates, row-by-row, potentially fruitful combinations. Yet, every situation is unique, and the most effective combination will thus vary and need to be framed locally. Having said that, by taking advantage of the inherent *flexibility* and adaptability of digital enablers, there is the opportunity to experiment and calibrate what works in the specific case.

The importance of complementarity and synergy between digital enablers, and their building blocks, similarly applies to the relationship between digital and traditional means of underpinning participation. Engagement processes that incorporate a blended approach, including face-to-face meetings and other means for personal contact carries proven advantages ((EMPATIA, 2017).

Rationale/ Impact Value-added	Purpose	Methods	Content	Tools	Examples of digital enablers of participation
Mapping & information gathering	Gather information, map emotions, community development	GeoParticipation	Information related to citizens' emotional links with the environment	Spatial tools, web app	Emotional maps, Carticipate
Reach	Engage communities, change behaviour, support empowerment	Open surveys, e-voting, participatory budgeting, e-democracy	Prototype development, co-prototyping and testing new HC activities	Digital and social media platforms, mobile telephony, search engine optimisation, blockchain	E-voting for wide audiences, Better Reykjavik, Vote
	Awareness raising allowing people to share and invite, diffuse information about threats	Competition, simple multiple choice questions, generic rewards such as food tickets	Engagement activities, co-create location-aware information, extreme weather alert, co-designed clean routes	Social media groups, smartphones, online communication platforms, SMS, geovisualisation, geotagging, open data	Emergency alert, Earthquake alert!, Air quality mapping, Evzdrop, WideNoise, Survive: SD
Inclusion	Ensure inclusion for all	Co-creation and sharing mechanisms incentivising users to create content and invite others, geographical mapping, participatory budgeting	Description of activities taking place and cultures active in the Healthy Corridor, use of symbols to overcome language barriers	Short videos, reporting websites, platforms, participatory sensing, open source, sms and other low-threshold technologies	Smarticipate, Decidim, Textizen, OpenStad
Targeting	Appeal to specific audiences, leverage CoI, sway citizens using conventionally fuelled vehicles, facilitate for cyclists	CoI specific competition, targeted rewards tailored for specific groups, tunnelling, personalisation, reduction, LfL, urban acupuncture	Tailor content in accordance with the interests or needs of target groups, discounts of payments towards merchandise and services, support circular economy	Digital and social media platforms, adaptation of language and rewards, Bike Bell, apps for cyclists, pass-by-participation	Patients-like-me, Womenability, Bella Mosa, Ride together, Reboot
	Measure and promote women friendliness, safeguard security for women	Women tailored city analysis framework, survey tools, exploratory walks, sharing mechanisms	Information about woman friendliness of cities, guidelines on ways to improve	PC and mobile survey tools, apps, helpline	Womenability, Shakti

Flexibility	Fine-tuning to maintain or evolve engagement levels	Neural activities, build on user-behaviour to alter content in interactive process	Organise content so that is works for multi-usage and multi-tools	Blend of tools, use of AI and machine-learning, mapping apps	CitizenLab
Interactivity	Connecting Communities of Interest (Cols) online for sharing and learning	Rating, hybrid set-up (online in combination with physical), webinars	Content related to Cols, use artists and events, musicians and concerts, chefs and recipes, sports activities, environmentalists,	Hybrid forums, potential for VR/AR space	Collaborative Cities Café, OpenStad
	Matching individuals for co-activities	Incentivising response actions by games, competition and associated rewards, LfL	Exchange of things and services	Online tools, social media	Social media, Plans-on-the-map, Tell-it-on-the-map, Urban Trekking, Bulky Basics
Accuracy	Co-reporting results impact from HC activities	Measuring of specific indicators such as physical activity, air quality, noise levels	Results impact from HC activities	Digital sensor technology, GIS	Humidity sensors, GPS trackers
Initialisation	Spark an interest for wide inclusion, awareness creation, generate engagement on specific topics	Triggering, opt-in, gaming, lottery, competition, linking to physical activities	Targeted marketing, connect to recent events, create a sense of urgency, provocative questions step-by-step progression	Digital flyers and opt-in schemes, alerts via social media channels, naturalcapital	Ride together, Cyclopath, BetterPoints, Superbarrio, Airesis.eu
Sustainability	Sustain HC activities, lasting behavioural change	Context-disruption, User to community sharing, peer-to-peer support, social enforcement, rewards incentivising users to create content and provide feedback, self-motivation LearnforLife (LfL)	Framing lasting synergies in HC, allow content to change so as to ensure long-lasting engagement, personalisation, reminders	Communication platform, clustered networks	News feed Cityplannersonline.com, Block by Block

Linking	Support local farmers, strengthen opportunities for organically produced food, favour healthy food and increase well-being etc. through Col	Co-designed and co-implemented with citizens, community creation, peer-to-peer sharing	Useful and attractive tips on what kind of products are available in the market, cooking ideas, recipes, etc.	Online platforms, GeoJSON, location-based apps, publishing on social media	Our GREEN Market (app), FallingFruit.org, Exchange of Services, Time bank, Local Currency
Innovation	Co-innovate the HC proposition, seeking stakeholders to help develop new HC offers, attracting new participants	Co-development of digital information Involvement of multiple stakeholders for experimentation	Healthy Corridors, innovative NBS	Open source, open data, digital platforms, blockchain, cryptocurrencies	Crowdfunding, Buurbook.nl, Mobile apps
	Engages citizens to find data-driven solutions, create ideas and share knowledge on a platform that acknowledges contributions	Collection of first-hand information, co-diagnostics, co-selection and co-design of relevant themes/issues and new solutions	The data and ideas created are central and are used by citizens to create new solutions	Mobile apps, maps, data banks, big data algorithms, deep learning, machine learning, AI	Cities of Service, Voorjebuurt.nl
Trust	Overcome conflicts, encourage collaboration and impact creation	Sharing of information, transparency models	HC activities that benefit individuals and target groups in the neighbourhood	Personalised Integrity, ownership, security, privacy, ethical issues, videos, publishing	Blijstroom, Cities of Service, Urban City Players
Overcome bureaucracy	Save time and stay within existing budget limits	Connect locally and understand how to reduce red tape, facilitate entry and exit	Simplify technology and engagement	Open source, using tools which are already available	FixMyStreet, Urban City Players, Airesis.eu
Enact improved governance	Induce empowerment, impact decision making	Bottom-up approaches, secure ownership models, Participatory budgeting, e-voting, suggestion box, wisdom of the crowd, policy watchdog rewards	Co-created content, price tags, budget restrictions	Big data, digital platforms, smartphones, GIS, PGIS, PPGIS and GeoWeb	Inductive Monitoring, FixMyStreet, Smarticipate, Big Questioning, CitySourced, The Local Data app, Better Reykjavik, Consensus, Civocracy

Table 3: Portfolio and framework of digital enablers (IKED and DTI, 2020)

Among the examples considered for further development in URBiNAT, the inclusion of urban farming and gardening in the school curriculum at primary school level, already implemented in Porto, is set to be coupled with digitally supported linking to farmers' networks. Building on and leveraging, CoI, is further staged to achieve a parallel strengthening of conditions for eco-food, based on increased social and customer awareness, along with trust among consumers in what is provided.

The concept of Healthy Corridors is of high importance here. By linking hubs and complementary sources of public space, Healthy Corridors stand to overcome fragmentation in city functions, breeding new creative meetings, communications, and creations in the urban environment. Digital enablers, again accompanied by hybrid solutions, stand to add crucial dynamic in fostering genuine co-creation by citizens and stakeholders in realising such outcomes. Envisaged benefits include greater awareness, inclusion, trust, commitment, and appreciation for what is accomplished. While managing prospective downsides, this is set to constitute an important aspect of URBiNAT's agenda ahead.

5.2 Proposed approaches and next steps

In this section, we pick up on the framework presented above to outline the way forward for URBiNAT. The focus here is on the next steps of the project, as we prepare for the practical application of digital enablers to achieve desired impacts, while combining and making most use of the key building blocks. Particular attention is paid to individuals and groups that are marginalised or vulnerable, possibly due to income, education, ethical belonging, or other specific attributes. As discussed, the local diagnostics undertaken in the frontrunner cities have not resulted in a clear picture of the infrastructure, tools, behaviours and other factors of relevance to grasping their situations, and how to address them. While the work under way for the follower cities aims to bring a fuller picture in this respect, those results will only come in gradually.

The dependence, in deprived areas, on a smartphone rather than a PC for Internet access, is well established (Pearce and Rice, 2013). As noted, m-participation offers special opportunities for vulnerable groups, although special arrangements may be required for successful initialisation of their engagement. In poor and minority communities, mobile Internet access is most strongly associated with the use of social networking sites (SNSs) (ibid), while news and factual information are less often accessed (van Deursen and van Dijk, 2014). Meanwhile, Internet content is often optimized for PC rather than mobile phones (Marler, 2018).

Until recently, mobile participation has tended to maintain an emphasis on place as stipulated in PPGIS, with the knowledge of citizens tied to that place (Corbett and Keller, 2006). This is resembling of the role played by physical "third places" (neither home nor work but, for instance, private and public space for purposes such as education, entertainment, recreation, shopping, or religious worship) seen to promote knowledge exchange and skills development in physical space. The role of such space remains critical in the digital era, although the physical and virtual elements are evolving.

Of particular relevance here is the creation of space, or arenas, for constructive processing of complex social issues and relations. A kind of 'hybrid' space has arisen (Schroeter and Houghton, 2011; Schroeter, 2012; Tomitsch et al., 2015), augmenting both physical and digital features, enabled by situated engagement. This is aided by more user-friendly functions opening up for mobile participation to take advantage of real time participatory sensing and new forms of

participation that follow from the creation of apps by citizens. On this basis, citizens are in the position to gather factual, objective data about their environments “on-the-go”, calling attention to the presence of an issue. The quality of sensors in mobile phones has improved rapidly and recently comes close to official simulation-based maps (D’Hondt et al., 2013). Mobile phones further stimulate idea generation by way of “situated engagement” (Korn, 2013). Instead of coming to a meeting at a particular time and place, citizens may browse or look for development plans about those locations that matter more to them. Geo-fencing using mobile GPS can serve as the basis for further innovation in generating valuable citizen participation in urban planning, at little additional cost (Ertiö, 2018).

A related concept is that of ‘net localities’, hybrid space created through diverse interactions, digital as well as non-digital. An example is use of public screens serving to display feedback from citizens twittering by citizens in real-time (Tomitsch et al., 2015). Open data contests coupled with suitable incentives may similarly be applied in support of building new relationships and alliances between key actors in the urban environment (Desouza and Bhagwatwar, 2012).

In the URBiNAT cities and study area, it is important to understand the position of the citizens. The targeted neighbourhoods in the URBiNAT cities display some similarities, e.g., regarding digital infrastructure and readiness, as well as socio-economic factors with a bearing on citizen participation (Nunes et al., 2019). Residents seem to overwhelmingly favour physical interactions instead of engagement via online solutions. Increased understanding is needed, however, of driving forces for citizens and their associated susceptibility for awareness creation, behavioural adjustment, readiness to engage in communities of interests, etc., as a basis for instigating bottom-up approaches to co-creation and inclusive participation.

Reflecting the key objective of digital enablers in the URBiNAT cities to be closely connected with the NBS, support them, increase their uptake and engage citizens via the so called participatory NBS, impetus towards increased uptake and long-term participation calls for sustained behavioural change. Particular focus on this element is elaborated in the participatory NBS-LearnforLife (Lfl) methodology, devised specifically to propel digital enablers.³¹ LearnforLife is framed for inspiring progressive learning as a basis for behavioural change, utilising five distinct key functions (Andersson, 2018):

1. Rewards - individuals are motivated by specific incentives that are tailored for each target audience to personalize the experience. Digitally, this can be translated into points collection, digital currency, visual recognition and praise, time bank or other types of visual elements.
2. Step-by-step approach - an important element which is devised for each target audience in order to neither “overwhelm” nor “starve” the user on content; instead content is fed in a gradual step-by-step manner that enables learning/behavioural change at an individually adjusted pace. In a digital enabler this could be mirrored by visualising every change/progress accomplished, enabling speedy feedback loops and countering fatigue.
3. Timely managed content and rewards to achieve effective incentive schemes. AI and machine learning can be deployed effectively to ensure highly receptive systems, establishing a strong link between actions followed by optimized reward structures.
4. Social interaction with peers and community - a function of debriefing increases the manifestation of the learning and the behavioural change. This can be applied effectively in

³¹ By way of other key instruments, LearnForLife (Lfl), a methodology and participatory NBS in URBiNAT’s NBS catalogue, specialises in tailoring incentive-effects in the light of user attributes, as is currently applied in the preparation of linking Col in support of NBS implementation in T3.4 of URBiNAT.

online communication, whereby one or several individuals can share results and private information with ease in a safe space.

