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POSSIBLE AND PREFERABLE SCENARIOS OF A SUSTAINABLE FUTURE

TOWARDS 2030 AND BEYOND

edited by
Cesare Sposito

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5

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PROJECT INTO THE FUTURE
Introductory essay on the topic

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This volume entitled 'Possible and Preferable Scenarios of a Sustainable Future – Towards 2030 and Beyond' is a collection of essays and researches dealing with a subject of sustained interest for the Academy and the craft and industry worlds. Investigating the future is an established practice for the academy and the world of crafts and industry. From the Chicago Columbian Exhibition of 1893 to the two Worlds Fairs of New York City (1939 and 1965) and so on, the future has been foreseen as filled with technology and amazing architecture. Not every vision of the future has described promising scenarios: the dystopian novel by George Orwell entitled Nineteen Eighty-Four, published in 1949, looked 35 years ahead, painting an anything but reassuring picture of the future. We have entered the third decade of the new millennium, and we must certainly reflect on the objectives we had set for 2020 and on the results we have achieved.

However, project into the future (pro-jàcere, from Latin, jump forward), explore and imagine how your life will change, boosted by human ingenuity and with the support of science, is in the human nature. The four visions of the future proposed by Norman Henchey (1978) conceptualized in classes – 'possible' (any future), 'plausible' (future that makes sense), 'probable' (highly likely to happen), 'preferable' (the best that could happen) – have been brilliantly described in the 'Futures Cone' reinterpreted by Joseph Voros (2003). As we move away from the present, the 'possible' tends to 'preferable' due to the lack of elements and data on which to base the programming and the planning: in fact, the certainty on the type of technologies and production methods that will be available, on the social structure and user uses, and so on decreases.

By 2030, the world will already be different: Thomas L. Friedman (2016) highlights that the three main forces of our Planet – Moore's Law (technology), the Market (globalization) and Mother Nature (climate change and biodiversity loss) – are all pressing at the same time, with inevitable consequences for the territory, cities, architecture, products and services that will be designed, developed and used in the future. The 17 2030 Sustainable Development Goals presented by the United Nations provide an answer for this time horizon, tracing the path towards a model to achieve a better and more sustainable future for everyone. But will these Goals be able to accelerate sustainable innovation? However, it is clear that how the future of our planet,

its landscapes, cities, architecture and consumer products will mostly depend on the decisions we make today, on our level of 'vision' and on how we will deal with the subject of sustainability with respect to the aforementioned Goals. Going beyond 2030, imagining 2050, we will certainly have to deal with a population growth that will reach ten billion people, of which 75% will be living in cities and urban areas (United Nations, 2019); therefore, the cities of the future will become crucial metropolises for the sustainability of the whole Planet. In the meantime, the academic, crafts and industry worlds are raising a series of questions.

Will we be able to promote the sustainable use of Earth ecosystems in the territories, to sustainably manage forests, fight desertification and stop biodiversity loss? How will the principles of circular economy have an impact on the design concept of the city, the architecture and consumer products? How will our cities change? Will they be more inclusive, smart, ecological, sustainable? Will they correspond to Carlo Ratti's vision of 'senseable cities', namely, will they be more human, sensitive, capable of 'sensing' through digital sensors and of meeting citizens' needs? Will they have a higher density and a vertical development to reduce land use? Will they be hyper-connected, efficient and less chaotic? Will we ever be able to handle the use of the resources in the cities with the regenerative ability of the ecosystem? Will we be able to significantly shift, at all levels, from urban to architectural, towards an ecological and smart management of water resources, in a circular and systemic perspective aimed at reducing consumption, introducing advanced and integrated ways of collection and purification, to reuse gray and rainwater in buildings and outdoor spaces? Will infrastructures, means of transport, roads, parking lots and green areas be influenced and deeply changed by the evolution of sustainable and/or autonomous mobility? Will green and blue infrastructure networks be implemented in our cities and territories? Will the use of green in cities be enhanced in its multifunctional value and in its ecosystem services supply? Will the outdoor areas be greener, public and 'people-friendly', safe and characterized by nature-based solutions?

The mixité of functions and uses will condition the creation and design of architecture, building types, outdoor spaces, urban design, with vertical 'neighbourhoods' of dwellings, offices, various services, commerces and entertainment to reduce mobility and travel times? Will the new buildings be, throughout their life cycle, zero-energy and zero-impact, green, smart, connected, resilient, adaptive, capable of optimizing the resource consumption and self-producing with renewable sources the energy necessary for their functions? Will we be able to deeply mark in the design, construction, maintenance and management of the built environment the awareness of the need to shift towards the reuse, recovery and recycling at different levels? Will we be able to make a deep renovation, also from an energy and ecological point of view, the existing building and to project it into the future? Will the implementation of 'enabling technologies' of Industry 4.0 (artificial intelligence, machine learning, virtual and augmented reality, robotics, etc.) have a significant impact on the innova-

tion of sustainable Living and consumer products, stimulating a new intelligence on 'common responsibilities'? Will the contamination of knowledge, creativity, startups, open source and future crafts speed up the change of the artificial world to build a more sustainable future for our planet? Will the digital and parametric manufacturing be able to improve the quality of the built environment, cutting down costs and time of production, for example, allowing the self-production and customization of a sustainable house and consumer products affordable for everyone? Will we be able to create our buildings and consumer products with (fully) recycled and recyclable materials? How will the innovation of smart, bio and nano-structured materials influence our life? Will the digital devices be increasingly integrated up to become 'wearable'? Will they favour a better quality of life? Will resilient societies and inclusive communities allow everyone access to services and economic opportunities? Will the services be more customizable, efficient, flexible and decentralized?

Paraphrasing Luciano Floridi, philosopher of Information and Technology at the University of Oxford, we ask ourselves if 'green' (of natural and artificial environments) and 'blue' (of science, technology and therefore the digital world) will succeed to guide a vision of the future capable of replacing 'things' (objects) with 'relationships', 'individual planning' with 'common planning', the 'experience economy' (and not consumption) with a 'policy of care and relationships' (and not production). Moreover, will we be able to anticipate the impact that these technologies will have on us and the environment around us, guiding the 'fourth revolution' – deeply linked to the role of digital technology in our lives, having the 'infosphere' at its core (the space of information of the digital era that concerns every aspect of our lives) – to overcome the distinction between real and virtual, always connected to the network, in a word 'onlife', while significantly improve our quality of life and ecosystem? How will customs and traditions, our way of living, working, producing, studying, consuming and socializing change? How will public and private health change, also in relation to the lesson we are still learning from Covid-19 pandemic emergency? How will the forms of living change with respect to emerging 'remote' modes, workplaces with smart working and co-working, learning environments with smart teaching and e-learning, business venues with e-commerce, etc.? How and with what tools and methods will we be able to safeguard, enhance and enjoy our landscape, cultural, architectural, and archaeological heritage? Will we be able to promote a territory through the virtualization of its cultural heritage and local traditions by uploading them online as a common asset for citizens and visitors?

