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Research Finding and Directions Identified by the Smart City 4.0 Sustainable LAB

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Research finding and directions identified by the Smart City 4.0 Sustainable LAB

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This chapter contains 11 writings in which the research directions of the cultural souls belonging to the Smart City 4.0 Sustainable LAB are illustrated from very different disciplinary perspectives. These texts provide a starting point for a sustainable development capable of bringing together all disciplines that deal with cities.

Smart City: the decrepitude of the ideology of innovation. A reflection by Giovanni Leoni



Fig. 4.1. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The subject of the Smart City has not been consolidated and most likely will not be consolidated as a field of scientific research. Maybe it was and is a field of action-research.

But for better or for worse the importance of the Smart City derives above all from its being a project. Like all the most effective projects today, able to branch into the various specialist disciplines and capture the attention of politics, the Smart City is a project of a narrative nature and not a figurative matrix. There is no iconography of the Smart City, only stories.

The structure of the Smart City as a project is very traditional: one speaks of a future city, a better city that does not yet exist but could exist. A topos of the modern project.

As a project, Smart City has: 1) a vision; 2) an articulation in specialisms; 3) an economic structure; 4) a political and communicative dimension.

The vision is elementary and not very innovative if we think of the two centuries that preceded us: technology will improve the quality of life in cities. This task seems to be entrusted to two areas in particular: 1) the management of big data; 2) technologies aimed at reversing the ongoing climate disaster. History shows that the theorem technical innovation = raising the quality of life in cities is not a foregone conclusion, because if we can ascribe quality improvements to technical innovation – or rather to the little control we have exercised over it. – we can also ascribe to it many of the difficulties, if not many of the tragedies, that the Smart City project intends to remedy.

Thus, the fragility of the Smart City project derives from its total reliance on specialised technological innovation without cultivating grounds for sharing and comparing different areas. More precisely, from the inability to develop non-specialised tools, conceptual frameworks, that are able to place limits and measures on the specialised actions of technological innovation that, by their legitimate nature, arise without limit or measure aside from the competitive ability to innovate. The inability to build instruments to control and measure technological innovation then dangerously borders on an unwillingness to set limits and measures if we consider the economic structure of the Smart City project. Because it is clear that, as a powerful vector of the economic dynamics of any action focused on technological innovation, the Smart City project tends to be subordinated to purely financial logics, often getting reduced to a smartwashing narrative.

The only terrain where the Smart City project – with this or any other nom de guerre – seems to be able to acquire meaning and dignity by transforming itself from slogans into concrete actions in the city is perhaps the terrain of politics. One could argue that the subject of the Smart City is no longer missing from most city policy programmes, but its inclusion comes with a choice: 1) politics –

understood as the action of political decision-makers – can continue to avoid responsibility by relying on the technological optimism of the Smart City narrative; 2) politics can take on the role of guiding and calibrating actions of technological innovation, giving them an instrumental role. Choosing the second option has significant implications for vision: 1) it means knowing how to go beyond two centuries of unconditional trust in technological innovation as a guarantee of economic and social improvement; 2) it means finding – also in the field of technological innovation – a mediation between the financial economy and the social economy; 3) it means rethinking the role of specialised knowledge with respect to ethics and public engagement. But above all it means carrying out actions of empowerment, of deliberate self-disempowerment of the institutional political actor and of specialised knowledge – including the now consolidated specialism of participatory processes led by politics – to build uncertain lands not modelled on pre-established narratives or on an imagined future city (and here it must be said that during the pandemic urban imagination as a guide to the real processes of transformation of cities revealed all its fragility and paucity). It is only by creating terrains of uncertainty, fields of listening, of comparison and self-limitation of specialised actors that the smartness of cities can emerge. Returning political action and the action of technological innovation back to the role of acts of service and government of the city that happens, opening up the field of action to creative cultures, to each actor and his or her specific ability to elaborate city cultures. The smartness that will emerge from a serious questioning of the invisible and potential dimension inscribed in the body of cities, in its constant and prevailing happening, will not be a single, universal, bright, future technological image but a site-specific smartness, not a model that is imposed on fixed standards and indices, but the calibrated and measured construction of places built as common goods.



Fig. 4.2. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

**A survey on temporary citizenship for a smartness of potential city.
A reflection by Andrea Borsari**



Fig. 4.3. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The idea of overcoming the uniforming, optimistic and non-specific character of technological innovation by opening up to the uncertainty of the real city as a place to intercept the potential for site-specific transformation, so well set out in the position paper by Giovanni Leoni, finds a possible field of deployment in the research on temporary citizenship that has accompanied the participation of the working group of which we are both part in the broader development of a critical vision of the notion of the smart city. Rather than a general disciplinary call concerning the aesthetics of the city, in this context it may be more useful to point out a specific research project in which different competences fall and which concerns what we have defined as temporary citizenship, that is, the confrontation with a dimension of gap or displacement related to the practices that a series of subjects implement within the urban context and which do not find adequate recognition in the formal definitions of citizenship.

The aim is to reactivate the concept of citizenship in a way that is not just a matter of time, but also a matter of place.

That is to reactivate, in a virtuous way, that dimension of the porous city (porosity is a category used by Walter Benjamin in his time, but recently taken up by Richard Sennett in a re-functionalised key) as a way of intervening in urban contexts to reopen communications and connections where there were none, creating a city that is capable of withstanding and enhancing the overlapping and embedding of different functions and social stratifications, enhancing our historic cities, be they medium, small or large.