5. Co-opetition - competition via collaboration strengthens the community engagement and builds a sensation of group identity and group dynamics. Gaming, potentially much enhanced when taking advantage of opportunities offered online, can often be applied effectively as part of digital enablers of co-creation. Experience demonstrates a strong potential for games to initiate interest, and then also for those engaged to do so intensively and with strong potential for strengthening group dynamic. A durable impact, however, tends to and upgrade and renewal of content at frequent intervals, in order to maintain relevance for users and prevent fatigue. There should be readiness also to switch to other tools for engagement when and if the attractiveness dwindles, to be co-monitored with citizens.

The systemic approach of this methodology demonstrates that the establishment of a co-creation process by putting a relevant mix of the five building blocks into action will increase the potential of achieving a long-lasting participation that will instigate behavioural change and an increased uptake of NBS. The LfL methodology is in particular suitable for implementation in digital enablers, especially as recent AI technologies allow for “learning together” with the individual.

In its overriding ongoing work on a Green Deal, a flagship environmental initiative, the European Commission places strong emphasis on digital technologies and solutions. The initiative recognizes the substantive development potential of AI and big data analytics and reportedly considers new opportunities for how to link different urban areas in joint learning processes (so-called “twin cities”). At the same time, it remains essential that the agenda is demand-driven, not subjected to supply-push, with mechanisms placing citizens at the core.

An important aspect is the role digital enablers play in realising social, inclusive and grassroots innovation, social entrepreneurship, and solidarity economy initiatives (Cozzens and Sutz, 2014). These are activities that take myriad forms and draw on diverse approaches, embedded in local collaborative networks, and enriched by diverse competencies, including in disadvantaged areas. While not a new phenomenon, drawing on digital enablers, their scope and reach have expanded enormously. This holds true in regard to awareness creation and more rapid uptake by users, and behavioural change. Additionally, digitally enabled sources of finance, such as crowdfunding, combine raising capital with an expanded user community and client base. Favourable impacts have been demonstrated for a range of products, across various industries (Mailoni et al., 2016) as well as in the form of improved human health (Halpaapt, 2020).

A particular role of digital enablers is to leverage the role of supportive interventions. In some cases, interventions in themselves incorporate distinct digital features. In the URBiNAT project, we set out to implement certain digital enablers, partly interwoven with interventions to stimulate solutions to outstanding issues. In Task 3.4, a process has begun to initiate, co-create, pilot, test and implement a few digital enablers in URBiNAT cities. Some will build on existing solutions while others will be generated from scratch, in the light of the preferences and choices expressed by citizens as well as the considerations put forward by stakeholders to back the Healthy Corridor concept. The co-creation methods to be applied are set to combine digital tools (web-based and market-based) as well as physical practices. Two main approaches are currently in preparation for the initial co-creation activities to be adopted:

i) Challenges/solutions-driven approach

The focus here is on common and key challenges which are considered to be of utmost importance when it comes to developing NBS and Healthy Corridors. We will work with the

citizens and relevant stakeholders in physical and/or digital workshops to identify challenges, and then select one or two to be addressed through initiatives involving citizens actively and with the support of digital enablers. At the second stage of this co-creation process, the selected challenge(s) will be carefully assessed and connected to a portfolio of solutions whereby the participants in the workshops will be engaging in teams linked to specific solution(s). The teams will, in the following stage, present their respective outcomes and the most viable solution(s) will be selected for piloting and implementation. In Sofia, for instance, local communities in the study area have identified a particular set of challenges related to harvesting fruit, where digital enablers offer opportunities for solutions (see chapter 4). In this regard, URBiNAT partners are exploring the application of various models using Participatory Geographic Information Systems (PGIS).

ii) Identity/strength-based approach

In this case, co-creation draws on established lessons of pedagogy and practical training (Saint-Jacques, 2009), on the effectiveness of reinforcing positive experiences and driving forces. The approach starts out assessing neighbourhood identity, attitudes, and values. A Community of Interest (CoI) is identified with reference to existing positive connotations in the neighbourhood which citizens share an interest in fortifying and building upon to resolve particular issues/for a specific purpose. CoI is thus about mobilising a “glue” which can be used to grow a viable platform. Operational attributes are associated with the CoI. For example, to what extent do we have a set of characteristics such as music, art, food, “green”, gardening, sports, or anything else that generate a particular CoI in our neighbourhood. At times, this positive identity is latent and requires effort and regeneration for its revival. In such cases digital enablers can support and nurture the process including citizen engagement towards reaching a critical mass of actions in strengthening the existing or latent neighbourhood identity.

Certain digital enablers to be developed or adopted will be city-specific from the outset and thus subject to tailoring. The exercise will be well documented, and, through the CoP, lessons be drawn for the purpose of enabling subsequent implementation in other URBiNAT cities, thereby increasing the general usefulness of the experience and the potential for wider spread.

A few digital enablers have been discussed with the cities with a view to preparing, piloting and implementing them in parallel in several other URBiNAT cities. As a condition for their application, such digital enablers must have the potential to address similar prioritised challenges or interests across the URBiNAT neighbourhoods. The three digital enablers described just below are under consideration for this purpose, including main features and learning processes.

a) The SERVICES Community - Platform for skills exchange and time bank

The URBiNAT cities share a deep concern with the socio-economic challenges arising from lack of job opportunities and associated high levels of unemployment (and under-employment) among residents in the selected neighbourhoods. As a related concern, lack of funds accounts for weak service supply in these areas. At the same time, many residents possess plenty of talent and useful skill-sets. Hence, an opportunity for exchange of services has been identified. In several cities, a certain level of service exchange has started to emerge during the pandemic as a result of volunteering efforts. Examples include citizens offering assistance with cooking food, homework, babysitting, etc. The idea is, applying co-design with citizens, to take these activities a step further by offering a platform where service providers and service seekers can be effectively guided and be in a better position to locate the services they are looking for, while at the same time providing individuals with an existing, or possibly dormant, skill-set, with a mechanism and outlet for presenting it to an orderly client base.

In effect, the aim is to create a “marketplace” where seekers and providers of services are able to connect and match with each other, operating in the local context. The platform to be provided can, in its simplest form, utilise a system of pure exchange, i.e., a sort of swapping of services. A richer approach would be to apply a system of points, hours (i.e., a time bank), or local currency, as a means of compensation for services. In practice, however, a functioning matching mechanism will require more than that, and must thus inevitably be prepared for add-on value-enhancing elements, in support of reliability and trust.

On this basis, it is envisaged that service providers will gain increased motivation and confidence in their undertakings, and build more of a professional profile, while also a growing number of clients will gain a positive experience and share a good word on services obtained. For these reasons, the platform brings a potential for boosting professional activity, create new jobs and bring a spurt in entrepreneurial ventures.

b) **Our GREEN Market** - App for locally produced food and a healthy lifestyle

In several of the URBiNAT neighbourhoods, there is a latent demand for locally produced eco-friendly food products at affordable prices. Existing market channels are rigid however with little impetus for innovation. Citizens have identified scope for improvement, associated with a revitalised and expanded local marketplace serving several purposes, in addition to the purchase of food items. The following is under consideration as complementary elements to be advanced as part of the Healthy Corridor concept:

- Support of local farmers including urban farmin
- Strengthened opportunities for organically produced food;
- Increased physical activity as citizen will be walking to the market;
- Home cooking activities favour more healthy food and increased well-being;
- Meeting place for citizens - other activities and Cols can benefit from having a regular public space for meetings;
- Specialised themes can be arranged to help sharpen a local edge and make adjustments according to season, the interest of particular communities or in other respects.

Our GREEN Market is in its ideation stage and planned to develop a number of features, co-designed and co-implemented with citizens, providing useful and attractive tips on what kind of products are available in the market at a particular juncture - along with cooking ideas, recipes, etc. Applying the methodology of Learn for Life, a participatory NBS available in the URBiNAT catalogue, citizens can sign into the app and gain points on their purchases - by sharing recipes, by regular visits and by engaging in other activities. The points can be used in exchange for discounts on future purchases. On this basis, producers will upload information on a regular basis, such as what products are available and what they can recommend according to price and stock. Citizens, on the other hand, can express demands, make use of the marketplace to prepare for and service festivals and other events, and generally offer their food products on this market.

In Nantes, a special website has been set up on Urban Community Gardening. When citizens were asked whether they use it for finding out about different crops or tips how to cultivate, none of them were aware of the existence of Our GREEN Market app. When asked if they would be able to use it, after checking, they candidly conveyed that the website simply was of no relevance to them. This further underlines the importance of involving citizens, from the stage of ideation to piloting and implementing digital enablers.

Based on current plans, Our GREEN Market will receive inputs from citizens and relevant stakeholders in the coming months. Given that the currently displayed interest keeps growing and the suppliers of food products respond positively, it will be implemented in several of the URBiNAT neighbourhoods for experimental use. Additionally, the app will be organised so that different cities can be connected and thereby gain inspiration from other local GREEN markets, their people, activities and food. In this vein, it will serve as an anchor for “between-city” communication and exchange of experience, operating at the core of URBiNAT’s CoP.

Our GREEN Market app aims for ambitious objectives such as to enhance awareness about locally produced food, adjust behaviour in the direction of a healthier lifestyle (e.g., walking to the market and consuming healthier food), provide an inspiring outlet for locally produced food, support local farmers, and empower citizens to organise activities within certain Cols. It is important to underline, however, that such impacts would not be introduced top-down, or by outside experts. URBiNAT is in a stage of working out the mechanism for hooking on to already existing driving forces, which can be leveraged to achieve effective bottom-up processes entailing citizen ownership. Examples include Community Gardens and Urban Farms which exist in several of the URBiNAT cities where they support recreation, food production and social involvement. These NBS can be further strengthened by digital enablers that help instil co-creation of food production while also underpinning increased demand for ecologically and locally produced products.

c) **C3 (Collaborative Cities Café)** - Connecting Communities of Interests (Cols) online for sharing and learning

In the light of the pandemic and the fact that many people would like to connect with other cultures and locations without embarking on physical travelling (which causes negative environmental impacts and is also currently associated with pandemic-related health concerns), online meetings and sharing in the virtual world have become a regular practice.

The C3 is planned to serve as an online forum for sharing and connecting Communities of Interest between cities and communities. The meeting place can take the form of an online webinar, an outdoor arena with a screen, a virtual reality space or whatever means is best suited for each Col and the connected activity. The following Cols have been identified as prime candidates for the C3 forum:

- Artists (all levels) and connected events such as exhibitions;
- Musicians of various genres, concerts, etc.;
- Chefs (professionals and home cooks) and food festivals and events;
- Green business entrepreneurs and mature local green businesses;
- Local sports activities which are specifically strong in the community;
- Environmentalists - forum for sharing practices for urban farmers and gardeners;
- Youth networks.

Governance of the C3 forum is planned to be shared between the municipalities and the Col networks, while bottom-up initiatives and citizen ownership is much encouraged. Benefits of this digital enabler include strengthening of neighbourhood identity and citizen well-being through recognition and meaningful activities; increased awareness of NBS and environmental impacts; mitigation of risks in regard to pandemics; and reduction in costs including negative environmental impacts in organising events. Finally, similar to Our GREEN Market, C3 carries the potential for fruitful parallel implementation in several URBiNAT cities, in support of enhanced and broadened exchange of experience and joint learning within an expanded CoP.

5.3 Risk and mitigation

Not only the opportunities but also the costs and risks associated with participation, as well as with digital enablers, need to be born in mind, along with considerations of mitigatory measures, to be reflected in strategies, policies and actions taken. This is necessary in order to develop an understanding of the conditions under which digital enablers are merited and how they can be devised and deployed most favourably. Such considerations also cast light on limitations to their use.

Some costs of digital enablers are highly visible, for instance by way of subscription fees for platform services. The UK based platform “Mapping for Change”, a social enterprise owned by University College London, secured some 500 000 euro of revenue from its inception in 2009, based on 20 contracts for providing geographical information services supporting sustainable neighbourhoods by empowering marginalised groups.³² Many DPPs offer service at no direct cost, however. The same applies to platforms for self-organisation. All in all, no universal model is at hand for platforms featuring public service and supporting co-creation, where some facilities are merely oriented towards information provision and others chiefly propel consultancies.

Meanwhile, as already noted, costs for hardware have become less of an issue, due to the rapid evolution of cellular technology. Mobile handsets have improved radically as a consequence of cut-throat market competition. Low-cost variants that display functionality not far off from the technical frontier are nowadays affordable for most users almost anywhere. Disadvantaged groups may still, however, be less well serviced by digital enablers for several reasons linked to the digital divide, including lack of awareness, skills, preferences of use, or reluctance of dealing with technology (Joss, 2018). A multitude of causes are at play, resulting in diverse consequences, leaving cities with no “silver bullet” at hand for handling all situations.