The 15 published papers deal with only some points of this broad subject, open to many variations. They are food for thought and give good practices capable of contributing to the international research and debate. The volume opens with a critique analysis of the most renown scholars and architects that lately have written for, mainly Italian, press and websites on the relationship between architecture, cities and the pandemic emergency, highlighting critical issues and solutions for the future from

different perspectives. Sometimes these opposite concepts converge on the necessity of transforming the crisis into opportunities for urban renewal at every scale (from domestic to public spaces, workplaces, health facilities, technological networks or transport systems). By using strategies – different in nature and goals – in a renewed relationship between rural and urban, this might be the perfect opportunity to balance spaces and relationships, smooth out social and economic inequalities and ensure a more sustainable life.

In the Architecture section, Resilience seems the key to project toward a sustainable future. Through new community forms – generated by the current pandemic crisis – stimulating the creation of new innovative social and planning strategies and practices. These include the Hybrid Communities of Place, 'cultivated in the digital space', capable of building enabling ecosystems, whose resilience is due to innovative forms of urban and architectural transformation. They include public residential districts where there are multiple levels of flexible sociocultural, typological-spatial and technical-environmental complexity, not only with respect to the reversibility or transformability of the proposed design solution, but in relation to the ability to interpret the different opportunities and potentials offered by each context, its values and reasons in relation to the moment of its creation. Through new interpretations of the concept of resilience applied to cultural heritage, detectable in Italy through the transformations occurred in historical urban areas and the role acquired by artisan and manufacturing activities in the applied arts, two specific and different events contribute to new economic paradigms. With the opportunities given by the digitization and dematerialization of processes, these paradigms can, on the one hand, boost economy and corporate assets of small and medium-sized companies, and on the other, promote unexpected scenarios capable of making the cultural characteristics of heritage more accessible and resilient.

Through new possible paradigms of urban regeneration – scalable processes, adaptable to realities with different (small) sizes and qualitative characteristics – in which the project loses its self-referentiality and, by assuming the role of coordinator with a 'sociological' mark, it can promote a cross-disciplinary process aimed at determining a model for the re-appropriation of smaller towns and villages, having a strong declared identity often not enhanced, and (in some cases) of the suburbs – often characterized by marginalization and deterioration. This has a double objective: the up-cycling/refunctionalization of the building heritage and the requalification/regeneration of open/public spaces for social sharing. Furthermore, through a proposal for the integration of digital tools (such as BIM and GIS), having an adequately structured data collection and processing methodology, the integration would allow, on the one hand, both the monitoring and management of the building heritage and the urban planning according to principles of sustainability, and on the other, to return to the man-made environment as dynamic inter-scalar model with in-depth information and with elements currently difficult to compare.

A study focuses on the relationship between adaptation and mitigation in the different dimensions (temporal, spatial, economic, political, psychological, social and design) aiming to highlight its existing or potential connections, in the perspective of a systemic, cross-disciplinary and multi-scalar design approach, capable of integrating the benefits in the imperative issues of global warming, measuring and evaluating the effectiveness of the two strategies by using concepts and enabling technologies consolidated in 'smart urban metabolism' to provide a relevant contribution to the ecological transition project and to favour a more effective reduction of material and energy flows in urban areas. Robust Design and Combinatorial Architecture are proposed as approaches to mitigate and modulate the contrast between visions and objectives of the 2030 Agenda for Smart Cities. They are developed through a decision tool and heuristic device, assisting the decision-makers in fixing the priorities related to urban morphology, architectural design, functional, technological, or engineering problem; the proposal is a method in which quantitative – predictable – and uncertain qualitative intangible and variable parameters (i.e., social, physical, sensorial, cultural, and economic) lead to a structural adaptation, emphasising the concept of formal adaptation to include the intangible aspects to mediate between the desires of the community in a specific moment and a long-term planning.

Another essay deals with a critical interpretation of the sustainability concept and the evolution of flexibility through different approaches created over time. They have defined, at a methodological level, the connection between the requirements for the sustainable project and, at an operational level, the actions taking place at the building and the public open space scales. The requirements are applied in design projects aiming to reach a comparison, on different scales, among physical elements and users, by acting not only in a spatial-three-dimensional sense but also in a metabolic and physiological sense, by enhancing and improving the psychophysical relationships between the environment – lit, with noises, spatial, biological, social – and people. A contribution on open spaces – mentioning the case study on the area surrounding Tiberius Bridge in Rimini – selects the project as a tool to transfer a structured knowledge capable of working with the social fabric, interpreting intangible demands and responding to the needs of the community that lives there. The space, 'open' to the different interpretations of its uses, can stimulate the sense of belonging to a community and expressing the values of an ever-evolving society. Moreover, it collaborates to create a truly lived-in place, therefore safe and active in the improvement of the quality of life of the community. According to this vision, it is not attractive because of scenic elements or devices added in it, but because of interventions aimed at making the place welcoming, respecting the local environmental values and restoring the relationship between park and city, showing possible freedoms where the functional aspect is overshadowed by the awareness of what the place can offer.

With respect to the development of technical solutions to increase the performance of building envelopes, in response to the stresses due to climate change, an experi-

mental research (currently developed at the Building Future Lab of the 'Mediterranea' University of Reggio Calabria) identifies a design methodology based on adaptive design techniques. These can dynamically answer reference contextual conditions, imagining working methods based on building dynamic simulation scenarios. Their goal is to create a highly adaptable model that can be used as a component for evolved envelopes to smartly and systemically manage the effects of climate variables and, at the same time, satisfy a wide range of needs. Energy accessibility, determined by low family incomes, high energy costs and low energy efficiency of housing, is the subject of a research investigating strategies that can favour it, in the long term and in the urban context of Eastern Europe, by adopting measures for the energy efficiency of multi-storey residential apartments, with the emphasis on achieving the optimal ratio between energy savings and financial resources used for the renovated houses.

The Design section includes essays and research on New Anthropocene, ethics, territorial design and networking, and digital manufacturing. In particular, the first essay proposes a new vision on design, compared to the one that has characterized it in recent decades, which has become a sort of magical glaze to make goods attractive rather than project size useful for facing the challenges of our time. The author recognizes the need to shift from the Paleo-Anthropocene in which we live – predatory and truly unsustainable – to a Neo-Anthropocene – socially and ecologically sustainable – where design, urban planning and all project disciplines should converge to create a Future City, an Augmented City, open, intelligent, sensitive, creative and fluid, characterized by empathy, the ability to design for and with people, for a better world. In relation to the liability system that revolves around man to alter and modify the landscape that surrounds them, a second contribution highlights the relationships between ethics and design, raising new issues that, untied from the rigid logic of the academic world, contribute to outlining a generative matrix of thought useful to provide elements for an interpretative exploration of the transversal aspects related to the taxonomy of design.