This dimension of precariousness is installed precisely where there is a gap between formal and substantial rights, where there is a crisis, as it has been defined, of citizenship based on the erosion of formal status, on the precariousness of access to resources with a tendency to oppose and segment an idea of territorialisation of citizenship, with unequal rights and forms of discrimination. This is the context within which we are developing a research with a working group within the University of Bologna, involving different competences straddling human, social and city sciences, from planning to architectural design, which puts us on the threshold of reflection concerning the

observation of the way in which practices incorporate the not yet explicit directions in which the status of citizenship is stressed - in the sense of subjected to unusual deformation - and integrated. There are a number of research data, including empirical data, that allow us to restore connections within the city. For example, we are working on the forms of temporary residence starting from the observation of the forms of housing of the students in order to redefine the concept of homing itself, also because we come from an experience that saw us subjected to forced confinement. More generally, this is a series of researches that attempt to question the new frontier that continually opens up on the slabbing and the margin between practices and formal recognition, focusing on the dimension of precariousness and temporariness, with the tendency to become definitively temporary, that characterises this situation and that allows us to recover a porous image of the city and its potential reality.



Fig. 4.4. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

**Home as infrastructure: new 'models' for living in the post-covid city.
A reflection by Guya Bertelli and Michele Roda**



Fig. 4.5. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

It sounds like a paradox to connect the concept of 'home' with infrastructure. But, among the many impacts, the pandemic pushes us to radically rethink the topic of living, with wide-ranging consequences that call into question the architecture's traditional boundaries.

In this line 'home' comes out of its singular dimension, enters a logic of complexity and proposes itself in a systemic vision as the 'infrastructure of the future': the physical, social and economic 'backbone' of a country that, in this crisis, has to find the push for strong innovation.

So, 'home' - even more the public one - redeems its own fragility, becoming the key factor in a process that just new design actions can fill with quality.

The concept of 'home-infrastructure' is proposed as an innovative vision able of re-establishing severed ties in the direction of a strong change in consolidated relationships. A plurality of factors contribute to this dimension:

- in the first place, the necessary rethinking of housing environments, so strongly stressed in lock-down periods, which have largely revealed conditions of backwardness and inability to give effective responses to the inhabitants' expectations;
- therefore the requirement to bring the public house back to the center of thought and politics, a condition that claims a today very important jump in scale, capable of reinterpreting the home itself as an integral part of urban fabrics, in a renewed balance among public and private, among opening and closing, among nature and artifact;
- finally, the standing of a gaze oriented towards the most fragile groups of populations, both from an economic point of view and from a socio-cultural one, as the pandemic has exacerbated a dramatic request for adequate and quality social housing.

Starting from this assumption it seems possible - and promising as well - to introduce within the debate the concept of 'house-infrastructure', in a perspective that intends the project of the 'house' - especially the public one - no longer within a submissive and defensive logic, but within an open and projective vision, which looks at it as a generating principle of urban form, integrating within the consolidated habitats, regenerating obsolete areas, building new forms of participation for a

society that think (and will think more and more) the domestic space as a relational place: between city and society, between built spaces and urban connective, between nature and flows. As an infrastructure, in fact.

These issues are urgent and necessary because the pandemic has shown the fragility of living and of 'house', attracting the gaze of many critics who have drawn a dramatic and unexpected condition: "*Here we are, in full pandemic from Covid-19 - all inside the greatest heterotopia ever known [...] - here we are forced to see the rest of the world enclosed in the space of our own home*" (translation by authors).¹ A condition that has pushed an intense debate in architectural culture, from which - even among very different positions - widely shared aspects have emerged:

- the absolute inadequacy of our housing assets in providing coherent responses to the renewed framework of needs;
- the centrality of 'home' in social dynamics, as a factor able of influencing the level of inequalities;
- the suffering of the real estate market, unable to offer, for some sectors of society, appropriate housing solutions, able to respond effectively to a pulverized and fragmented demand, characterized by multiple situations and by countless types of families - ever smaller, Italian or international, locals or 'nomads'.

Starting from these assumptions, it is appropriate, and necessary as well, to outline a new horizon: moving between decline and development means stressing in-between space, where global questions call for local actions and vice-versa, where inertia and resilience are the key-words. From here it is perhaps important to 'start-again'. From those situations signaling their state of vulnerability and weakness: the degraded suburbs of the 'widespread city', the abandoned spaces of post-industrialism, the interstitial areas, the environments 'forgotten' by the most recent planning. In fact, precisely these 'intermediate territories' - marginal places or fragments of a centrality never been completed - are able to inspire, in their being perpetually in a state of potential 'contention', possible opportunities for redemption from a situation of immobility which is already settled. In fact, it is in these marginal places that 'house' can take on a new 'morphogenetic' role since it is able to trigger *«a generative process that acts for local, limited, discrete surroundings, but induces very extensive structural changes. They affect the qualitative contents and not just the quantitative data, regardless of the dimensional scales of the intervention, since they are based on the relational links that exist between the different components of the urban framework and transcribe the polysemic nature of the space»*.² It's a nature capable of introducing not just a relational dimension of the house itself - which in this rediscovered relationship between local and global takes on the new meaning of space 'between' - but also a dynamic vision of a significant node between the permanent condition of 'being within' and the variable condition of 'going outwards', within a continuous dialogue based on mutual correlations and interferences.

In this process, it will be necessary to re-elaborate the distinctive principles of living on the basis of new parameters of coexistence among town and society. Today more than ever, in fact, architecture finds itself the need to recover its social mandate, aimed at understanding, in the unexpected urgency, the boundaries of disciplinary ethics and collective duties. Especially for the public 'house', where the reflection must be even more intense: the dissolution of the public space within the domestic walls, together with the parallel hybridization of the private space, urgently require a rebalance of the internal-external relationship, at the moment in which the 'house' seems to take on an increasingly complex and composite form - 'plural' we could say - not very open to a homologating reduction but oriented towards the multiplication of identities.