With the onset of COVID-19, societies everywhere have turned to digital enablers as a matter of “last resort”, apparently the only available means of communication under conditions of societal shut-down and social distancing. This is partly as digital tools allow for communication irrespective of one’s location, i.e., being accessible from home as well as from offices, and also the ease with which they can be applied by largely any number of participants. In many cases, digital enablers have been critical for upholding organisational functionality. Having said that, the implementation has generally been patchy, and has had to battle various challenges as well.

Other sources of costs and risks are inherent to participatory processes themselves. Tensions may arise from empowerment by citizens and local communities, in effect preventing contracting out services and the hiring of efficient developers (Raco, 2013). Citizens or other actors may further manoeuvre so as to limit active engagement to a narrow band of subjects, opening for “cherry-picking” of those tasks where benefits are readily at hand, while tricky and demanding decisions are effectively brushed aside. On the other hand, digital enablers may be deployed as to make government and bureaucracy more efficient, including when it comes to consultation and interface with citizens, and promote peer-processes that strengthen constructive compromise. Yet, while co-production brings potential “value for money”, it usually cannot produce value *without* money (Bovaird and Loeffler, 2012).

³² <https://mappingforchange.org.uk/>

On a related note, while maintaining relations that are already firmly in place is relatively straightforward, personal relationships and trust are more difficult to establish purely online. The effectiveness and sustainability of online communication is therefore typically facilitated the larger the number of individuals who already know each other from past physical meetings, and, preferably, already have concrete experience of working together. This may lead to entrenched positions, breed inward-looking mentality, make newcomers face entry-barriers and result in online networks growing less tolerant and diverse over time.

The “smart cities” concept, meanwhile originated in the application of ICT around 2008-2009, and has remained closely associated with the rapid evolution of digital tools. Some argue it is not “new”, however, but that recurrent movements of “modernism” may be viewed as vivid precursors of the smart city concept, taking multiple shapes through the history of urban development (Cugurullo 2018). As for such previous waves, governments’ main motive basically amounted to supply “push”, i.e., diffusing information and stimulating citizens to make active use of services on offer.

From the start, the service development embodied in the smart city agenda featured a strong element of private sector expansion and advancement. The private sector has mostly been relied upon for assuming a lead role in operating and constantly sharpening the ecosystem at the heart of the smart city, or at least to commit to ambitious “public-private-partnership (PPP), for the sake of adding resources or unlocking value in existing infrastructure, raise efficiency, ensure customer-relevance, mobilising competencies, and fuel innovation (Scuotto et al., 2016; Deloitte, 2018). The flip side is a notion of bias in favour of both technical advance and commercial interests, at the expense of other stakeholders. Critics argue that the smart city agenda leans on technology as the panacea to resolving problems, while the key to success is about serving the interests of the people who spend their days there (Greenfield, 2013; Calzada and Cobo, 2015; Mosannenzadeh et al., 2017).

While the smart city agenda clearly is about a lot more than technology, and each city displays features of its own, the literature at hand yet conveys a fairly bleak representation of citizens in most cases, despite prominent exceptions. The smart city agenda has gone through stages, however, with a more holistic notion taking hold in recent years. Again, the eco-city concepts and NBS development, represent ambitions to attain another balance.

With these aspects in mind, we are clearly witnessing an evolution in the formulation of objectives for digitalisation in urban development. Traditionally, government and urban administrations used to stress sectoral ambitions, e.g., in transport, energy, waste, or shaping green areas. Today, all over the world, administrators in charge of smart city agendas increasingly speak of placing citizens at the centre, with participatory processes often referred to. In practice, however, achieving relevance in daily life generally has a long way to go (Falco and Kleinhaus, 2018; Ertio, 2018). In many instances, employed procedures come across more as a fairy-tale than anything that matters in practice. Many smart city agendas have had their credibility undermined by the lingering gap between rhetoric and reality.

Empirical reviews point to a continued impetus of mellow governance and institutional weaknesses (Peixoto and Steinberg, 2019). In the mainstream, transformative approaches remain subordinate to business-as-usual ruling by conventional planning, policy and commercial influence. Part of the issue is the prevailing organisation of sectoral responsibilities managed in hierarchical “pipes”, where exchange of information is contained within established chains of command, favouring fragmentation and focus on short-term fixes. Under such conditions,

compliance with conventional sector responsibilities represent the easy way out for technocrats, while issues that transcend entrenched administrative boundary lines are bound to be under-reported and under-addressed (Hölscher et al., 2019).

Citizens are likely, if given the chance, to cry out for action to deal with the problems that remain unresolved as a consequence, while decision makers and experts may cultivate a culture of dismissal to the proposals and innovations put forward by those that inhabit the city, especially those neighbourhoods whose needs are the least attended to (Barnaghi et al., 2015).

This is not to say that the outright resistance can be observed; the typical position will more likely be one of neglect. At any rate, the outcome will be the same, scanty genuine progress for inclusion and co-creation (Carp, 2004; Puerari, et al., 2018). Against this backdrop, much of the literature on smart cities thus signals a disturbing notion that not much is really changing when it comes to prevailing power relations, with traditional motives continuing to have the upper hand in promoting technical and commercial winners (Glasmeiger and Nebiolo, 2016; Cugurullo 2018).

Any return to business-as-usual is hardly in the cards at local level, however. At national level, populist movements may ride high on public and social upheaval, and push back against meaningful consultation and participation, but the active consideration and involvement of those who live and work in the city is becoming established as a core aspect of urban planning, an integral part of intelligent space management, services development, and social life (Oliveira and Campolargo, 2015). While public service can be quality assured to a much higher degree by involving users, the call is on for participation and diverse representation to realise deeper accountability for decision makers and experts (Peixoto and Fox, 2016; Elelman and Feldman, 2018). Ensuring that technological advances are in sync with the requirements of sustainability, public space, social fabric and the well-being of citizens is inevitably shifting from being a side-affair to becoming a major watershed factor, defining the central tenet for smart city designers, urban planners, and decision makers (Ismagilova et al., 2020).

When processes of public consultation and participation are set in motion, however, planners tend to lack adequate training and be ill prepared with little access to proper frameworks for evaluation. Proper tools for assessing outcomes in terms of distributional impacts, and whether those most in need are particularly scarce, are mostly lacking, however (Shiple and Utz, 2012). For sustainable success, such aspects cannot feature as an after-thought, or correction of glitches in overriding technical or social frameworks. This entails framing a more complete set of competencies, which allows for full-fledged considerations of social and behavioural aspects.

Based on interviews in several cities, Filion et al., (2015) observed the presence of struggles between institutionalism, political economy, and path dependence. Successful strategies to build capacity for 'transformative change' (Wolfram, 2016), point to the importance of basing insight on multiple sources, including different scientific disciplines, practitioners and citizens. Compare with the notion of upward and downward accountability commented on in Chapter 4, with implications for civic engagement, to bring about any far-reaching governance reform.

Healy (1999) argued for the critical importance of creating extended peer communities as a basis for establishing the trust required for coming to grips with, and addressing, complex societal problems. Online communication vastly expands the speed and efficiency with which this can be done although, at the same time, success is likely to hinge on shared leadership arrangements structured for that purpose (Johnson et al., 2015).

The movement around digital enablers in support of participatory processes linked to NBS and Healthy Corridors represents, in a sense, a relatively uncontroversial playground for bringing about horizontally coordinated competence development and capacity building to back up meaningful public consultation. In effect, it serves as well as a countermeasure and mitigation against the remaining bias in the smart city agenda. This is particularly as it is shaping up as a focused effort of bringing digitalisation to bear on where it matters most, in support of people, and reformed governance. URBiNAT's strong focus on deprived areas and disadvantaged groups means that priority is placed on where the need, as well as the room for making a difference, is the greatest.

The Erasmus+ project COMENSI offer a number of observations of what can be accomplished by the application of digital enablers in deprived areas.³³ The opportunities at hand, however, are matched by the presence of hurdles already referred to. Constraints in infrastructure and technologies, as well as lack of preparedness or susceptible mindset, may have to be mapped, analysed and evaluated, applying also to specific categories of citizens selected for targeting. If this applied to groups of elderly, their use of advanced digital tools is likely to lag behind. On the other hand, content-related skills in their possession may in effect result in greater benefits from their Internet use and associated receptiveness (van Deursen et al., 2011). Categories of young adults and children, meanwhile, display greater technical sophistication but feature other sensitivities and vulnerabilities (Livingstone 2016; Wang et al., 2018).

It is important not to become complacent and extend a particular approach to where it does not belong. Similarly, what works for a while, may not do so in the medium- to long-term. The application of games is a case in point. Their potential to raise interest or even captivate many users in the initial stage, is well known. There is a tendency for the interest in games to wane, however, meaning that excessive or extended use of gamification is likely to make it a lot less effective. Once the game is known, boredom sets in, after which the game is abandoned. A strategy which incorporates strong game-based components must therefore bear this in mind from the start. More generally, measures need to be accompanied with not just *ad hoc*, static or piecemeal monitoring and evaluation. When games are introduced to achieve intensive user engagement early in the co-creation process, they need to be accompanied by strategy for how to maintain and renew user motivation over time.

The prevalence of costs and risks much depends on when and how digital enablers are put to use. Given the rich menu of opportunities on how to devise them, as well as possible benefits to attain, digital enablers may be applicable to help resolve outstanding issues across a whole range of situations confronting cities and urban planners. Effective use draws on an ability to adjust and evolve, however.

Digital enablers can be devised to promote various teamwork models (de Vries et al., 2018), and to instigate bonding between social networks (Guerrero et al., 2015). Dialogue and cooperation can be promoted within local communities, while reducing dependency on government (URBACT, 2019). Coming into play here are design approaches, operational efficiency, and participatory processes operating at community, or group level, with social relations awarded strong attention (Nam and Pardo, 2011)

A related aspect here is the scope for shifting perspective from beyond a narrow “what is in it for me” perspective to include “what is in it for us”. Studies of special vulnerable groups point to a

³³ <http://www.tesseract.eu/project/comensi/>

combination of challenges and negative impacts of intensified exposure to digital communication, but also to the scope for remedial action. An example is that of children whose vulnerability is worsened by the absence of an educated and caring parent, calling for digital support of co-creation through means that strengthen the social dimension of children's lives (Livingstone, 2016). Another is that of young Facebook users who become the subject of privacy losses, harassment, and serious depression, which can be met by a revamping of social media networks (Marwich and Boyd, 2014). Recent advances in real-time participatory sensing further open for new models of creative and socially bonding co-creation (Ertio, 2018).

Key questions for urban planners thus include how to recognize the need of evolution, be receptive to needs of change, battle inertia, and withstand unproductive and distortive pressures. This relates to the importance of building "transition" management, placing actor agency at the centre while avoiding capture by self-interest, handling holistic and integrated approaches, incorporating "reflexivity" and social learning as criteria for the quality of outcomes, and creating space for overarching change fuelled by collaboration involving diverse interests and actors (Healey, 1997). Additionally, there is the need of taking into account "the bigger picture", i.e., to capture how individual projects relate and can either counter or strengthen each other. Consistency in employing a combination of techniques as a cohesive strategy can clearly be more effective than piecemeal measures, also in term of building political support (Shiple and Utz, 2012). This is as encapsulated in the notion of Healthy Corridors, which introduces new means of prioritisation, while also placing strong emphasis on synergies and systems solutions to address the pressure points that matter most to cities and linking them.

In URBiNAT, the parallel application across the cities and communities involved, of digital enablers promoting participatory processes in urban regeneration, will allow for experimental as well as structured and documented learning how to underpin Healthy Corridors. This will facilitate an increased understanding of general principles vs. the role of the specific context in determining what works and what does not. Such cross-border co-operation, within the EU as well as beyond, is staged to help build capacity and strengthen coordination between interlinked policy spheres, in support of better governance (European Council, 2019; Dubow et al., 2019).

That the task stretches way beyond Europe should be underlined. URBiNAT's CoP critically needs to stay on course in managing diversity and promoting sharing of experience and joint learning between culturally and institutionally diverse actors (Andersson et al., 2020). Online communication has been seen to risk losing acceptance of diverging views, and thus comfort to express one's own opinion (Dwyer, 2007; Smith et al., 2011). Along with pressures for uniformity, vCOPs risk waste of time, reduced efficiency and fatigue among members. As we have seen, countermeasures need to be devised, with stewardship to ensure exchanges that are both structured and engaging (Bourhis et al., 2005; Dubé et al., 2005), and with a view to cherishing a combination of commonality and group belonging with openness and appreciation of diversity (Kimmerle et al., 2013). In many cases, it has proven preferable to blend online and physical interface, as a means to both maintain and renew what might otherwise have been on track to evolve into a primarily virtual and quite narrow network.