Overcoming the physical and digital distance – which has characterized this last year because of the pandemic – is the subject of the essay presenting considerations on a new innovative society (Society 5.0). In this society the companies are part of a complex relation system that can boost the creation of new sustainable and interconnected production chains (territorial design and networking), based on relational paradigms where the IoT, new methods and tools (the result of cross-fertilization and a cross-disciplinary or transdisciplinary approach) combine different, sometimes distant, scientific sectors and harmonize cultural, social, economic and political elements. The volume ends with a case study on digital manufacturing of street furniture elements marked by a participatory and interactive process, capable of satisfying social needs and preferences of a specific group of users in a context where this production method is little known and used. Modularity and stratification become the unifying element of the building language that does not follow a specific predetermined pattern but that is defined by the suggestive ac-

tivity that must be carried out. The modularity of the components is not guided by a predetermined aesthetic but is moderately free to flow, expand, aggregate and generate.

In conclusion, we agree with Fabrizio Tucci (2020) who, in the editorial of volume 8 (2020) of Agathón journal, argues that a vision of the sustainable future of living, by looking at the two time horizons of 2030 and 2050, will be played on an increasingly synergistic work aimed at providing answers to the ten main macro-questions: 1) ecological transition and increase in environmental quality; 2) transition to the green economy and effectiveness and circularity in the use of resources; 3) mitigation and adaptation to climate change, towards total carbon neutrality; 4) bioclimatic, energy efficiency and renewable sources, towards the model of positive energy cities; 5) progressive reduction of land use, towards the 'zero land use' model; 6) dialectic between globalization and glocalization; 7) digital transition, enabling technologies and opportunities linked to Data Science systems and to Industry 4.0; 8) interaction of the most advanced and diversified expertizes with increasingly smart communities, to share and include; 9) 'polychrysis' challenges originating from the pandemic and the threat of future pandemic forms; 10) innovation of ways and spaces of living, working, studying, producing, consuming and socializing, in a synergic and transversal interface 'with' and 'between' all the previous macro-issues. These ten subjects, approaches and visions must be considered as actions of a strategic ever-evolving project that concur in synergically and systemically defining the scenarios that can allow us to create a built environment and a more desirable and sustainable future for ourselves and for future generations.

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VOICES FROM LOCKDOWN ON FUTURE CITIES
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ABSTRACT
Throughout history, epidemics have often generated advances in architecture and urban development. Today, Covid-19 has questioned housing by undermining the certainties of modern culture. The pandemic has forced us to slow down the pace and change our priorities: private and public spaces have revealed their shortcomings, both in quantity and quality. The paper listens to the voices that have appeared in the press and on websites in recent months on the relationship between architecture, city, and Coronavirus, intersecting critical issues and proposals for the future from different perspectives. The visions are sometimes opposed but often converge on the need for urban renewal at every scale. Following the sociologist Sennet, it could represent an unmissable opportunity to rebalance spaces and relationships, smooth out social and economic inequalities and guarantee a more sustainable existence for all.

KEYWORDS
coronavirus, city of the future, post-pandemic home, guidelines, debate

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Throughout history, epidemics have often generated advances in architecture and urban development as inevitable responses to changing human needs and new hygienic requirements (Colomina, 2019). Houses and cities have adapted and shaped their forms and functions as a result of infectious or bacteriological diseases that have affected our communities (Pareti, 2020). On several occasions, the health emergency has proved to be an extraordinary opportunity for intervention, improvements, and modernization of living and public spaces (Jensen Carr, 2014). This transformative power results from the fact that contagious and ubiquitous illnesses have always indifferently afflicted and touched all social strata of the population, forcing the entire world to recalibrate needs and priorities. In a lecture given in 1993 on the transformation of urban space from the Middle Ages to the Renaissance, the famous architect Giancarlo de Carlo recalled how one of the first rules established in the modern era was «[…] che le strade debbano essere più larghe, per consentire la ventilazione trasversale, e pavimentate, perché la mota facilita il trasmettersi delle malattie, in particolare la peste, il flagello che aveva profondamente coinvolto e scosso tutti gli esseri umani» (Tuscano, 2019, p. 105). The urban transformation of Paris made by Haussmann's administration was a famous and significant project aimed at controlling the lack of hygiene, but especially cholera that had devastated the city on several occasions in the first half of the 19th century (Orazi, 2020). The measures that led to the metamorphosis of the French capital touched heterogeneous spheres, affecting the urban context (road network, green areas, etc.), infrastructures (sewage, electricity and water systems), but also the home environment (ventilation, layout planning, etc.). The same pathology was also behind the famous 'sventramento' of Naples carried out by the Depretis government thanks to the 1885 Law for the Rehabilitation (Alisio, 1981). But at the end of the 19th century, tuberculosis also triggered a reflection on the need for more hygienic spaces, prompting architects to improve ventilation and the water system, as well as to reduce dust by removing the overabundance of curtains and carpets in favour of white walls (Teyssot, 1987).

As Beatriz Colomina has stated, «[…] l'architettura moderna ha più che altro a che fare con la difesa della salute» (Rodriguez Martinez, 2020). The Spanish flu, often considered to be the last great pandemic, somehow influenced the hygiene reform of the 1920s, implicitly dictating the rules of the clean, essential and antiseptic rationalist home. Similarly, the Covid-19 has questioned housing by undermining the certainties of modern culture and forcing us to slow down our pace and adjust our priorities. Private and public spaces have revealed their shortcomings, both in quantity and quality. And so, press – specialized magazines or widely circulated newspapers – websites and social networks all over the world have generated a lively debate involving architects, designers, urban planners, sociologists, philosophers, etc, second only to that of doctors, virologists and epidemiologists (Fig. 1).

From activities carried out by the Corriere della Sera (Cambiare la città? Dialoghi sulla vita, l'ambiente, la letteratura e l'architettura dopo il Coronavirus, 29/05/2020)

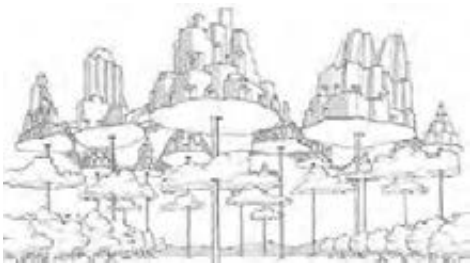


Fig. 1 | A virus-proof city (source: www.lastampa.it; B. Camerana, 2020).

Fig. 2 | Dining between balconies (source: www.ilrestodelcarlino.it, 2020).

to the Observatory on the Coronavirus emergency realized by the Fondazione Innovazione Urbana in Bologna, from the numerous surveys accomplished by Il Giornale dell'Architettura to the set-up of the multidisciplinary online platform DOPO (Design Oriented Postpandemic Opportunities) or the architettiperilfuturo.it – inaugurated with a 24-hour marathon of thematic events – the considerations on the living environments in Covid-19 emergency times have inevitably shone a light to the inequalities and vulnerabilities of today's society (Chipperfield, 2020), rekindling the spotlight on the housing issues. The analysis focuses on debates about the impact of health emergency on our daily lives, paying particular attention to the domestic and urban environment in Covid times, deliberately omitting other spaces such as work and care ones. The study of the views taken by the many actors of the urban transformation process will allow us to identify the current limits and future outlooks of the contemporary city. The critical re-reading of these topics will bring out convergences and oppositions resulting from different geographical and cultural contexts.