¹ Pierluigi NICOLIN, *Architettura in quarantena*, Skira, Milano, 2020.

² Sergio CROTTI, 1991, translated by the authors.

Rather than responding to a series of goals and indicators, the 'home' of the future will have to be articulated on the basis of a complex reaction to some standards, which could be based on five dialectical pairs today strongly involved in the debate on housing:

- Sustainability / Hospitality;
- Creativity / Multifunctionality;
- Accessibility / Connection;
- Security / Inclusion;
- Adaptability / Resilience.

To conclude with the hope of a fertile outcome of the conceptual categories, we could recall various prefigurations over time aimed at exploring spatial hybridization, overcoming conventional compartmentalizations in favor of a multiple relational, communicative and participatory connective and therefore with intrinsically infrastructural requirements. From the often utopian origins in the radically innovative intentions of the layouts (so evident in the daring experiments of the Sixties) to the requests oriented to emancipation from housing shortages, to the impulses aimed at redesigning the boundaries between individual and collective spaces as social places, we can see precious testimonies of the multiple explorations of new frontiers of plural living. In this sense, it could also be argued that the golden age of Italian public housing was an extraordinary example of 'infrastructuring' of those places where today we would like to open a season of regeneration, hand in hand with the commitment to abandoned areas, urban voids, obsolete and degraded places. What seems to gradually distinguish the most recent experiences, however, is a growing awareness of the level of complexity of the inhabited areas (in a physical-social-economic sense), especially in metropolitan areas, which pushes to the research for strategies of high spatial integration, going beyond existing diaphragmatic separations.

The challenge therefore seems very difficult today, since it is aimed at a brief recomposition of the different elements competing in the definition of the concept of 'house-infrastructure', with the hope that the requests, advanced by various parties for more just, green and healthy cities (referring to the recent UN-Habitat dossier) fully involve living, and mainly the 'public house' sector.

But this is still a goal today.

'House-infrastructure' is for now a design vision, a look to the future, an attempt to update - in the face of a changed awareness of living, perhaps still too shaken to assume definitive solutions - principles and paradigms to face the new 'spirit of the time'.

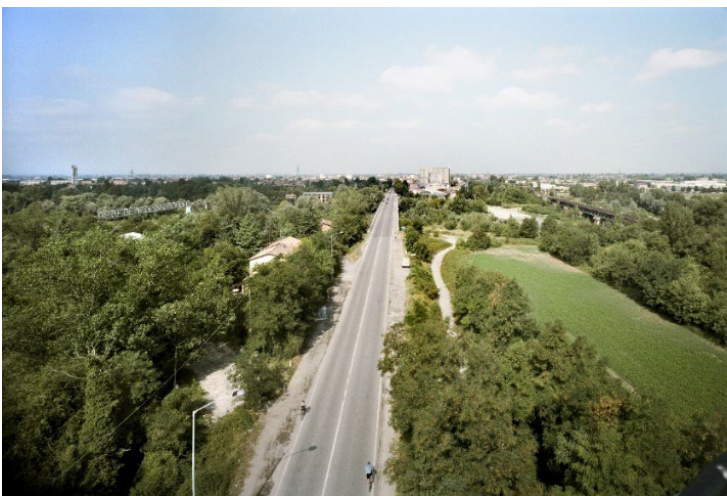


Fig. 4. 6.Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The Seventh Dimension. A reflection by Dario Costi



Fig. 4. 7.Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

I have entitled this paper *The Seventh Dimension* because, as demonstrated by much of the scientific literature in this field, the smart city is always evaluated and estimated through six dimensions³, but in these categories of analysis the city of public spaces, the city of architecture, the city of the physical configuration where the community lives is almost entirely lacking.

Joseph Rykwert told us clearly that in antiquity the idea of the city was represented by monuments and foundation rites that bound people to the city through its built symbols.⁴ Today, what remains of this rite of belonging? What does the idea of the city mean today? It means having physical places that we all recognise as references of our urban identity, of our emotional relational stability. The built city and its architecture are necessary for the city of life.

Stefano Zamagni recalled how the Romans spoke of the perfect combination of *civitas* and *urbs*, that is, between the city of souls and the city of stones, as if they were representations of a dual dimension, that of people and that of space. They are two sides of the same coin, two realities that are continuously intermingled, verified and overlaid. If we imagine returning to the concept of the city of the Romans, we must imagine a co-presence of a physical city and a city of life, of souls, of people. In reality, if we are to address this fundamental theme seriously, we must recognise that in city evaluation systems, which imply a recognition of objective values, this co-presence is reduced to almost nothing.

In a recent study that we carried out⁵, we selected 20 ranking systems for evaluating Smart Cities, from the world scale to the regional scale of Emilia-Romagna, where 183 indexes were identified, derived from 975 indicators that we catalogued and traced back to the 6 dimensions (smart governance, smart living, smart people, smart mobility, smart economy and smart environment). Of

³ FRANCESCO MANFREDI, *Smart Community. Comunità sostenibili e resilienti (Smart Communities. Sustainable and resilient communities)*, Cacucci Editore, Bari 2015

⁴ JOSEPH RYKWERT, *L'idea di città, Antropologia della forma urbana nel mondo antico (The Idea of the City. Anthropology of the Urban Form in the Ancient World)*, 1963, recently republished in Italy by Adelphi Milan, 2002.