Connecting with, or mirroring, real world relations, may require special efforts in disadvantaged areas. This is as commonality and trust tends to rely more heavily on unique social codes, such as dialect or local symbols, to signal loyalty, common interests, and relevant experiences (Plaskoff, 2003). Establishing a sense of shared identities and aspects of benevolence in that kind of environment therefore must likely draw on other means, besides online initiatives. Particularly

citizens who belong to disadvantaged groups may not be ready for, and not appreciate, having to click on an app to receive certain information, or be able to express an opinion.

The URBiNAT study areas are in fact marked by strong traditions of face-to-face interactions with citizens, and with these being in continued high demand. Examples include posters and flyers, “knocking-on-citizens’ -doors”, meeting with people in squares and other public places, identifying and mobilizing “champions”, by way of an individual (physical human being), with organisations or networks, which can be engaged to motivate participation in support of NBS and how they are put to use.

Høje Taastrup is a case in point, where the process is ongoing in regard to learning how to arrive at the best balance and a blend of traditional face-to-face interaction and digital enablers. The former is regarded as essential to building trust, while the latter carry complementary strengths, such as speed and achieving reach.

Digital enablers must thus not be viewed as a panacea for engagement. Many cities continue to rely strongly on personal connections. Indications are that the usefulness of online engagement may bear on an effective translation into offline realities. In many cases, reintroducing physical elements may in effect serve as a complement to online communication.

Additional factors risk jeopardizing the merits of digital support for citizen engagement, unless met with adequate mitigation and countermeasures.³⁴ Some have to do with the use of digital tools as a measure to support populism, fake news and political prosecution, as well as discrimination, harassment and aggression against vulnerable groups, women, children, minorities, and so forth. Meanwhile, breach of security and cyber-crime gives rise to enormous costs. Hacking, Internet fraud, ransomware attacks, identity theft, etc., represent sophisticated activities mostly carried out for the sake of money-making, either targeting or capturing computers or networks to commit crimes. Not only are cybercrime entities increasingly well organised, with negligible risk of being caught, but the sophistication of malicious goods and services attainable on the Darknet is steadily growing (World Economic Forum, 2020). Some 5,2 trillion USD have been estimated to be at risk from the range of cybercrimes over the next five years (Ponemon Institute, 2019).³⁵

Although the bulk of such financial losses hits the corporate sector, including high-tech and financials, the public, consumers, and also individuals and communities who are vulnerable due to their lack of skills, inadequate cyber-defence, or a delicate social status, face disproportionate risks. Also, cellular technologies are lacking strong identification mechanisms, which is on course to open for identity theft and intensified use of methods such as spoofing, porting and mining to access personal information for misuse. The continued rapid advance of new technologies and applications, smart sensors and IoT entering our everyday life, and the linking of rapidly accumulating data which come in different formats and from disparate networks, without any uniform standards to govern security, create new vulnerabilities to criminal activity and the undermining of network security and functionality of vital societal functions.

Beyond such threats, the growing reliance on online communication comes with systemic issues. Today, the combination of intensifying nano-surveillance, inadequate security and privacy

³⁴ See the URBiNAT Grant Agreement, Annex 1, Part A, section 1.3.5, pp.48-9.

³⁵ <https://newsroom.accenture.com/news/cybercrime-could-cost-companies-us-5-2-trillion-over-next-five-years-according-to-new-research-from-accenture.htm>

protection, weaknesses in accountability and ethics considerations, in effect put civic rights and the open society at risk (Greenfield, 2013; Townsend, 2013; Ktchin, 2016; UNESCO, 2020).

The opportunities following with the digital revolution have already been subjected to rampant misuse and breach of trust by both public institutions in the largest countries³⁶ and by private business. As for the latter, enormous commercial gains are continuously concentrated in the dominant proprietary vendors, with Google and Facebook on the forefront, through their continuous collection and commercialisation of personal data entrusted to them by unsuspecting users around the world (Fuchs, 2009). Big data analytics are expected to keep growing and feeding more precise segmentation of consumer markets, linking social media, call logs, and services. Its total value was estimated at approximately USD 8.5 billion worth of investments in 2017 and is projected to grow to USD 40.6 billion in 2023 (Frost and Sullivan, 2018).

Having said that, counterforces are on the move, with the EU framework for data protection and online privacy having set new standards for what is acceptable. Adequate anonymisation of data, protection of user identities and shifting to open source is called for in all research, in innovation for digital enablers, and by public entities. A combination of research and civil action have become more vocal in exposing the consequences of data misuse as well as the opportunities at hand for mitigation (Posetti and Bontcheva, 2020; Forum on Information and Democracy, 2020). Voices are increasingly heard calling for the break-up of the tech giants. Technological responses are appearing as well, such as blockchain functionality in e-voting platforms underpinning secure processing of big data as a source of integrity and trust (Pawlak et al., 2018).

Many cities find themselves in a situation where multiple local communities have already adopted social media platforms such as Facebook, Google, Instagram, etc., for information exchange or the provision of digital platforms or services, drawing on perceived low-cost, ease-of-use, and advantages in terms of reach and familiarity.

Lack of transparency and skewed power relations thus far appears endemic to this market. The business models of the dominating tech giants are firmly reliant on the collection of personal data at no cost, data misuse and privacy violation. While some observers argue that young people would willingly take part in such sharing, studies examining the subject found ignorance on their part of the consequences a major reason for their continued engagement. With the spread of pandemic in 2020 and associated enhanced dependency on ICT for many individuals and organisations, malicious activities and malware have increased massively, resulting in new threats, again with the disadvantaged likely to suffer the worst consequences. This implicates a huge need for awareness-creation and education, especially among young generations, to make informed decisions on digital applications (Vesnic Alujevic, et al., 2019). A related urgent and keenly needed effort would be the underpinning of local community centres to encourage co-creation of digital enablers, backing citizen engagement in defence of user data and identities, along with social fabric and environmental assets.

³⁶ Some of the most pervasive and systematic breach of trust, such as that practiced primarily for half a century by the US government through its backdoor to Krypto, has been relatively low-tech, see: <https://www.washingtonpost.com/graphics/2020/world/national-security/cia-crypto-encryption-machines-espionage/>. In 2013, Edward Snowden disclosed PRISM, through which the NSA tapped the servers of nine leading internet firms, including Facebook, Google, Microsoft, and Yahoo, for online surveillance of organisations and individuals worldwide, revelations that soon led to many more (Cate and Dempsey, 2017).

Specialised quality services and programmes provided by proprietary vendors may naturally be applied for professional and analytical purposes. Also, in the absence of outright, damage to participants or wider society, authorities should not be recommended to interfere with the specific platform choices if local communities. Protecting citizens against systematic exploitation of their personal data is another subject, however. In framing strategies for the application of digital enablers in support of the common good, cities have a responsibility to be aware of the possible downsides and, as appropriate, apply counter-veiling measures. Along with stakeholders and citizens themselves, cities should promote collaborative efforts and co-creation in building awareness of pros and cons, thereby helping to build a better informed and competent customer base. These should be pursued in tandem with the formation of a regulatory and institutional environment that is conducive to participation and diversity of services on terms that are ethically sound, respectful of privacy and secure, while also efficient and relevant in the local context.

As observed in Chapter 4, Brussels and Nantes are both involved in dialogue with citizens, entailing the introduction of open systems/open source platforms, without reliance on such vendors. Important non-controversial elements include awareness creation and capacity building, for citizens to be given choices and become able to make informed decisions regarding which platforms and networks to use, and also as a basis for less constraints and more open-ended innovation. These aspects, again, are particularly relevant for vulnerable groups, including women and children in deprived areas.

A final word is merited on what is at stake. For the US, already Putnam (2000) had predicted that inequality was on course of getting out of hand and usher in a vicious circle of political turmoil. In the US, as well as in the UK and other European countries, geographical and social mapping effectively illustrate ways in which populist movement applied big data analytics with skill and precision to thrive on social polarisation (Autor, 2016; Becker et al., 2017; Ginsburgh, 2020). Excluded individuals and communities may hence fall easy prey to “fake news” propelled digitally for political purposes just as they are more vulnerable to cybercrime and commercially driven misuse of data³⁷. These patterns foreshadow continued challenges centred on the need of coming to grips with the digital divide as a necessity for overcoming the threat of a worsening vicious circle where social and political risks are tottering side-by-side.

5.4 The impetus of COVID-19

As commented on in previous sections, digital communication generally, including the use of digital enablers in support of urban regeneration specifically, have attained radically increased importance with the onset of COVID-19 in 2020. Gradually, most countries adopted far-reaching lock-down of economic and social activity, limiting people's physical movement to halt or reduce the spread of the virus. In parallel, millions of people “self-isolated”, especially the elderly and others vulnerable to serious illness and death due to pre-conditions.

³⁷ Campaigns associated with a range of national elections, from the meddling in Ukrainian politics by Paul Manafort and the Habsburg Group 2006-2014, across Cambridge Analytica in the UK to promote Brexit, and Russian-engineered and other troll farms intervening in the 2016 US Parliamentary election, provide examples of systematic disinformation exerting massive influence on the destiny of national and also global social systems. The social media accounts, primarily Facebook but also linking to other networks, of at least 126 million Americans were shown to be compromised, with much of the activity that took place yet unknown, unmapped, or not put in the open. See, e.g., ICO (2018), Cadwalladr and Graham-Harrison (2018).

As a related development, many organisations, in most parts of the world, have shifted some practices and procedures to communicating online from home, replacing physical meetings in work-related activity, social exchange, education, care giving, etc. Many providers of digital tools offering connectivity, such as online conferencing, messaging apps, educational platforms, and so forth, have met with strong demand and responded by enhancing their capacity, offering improved and novel services. The result has been a mixed bag entailing both costs and benefits. Clearly, gains have arisen from increased organisational flexibility, reduced costs of transport and logistics, and less time wasted when some previous, non-productive, activities were avoided. Employees having to be at the office for full office hours every working day no matter what, for instance, turned out not to be universally beneficial. Meanwhile, as many more people started to engage online, favourable network effects emerged. Some of the adjustments that have taken place are thus certain not to be just temporary but likely to last well into the future, although to what degree will vary between Work practices, sectors, countries, and cultures.

As a consequence, in some strands of activity, palpable productivity gains have resulted. Flexible technological and organisational solutions are being tested widely but, in sectors and job categories where adaptation is difficult, activities have been discontinued altogether. Enormous job losses have been recorded, e.g., in collective transport, tourism, culture, sports, and experience-based industry more broadly. Fresh graduates and others in search of employment meet with an excruciating job market. International trade and investment have contracted. Manufacturing has declined overall, and commodity prices initially fell dramatically, although there has been a gradual recovery in most areas.

While personal and household services have suffered massively, some business services and those in support of online activity have benefited from new demand. E-commerce has expanded and entered new domains, the flipside of which is the disappearance of many small outlets and traditional units. Telecom, the health sector (including virtual healthcare, and pharmaceutical and medical devices), the online grocery sector, e-learning, and remote working tools and software have boomed. Where organisations and individuals have shifted to remote work, notably from homes, digital enablers have gone from a convenience to becoming a necessity for exchange of information and coordination.

The degree to which online communication has been able to come up with viable answers to the need of adjustment, matters greatly for the consequences. In tertiary education, many universities have shifted to online lecturing, allowing for programmes and courses to continue, but with much reduced teamwork and exams generally grinding to a halt. Secondary and primary education was mostly put on hold altogether in the spring of 2020. The schooling that did take place, notably at home, received scanty support, through digital or other means, again putting particularly vulnerable groups at risk.

From early on, the pandemic brought about dramatic changes in daily routines. The closure of workplaces, universities, schools, restaurants, and other facilities offering public space for leisure and socialisation, have led to accumulated hardships while also creating a sense of isolation, subjecting many already troubled to severe stress and greater risk of problems with mental health (Conrad, 2020). That family members have been “locked in” with one another has been a boon to some but caused relational and mental problems to skyrocket among others, with domestic violence at record highs (Mahase, 2020). While unemployment has shot up, and markets for new jobs closed down, many in the age group beneath 25 display particularly elevated levels of stress and loneliness. Suicides among vulnerable groups have clearly risen in many countries, including the US (Czeisler et al., 2020). In countries such as Korea and Japan, although systematic evaluation

will take time to develop, indications are that the increased number of young girls who succumb this way may outweigh the number of fatalities from the pandemic. The longer the shutdowns and social distancing continue, the more the problems are set to accumulate among marginalised groups.

Broadly speaking, blue-collar workers have fared worse than white-collar workers, and women have been hit harder than men, especially those with lower education or training. Workers in jobs that require face-to-face interactions (e.g., accommodation and food services and retail) are most likely to be laid off or subjected to furloughs (Gottlieb, Grobovsek, and Poschke, 2020). More specifically, those with a low score on the tele-workability index, who have fewer years of education, engage in part-time work, and with earnings toward the bottom of the distribution, face disproportionate risks. Such factors further create dramatic variation between countries in the risk of falling into poverty and also with regard to prospects of people regaining their livelihoods during the recovery (Brussevich et al., 2020).