Living the pandemic | Perhaps, most of all, the pandemic has undermined current housing models that have proved inadequate to face the sudden changes imposed by the emergency. The need to overturn consolidated design schemes and invent new ones has triggered an intense multidisciplinary debate, including not only architectural, construction and design issues, but also technological, biological, psychological ones (Biolchini and D'Ambrosio, 2020). This unexpected 'domestic cult' arising from the confinement (Di Caro, 2020a), has revealed the inadequacy of our 'performing' townhouses – characterized by small sizes and minimal or sometimes non-existent open spaces of relevance (Magnago Lampugnani, 2020) – increasingly experienced as hotels rather than shelters (Lambertucci, 2020). As Carlo Sini, one of the greatest Italian philosophers, observes, the lockdown has offered new perceptions of our everyday spaces: these rooms sometimes unknown, which we often cross without experiencing them because in the throes of our 'runs and chases without rest', reveal their 'suffocating repetitiveness' (Sini and Bonalume, 2020).

The inclusion of new functions, such as work, learning and social relations, according to the sociologist Giovanni Semi (2020), has contributed to breaking down all boundaries of privacy, leading to the progressive 'publicizing of the private' and 'privatization of the public', already advocated in the 1960s by the German philosopher and political scientist Hanna Arendt (1964). According to Massimo Cacciari (Mirenzi, 2020), 'In these situations, the house is a hell'. Also, the psychologist Francesca Pazzaglia, director of the Master's degree in Psychology of Architecture and Environment at the University of Padua, attributes the smart working-related 'cognitive displacement' to the overcrowding of the rooms and their overlapping of uses. That reduces efficiency, attention and ability to react, creating a continuous flow in which it is difficult to mark spaces and times (Di Caro, 2020a; Fig. 2).

The new functions that have been suddenly assigned to the home, have transformed it into a 'virtual stage' on which the life of its residents takes place, through a game of connections and reciprocity with the outside world (Ruzzon, 2020). Therefore, according to the master of contemporary design Michele De Lucchi, the new house should be 'scraped' from what makes it stable and immovable and assimilated to an installation with elements that can be assembled and disassembled, like stores or shop windows (Di Caro, 2020b). Even the architect Massimo Pica Ciamarra (2020) states that greater compositional freedom and an optimal systems layout, to be relegated to the perimeter of the building, would guarantee our 'digital society' adaptable spaces able to ensuring sharing and, if necessary, isolation. Besides, an appropriate raising of the minimum surfaces of housing, sometimes very small particulary in some big cities, would allow everyone, especially the most vulnerable social groups, decent living conditions. And the French architect Jean Nouvel had already demonstrated it in the 1980s in Nîmes by designing a popular neighbourhood with spaces well above current standards (Suigo, 2020). But, as the Neapolitan designer underlines, in addi-

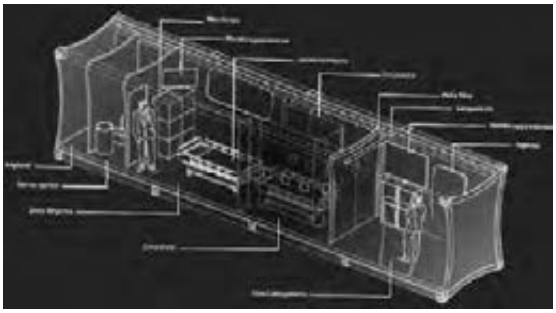


Fig. 3 | The Future Home by Archea and Fuksas, 2020 (source: www.ansa.it, 2020).

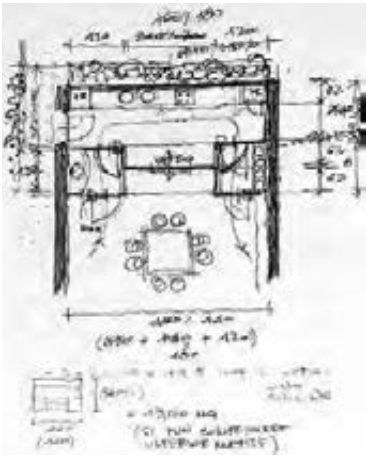
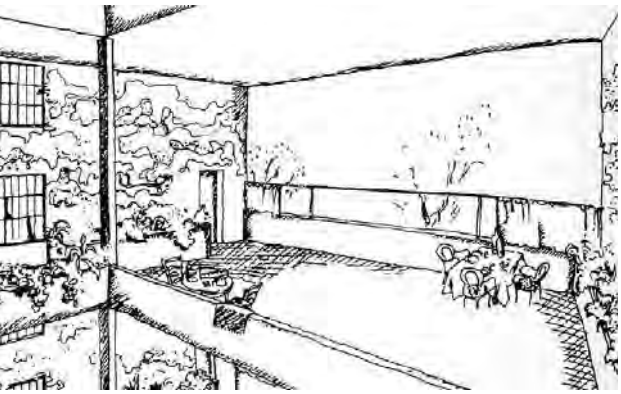


Fig. 4 | Covid-kitchen (credit: Fiorino, 2020).



tion to the quantitative aspects, it would be necessary to consider the qualitative ones, including parameters of structural, constructive and plant eco-compatibility (Pica Ciamarra, 2020).

These criteria, moreover widely shared, also converge in the Guidelines developed during the emergency by the famous Italian architectural firms Fuksas and Archea and even sent to the Italian President Sergio Mattarella as a request for reflection on the new requirements of living (Maciocchi, 2020). The recommendations for the design of new less isolated and safer pandemic habitats, developed with the advice of an international multidisciplinary team, include the use of new technologies but also the recovery of old habits (Fig. 3). The aeration systems with automatic open-air changes are flanked by natural ventilation ones (Lambertucci, 2020), while the need for a connecting space between inside and outside leads back to the tradition of the vestibule of the ancient Roman Domus or the genkan, typical antechamber of the Japanese dwelling (Fiorino, 2020). In the post-pandemic house of Fuksas and his colleagues (Lambertucci, 2020), therefore, the entrance hall becomes a precious and fundamental area where storing objects (shoes, clothing, masks), but also placing devices to sanitize (hand basin, lamps for ultraviolet ray) and medical instruments for the remote diagnosis (pressure gauge, pulse oximeter).

And other distribution spaces, gradually eliminated from our homes in the name of surfaces optimization and on the basis of increasingly stringent market logic, are also back in vogue. The corridor, dating back to the 19th century, defined by Rumiz (2020a, 2020b) in his quarantine diary as the new ‘empty place’, today could satisfy the needs of privacy and constitute ‘a modern sorting center’ among other spaces overloaded with functions (Marcante and Testa, 2020). The service rooms would also be susceptible to renovation: if liquid crystal screens in the kitchen (Fig. 4) could trigger a visual connection with the rest of the family (Fiorino, 2020), the ‘fragmentation’ of the bathrooms would allow its simultaneous use by more people (Ferri, 2020). The living room continues to be the undisputed fulcrum of the dwelling: the multifunction-

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Fig. 5 | Immeuble-villas by Le Corbusier, 1922 (source: www.ilgiornaledellarchitettura.com, 2020).

Fig. 6 | Nemausus by Jean Nouvel in Nîmes, 1985-87 (source: www.jeannouvel.com, 2020).