⁵ FRANCESCO MANFREDI, DARIO COSTI, *Community Regeneration Masterplan. The Five Dimensions of Sustainability: Guidelines For European Cities*, Springer, Berlin, 2023.

the 975 indicators, only 19 (just 2%) concern architectural, urban design aspects and relate to the quality of public spaces, denoting a major difference with the ancients, who envisaged a symbiosis, a continuous dialogue, estimated at a ratio of 50% *civitas* and 50% *urbs*. This difference points to a cultural, even more than a substantive, problem that arises from an approach that disregards civilisation as a finite place that has contributed to the process described by Bauman⁶, causing communities to liquefy.

The mission is therefore to reconstitute the community around the new possibilities of interconnection capable of triggering those processes of connective democracy mentioned by Derrick De Kerckhove, as well as the processes of re-appropriation of physical space for a new *Right to the City*.⁷

The post-war city is a city that has become progressively peripheralised. It has disintegrated, it has alienated people, it has not enabled them to be together. The city of the future needs to be completely reorganised, reconstructed and reconnected, echoing the thought of Giovanni Maria Flick, who attributes to the city the role of “social formation” envisaged by the Constitution, as an instrument of personal growth, the bridge between the individual and the institutions. The *Right to the City* thus becomes a constitutional right to be claimed in order to demand a better city, a city that creates the conditions for truly integrated social living.

Urban design themes are now more critical than ever. When we think of the city of Zero Land Consumption, Renaturation and Urban Regeneration we have to envisage a city where public spaces can be reconnected through urban parks, intermediate spaces, fragile landscapes, places that can be reclaimed to reconnect the entire great legacy of parks and squares that already exist. Digital technology has certainly made relationships between people more virtual, but the physical city has also greatly increased this dispersal.

I have been discussing the themes of the *City of People 4.0* for some time, drawing on the idea of the City of Man that was connected to Adriano Olivetti’s concept of Community - the concept of overcoming the struggle between the material and spiritual spheres - while also trying to understand how the fourth industrial revolution can be above all a service to the community.⁸

In coining the term *fourth industrial revolution*⁹, Klaus Schwab reminds us that the more we think about the goals we can assign to these tools, the more powerful will be the application of technology and the debate on the *culture of technology*, which has perhaps always been somewhat lacking in the West but is now more essential than ever.

Everything is indeed changing and we must prevent the affirmation of that view of technology described by Emanuele Severino.¹⁰ The prospective scenarios point to a very interesting future. Academics working on autonomous driving remind us that in a few years’ time, perhaps 80 per cent of parking will no longer be necessary, 80 per cent of accidents can be avoided, and pollution will also be reduced by 80 per cent. What I call the 80% LESS rule opens up an important prospect of reclaiming public spaces in the city. We all know that today’s urban voids are largely car parks, spaces designed for a city of cars. Hopefully, these areas can be reclaimed by civilised living and handed back to the people.

Therefore, today we must begin to reflect on how these technologies can not only improve people’s lives but also incentivise, stimulate and bring about an urban regeneration of public spaces as places for a community that can and must be reconnected. So let us imagine a Wise City, the *City of People 4.0*, as a place to consider the reconnection of public spaces, the design of community spaces on the surface level and the creation of the digital infrastructure system at the underground

⁶ Zygmunt BAUMAN, *Modernità liquida (Liquid Modernity)*, Laterza, Bari 2002. An updated perspective is captured in the short interview *Futuro liquido, Società, uomo, politica e filosofia (Liquid Future, Society, Man, Politics and Philosophy)* edited by E. PALESE, Edizioni AlboVersorio, Milan 2014.

⁷ Henri LEFEBVRE, *Il diritto alla città (The Right to the City)*, Marsilio editori, Padua, 1970.

⁸ Adriano OLIVETTI, *Città dell’uomo (City of Man)*, first edition 1960, republished by Edizioni di Comunità, Ivrea, 2015.

⁹ Klaus SCHWAB, *La quarta rivoluzione industriale (The Fourth Industrial Revolution)*, Franco Angeli, Milan, 2016, p.16.

¹⁰ Emanuele SEVERINO, *Il destino della tecnica (The Destiny of Technique)*, Rizzoli, Milano, 2009.

level, in order to harmonise the technologies and architecture of the city, but also to recover the relationship between the city of souls and the city of stone.



Fig. 4.8. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

Smart Small City. A reflection by Gabriele Lelli



Fig. 4.9. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The digital revolution is an opportunity to rethink our cities, cities which talk differently with other urban elements and where real and digital could merge into one single identity. Future urban transformations have to address digital and technological innovations. In urban design, this means rebalancing both urban resources and urban quality of life objectives. Within this framework, the new innovative tools become new design resources, while the redefinition of urban quality remains a fundamental step to realize a contemporary idea of the city with its urban values.

Our work with the Next City Lab group deals with it, conducting applied researches on forthcoming urban issues. Doing applied research, landing ideas and innovations in the physical territory while verifying the results, is the most suitable approach to face this period of sweeping changes and take advantage of the intertwining bonds between real city and digital tools. Just by way of example, using Digital Twin solutions could be interesting if they create applications that improve physical urban space and quality of life. As the Wien Digital Twin platform, realized and used to manage public space and offer a new way to involve their citizens.

There are three main areas to leverage urban transformation processes. Firstly, the electronic devices that have so much contributed to change our lives and our cities. Smartphones, sensors, drones, electric scooters, and self-driving cars, the list is constantly updating.

The second area concerns the behaviors of city users and communities, which generally change urban life without affecting city form. This is an outstanding lever for change, but it must start from the bottom, from local communities, to have the potential to deliver its positive impacts. Only in this way can be created effective smart communities, where blockchain technologies are deployed to generate new economic and social value. The growth of other needs and common goals will slowly contribute to the creation of other urban behaviors.