Job losses and collapsing incomes for many self-employed go together with less access to health care and insurance channels that could help weather the crisis. Economic and social stress thus blend with the hardships brought about by the pandemic itself. Workers with lower incomes, and already hit by underinvestment in public infrastructure for medical treatment, are at the greatest risk (Liu et al., 2020). While, again, the elderly have had by far higher susceptibility to grave illnesses and therefore generally been isolated the most, an entire generation of young people experience crumbling educational-, job-, and career prospects. While financial markets have held up and equity values boomed on the back of public stimulus, the already grave discrepancies in wealth and incomes worldwide are reaching new heights. Vulnerable groups in developing countries are suffering the most, but unless a broad-based economic recovery can take shape within the near future, a risk of widespread frustration and despair is looming.

The perception that government stimulus has little bearing on such developments while instead propping up big business, enriching the richest and leading to ever-increasing polarisation of incomes and living conditions, needs to be taken seriously. A wave of innovation in digital enablers do feature among the concrete responses (Figueroa and Aguilera, 2020). Various digital enablers attempt to alleviate the mental health burden of COVID-19. Improved platforms and platform services lend support to the scaling and delivery of confidential counselling, Preventive apps and text messaging are on the rise. Design choices offer easier-to-navigate user interfaces, with vocabulary as well as content and methods tailored to new user groups, including those with low proficiency in English. Training for those with low-tech skills, through outreach programmes by healthcare staff, may help patients/affected citizens understand how to optimize usage.

While digital connectivity has become a lifeline to essential information and services --applying to education platforms, health care portals, job offers and social interactions, reliance on digital technologies coincides with a worsening compromise with cyber-security. Adding to this, vulnerabilities online are exploited by the Darknet, featuring by governments businesses and organised crime among the beneficiaries.

As a particular aspect, the rapid advance of big data, AI, tracking, and surveillance, has already shifted the boundary lines by way of respect for privacy, data minimisation and misinformation (Zuboff, 2019). While such issues were given high attention before the pandemic, the strong demand for contact tracing apps and other technologies aimed to control virus transmission, has de facto left considerations for privacy protection behind. Not just autocratic governments but many traditional democracies have reined in citizens' mobility, behaviours and rights across-the-

board.³⁸ Meanwhile, as work has shifted outside offices, many use personal devices that lack standard security features. Not only has traditional cybercrime intensified, but the suffering of isolation and anxiety is exploited by newly constructed websites featuring conspicuous corona-related messages for the purpose of tricking unsuspected victims to download malware and phishing their identities.

Against this backdrop, a need has risen for renewed attention to the importance of safeguards for privacy and the rule of law. Innovations have helped bring about some remedial action and new forms of “digital counselling” have arisen, pioneered by the public as well as the private sector and even local communities, building competencies and promoting safety protection online (Kitchin and Dodge, 2019; Ismagilova, 2020). “Early warning” systems have been launched to flag the rise of problems as they arise. Further, initiatives are gradually introduced to facilitate and promote meaningful human interaction online, in support of well-being and public health, in part to revive hampered physical cultural, sports- or other entertainment activities (Galea and Keyes, 2020).

The already noted need of collaboration attains additional dimensions with the challenges confronting digital infrastructure in the era of big data and IoT (Marcus and Davis, 2014). Coordinating communication protocol and standardisation while managing heterogeneity will be key for achieving basic interoperability between smart cities (Allam and Jones, 2020). A globally interconnected, smart cities network would enhance the handling of technical aspects, while at the same time spurring joint initiative by cities in tackling the inter-related threat of inter-related health, social and economic challenges at local level.

Technical advances and the rise of new applications must be matched by collaboration on the development of legal and privacy safeguards for users, as well as initiatives on the social economic front. In health applications, a comparison is warranted with therapists being held to standards of responsible practice and confidentiality. With telehealth, insurance companies and health systems must be required to accommodate digital and mobile interventions without personal risk spinning out of control (Figueroa and Aguilera, 2020). Apps and text-messaging must comply with basic requirements to be safe, secure, and responsible.

Such consequences and implications of intensified use of and reliance on digital enablers during COVID-19 are visible in URBiNAT cities. Existing network activities have intensified, and new ones have arisen, as can be seen from the right-hand column of Table 3. To exemplify, in Porto, at the general city level, the so-called City Café, a monthly seminar series, was moved online. Thereby it was made more inclusive and the format more interactive, with the help of digital enablers. Aiming at the study areas, Nantes developed a food delivery app useful to all residents while also providing an instrument for volunteers to support the elderly. Brussels, meanwhile, introduced smartphone applications for meal-sharing volunteering activities. Spontaneous initiatives were taken by citizens in URBiNAT neighbourhoods as well, to develop online alternatives to impeded physical activities, using digital platforms, websites and blogs, and also to innovate in methodology and content.

Initiatives in the deprived areas have generally been made difficult, however, by several factors. In Nova Gorica, access to the Internet clearly acts as a hampering factor, especially in the evenings when widespread online activity causes overload to broadband capacity. Generally, however, Internet access is not the main issue, but rather the mismatch between needs and access to digital tools. While mobile phones including smartphones are available to most, laptops and tablets

³⁸ <https://www.nytimes.com/2020/10/09/opinion/international-world/technology-covid-19.html>

much less so, yet most content devised for online work and studies is tailor-made for the latter. During COVID-19, several cities have acted to address such imbalances. In Brussels, the municipality approached the corporate sector to fill the gap by donating old equipment no longer in effective use but still available for remedial solutions. The collection and distribution to citizens was organised with the help of volunteers. A related initiative, Reboot, was pursued by Porto, as noted in Chapter 4. Then we have the proliferation of mobile apps and services.

Other specific initiatives have been launched in the URBiNAT cities during the pandemic, making use of digital enablers to support service provision to vulnerable citizens. Specific examples include meal-sharing and platforms for volunteer work offered to the elderly and families in need (Porto, Nantes, Brussels). These developments will be further built on by URBiNAT by linking them to the neighbourhoods and the NBS under preparation.

At the same time, COVID-19 has compromised and/or distorted various URBiNAT activities, calling for countermeasures. This applies broadly to the participatory processes, with methods such as Walkthrough and the undertaking of workshops strongly affected. The co-selection of NBS and co-design of urban plans, staged to be advanced through multi-stakeholder physical meetings, had to be re-organised. Initially, co-creation workshops gave way to exercises online for co-selection, with fewer stakeholders directly involved. High priority has been placed, however, on working out means to increase inclusiveness and finding new ways of engaging vulnerable groups in the study areas. As one outcome, a hybrid approach has taken shape, where a small group of citizens meeting physically connect with and support much wider networks online. In the same vein, URBiNAT has opted to combine online communication with strategically scheduled smaller physical meetings and workshops arranged with citizens taking centre-stage. A few selected participants from other cities have been present, to provide outsider perspectives, while also refreshing personal bonds in linking between the cities.

With increased time having been devoted to online meetings, the risk of fatigue has been countered by the application of innovative and interactive measures. This includes organisational improvements resulting in more focused meetings and the introduction of methods and content fitted to enhancing the motivation and empowerment of participants. Innovative approaches and adjustment of processes have thus been applied, experimenting with blended communication, combining online and offline formats. Yet, the learning journey is ongoing, as propelled within URBiNAT CoP, and challenges remain in how to pursue meetings and other activities online on terms that are inclusive, effective, inspiring and account for concrete results, applying to URBiNAT as well as more generally.

The marked reduction in economic activity that has followed from the introduction of various restrictive measures, meant to contain the spread of infection, has given rise to some unintended positive side-effects. This includes reduced pollution levels and improved air quality, at least temporarily benefiting health in mega-cities and deprived neighbourhoods. In looking for ways to manage or mitigate the consequences of social distancing, however, most urban areas have kept struggling. Where possible, citizens have called attention to the importance of the physical environment for health and wellbeing, including the role of urban greenbelts. Where lockdown restrictions have not been as strict, and/or where they have been lifted, people have prioritised walks and sought ways to enjoy nature. The public spaces visited most frequently have been parks, forests, and beaches.

In this context, many digital enablers have emerged helping users identify and map nature (plants, insects, birds and other animals). A spectrum of new apps has served to underpin the interest,

engagement and commitment of citizens, belonging to various socio-economic groups, in support of securing sustainable biodiversity locally. The pandemic has also put air quality on the radar as COVID-19 causes significantly more fatalities amongst those with a weakened respiratory system, thereby casting light on the health hazards of air-pollution. As part of URBiNAT, the participating cities and experts have initiated work on developing user-friendly digital enablers as a means to increase awareness in regard to air- and water-quality, inducing behavioural change in support of enhanced citizen wellbeing and health in the urban environment. Related Horizon 2020-projects similarly advanced NBS by facilitating for stakeholders to collaborate in planning and designing blue-green infrastructure, strengthening supportive business-models and conditions conducive to climate-resilience using various tools, including software, repositories, platforms, etc.

URBiNAT, in conjunction with its international networks, has taken steps to establish an online “idea bank” to collect, structure and diffuse information on ideas for future projects to bring about a better world in the aftermath of COVID-19. In the early stage, one of the themes that came up included instigating action by individuals and communities to mitigate climate change during periods of lock-down. This included ideas how to further digital enablers featuring virtual planting and moving green activities online. Subsequently, platform initiatives restoring social relations by matching skills and needs, opening for avenues back to the job market or entrepreneurial activities, are in high demand. The importance of this agenda stretches well beyond Europe and encompasses organisations and individuals in the Middle East, Asia, Africa, and the Americas.

Related to this, many people who are mobile and can afford it are in the process of moving out of the city. Others are looking to relocate within the city, often to leave city centres, and acquiring housing in less densely populated suburbs, or choosing to remain in small towns and villages they returned to during the crisis, working for a lesser return but closer to nature and less health concerns. In some respects, these reinforce the emptying of offices, bringing synergetic reductions in the demand for central space. The notion of a new - not yet known - “normal” has emerged. Lasting cultural and behavioural change is part of the picture. Cautiousness in social relations is likely to stay, distance has come to matter again, while online communication keeps growing, partly fuelled by innovation in response to the outstanding needs. More needs to be done, however, to accomplish an enhanced momentum in policy-citizen dialogue and initiatives to restore the foundations for wellbeing and sustainability.

6. Conclusions and Recommendations

Digitalisation is one of the main aspects of modern society that attracts the most interest and attention from many directions, for multiple reasons. The literature and empirical findings circumventing digitalisation are full of paradoxes, however. Here, we have a phenomenon attracting enormous attention and investment, transforming people’s work and private lives, carrying vast implications for virtually all societal domains. Yet, the potential benefits and actual outcomes of all this are often obscure, ambiguous, and leaving a lot of unfulfilled promises behind.

In the previous chapters, we contemplated the role of digital enablers in support of co-creation of NBS and Healthy Corridors, with special consideration to citizens’ engagement and urban regeneration, reflecting the agenda and concrete efforts pursued on the ground in the URBiNAT project. We have done so keeping in mind the basic caveats, that participatory processes have far

from always proven successful, or even desirable in the first place, and that digital enablers need not necessarily be preferable to non-digital means of instigating participation. A combination of non-digital and digital enablers of participation, hybrid solutions, may in many bases offer advantages, for instance, in realising the inclusion of disadvantaged groups.

Having said this, as a central tenet of our ongoing work, the spectrum of opportunities at hand, when it comes to devising and applying digital enablers, merit close attention. For one, ICT and digital enablers stand to facilitate and leverage how data is collected, structured, and diffused. Through massively enhanced reach and speed of communication, interactivity and means of inspiration, digital enablers open up to realising entirely new levels of targeting, inclusion, flexibility, adaptability and so forth. Digital enablers can be adapted and fine-tuned in accordance with specific circumstances, local context, and passing through consecutive stages of co-creation. Advantages may arise through innovation coupled with entrepreneurship and the rise of special business models, and/or social innovation and solidarity economy initiatives.

Throughout we have highlighted the role of digital enablers in support of participation, with particular reference to NBS and Healthy Corridors. This is an essential context for coming to grips with fundamental challenges confronting the urban environment and how it is governed. As pointed out by various observers, participation is not always constructive and may come with a cost, requiring time and effort. Digital enablers may additionally be accompanied with issues, such as loss of personalisation and challenges regarding trust. They will also not attain their promising results with any automacy. Applying digital enablers requires competency, ability to judge options at hand, identify areas in which the benefits are particularly likely to dominate, thus, to be given priority, and also the skills to make constructive choices in how to devise and apply them. Finally, there is the need of enhanced capacity to deliver on what digital enablers stand to bring about in terms of outputs of participatory processes that ideally entail a spectrum of diverse citizens and stakeholders.