Fig. 7 | Renewal of a building in Bordeaux by Lacaton & Vassal (source: www.lacatonvassal.com, 2019).

al place where it is possible to gather or isolate oneself, thanks to new technologies and special modular and removable furnishings, that allow different uses, even contemporary, of the same environment (Fiorino, 2020).

In the long months of confinement, even the 'borders' of our homes, representing an alternative to the virtual sociality and allowing the search for real relationships, have assumed renewed importance (Fusco and Saitto, 2016; Fig. 5). The threshold, as Agostino Bossi already predicted in 2016, from simple «[…] piano di calpestio matericamente differenziato interposto tra la pavimentazione di due spazi comunicanti tra loro [si è trasformata nel] luogo dove s'incontrano e interagiscono spazi abitativi, punti di vista, stati d'animo, aspettative, sentimenti» (Bassanelli, 2020b, p. 49). The windows, like telescopes oriented towards the horizon, (Fiorino, 2020), have constituted privileged observation points and with their sills, sometimes transformed into seats or small gardens, they seem to have renewed the concept of 'furnished window' conceived by Giò Ponti in the 1950s (Fiorino, 2020; Arditi and Serrato, 1994). Terraces and balconies, safe floating microcosms, have been at the same time symbol of privacy and connection with the world, representing a sort of 'hand outstretched towards others', as the French philosopher Paquot states (2020; Origoni and Origoni, 2020).

The presence of spaces projecting outwards has shown that they could have a deep impact on the life quality of the inhabitants, especially the elderly and children (Mello 2020b). And this issue, already subject of reflection in the past – as shown, among others, by the experiences of Jean Nouvel in Nîmes (Fig. 6), who had granted public apartments a double view and terraces (Suigo, 2020); or architects Lacaton & Vassal in Bordeaux (Fig. 7), who renovated an old post-war building by removing the original facades and adding a layer of balconies and winter gardens to ensure air, light and greenery (Bassanelli, 2020b) – has become today still more current (Bassanelli, 2020a). In light of what has happened the provision of open spaces, preferably with shape and size that allow them to be livable, appears to be an essential requirement for post-pandemic housing. And that could also constitute an opportunity to renew the re-

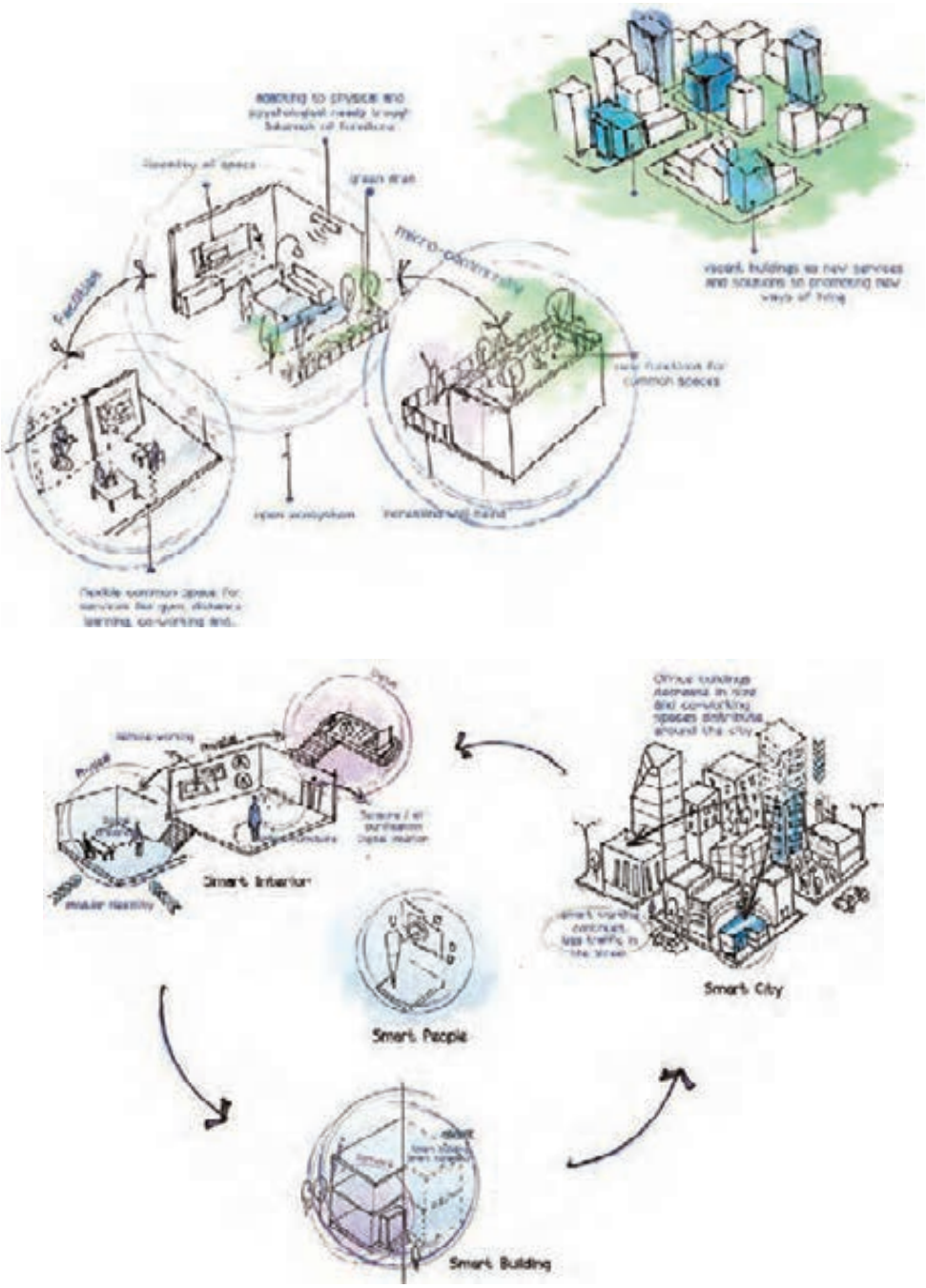

Fig. 8 | 'Living' according to Matteo Fantoni Studio (source: thedesign.tech/it/, 2020).

Fig. 9 | 'Workplace' according to DEGW/Lombardini22 (source: thedesign.tech/it/, 2020).

Figg. 10, 11 | Feel Up Town in Milan by Sio Engineering and Labics (source: www.impresarusconi.it, 2020).

Fig. 12 | Milan Tower by Studio Beretta Associati (source: www.impresarusconi.it, 2020).

lationship with nature, thanks to condominium gardens on the roof or greenhouses on the terraces (Spremberg and Ferrari, 2020). But perhaps, today more than inventing new forms, it would be enough to rediscover the traditional ones, already characterized by a certain continuity between inside and outside, as Giò Ponti underlined in 1928: «[…] Nella casa all'italiana non vi è grande distinzione di architettura fra esterno ed interno: altrove vi è addirittura separazione di forme ed i materiali: da noi l'architettura di fuori penetra nell'interno, e non tralascia di trascurare né la pietra né gli intonaci né l'affresco; essa nei vestiboli e nelle gallerie, nelle stanze e nelle scale, con archi, nicchie, volte e con colonne regola e ordina in spaziose misure gli ambienti per la nostra vita. Dall'interno la casa italiana riesce all'aperto con i suoi portici e le sue terrazze, con le pergole e le verande, con le logge ed i balconi, le altane e i belvederi, invenzioni tutte confortevolissime per l'abitazione serena e tanto italiane che in ogni lingua sono chiamate con i nomi di qui» (Ponti, 1928, p. 7).