Finally, the most visible lever for change of our cities, i.e. the infrastructures and the urban form. In this field, the transformations are often designed as minimal interventions on urban fabric to increase urban quality and trigger new synergies, as we can figure out from the many reuse and urban regeneration projects. They tackle public space, roads, bike paths, new urban services, and a

new relationship with the natural environment. All urban dimensions are intertwined with each other to make new synergies. RAISE>UP, a spin-off from the University of Ferrara, aims to find these synergies.

According to this approach, our applied research is focusing outside the largest cities of the Emilia Romagna region, in the sprawled lands of small and mid-sized towns. In these areas, the "building mass" is different from cities making it necessary to explore other strategies to turn them into Smart Towns. Within this process, critical thinking is a key point to design effective solutions with a positive impact on local communities and the environment. Furthermore, we have to consider the territory of small and mid-sized cities as a network of places where their local identity can be valued, preserved, and improved.

In conclusion, urban transformations for small towns, that often are characterized by good living standards, will have as main objective the citizens' quality of life while maintaining their bell tower and local identity. This challenge can be pursued by innovating urban services and the meeting opportunities, which are currently lacking, taking advantage of the new enabling solutions of the current digital revolution.



Fig. 4.10. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

**The city's potential for energy transition.
A reflection by Carlo Alberto Nucci**



Fig. 4.11. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The EU Mission on Climate Neutral and Smart City combines the achievement of climate neutrality with the implementation of the Smart City model. A city today cannot be 'only' smart, it also requires climate neutrality, i.e., the achievement of net zero greenhouse gas emissions. To achieve this double objective, Europe envisages the development of various financial instruments and regulatory interventions, accomplished by using the indications gathered through a bottom-up approach, along with the introduction of a Climate City Contract, ideally signed by national or regional authorities and possibly by the European Commission. A multi-level governance is indeed considered an indispensable element for the success of the Mission. The progressive electrification of consumption in various sectors, favoured by the growing diffusion of generation powered by renewable sources, and the push towards the creation of energy communities envisaged by the RED II and IEM European directives, underline the growing importance that the electricity system will play in this context. A massive use of information and communications technologies (ICT) for power transmission and distribution is necessary to cope with the uncertainty of renewable sources and with the increased complexity of the control and operation of the electricity system. In recent years, an increasing number of small generation units have been connected to the part of the electricity system - the distribution networks, the one close to the end users who are now also able to produce significant quantities of electricity - where only consumption was originally foreseen. The term consumer is therefore often replaced today by the self-explanatory term prosumer. Thanks to the diffusion of ICT, electricity, thermal, gas, and even water supply networks are expected to be managed in a more coordinated way to exploit their synergies: one of the most interesting technical challenges for the Smart City is hence such a smart sectors integration. What briefly outlined above, offers more than one element to justify what has been already argued for some years, namely that the Smart Grid is the first enabler for the implementation of the Smart City concept, especially with reference to energy sustainability, allowing the efficiency improvement of traditional networks and

services for benefit of citizens. The enhanced ICT infrastructure, the increasing development of renewable generation connected to distribution networks, the progressive electrification of some sectors, the availability of smart devices by consumers and prosumers, and the rapid spread of Internet of things are the relevant characteristics of the Smart City.

It is now generally accepted that the climate emergency must be addressed in cities: they cover about 3% of the planet's soil but produce over 70% of all global greenhouse gas emissions. Cities are growing rapidly; in Europe, it is estimated that by 2050 almost 85% of Europeans will live in cities. Cities are also the "laboratory" in which the decarbonisation strategies of energy, transport, buildings, and even industry and agriculture coexist and intersect. As the density of infrastructures and their use is greater in cities than in the countryside, there is also greater potential for intersectoral integration of complex infrastructures to achieve a more general smart grid paradigm. A convincing example of what has just been stated is represented by Energy Communities, formed by citizens' associations, commercial activities or companies for the production and sharing of electricity from renewable sources. They own indeed a significant potential for the accomplishment of the energy transition in our country and represent the core of smart districts, capable of transforming themselves into a so-called Positive Energy Districts.



Fig. 4.12. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

**Into the future with open eyes.
A reflection by Roberto Menozzi**



Fig. 4.13. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The topics discussed in the interviews transcribed here offer a wealth of indications and suggestions that may help us reflect critically on the *smart* and - hopefully but not automatically - *wise*¹¹ future of our cities. In particular, the field of *autonomous drive* and *intelligent mobility* can serve as a paradigm for the several technological transformations encompassed by the *smart city* transition. The first common trait of these ongoing transformations is the synergic *convergence* of a number of technologies - some of them very new, some not so much - on the activities characterizing our lives of social and productive beings (e.g., mobility), aimed at an increase of their efficiency, safety, and sustainability. The key word here is *convergence*: while the relevant technologies are not necessarily novel or revolutionary, what is novel and revolutionary is that they recently came to cooperate in the testbed of our cities raising a sort of *perfect storm* where each of them becomes an enabling and accelerating factor for the others.

The penetration of this variety of new tools aimed at making our activities simpler and more efficient, however, does not come without a price to pay, nor is it risk-free: we should be aware of this price and of these risks lest the *smart city* should become in the end a *smarting city*. In this regard, one of the points most deserving of attention is our progressive and often unwitting waiving of shares of our autonomy, freedom, privacy, and responsibility.