Navigating this space, URBINAT and the present report call attention to the value-added that may be obtained by granting inclusion of voices that are otherwise marginalised and/or stuck on the defensive, thereby potentially helping to balance, or overcome, the influence of “insiders” or vested interests, and open up for constructive compromises and collaboration. The reach and functionality of ICT and digital enablers further stand to underpin social interactions and synergy between diverse knowledge exchanges, occurring “anywhere, anytime”. 3D visualisations, Augmented and Virtual Reality, can be used to allow individuals to immerse themselves into future states of their neighbourhoods to get a feel for what they could be and look like.

We further observe and elaborate on the scope for realizing constructive collaboration, moving beyond a narrow “what is in it for me” perspective to include “what is in it for us”. Adequately devised and applied, digital enablers can contribute greatly, e.g., through peer-to-peer review devised to support social bonding and community values. Such functionality can be performed by real-time participatory sensing using not just smartphones, but also simpler mobile phones freely equipped with apps increasingly attainable for most people at low cost. Co-creation of digital enablers, although carrying costs, offers specific opportunities in this regard, especially for certain target groups such as youth in deprived areas.

In examining the use of digital enablers, we have reviewed and drawn upon several strands of literature. These include, but have not been limited to: i) the factors that influence the impact of ICT, such as commercial drive, lack of skills, organisational rigidities, convergence of Internet and mobile technology, and the rapid development of smartphones; ii) the health sector and its search

for ways of enacting awareness creation and behavioural change on the part of patients or those with habits endangering their health; iii) the “smart city” concept and its various manifestations, such as user-driven innovation and cities as playgrounds for counter-discourses; iv) the digital divide and its varying shapes, such as access to and use of devices, level of education and digital literacy; v) the contribution of participatory processes, related to concepts like participatory design, collaborative design and the engagement of user experience; vi) the contributions and impacts of NBS, and their extension into Healthy Corridors.

A commonality running through the topics mentioned has to do with the role played by confounding factors. Impacts are not given but depends on context and competency. Governance matters, including the ability to overcome or balance disruptive influences, and appreciate broad-based and long-term benefits. As has been illustrated in this report, a vital distinction needs to be highlighted, between usage in support of information provision vs. that of propelling active engagement, including empowerment. The main thrust and prospective benefits of the digital revolution have to do with its potential for achieving the latter, especially for those that are otherwise excluded. At the regional and local level, a range of opportunities arise for digital enablers which can be deployed in support of participatory processes capable of underpinning improved governance frameworks in this respect.

While outlining the opportunities, the report identifies and examines the downsides and risks as well. Participation is not without risks and costs, with the same applying to digital communication. Time and effort are required, to build capacity for informed deployment, and then implementation. The result may be a worsening of conflicts between dissonant interests and hard decisions needed to tackle complex trade-offs may become even more infected, rather than eased. Issues of security, privacy, manipulation, and disinformation are at hand as well. If such aspects are ignored, left unaddressed, or even exploited, vulnerable groups may fare worse rather than better, long-term solutions lose out to populist short-term fixes, and authoritarianism fester.

The importance of utilising ICT for creating awareness and increasing openness, tolerance and knowledge production, vs. being mobilised for opposite purposes, is not sufficiently appreciated. At the same time, the serious crisis brought about by COVID-19, which causes severe damage to vulnerable groups, women and young generations, has led to much enhanced dependency on digital enablers. Despite the need and the widespread efforts by citizens and other stakeholders, their contribution remains under-developed. A major turn for the better will require that the potential opportunities are granted much greater attention, including the capacity to devise and apply digital enablers in support of favourable participatory processes, and this in tandem with the undertaking of complementary capacity building, competence development and governance reform.

6.1 A novel framework, synthesis and portfolio of digital enablers

Going beyond technology as such, this report enters on the “inside”, opening the “black box”, of digital tools, to decompose the main components that need to be drawn upon and operate together in a framework for digital enablers. On this basis, our analysis is routed around: i) *purpose*, ii) *methods*, iii) *content*, and iv) *tools*. Each of these building blocks need to be incorporated and devised with a view to supporting engagement and participation by citizens and other stakeholders to co-create NBS and Healthy Corridors.

The four building blocks can be matched and combined in multiple ways, bearing in mind the specific context. As such, certain commonalities are in play. A successful approach requires involving citizens and stakeholders from the start, in consideration of and for identification of the underlying purpose, or objective, to be achieved. Digital tools applied should offer ease-of-use and benefit from the familiarity of special target groups. Methods, such as competitions, games, rewards and surveys, may be applied to initiate active participation as well as for supporting sustainable engagement. Content critically helps to fine-tune mechanisms of targeting and to accomplish relevance for diverse groups, including in marginalised and vulnerable communities. This may be fixed by addressing and making arrangements for differences in language, working with symbols, visuals, and bringing to the forefront mechanisms for social bonding that reside in culture.

Before proceeding with digital enablers in underprivileged neighbourhoods, one needs to take account of the context, culture, the diversity of attributes, and stakeholder relations. Various aspects of the local environment, here with a focus on deprived areas, require attention. This includes the status of digital infrastructure, the penetration rate of digital tools, and the level of digital literacy among various categories of people living and acting in the neighbourhood. Culture and mindset further matter gravely, e.g., when it comes to shaping attitudes and behaviours, affecting individuals, groups, and organisations. Traits within these categories influence the means for communication and trust-building, while concurrently bearing on professions, gender, age, civil status, ethnicity, interests, digital skills, competencies, and so forth. While all this complexity calls for carefully devised assessment and implementation, digital enablers offer a rich set of opportunities to devise and apply solutions in support of enhanced collaboration and the ability to work out joint solutions

URBiNAT draws on structured experimentation and advancement among the cities, notably in the selected neighbourhoods and study areas that stand at the core of the project. The resulting comparisons feed into sharing and learning exercises, progressing through the mechanisms put in place by the Community of Practice (CoP) framed for URBiNAT. The neighbourhoods are all, to a lesser or larger extent, using digital enablers to underpin participation and co-creation. As the COVID-19 pandemic has created an urgent need of identifying new ways of reaching particularly deprived areas, high hopes have been placed on digital enablers. More efforts are required, however, to gain operational capacity in order to meet the severe challenges at hand and open for more vibrant bottom-up initiatives, as well as to make best use of digital enablers in the co-creation of NBS and Healthy corridors. Among residents in the neighbourhoods, meanwhile, we witness signs of fatigue and faltering enthusiasm. Special efforts are required to incentivise and inspire citizens, using innovative hybrid combinations of online and offline modes of interaction, fitting the specific situation confronting targeted user categories.

The level of digital literacy clearly varies markedly between the neighbourhoods, a subject not sufficiently explored in the local diagnostics undertaken thus far in the URBiNAT cities. While it is well understood that digital literacy and accessibility to digital tools typically represent a hurdle for engagement in deprived areas, digital enablers offer versatile avenues for reaching and engaging various target audiences. A case in point is that of youth, who tend to lose out in traditional schemes. Social media and m-participation can be applied in innovative ways, including to bring about co-creation of digital enablers by citizens themselves.

One can note that the digital revolution, with the rise of novel business models has most critically been driven by market forces and commercial interests, acting at significantly higher speed than governments or city municipalities. In many cases, authorities have perceived little choice than to

hook on to new technologies and applications, including usage of social media channels and platforms with which their citizens were already involved. This means that the cities themselves did not commence to invent channels of their own, as the already existing ones were faster in both learning from, and adapting to, the behaviours of their users. Recently many cities have realised that they should provide citizens platforms with both public and private space for attractive and inspiring engagement of their users. Among the URBiNAT cities, the city of Brussels is under way to implement such a platform. This in turn requires continuous monitoring and organisation to feed the collected information back into decision-making. Put differently, the degree to which available information is communicated and used as actual inputs to policy, urban planning, and governance reform, is key to retaining the credibility and long-term acceptance of such systems.

6.2 A portfolio perspective

A central contribution of this report is the presentation of an innovative approach and structured mapping of digital enablers, the rationales and elements that comprise them matched with the experience around what has been attempted and worked out. On this basis, the report outlines a portfolio approach, pointing to potentially useful combinations of building blocks (again; purpose, methods, content and tools), kinds of rationales/impacts/ value-added that may be aimed for in the application of digital enablers, as well as examples of digital enablers.

The aim of this portfolio, visualised in Table 4, is to provide inspiration and guidance when it comes to digital enablers in URBiNAT neighbourhoods and other cities. It is in no way cast in stone, however. The portfolio moreover does not provide rigid directions. On the contrary, where possible and efficient, digital enablers are to be co-created, as are the individual building blocks, along with their application through the participatory process. The portfolio puts together a framework to help demonstrate what may work out or has been seen to work. It is to be regarded as a living representation, set to evolve based on continued collection of relevant, new developments and experiences.

Devising and applying digital enablers effectively further requires consideration of the scope for complementarity while countering contradictions and potential conflicts. Some impacts are mutually strengthening, as in the case of building interactivity and linking, or in the way of creating trust. Exerting sustainable impacts and achieving transitional governance, for instance, are mutually reinforcing, while inclusion for all and targeting may be accomplished along separate tracks. What works by way of initial inspiration is typically different from enacting long-term behavioural change.

What brings a successful application of digital enablers is likely to vary through the stages of co-creation, ranging from the preparations and identification of NBS, to their design, implementation, and monitoring. At the start, digital enablers may help build and diffuse awareness of NBS, e.g., inspire urban gardening, physical activity, and realise participatory budgeting. In local co-diagnostics, properly devised digital enablers stand to facilitate citizens' active engagement in defining the prime challenges and opportunities of their neighbourhoods. They may similarly be applied so as to inspire and facilitate co-selection of NBS to be implemented, as well as their co-design, partly for the purpose of engaging a broader range of citizens, or others than those that would otherwise be engaged, in framing NBS and Healthy Corridors for a better match with local needs. Subsequently, digital enablers help underpin co-implementation, on terms that allow for lasting impacts, entailing experimentation with and learning from methodologies and content conducive to lasting behavioural change. Finally, digital

enablers can enhance co-monitoring, by the help of sensors and GIS, interactive boards and websites, and facilitate learning and knowledge exchange between URBiNAT neighbourhoods and other stakeholders.

The extent to which the building blocks of digital enablers provide complementary impetus for participation, and steer clear of contradictory influences, is likely to matter greatly for which results can be attained. There is no single or given way to get this right, yet, a logical and natural combination of the elements at hand can be distilled. Additionally, there are plenty of experience and lessons from which to take inspiration. The significance of consistency similarly applies to the relationship between digital and traditional means. The best results may often come about from applying a blended or hybrid approach, combining digital enablers with face-to-face encounters and other means for personal contact when possible and suitable.

The basic foundation for successful implementation of digital enablers has to do with the prevailing digital infrastructure in the area, encompassing, availability of affordable networks, access to specific tools, and the readiness by citizens to use those tools. Another basic element for shaping digital enablers with the potential to be welcomed and used by citizens has to do with the co-creation process, i.e., to what extent citizens and relevant stakeholders collaborate and are able to engage in constructive compromise. This includes characterising and framing the issue at hand; identifying needs, challenges, strengths, shared interests and/or dreams; and putting in place a number of building blocks for targeting, reach, initialisation, etc.

Culture represents an additional key aspect and pre-condition for achieving favourable results. URBiNAT undertakes mapping of local participatory culture, with the effort partly channelled through local task forces. Their mandate includes stalking out supportive functions through the establishment of Living labs. A prominent role for digital enablers relevant to this context is to help bring into focus the task of crafting common solutions. The means are at hand to instigate maturing processes in support of common identity, collaboration and the ability to strike meaningful compromise, applying to various domains of the portfolio, including Reach, Inclusion, Targeting, Interactivity, Initialisation, Sustainability, Linking and Trust.

6.3 Key take-aways for stakeholders

Key take-aways are next addressed in relation to different stakeholder groups, namely policy makers; city administration; citizens; NGOs, interest groups, and not-for-profit organisations; the wider society and other stakeholders.