The search for continuity between inside and outside has also contributed to the rediscovery of those condominium spaces (courtyards, stairwells, roof terraces) often neglected, which instead in the phase of confinement have revealed all their effectiveness, transforming themselves into places of aggregation, socialization, physical well-being and leisure (Molinari, 2020). That suggests the opportunity to exploit its multiple potentials in the future, enriching them with appropriately equipped areas to be used for numerous activities (smart working, e-learning, gym and kindergarten), perhaps also providing sanitation facilities and first aid equipment (ventilation, oxygen tank, defibrillator). Even the existing buildings, wisely reorganized, could provide adequate responses to current needs and new spaces, possibly recovered from courtyards, porches, attics and roofs.

The results of the ongoing debate already seem to converge on the concept of a post-pandemic home based on requirements of flexibility, hygiene and sustainability. These criteria are well explained also in the programmatic document DesignTech for

Future – Design and Technologies to Design the World after Covid-19, promoted by the DesignTech Hub of Mind (Milan Innovation District) to renew the social coexistence rules and identify new models of spaces to live and inhabit, both private and public (Whitepaper, 2020; Figg. 8, 9). Arising from a multidisciplinary analysis and articulated in different areas of intervention, the guidelines proposed by MIND, show the convergence between design and technology as the answer to all current emergencies and suggest the characteristics of tomorrow's buildings: choice of germo-repellent materials, sustainable and assemblable solutions; usability of open spaces to making homes 'open ecosystems'; great attention to the wellbeing of the inhabitants by monitoring many parameters (air quality, water, thermal, light and acoustic comfort) and using appropriate sanitation systems (Editoriale, 2020a; Whitepaper, 2020).

And precisely in this direction the first Milanese experiments, now in the implementation phase, seem to go (Peretti, 2020). The new Feel Up Town complex (January 2021-2023), arising from the collaboration between Sio Engineering and Labics, involves the construction of four buildings composed around a large internal courtyard of about 3,000 square meters, a sort of exclusive garden raised above the road (Figg. 10, 11). Based on the principles of 'wellbeing city' and 'healthy city', the residences will be equipped with diversified condominium services (swimming pool, gym, co-working rooms, cinema, children's play area, collective lockers) that can be booked via an app and sanitized after the use (Editorial 2020b). Even the type of skyscraper seems to be able to satisfy the renewed needs of the pandemic. The Milan Tower (Fig. 12), near the Central Station, designed by Studio Beretta Associati, with its 24 floors for residential use, as well as including state-of-the-art condominium equipment, will give particular attention to sustainability (photovoltaic panels, rainwater collection for irrigation purposes; controlled ventilation systems that provide air exchange and exploit the heat of the expelled one) and the sanitation

Fig. 13 | 'Architettura in quarantena' (2020), book cover.

Fig. 14 | The day after by Stefano Boeri (source: www.larepubblica.it, 2020).

Fig. 15 | 'Cucinella: con il Post-Covid la rivincita della periferia e delle città medie' (source: www.assoinar.it, 2020).

Fig. 16 | 'La città per l'uomo ai tempi del Covid-19' (2020), book cover.

systems (UV lamps that kill viruses and bacteria, Pco active sanitation, borrowed from the aerospace sector; Galli, 2020).

City vs Countryside | The impacts of the pandemic are not limited to residential spaces and associated areas, but also affect the city. And in this process of transformation on an urban scale, the architect also plays a fundamental role: he reshapes the places of sociality, mobility, and services, responding to the renewed needs resulting from the management of health emergencies that have even changed the relationship between public and private life (Spada, 2020). Pierluigi Nicolin (2020, p. 27), however, warns against «[…] tentazioni che vedono nel crudele distanziamento interpersonale un precedente da cui partire per costruire gli schemi urbanistici del futuro» (Fig. 13).

The old 'city vs. countryside' opposition is back. Stefano Boeri (Fig. 14) with his slogan 'away from the cities' (Giovara, 2020) and Massimiliano Fuksas (Musillo, 2020) who sees the countryside as an 'alternative for all', are the supporters of a return to life in those abandoned villages of which our peninsula is so rich. Thus, the change in our lifestyles could also be a valuable opportunity for the regeneration and rediscovery of places worthy of enhancement (D'Argenio, 2020). As the Milanese architect explains, this is not a 'nostalgic or romantic' operation but a 'totally contemporary' one (ANSA editorial office, 2020), which does not disregard the use of new technologies to overcome the digital divide and make existing buildings environmentally friendly, avoiding further land consumption and triggering a circular economy. In the exhibition that opened in New York in February 2020, Countryside – The Future, Rem Koolhaas had already identified the countryside as the site of the next urban utopia (Mello, 2020a). Emphasizing the 'silent modernity of the countryside', the Dutch architect highlighted the change in perception of a space that has always been considered uncivil and to abandon, and which is now gradually being transformed into a place of civil redemption, a guarantee of survival, even becoming beautiful and attractive.

Fig. 17 | 'La città della prossimità aumentata' by Maurizio Carta (source: www.ilgiornaledellarchitettura.com, 2020).

Proponents of the rediscovery of the countryside contrast with advocates of bringing nature back into the city by introducing greenery into open areas, roofs, roads, and unused railways, as suggested, among others, by the famous Swiss architects Jacques Herzog and Pierre de Meuron (Editoriale 2020c). Mario Cucinella himself is somewhat perplexed about the happy move to the countryside saying «Green, no grazie» (Masneri, 2020). For the Sicilian-born architect, moving to the rural areas would be «[…] difficile, faticoso, mancano reti e collegamenti fisici. In Italia abbiamo questa risorsa magnifica che sono le città medie. Credo che il futuro passerà da lì e dalle opportunità offerte dalle periferie» (Borangini, Bond and De Fabiis, 2020, p. 17; Fig. 15). It is therefore a question of rethinking the shape of the future city and its relationship with the countryside. Many actors of the current debate believe that the solution could be found by stopping the overbuilding of agricultural land, combating urban segregation, discouraging overcrowded neighbourhoods and buildings, and finally protecting the historic landscape «[…] come pegno vivente di una vita urbana che non intenda divorziare dalla natura» (Settis, 2020a, p. 9; Fig. 16).