Taking the case of autonomous drive and intelligent mobility as an example - but it would not be hard to find other cases-in-point - a scenario in which vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications allow continuous and pervasive tracking of individual movements should raise - I believe - some Orwellian concern; nor is of little consequence our decision of relinquishing to hardware and software tools - sophisticated as they may be - ethically grounded decisions such as those a driver happens to make, often instinctively, when facing unexpected and dangerous contingencies. This sort of concerns is compounded by another one: technologies that are conceived, developed and deployed with a goal - among others - of increased sustainability, such as

¹¹ "For wisdom is the property of the dead - A something incompatible with life", W. B. Yeats, *Blood and the Moon*. That is to say, being *smart* is easier for us humans than being *wise*.

those concurring to foster more rational and efficient mobility, end up posing themselves new sustainability challenges. For example, we have to consider the problem of upscaling the capacity of the communication and data management infrastructure to accommodate the gigantic amount of V2V and V2I data, as well as the energy demand and environmental impact of the distributed mega-computers and data centers that will control and regulate the large mobility infrastructures.

For these reasons, we should appreciate the value of every opportunity that draws our attention to this kind of cost-benefit analysis.

This vigilant and critical mindset should obviously be far from any kind of obstructionist or luddite temptation, which - on top of being plainly wrong - would be perfectly inane. More than twenty-five centuries ago someone with a keen eye wrote about us: “and now nothing will be restrained from them, which they have imagined to do”¹², thus ringing a very foresighted alarm bell about the dangers of our technological *hybris*.

We nevertheless owe it to ourselves and to the generations to come to cultivate this sense of awareness and vigilance to guide us toward well-balanced and humane choices. The progress of technology is ripe with dangers if it is not paralleled by the progress of our ability to critically evaluate its overall impact on our society, wherein we must strive to be *citizens*, not merely consumers or cogwheels in the productive machine - indispensable as these two roles are.

At the end of the day, our vow can perhaps be summarized paraphrasing the last words of the emperor Hadrian in Marguerite Yourcenar’s novel: *Let us try, if we can, to enter into the future with open eyes.*



Fig. 4.14. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

¹² Gen. 11, 6 (KJV).

ICT as the Enabler of a Virtuous Circle in a Smart City. A reflection by Gianluigi Ferrari



Fig. 4.15. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The cities of the future are expected to be secure, safe and reliable. Smart cities can be defined as “innovative cities that use ICT (Information and Communication Technologies) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that they meet the needs of present and future generations with respect to economic, social, environmental, as well as cultural aspects”.¹³

Digital transformation is crucial to identify the directions that a smart city should follow to shift from being an isolated environment to an intelligent municipality.^{14 15} Let us recall that digital transformation is the final outcome of the digitalization process. In the context of smart cities, the steps towards digital transformation are the following:

- Digitization: process of conversion or coding of information in digital form, so that the same information can be managed by computers. More generally, integration of Information Technology (IT) in everyday tasks.
- Digitalization: use of IT or digital technologies to introduce changes inside the existing processes. IT is the enabler to improve the main activities within the entire value chain. In

¹³ Simon E. BIBRI, John KROGSTIE, *Smart sustainable cities of the future: An extensive interdisciplinary literature review*, *Sustain. Cities Soc.* (2017) 31, 183–212.

¹⁴ Mervi HÄMÄLÄINEN, *A Framework for a Smart City Design: Digital Transformation in the Helsinki Smart City*, in *Entrepreneurship and the Community: A Multidisciplinary Perspective on Creativity, Social Challenges, and Business*; Springer International Publishing: Cham, Switzerland, 2020; pp. 63–86.

¹⁵ Katarina TOMICIC PUPEK, Igor PIHIR, Martina TOMICIC FURJAN, *Smart City Initiatives in the Context of Digital Transformation—Scope, Services and Technologies*, *Management*, 2019, 24, 39–54.

the context of a smart city, the value chain encompasses multiple layers: from single citizens to the entire urban community.

- Digital transformation: implementation of the technological transformation, i.e., the most pervasive phase of the evolution that a smart city has to undertake. It identifies a new way of rethinking of the city, a deep change necessary to exploit fully the opportunities which come from the multiple available technologies.

To make the cities of the future intelligent, the first step is represented by the definition and deployment of a reliable connectivity infrastructure, supported by heterogeneous networking, allowing information exchange in the most flexible way.¹⁶ A smart city should improve the life quality of citizens, e.g., through the use of (Internet of Things (IoT)-oriented (or, more generally, System of Systems (SoS)-oriented) technologies¹⁷, with the final goal of maximizing the efficiency of the offered services. This should also include efforts to make the best use of existing resources (e.g., managing mobility, congestion, pollution, and urban food production) to maximize the safety and security of citizens.¹⁸ ¹⁹Such digital transformation is expected to provide European cities with the ability to interact and support each other efficiently, thus fostering European autonomy at the urban level and paving the way to more secure and safer European urban scenarios. Furthermore, a European effort in developing the technologies needed by a smart city will reduce the dependency on other (non-European) providers. RUGGEDISED is an H2020 EU project where six European cities are joining forces to accelerate the path towards a sustainable future by creating model urban areas²⁰: three cities act as “lighthouse cities” and three cities act as “fellow cities” (one of the fellow cities is Parma).

The Strategic Research and Innovation Agenda (SRIA) 2022²¹ provides a perspective on Electronic Components and Systems (ECS) considering the following layers.