Policymakers: Digital enablers offer a number of key benefits for policy makers. Part of the opportunity at hand is of technical nature, such as reaching more citizens, targeting special groups, or gaining a better understanding of their needs and behaviours. Other aspects are subtler. Digital enablers can be unleashed to identify and address conflicts of interest, through linking and building trust. Additionally, digital enablers can be devised and applied so as to alter the very process of urban planning, with channels put in place for the perspectives and creativity of citizens, non-experts and representatives of minorities and deprived areas to be effectively represented in decision-making and the enactment of NBS and Healthy Corridors. Furthermore, digital enablers facilitate monitoring and data collection providing policy makers with data and insights on citizen observations and behaviours. Several key elements should be carefully considered by policymakers, to be reflected in policymaking and initiatives:

- Better mapping and diagnostic of the way that digital infrastructure, available digital tools and participatory culture set the stage for what digital enablers can achieve.
- Incorporate insights from the above in framing measures going forward to realise connectivity, 4G and 5G, understand the importance of the citizens' access to tools and put schemes in place for improving digital literacy.
- Understand the eco-system of the co-creation of digital enablers – engaging entrepreneurs, citizens, urban planners, municipality workers, and technicians.
- Safeguard privacy concerns – provide resources at administrative level in order for them not to be dependent on existing vendors, and be able to handle security, privacy and issues associated with misuse of data and manipulation.
- Where suitable, use existing, already validated digital enablers, while weighing against the value of co-creating new ones, with special value if created by citizens themselves.
- Encourage stakeholders to set up digital platforms that are independent in regard to ownership of data, management of data, etc.
- Provide means for the stakeholders to make use of open systems/open data in order to address specific challenges, such as air pollution, health issues, mapping of green areas, lack of engagement as well as engaging specific CoIs.
- Make active use of digital enablers to underpin community identity and leverage ability to compromise, collaborate and agree on joint solutions.
- Build the capacity to make informed decisions whether to apply existing digital enablers when co-creating new ones with/by citizens.
- Apply digital enablers to engage citizens in identifying the issues of deprived areas and propelling co-creation and high activity levels by citizens in resolving them.
- Identify gaps that have become critical with COVID-19, including from dependency on digital enablers. Active search for countermeasures to downside, experimenting with diverse actions, including structured leadership, engaging co-creation, but also a blended approach, where digital enablers carry connections to physical space and meetings. During the pandemic, co-create arrangements that enable social contact while still respecting social distancing.
- Actively pursue capacity and measures in support of mindset to help build coherent support to sound governance, based on genuine appreciation of the potential benefits emanating from citizen participation and constructive interface between experts and non-experts.
- Be aware that digital enablers (and relatedly, digital democracy) come with the need for investments in IT and software, skills, and knowledge development.

City administration: The municipality and its organisation meet with a multitude of complex and multifaceted responsibilities. It needs to be recognised, however, that its role incorporates that of enabling participatory processes and co-creation. Having access to diverse approaches in this respect, with the ability to tailor the most appropriate to suit a particular situation, should be a standard requirement. The range of opportunities offered by digital enablers, however, coupled with the rapidly accumulating experience and lessons how they can be devised and applied, bring to the forefront the following:

- Ensure that the state and orientation of digital infrastructure meets with citizens' needs by way of access to the Internet, matches the situation with regard to tools, and how it can be accompanied by competence building measures so as to help bridge the digital divides.
- Build organisational capacity and strategy for active use of digital enablers not just for e-government service in a traditional sense, but so as to induce co-creation of NBS and Healthy Corridors.

- Adapt administrative procedures and build capacity to manage transformational change.
- Take account of reflexivity and social learning as part of the criteria for quality outcomes.
- Work proactively to establish links to citizens as a basis for effective co-diagnostic.
- Safe-guard inclusion and understand how to include and target unusual suspects..
- Take note of and help foster CoIs with the potential to building bridges and connecting diverse groups and communities.
- Manage stakeholder relations, promote dialogue and achieve constructive conflict resolution between opposing interests.
- Inspire and enable co-creation for shaping of digital enablers both via online fora and physical meetings, allowing citizens to take part in devising digital enablers, with consideration to their building blocks.
- Connect digital enablers to indicators in order to generate valuable data for fine-tuning of digital enablers and future learning.
- Create platforms capable of instigating training and inspiration for using open source and encourage use of open data and innovation.
- Collaborate with other city administrators and incorporate proven open, non-proprietary and secure platforms already being applied by other city administrators to engage citizens in co-creation.

Citizens: Use of digital enablers should be user-friendly and well-anchored with citizens, so as to match their needs and operate in tandem with their actions to open up new opportunities. The starting point may be framed as specific challenges or shared interests. Inspiration may be found in the possibility of using various digital enablers as part of a development creating new value-enhancing networks and concrete activities. A blended approach to co-creation and engagement is welcomed as certain citizen groups prefer to become engaged via online arrangements whereas other citizens consider physical meetings and presence key to any participation. By acting along these lines, the likelihood to engage the so-called unusual suspects is significantly increased.

Policymakers need to build awareness as a basis for strategy that deals with the degree to which there should be active participation in networks with citizens and other stakeholders. Adequately devised, digital enablers provide powerful means to cherish a number of favourable effects for large numbers of citizens, which may include behavioural change along with healing of social relations and the underpinning of shared community values. Capturing the opportunities requires placing effort into learning and capacity building though. It includes establishing competency for making active use of the four building blocks constituting digital enablers, and how they can be devised in sync with a view to achieving varying objectives. For deprived areas and disadvantaged groups, smartphones and associated apps may not only be used for effective reach and targeting, but citizen participation can be further enhanced by their active engagement in co-creating the digital enablers that are most suitable and of highest relevance to them, in their environment. If built upon to support capacity-building, citizens and communities can grow to take their own actions, fusing social change and laying the basis for “democratic innovation”. For stewardship of such processes, cities need to build capacity for “transition” management, utilising “reflexive” governance to create the space for overarching change fuelled by collaboration involving diverse interests and actors.

Managing Facebook/other platforms: Facebook offers its own, ever-present platform to allow citizens to interact with one another. What has not been generally well understood or forgotten is that this platform, coordinated with numerous other sources of data, is applied to generate a continuous, ever-present collection and processing of in-depth information traded for commercial or other purposes, in effect covering most users. The scope for Facebook and other proprietary

platforms to make high returns increases steeply the larger number of users covered, partly due to their resulting enhanced bargaining power vis-à-vis clients. Meanwhile, Facebook and other commercial platforms are commonly used by self-organised groups, which may thereby clearly enjoy practical benefits of ease and convenience (Saad-Sulonen and Horelli, 2017). As an option though, non-commercial, open source platforms may grant such groups a higher degree of independence, privacy, less vulnerability and meet with stronger development potential. Yet, their application will require greater effort and resources, at least in the short term. Seeing the advantages and potential benefits for citizens when it comes to non-commercial platforms this can nevertheless be worth considering. The pros and cons must be balanced while ensuring actual means of reaching and engaging citizens for constructive participation.

NGOs/interest groups/non-for-profit organisations: NGOs, closely linked with specific Cols, can cultivate relationships with target groups using digital enablers; widen the scope for further reach; actively invite citizens to participate in co-creation; improve understanding for the associated benefits; and open up for connecting citizens through Cols. NGOs usually have a very strong “purpose” to which their most loyal members and target audiences find it easy to relate. As such, members and other stakeholders who share this sense of purpose are easily motivated to engage and contribute through digital enablers that support the fulfilment of this purpose. As NGOs struggle to expand their base of volunteers and donors, constructively devised and deployed digital enablers can facilitate targeting relevant audiences while under-pinning mutual value creation. Digital enablers may also help NGOs achieve a more efficient distribution of support services.

Business/private sector: The private sector leads in the research and development effort that propels technical progress, innovation, associated competence development and user-driven applications. Furthermore, the private sector and businesses can play a significant role in addressing some of the shortages that make digital enablers unattractive to citizens in deprived areas. Businesses may further help contribute real “content” to NBS and Healthy Corridors, e.g., related to diverse kinds of innovative service provision, that helps underpin their attractiveness to citizens. Specific examples include making available discarded plants, recyclable construction material, reusing batteries or upgrading outdated IT hardware, as well as offering bicycle, furniture, and electronics repair workshops. At the same time, dominating business interests will strive for lock-in of users and thus counter diversity and broad-based opportunities. Policymakers need to recognise the strengths of business and open for engaging it in value-enhancing development, on terms that promote the social good. In this, digital enablers have a key role to play, including by supporting governance frameworks capable of defining public-private win-win partnerships. Here, decision-making at local level is better placed, given the proximity to the actors and interests at hand. Going against dominating business interest may be more difficult, and there may be greater damage of promoting narrow interests. Digital enablers therefore meet with special needs at local level to bridge conflicting interests, including by promoting counter-valuing impetus for civil society and citizen participation. Their engagement in fact holds promise for receptive enterprises. Co-creation featuring citizens entail more demanding and creative customers along with scope for innovation. In the context of URBiNAT, the application of digital enablers to frame engagement of enterprises in NBS ideation, production and/or implementation along with citizens, thus enhances the potential for value-generation.

Innovators: Whether social or economic innovators, they can help cultivate relationships with target groups via digital enablers while playing a key role in developing and fine-tuning user- and needs-driven digital enablers, including, for example, app-based services. Innovation and business development are of high importance for unleashing new solutions, for competition, restructuring,

productivity growth and jobs creation. The momentum in many cases reside particularly in start-ups and potential high-growth companies. Yet, a small circle of mega-companies taking advantage of extreme network effects have come to attain out-sized dominance, perpetuated by their ability to stay vigilant with regard to newcomers and systematically acquire those that challenge their market position. Downsides of these market conditions, including privacy-violations and exploitation of personal data must be countered, including at the community level through the support of diverse and user-centric solutions, including via open source, facilitated for instance by inclusive community-centres and associated training and competence development. URBiNAT similarly champions open systems and open data. At the same time, creating fertile terrain for dynamic start-ups, entrepreneurs and innovators, in the commercial as well as social fields, matters greatly for realising dynamic and development-oriented local ecosystems. Those assuming leadership in promoting long-term strategies involving users and citizens to help pull demand-driven solutions, shifting consumer preferences along with employee behaviours, can serve as anchors for inspiration. Similarly, proactive investment to address gaps in expertise, raise digital literacy and support quality services, and thus feed trust, should be encouraged and rewarded.

Further examining the way forward, we underline the potential opportunities that arise with the potential linking of related Communities of Interest, based on which we present three candidate tracks for how to proceed with co-created digital enablers in the URBiNAT cities, drawing on either a strengths-based or a needs-based approach. Some specific observations and conclusions are presented in regard to these approaches to address the post-pandemic situation expected ahead, by promoting increased awareness and quality use of digital enablers.

6.4 Aspects requiring further consideration

When we contemplate the enormous applicability and potential of digital enablers in the context of participatory processes linked to NBS and Healthy Corridors, we should be aware of the presence of mighty distractions and potentially counter-vailing forces. A fundamental observation has to do with the basic, mainstream orientation of the digital revolution and the forces that underpin it, which may in effect diminish the priority that key actors award participation and associated reforms to governance.

The situation at hand may be referred to as an imbalance, or gap, between the dominating research and development orientation shaping mainstream technical progress and the focus of digital applications. These forces are currently playing out in efforts to take AI and deep learning utilising Big Data, to new levels. In doing so, the main preoccupation of private sector investors and organisations that drive this development, is placed on mapping and directing consumer behaviours primarily for commercial, and at times, political purposes. While attention is paid to the importance of shaping sensible usage for these technologies, and the EU indeed is taking action to frame limits to violation of privacy and misuse of personal data, the continued rapid advances of IoT, smart sensors and big data mean that an orderly framework is a long way off. Following the pandemic in 2020 and rapidly enhanced dependency on ICT for many individuals and organisations, a huge need has arisen of awareness-creation and education, to make informed decisions on digital applications. This could be linked to local community centres encouraging co-creation of digital enablers, backing citizen engagement in defence of user data and identities.

Along a parallel track, many digital enablers that have been developed with a view to achieving social content and impact, were originally created within the framework of the health sector. A key purpose here has been that of inducing medical adherence and self-monitoring, utilising tele-medicine and to some extent personalise physical activity programmes. This sphere has been progressing in a voluminous experimentation and learning journey, advancing an in-depth understanding of when and how attitudes and behaviours can be changed as a means to advancing particular health services while also supporting citizens' health and wellness.

A third relevant track of high importance for the digital revolution, is that of the smart city. Smart sensors, IoT, Industry 4.0 and broadband capacity have been deployed for the purpose of transforming the urban environment, along with the whole spectrum of fundamental functions, utilities, and amenities. As discussed, however, challenges have been obvious, creating a widely diffused insight that the use and usefulness of technology ultimately depend on people, and their engagement.

It is within this fragmented and also polarised landscape we have to judge what momentum can be accomplished and what capacity forged, to realise the potential benefits of digital enablers of participation. Linking to the mainstream drivers of commerce or politics, synergies with the advancement of behavioural responses to health issues, and/observing as a bridge to success for the smart city agenda can all play their part.

Yet, adequate momentum, resources and effort are required to realise the potential of citizen engagement in urban regeneration. In order not to be hijacked by technical deliberations, different relevant competencies and insights need to be pulled together. The needs addressed must clearly span urban design and planning, technicians, businesses, entrepreneurs and financiers, environmentalists, social and behavioural scientists, facilitators, and so forth.