To reconcile city and countryside, the historian Salvatore Settis believes is indispensable «[…] la piena coscienza della loro necessaria complementarietà e il ripristino, fra l'una e l'altra, di confini chiari alla mente, ma anche fisicamente percepibili» (Settis, 2020a, p. 7). Renzo Piano also tries to imagine a world where there are no differences between urban and rural, the center and the suburbs: «[…] Esiste, dice lui: basta progettarlo. Ed è da qui che possiamo ripartire» (Piano, 2020, p. 4). Still intending to recompose the city/countryside dichotomy to find new balances and ways of life, the '15-minute city' model, developed by Professor Carlos Montero (2016) and already tested by several French municipalities, is back in vogue. Osmotic and polycentric, it appears as one of the most welcome and relevant solutions at this particular moment in our history (Fig. 17). It is essentially based on the 'circular metabolism of all functions' (Carta, 2020), where people are closer to places of production and essential services (schools, shops, restaurants, urban green and public spaces).

Fig. 18 | 'Mobility' according to MIC Mobility in Chain (source: thedesign.tech/it/, 2020).

Fig. 19 | The 'elastic city' of the future according to Eleonora Carrano (source: www.ilfattoquotidiano.it, 2020).

Fig. 20 | 'Cambiare la città? Dialoghi sulla vita, l'ambiente, la letteratura e l'architettura dopo il Coronavirus', poster (source: milled.com, 2020).

This functional mix could also reduce traffic circulation, thus cutting CO_2 and fine particulate matter down, and adhering to the recommendations on sustainable mobility included in the MIND guidelines (Whitepaper, 2020; Fig. 18). Fragmentation into small, autonomous, and potentially isolated areas, as in health and climatic emergencies, is also the basis of the concept of the 'elastic city' defined by Jorge Lobos (Carrano, 2020). The Chilean architect, scientific head of the Emergency&Resilience master's degree course at the IUAV in Venice, suggests a series of self-sufficient urban clusters capable of opening up their boundaries and then closing them if necessary, breaking them down into small, autonomous, and isolated groups (Fig. 19). Renewing the sense of community, applying the urban model of villages also to the metropolis, seems to be the challenge for the historic centers of large cities, where civitas and the feeling of belonging are no longer present (Bertelli, 2020).

According to RiAgIta (Ripensare, Ripartire, Agire, Laboratorio città Italia) the social role of architecture is to continuously adapt open and closed spaces to new uses and with newfound coherence (Biolchini and D'Ambrosio, 2020). These goals concern the square, the traditional beating heart of our cities, but also all the other public spaces, a place of identity and community values, now searching for a new configuration as also stated by architects Michele De Lucchi and Benedetta Tagliabue (Manfra, 2020; Fig. 20). Therefore, it is not a question of realizing spaces or new public build-

ings, but of transforming existing ones, because, «[…] con la sua leggerezza e la sua flessibilità l'architettura moderna può facilmente rispondere a cambi di destinazione che si rendessero necessari nei prossimi periodi» (Nicolin, 2020, p. 29). Also Cucinella argues that there are countless «[…] involucri e volumi dove basta inserire degli elementi specialistici [e che sia necessario solamente] imparare ad usarli e adattarli a nuove esigenze» (Borangini, Bond and De Fabiis, 2020, pp. 18, 19).

The urban future cannot be imagined without a preliminary rethinking of society, with a view to 'city as a common good' (Cannata, 2020), capable of increasing «[…] un'etica della cittadinanza attiva e comunitaria e che, al contempo, sia in grado di garantire ai suoi abitanti i diritti fondamentali sanciti costituzionalmente» (Cannata, 2020, p. 1). Contributing to the widespread and rapid diffusion of Covid-19 was precisely the life of proximity, especially in the metropolis, which led Settis to declare that «[…] il vero virus è la città prigione» (Settis, 2020b). So, it is perhaps in that revenge of the suburbs, which Cucinella names «[…] città moderna […] dove non si vive tutti attaccati e c'è molto più spazio verde e servizi di base di prossimità» (Borangini, Bond and De Fabiis, 2020, p. 18), that a possible way out can be identified.

The city of the future will be not only smart but also safe, embodying a model where «[…] la tecnologia dialoga con la necessità di sicurezza e di controllo degli spazi, per ripristinare un senso di tranquillità nelle persone» (Whitepaper, 2020, p. 74; Fig. 21). It should also be considered a complex organism extending over a wide area, able to promote social cohesion and eco-sustainability through the use of technologies that make it possible to network and enhance local dimensions, without undermining their specific features, intensifying their strengths, and 'repairing' their weaknesses (Bertelli, 2020). While architects, town planners, and sociologists all agree that it is only outside the emergency that it will be possible to reflect collectively, weighing up the various hypotheses, Franco Purini also argues that it is essential to have «[…] co-

Fig. 21 | Public Spaces according to Progetto CMR (source: thedesign.tech/it/, 2020).

Fig. 22 | 'A distanza di sicurezza, o della prossemica' (source: www.ilgiornaledellarchitettura.com, 2020).

noscenza appassionata [del fenomeno urbano perché] se non ci fosse l'emozione la ragione non sarebbe infatti in grado di far sì che le idee sulla città non siano solo 'astrazioni necessarie', ma diventino espressioni essenziali del nostro corpo, delle nostre memorie, delle speranze che vogliamo vedere realizzate e della volontà di far parte di una comunità sempre più consapevole di sé» (Purini, 2020, p. 6).

Conclusions | Initially, the voices that have filled the press and websites in recent months have focused exclusively on professional practice during the emergency (Milan, 2020; Peluso, 2020). But quite quickly they began to reflect on the relationship between architecture and Coronavirus, highlighting the limits and critical aspects of the contemporary city: from domestic to public space, from places of work to those of care, from technological networks to transport systems (Papa, 2020; Fig. 22). From these discussions, a common idea emerged of wanting to turn the crisis into an opportunity. Thus, all the actors in the urban process have begun to see the pandemic as a means of accelerating the redesign of our life scenarios, correcting the past mistakes (small surfaces, dormitories, cities without services, and green areas), and acting on the future. From this point of view, Covid-19 would represent an opportunity to rewrite spaces with greater knowledge, through multiple strategies that differ in scale, nature, and aims. The social vocation of the project, capable of making a substantial contribution to improving the life of the planet and human beings, is also becoming increasingly evident.

The awareness of the inadequacy of our homes, particularly evident in this period, has generated the new concept of the post-pandemic house: an unanimously shared model, based on maximum flexibility, revaluation of interstitial and condominium spaces and the use of new materials and technologies. The concept of sustainability, which emerges from the numerous comparisons, also seems to have expanded and no longer concerns only energy performance or compliance with current regulations: guaranteeing a life quality for the inhabitants and rebalancing the real estate market are the new priority objectives. The proposals for living in the future, therefore, converge on the need for a palingenesis (Nicolin, 2020) which could also be an unmiss-

able opportunity to rebalance spaces and relationships, smooth out social and economic inequalities and guarantee a more sustainable existence for all (Sennet, 2020).