- Foundational technologies: the concept of SoS plays a key role in the development of complex systems, such as a smart city. However, other aspects (such as components, module, system integration and embedded software) are relevant.
- Cross-sectional technologies: most of the aspects of this layer are relevant: (i) artificial intelligence, edge computing and advanced control; (ii) connectivity, as we already mentioned above; (iii) quality, reliability, safety and cybersecurity.
- ECS Key application areas: most of the considered areas apply to a smart city: (i) mobility (vehicle traffic management is always a city’s priority); (ii) energy (an efficient smart grid allows the urban authority to have an accurate real-time overview of the energetic situation and, possibly, an accurate forecast); (iii) health and well-being (citizens need to remain active as much as possible and, if fragile, need to be supported); (iv) agri-food (urban gardens are relying on smart agriculture ideas and applications) and natural resources; (v) digital society.

¹⁶ Laura BELL, Antonio CILFONE, Luca DAVOLI, Gianluigi FERRARI, Paolo ADORNI, Francesco DI NOCERA, Alessandro DALL'OLIO, Cristina PELLEGRINI, Marco MORDACCI, and Enzo BERLOTTI, *IoT-enabled smart sustainable cities: challenges and approaches*, Smart Cities, vol. 3 (2020), no. 3, pp. 1039–1071. DOI: 10.3390/smartcities3030052.

¹⁷ Matthias LEDERER, Juliane KNAPP, Peter SCHOTT, *The digital future has many names—How business process management drives the digital transformation*, in Proceedings of the 2017 6th International Conference on Industrial Technology and Management (ICITM), Cambridge, UK, 7–10 March 2017; pp. 22–26.

¹⁸ Emanuele CRISOSTOMI, Robert SHORTEN, Fabian WIRTH, *Smart Cities: A Golden Age for Control Theory?*, IEEE Technol. Soc. Mag. (2016), 35, 23–24.

¹⁹ Sam MUSA, *Smart Cities—A Road Map for Development* IEEE Potentials (2018), 37, 19–23.

²⁰ H2020 EU Project RUGGEDISED, URL: <https://ruggedised.eu/home/>.

²¹ Strategic Research and Innovation Agenda (SRIA) 2022, available at <https://efecs.eu/publication/download/ecs-sria-2022.pdf>.

Digital society should really be enabled by a smart city, and vice versa. Therefore, we can identify ICT as the enabler of a virtuous circle:

- a smart city supports a digital society, providing to citizens new and effective tools to improve their life quality;
- a digital society allows a smart city to introduce new technologies, which can be effectively exploited by citizens.



Fig. 4.16. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

The role of digital infrastructures. A reflection by Sergio Duretti



Fig. 4.17. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

What is the role and the right impact of digital infrastructure and services in a full development of the potential of a smart city and more in general the whole territory? How can a pervasive and widely distributed infrastructure strengthen or decrease the road for a more sustainable and wiser city and improve a better quality of public, private and nonprofit services?

The indicators detailed in ISO 37120 - Sustainable cities and communities, indicators for city services and quality of life - are the international reference point for sustainable cities with 80 indicators in 19 categories. They can help us to evaluate the general relevance of digital infrastructure to measure smartness and sustainability of a territory.

The analysis shows how 36 indicators in 15 categories are related to digital topics confirming a wide and multidisciplinary coverage. This is true for the economy as well as for energy, for mobility as well as for governance.

The category 18 devoted to Telecommunication indicators points 3 indicators:

- percentage of the city population with access to sufficiently fast broadband as measurement of digital divide of citizens to access to (smart) working, to (distance) education and learning, to (advanced) content platforms;
- percentage of city area under a white zone/dead spot/not covered by telecommunication connectivity as measurement of digital divide of territory;
- percentage of the city area covered by municipally provided Internet connectivity as measurement of public initiatives against digital divide.

Starting from this last indicator in the region Emilia-Romagna, in the first years of the new century, adopted a strategy for a strong public initiative. Using European structural funds in coherence with the Lisbon Strategy launched in 2000, since 2002 was designed and made an optic fiber network for connecting all the Municipality of the region. This network was called Lepida, in honour of ancient Roman consul Marco Emilio Lepido, the builder of Via Emilia. Some numbers give an idea: in december of 2022 the Lepida Network has reached 134,000 Km of fiber optic laid with 5.400 optic fiber access points for connecting public buildings (municipal buildings, libraries, theatres,

museum, hospital, public health centers and laboratories, universities, research center, schools). If the network described reaches the goal of the third indicator, another infrastructure is closely related to the second indicator: a South Radio Backbone is capable of reaching even the most remote areas with adequate performances; it qualifies as a further asset useful to provide solutions against the Digital Divide and management of emergencies with 226 radio transmission sites.

Regarding the first indicator, since 2017 the project EmiliaRomagnaWifi covers areas on the regional territory, with the provision of a free service for citizens in public buildings and places. It provides Ultra Wideband WiFi connection homogeneously and without registration with 10.800 access points, 1 for 408 inhabitants.

Finally 2 others initiatives is running:

- an IoT Network for Public Administration based on LORAWan protocol, is available to both PAs and private citizens, associations, companies, aiming to allow the collection of data from thousands new sensors, placed at their own chosen positions;
- an infrastructure for Industrial Areas, now 90 in the whole region, as provided by a Regional Law, with ultra broadband for companies.

All these assets described are managed by Lepida ScpA, the ICT in-house public company, owned by 442 local public bodies (Region, Municipalities, Universities, Health local public company and other public structures).

It is important underline as final consideration that this “platform” (not only technological bur also organizational, relational, social - in a word cultural) is not a sufficient condition for doing a smart city and territory but is the best way for enabling multidisciplinary ideas and proposal and make them achievable.



Fig. 4.18. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

**Autonomous and connected mobility within the smart city framework.
A reflection by Francesco Leali and Francesco Pasquale**



Fig. 4.19. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

It is fair to say that the more autonomous the vehicles will be from the driver, the more dependent they will become on the city and its digital infrastructure.