The benefits of digital enablers emanate from a range of strengths and opportunities. Some of these are associated with greater reach and diffusion, inclusion, flexibility, tailoring, innovation, and others identified in this report. In terms of practical approaches, digital enablers can open for co-creation in identifying the real issues, relevant on the ground, the search for and implementation of solutions, reconciling conflicting interests along the way. Stakeholders with shared interests can gather in Communities of Interest (CoI), drawing on either a strengths-based or a needs-based approach, with digital enablers adding distinct value by creating inspiration and commitment around common initiatives and activities. Experimental applications of digital enablers are in preparation in URBiNAT, to open for further insight and lessons on how digital enablers can leverage, link and mature Communities of Interest (CoI) in support of citizen participation applied to NBS and Healthy Corridors.

Participation and digital enablers are generally viewed as entailing costs and risks, which need to be taken into account. While there are direct costs associated with platforms, technologies, and network charges, for instance, these are typically becoming less and less salient. Indirect, hidden costs are inflicted by proprietary vendors, however, along with the misuse and exploitation of personal data. Developing new DPPs generates costs in the form of time, efforts and expert fees which must be outweighed by societal gains if it is to be worthwhile. Others observe, however, that digitalisation brings a potential for more efficient government, enabling policy-citizen interface as much reduced costs. In either case, priorities need to be made, when and how to catalyse, invite or welcome participation.

Although engaging deprived areas and disadvantaged groups meet with hurdles which few cities have targeted adequately thus far, they probably represent the arena which stands the most to gain from unleashing digital enablers in support of co-creation, NBS and Healthy Corridors. Special effort is typically a prerequisite in this case, by way of local diagnostics and working out proper strategies for how to tackle weaknesses in infrastructure, lack of access and/or mindset issues. Even further effort is required to ensure a match in the way digital enablers are framed in accordance with what a specific target group is susceptible to. In URBiNAT, these challenges, along that of involving key stakeholders, will be met head-on and addressed by the participating cities, with the goal of generating new lessons and insights on how digital enablers can indeed generate value in this context. Here as well, the build-up of wider strategies around synergetic measures in the context of the Healthy Corridors, aims for building the case for the wider benefits of physical, mental and social well-being in urban regeneration.

Based on observations of existing digital enablers, the bottom-up initiatives undertaken thus far, emanating from citizens, in many cases rely on mainstream social media channels, such as Facebook and Instagram. The gains in terms of accessibility and convenience stand against the reliance on vendors that subject citizens to issues of data ownership, privacy and user manipulation. Observations and conclusions presented to these and related compelling issues surrounding digital enablers, partly to address the post-pandemic situation anticipated ahead, put emphasis on promoting adaptation and innovation in the way digital enablers are devised and applied. The aim is to enable a fluid and effective participatory process that responds to real issues, without getting trapped by the potential downsides of digital enablers.

Finding ways of motivating a broader spectrum of citizens, to express their preferences and to become part of developing solutions instead of being viewed as “the problem”, is key to the realisation of an inclusive co-creation process. Countering risks of conflict meanwhile, is possible by digital enablers underpinning collaboration, while also facilitating fruitful linking and increased trust, including the involvement of experts and scientists in support of sustainability, a “watchdog” role for citizens, or other mechanisms motivated by the complexity of systems aspects or the cross-border nature of many environmental issues. Moreover, each city and each community will only reach so far in working out responses “on their own”. Although each city and area is unique in some respects, and the special context needs to be considered, it also holds true that many of the challenges, and how they can be addressed share common features. Exchange of experience and learning from practical experience needs to draw on broader networks and structured collaborative agendas, while also conducive to local experimentation and learning.

As stated in this report, digital enablers provide numerous possibilities to support constructive combinations and synergies in managing these various tasks. This includes their capacity to structure and diffuse information on how they can best be devised and deployed. A platform including a repository of digital enablers with the aim of citizen participation and actors involved such as technology developers, idea initiators, etc. is under consideration for the next stage of URBiNAT. As outlined in this report, the complexity of digital enablers and the associated co-creation would benefit from having access to user-friendly tools for navigation of the existing enablers and their connected actors.

Yet, digital enablers involve costs and risks, and will not always represent the best solution. Their application should draw on adequate preparations, while guided by a mindset and preparedness to learn and adjust along the way. In some cases, digital enablers should also be combined with other, more traditional means of engaging citizens.

Informed use of interactive communication via smartphones opens for novel approaches to bottom-up initiatives by otherwise marginalised citizens, for example in app development that can be tailored to reaching and attracting the interest of deprived neighbourhoods and/or disadvantaged groups. Along the way, new innovative apps or applications may arise, as the result of user initiatives, with the potential to instil value-enhancing social innovation as well as commercialisation and business development.

Policymakers encounter the opportunity to shape frameworks for interaction, capacity building and genuine participation and co-creation by citizens. Embarking on a successful strategy in this respect requires overcoming fragmentation and developing the capacity for capturing synergies at multiple levels. Virtuous circles of self-reinforcing processes should be aimed for, devised with a view to resolving contradictory interests, build long-term capacity, induce lasting behavioural change and support long-term benefits and win-win for the key actors.

Digital enablers offer a rich and diverse set of instruments capable of generating value through multiple mechanisms. For the next stage, URBiNAT aims to realise, document and draw lessons from concrete initiatives on the ground across the participating cities. On this basis, we aim to further explore and evaluate the role of digital enablers in co-creation, as a means of addressing the fundamental issues at stake.

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Appendix 1:

Examples of Digital Enablers from cities around the world with key features

Name of digital enabler	Purpose Features/ explanation	Stage in which the enabler is relevant	Tools of High importance	Method of Importance	Content of Importance	Guideline issues*
Ride together ³⁹	Digital enablers help developing a community of bikers by the support of digital tools to use for biking in the city. It facilitates biking on safe and fast routes and also connects with emergency services. Another purpose is to support the municipality in preparing for safer biking systems	Co-diagnostic – co-diagnose safe cycling routes Co-design – routes for safer cycling mobility Co-implementation – informing other cyclists of amenities and temporary hazards along the routes Co-monitoring – the actual use of the designed and designated routes and the experience of using them	Digital tools are: bike bell mobile app map	The bike users can provide their inputs about specific areas about safety, condition of the bike passage, etc.	Details of specific areas showing safety situation, road condition, reporting of dangerous spots, places of relevant amenities, etc.	Important to consider data and privacy issues Important to show and communicate behavioural changes Trust and linkage to local government action
Cities of Service ⁴⁰	Engages citizens to find data-driven solutions and community building in the cities. People are encouraged to volunteer their time to create ideas and share their knowledge at a platform where their contributions are acknowledged	Co-diagnostic – citizens contribute problem areas Co-design – citizens contribute new designs Co-selection – citizens participate in selection	Mobile apps Maps Discussion fora Data banks	Collection of first-hand information, involving citizens in identifying relevant themes and solutions, and creating new solutions.	The data is very important and citizens use the gathered information in the creation process of new solutions.	Effective communication and feedback loop needed to citizens and project start-ups formed as a result of Cities of Service Transparency of data

³⁹ <https://marlennescalante.com/portfolios/ride-together/>

⁴⁰ <https://citiesofservice.org/about>

Womenability⁴¹	The purpose is to measure women friendliness of cities based on women's own inputs and propose guidelines for improvement	Co-diagnostic linking to co-design	PC and mobile survey tool	Women-tailored city analysis framework Survey tool Exploratory walks	Structured and themed assessment tool Media coverage – in articles and some posts. Guidelines produced and disseminated	How do we target and engage other groups which, similar to women, may feel that the city is not designed appropriately for them? (Inclusion).
Mijn in Amsterdam⁴²	Mapping use, satisfaction levels and experiences of park users in the Rembrandt park in Amsterdam To feed refurbishment of park in 2020.	Co-diagnostic (of opinions combined with geographical locations in the park) Co-monitoring (crowd-sourcing data)	PC and smartphone app	Survey tool Exploratory walks	Mapping of ways parks are and can be used and of emotions that arise with usage of parks. Promotional content that can be used to increase their attraction	Communication and interaction with citizens to increase the participation of specific groups, e.g., the elderly and other people with specificities.
Bella Mossa⁴³	The purpose is to motivate citizens to change mobility behaviour by offering them incentives and rewards	Co-implementation in terms of motivating citizens to change behaviour Co-monitoring for examining actual behavioural change and most important motivators	Mobile app combining tracking, motion sensing and user interaction with sophisticated server side algorithms that verify activities and characteristics	Offering incentives and engaging in target surveys	Rewards from commercial or public offerings Easy to choose alternative mobility behaviours Easy to use information on the initiative	Limited to smart phone users In this case primarily targeting citizens that commute (mobility)
Parklet & map design tool⁴⁴	The purpose is to support citizens in finding a spot and apply to the authorities for a parklet placement as well as	Co-design (including co-selection of the space to place and set up the Parklet). Co-monitoring the	PC applications for maps and design tools that work on smart phones	Promoting parklet design options and facilitate co-creation using various tools	Design examples Stories from parklet users Stories about co-creation using	Help functions for citizens with special needs to access parklets.

⁴¹ <http://www.womenability.org/>

⁴² <https://mijnpark.environmentalgeography.nl/>

⁴³ <https://www.betterpoints.ltd/blog/tag/bella-mossa/>

⁴⁴ <https://www.streetlife.wien/parklet/>

	supporting design of parklets.	establishments of parklets			various tools	
Air quality mapping ⁴⁵	The purpose is to raise the trustworthiness of air quality measurement locally to influence the city and citizen behaviour	Co-design/selection of clean routes through the city Co-monitoring of air quality developments	Online maps via apps and computer applications	Measuring and mapping air quality across city districts	Creating new and healthier connections between different parts of the city	Increased awareness of (bad) air quality can cause frustration by some due to their inability to move.
The Urban Mine ⁴⁶	The purpose is to provide citizens with an understanding of how they can help reduce waste, repair appliances, reuse, recycle or make use of waste as a resource	Co-design of infrastructure and sustainable eco-systems in cities Co-implementation of more sustainable consumption behaviour	PC and smart phone app	Creating access to sustainable and waste reducing solutions near you. Encouraging citizens to help complete the map or set up what is not there.	Stories of citizens looking up activities that helped them lead sustainable lifestyle	Ways to make use of the scheme to convince more to care for sustainability?
Online contest for 15 vacant lots (Nantes) ⁴⁷	The purpose was to engage citizens in an idea contest for the best possible uses of 15 vacant lots of land in Nantes	Co-diagnostic – in that people express ideas that reflect what they feel they miss in the area Co-design – in that citizens submit ideas to the competition	PC and smart phone app	A competition set up by the municipality requesting ideas for land use from citizens' groups in Nantes.	Making vacant land available for experimentation Have citizens judge the ideas of citizens' organisations	Inclusion – are we getting all on board or just those who are online? What happens to the many ideas that do not qualify?
Lande (showing vacant land) ⁴⁸	Similar to Nantes case but here citizens are given the opportunity to notify of land/vacant slots that seem vacant and can potentially be temporarily used by citizens	Co-diagnostics – finding vacant space for NBS development and identifying interest from nearby citizens Co-design – in terms of selection of space to be developed. Co-monitoring in terms of volume of space being vacated or developed.	Computer application and smartphone app	Identifying on-going projects in vacant spaces or identifying vacant space and making other people aware of it and recruiting help to co-develop it	Interactive and dynamic maps – Photo evidence of spaces that have been exploited by co-implementing with Nature based solutions	Requires help in the administrative process of finding owner and communicating with owner as well as requesting use of the space for certain purposes

⁴⁵ <https://cphsolutionslab.dk/en/news/luftforureningen-i-kobenhavn-er-blevet-kortlagt>

⁴⁶ <https://www.giacimentiurbani.eu/>

⁴⁷ <https://dialoguecitoyen.metropole.nantes.fr/project/15-lieux-a-reinventer-1/presentation/presentation-181>

⁴⁸ <https://landemtl.com/>

***Guideline issues**

The matrix above provides examples of digital enablers with key features, which include guideline issues. These are important and critical aspects that may arise and need to be mitigated in order to guarantee successful citizens engagement, namely in terms of ethics, ranging from privacy, security, deliberate exclusion, and reverse effects such as the risk of reinforcing the stigmatization of a specific area (e.g., App mapping unsafe or risky areas). Ethics, together with human rights and gender, are transversal to all categories of guidelines for successful citizens engagement, with a particular attention to “communication and interaction” and “risks assessment and mitigation measures”. Ethics principles, as defined by URBiNAT, cover both research and participation, legal requirements as established by the European Union and the countries in question, as well as specificities of individuals and groups. As a result, two documents can be referred as also guiding the development and use of digital enablers in URBiNAT:

- the URBiNAT’s Code of Ethics and Conduct, which consists of a set of general ethical principles and procedures to be adopted and endorsed by all those involved in the project’s activities;
- the URBiNAT’s Code of Ethics for Communication and Dissemination, included in its Communication and Dissemination Plan (D6.1), to which all partners in the URBiNAT project are required to adhere.