The interconnection between CCAM (Cooperative, Connected and Automated Mobility) and infrastructures will grow proportionally with the introduction of driver assistance systems, that are gradually filling the market. Based on a scale that conventionally goes from 0 to 5, where 0 stands for no driving assistance, while 5 represents a completely autonomous driving, at the state of the art it is allowed to circulate on open roads with level, but prototype are testing already at level 5 in confined ODD (Operative Design Domain). The next stage 3 already involves the transition from V2V (vehicle to vehicle) to V2X (vehicle to everything) technologies, thus making the vehicle interact with the surrounding environment.

While in the nineteenth and twentieth centuries the infrastructures of modernity heavily impacted the environment with concrete and steel for the construction of roads, bridges, tunnels and stations, nowadays the data infrastructure for computer science and information technology are largely intangible like the wave frequencies in which they travel. Yet it no longer make sense to split infrastructures in the two categories of tangible and intangible: all the orthodox infrastructures now imply some form of digital equipment and every digital technology will always rely on a physical network and interface devices for its usage.

Overcoming this dichotomy leads to consider an integrated design of triple interactions among human, environmental and technological networks, each of them being digital and physical at the same time. Human networks are all the interpersonal relationships, starting from the family and thus the dwelling, including affections, friendships, work relationships, associations, institutions, etc ... The environmental networks are those that determine the eco-systemic balance of the land, such as green and blue infrastructure, ecological corridors, biospheres and different site-specific naturalistic compound. At last, but first as carbon footprint impact, the technological infrastructure are those typical of the anthropic occupation of land. They primarily concern the management, as production and/or distribution, of energy, water, transport, and waste.

The mobility pattern should better integrate with the other network systems not only from a technological, but also an organic perspective on the city, in terms of a global complexity that exceeds the sum of the single disciplines. Recognizing the primacy of people over machines, *civitas* over *urbs*, the progressive and yet inevitable adoption of technologies based on artificial intelligence will always be subordinated to a scale of socio-cultural values of the community to which they will be proposed. In order to match these values, the information technology underlying autonomous driving should enable three major achievements. The first one undoubtedly concerns inclusiveness, as the process of extending the right to mobility as large as possible to fragile or disabled people. The second one complies with sustainability, as traffic reduction is crucial in terms of both reducing emissions and regulating the discipline of the use of the soil resource. The third goal faces the essential matter of security, in the double meaning of the reliability of an ethical algorithm that would preserve the physical safety of driver, passengers and other road users, and in that of data cybersecurity, a very broad discipline that ranges from privacy to the prevention of hacking.

In the field of civil transport, connected and driverless vehicles available on demand, without not only the costs of the ownership and the maintenance - as already happens today with some financial loans - but also free of the inconvenience of the parking and a garage, could be the key factor for the turnover of mobility models from car-ownership-centred to MaaS (Mobility as a Service), offering a widespread and tailor made transport service for a wider range of people or goods. Innovation will be played out on ongoing processes, crucial for the necessary background knowledge, as well as on new markets for innovative products and services, which will allow to break down further categories such as private/public, individual/ collective transport.

New vectors will change the infrastructure and thus the environment in which they will move, both at the scale of the micro-mobility of the last mile and in the so-called *15 minutes city* models, and in the longer journeys on urban and regional routes, which must be guaranteed and improved precisely in order not to fall back in the epigone of those urban models that generated healthy neighbourhoods on one side and ghettos on the other.



Fig. 4.20. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

**Experiences of integration between driverless vehicles and urban infrastructure: the case study of the MASA open lab - Modena Automotive Smart Area.
A reflection by Marko Bertogna.**



Fig. 4.21..Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo

MASA's mission is to prototype the technologies for the mobility of the future, which are largely linked to information technology, artificial intelligence, computer science and computer vision, vehicle/man, vehicle/machine and vehicle/infrastructure communication technologies, as incremental process of enabling equipment not only for mobility, but for all the smart city realms. The open lab operates in the real context of a city area, testing level 5 autonomous driving applications on different types of vehicles, ranging from racing cars to small drones or delivery bots. In fact, while the technological avantgarde is still challenged in the racing compartment, the technological transfers will affect multiple vectors for urban mobility.

In terms of urban infrastructure, along the test routes of the area have been installed multiple intelligent cameras, with integrated chips on which algorithms have been written, in order to detect obstacles and other road users. Due to a deep respect towards privacy issues of images and all the provisions related to the GDPR legislation, the technology chosen is of the *on the edge* type, i.e. without remote communication as the data is encrypted by the camera itself before being sent. The possibility of real applications is linked to the time in which it is possible to carry out the transmission and processing the data, thus constituting a key factor in guaranteeing a safe and smooth running: to date MASA is the only research centre that can certify an operational time less than 100 milliseconds.

Although the current applications of autonomous driving are of an exclusively experimental step, the technological goal for commercial use is not far as it might look, given the continuous progress in the field of artificial intelligence and neural networks that govern data, and consequently by that the vehicles. Obviously, however thin the margin of error still exists, its resolution remains the constraint for the homologation and the mass production of driving assistance systems of a higher level than 2.

Assuming that it is therefore only a matter of time, the adoption of these technologies will have a disruptive effect on the urban landscape, comparable to that of the car itself, which has shaped most

modern cities. Architects and landscapers, who have the task to imagine urban structures for the next decades, will take the challenge to integrate the innovations of mobility in the larger frame of the city.



Fig. 4.22. Lungo la Via Emilia (Along the Via Emilia) © Photo Alessandra Chemollo