The urban question is still open and certainly more debated. The critique of the contemporary city, coming from many fronts, does not find a single and widely approved solution. The historical contrast between city and countryside is now again relevant: the 'simplistic' rediscovery of 'insularism', supported by many eminent protagonists of the urban process, is opposed by the perplexities of those who see this hypothesis not always easily achievable. In fact, even without defining it as a 'past utopia' or 'formal exercise' (Nicolin, 2020), many voices have highlighted all the difficulties in implementing this choice caused by bureaucratic and cultural issues and nevertheless by the ancestral infrastructural limits of the places. Therefore, recurrent mediation solutions are emerging in which nature enters the urban fabric – through green public spaces, vegetable gardens, etc – and the neighbourhoods are reconfigured according to the 'city in 15 minutes' model. On the other hand, as many protagonists of the debate have guessed, rurality and urbanity should not be understood as two opposing but complementary realities. Especially since living in the countryside would not always be a viable alternative and, at the end of the health emergency, cities, that are the beating heart of modernity from the time of Baudelaire to Benjamin, up to the present day (Cocco, 2017), could come back into vogue. And perhaps it is no coincidence that precisely in a metropolis like Milan, the debate is very heated and the first practical and theoretical experiments on post-epidemic living are taking place.

Numerous voices converge on the fact that probably, in the near future, we will re-appropriate our private and social life, remote work will be a possibility and not a prescription. The renewed places of living will attempt to combine needs for freedom and health, currently still apparently irreconcilable paradigms. Therefore, as frequently highlighted, it is necessary to distinguish the moment of emergency from the subsequent return to normality (Di Caro, 2020b), since distancing cannot be the main requirement on which to base new projects. And therefore today, still during the pandemic, it is perhaps difficult and premature to draw conclusions, because, as Nicolin states: «[…] Dobbiamo metabolizzare, non siamo pronti a un'immediata risposta, e io su questo mi espongo. Bisogna frenare. L'architetto crede di avere la medicina universale, la panacea. Io ho preferito sposare la linea della 'modestia'» (cit. in Moro, 2020).

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HYBRID COMMUNITIES AND RESILIENT PLACES
Sustainability in a post-pandemic perspective

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ABSTRACT
The circumstances of the global pandemic have affected the dynamics of everyday life, accelerating processes of radical transformation of living, in its physical, social and virtual dimensions, oriented towards the creation of enabling ecosystems, resilient places and communities. Institutional, social and design innovations related to the main sustainability policies, Hybrid Communities of Place – social formations 'cultivated in digital space' – and sustainable urban and architectural transformation practices are therefore examined to identify the most concrete, credible and commensurate with the complexity of this century's challenges. In a post-pandemic perspective, the contribution suggests to consider public residential neighbourhoods as places of great physical and social, energetic and environmental complexity, in which to experiment with the renewed values of urban and architectural design.

KEYWORDS
sustainability, resilience, hybrid communities, covid-19, built environment

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The contemporary present is marked by a strong uncertainty about the stability of the technological, economic, productive, energy, and infrastructural systems on which society depends in their everyday-life practices (De Certeau, 2011) and the dynamics of social reproduction (Lefebvre, 2016). The circumstances of the pandemic have increased the awareness of living in a complex and fragile socio-economic context. People demand a more social, environmental, and economic sustainable way to experience the space. For these reasons, it is crucial to frame the post-pandemic perspective in the broader framework of sustainability, acknowledging the renews needs of the individuals within the domestic, urban, mobility, and consumption sphere. During the pandemic have emerged new patterns of consumption and lifestyles, strategies, and practices of sustainability. The understanding of such can help, on a social level, to accept more smoothly the changes required to local bodies, which should experiment with institutional innovation within their inherent structures. This contribution aims to address four main topics. The principles and tools of the theoretical and cultural framework of holistic sustainability within the key strategies at the national, EU, and international levels. The post-pandemic scenario and its effects on the quality of living. The emerging Hybrid Communities of Place, according to the definition of Ezio Manzini. The design approaches that support sustainability – environmental, economic, social – at the urban, architectural, and technological scale.

The contribution aims also to understand which design and meta-design processes can satisfy the different dimensions of sustainability, acknowledging the sudden change in the framework of needs and performances required to the residential space (indoor and outdoor) and the complexity of social, environmental, and energy challenges of this century. In light of the current circumstances, the contribution, therefore, examines whether institutional and social choices can meet at the design level, prefiguring scenarios and objectives for future research that include issues such as health, prevention, production, and consumption within the debate on urban regeneration. The unprecedented combination of factors that characterize the contemporary condition can only be resolved in original, unpredictable reflections. The pandemic issue brings, as a consequence, a variety of implications concerning the health and safety of urban and domestic living, also related to typological, spatial, technological, and digital solutions also suggesting to face the transformation of the built environment in a glocal perspective to address the different dimensions of sustainability.

A Post-Pandemic Perspective[1] | The circumstances of the pandemic have accelerated the awareness of issues proper to the sustainability debate. The slowing down and expansion of daily life during the lockdown has overturned perceptions of well-being about the quality of housing, basic services, and public spaces, nature and landscape, mobility, air pollution, and physical and mental health. Equally, themes such as economic, digital, and gender gaps, solidarity, and cohesion complete the framework needed to understand the post-pandemic perspective that will guide future sustain-

ability and resilience actions, especially at the urban scale, considering the relationship between these factors and the dynamics of the pandemic. First, the spread of Covid-19 and the increase in mortality rates concerning urban air quality as a result of two causes. One identified by the Harvard Department of Biostatistics, which reports an increased risk in the elevated presence of particulate matter in the air (Wu et alii, 2020), which according to the Italian Society of Environmental Medicine (SIMA) would be able to carry trace amounts of virus RNA. The second is related to exposure to nitrogen dioxide, a toxic pollutant produced by fuel combustion, which increases mortality risk factors with effects on hypertension, cardiovascular disease, pulmonary dysfunction, diabetes, and the immune system (WHO, 2003; Ogen, 2020). In this sense, there are prevention and containment measures that depend on urban healthiness and quality.

Another level of effects concerns the quality of urban living, at the neighbourhood scale, and domestic living at the residential scale. In the first case, with the endowment of basic services and the social capacity to reorganize around a need, in the second to the morphological and technological quality of indoor and outdoor spaces. Taking the Italian public residential districts as a reference, it is possible to detect, with due exceptions, a diffuse lack of – or scarce accessibility to – basic services, partly counterbalanced by the increase in e-commerce services and home delivery[2]. These are subordinated, to the level of digitalization of each and the possibility, including economic, of using the technological tools to access them. Also, emerge the ability of a more or less structured network of solidarity provided by non-profit organizations and spontaneous volunteering[3]. This phenomenon fills the gaps in the public service in support of the most vulnerable segments of the population by providing them with goods and assistance both at home and remotely, organizing fundraisers for third parties, also carrying out a general and widespread control of the territory (CSVnet, 2020).

Two post-pandemic perspectives emerge from these considerations. The first, on a social level, is that aside women, children, elderly, differently-abled, homeless, and indigent, also workers with dependent children without smart working opportunities and people without any internet connection or digital devices are now considered fragile categories. The second, more positive, is that in the specific Italian reality, many voluntary associations are already operating a general structural and organizational rethinking to optimize the provision of services in case of future emergencies (CSVnet, 2020).

On the residential scale, can be identified two scenarios: the first concerns the house, the indoor environment, and its spatial, technological, and environmental performance; the second concerns the provision of outdoor spaces of residential relevance, whether private, semi-private, semi-public, common. In the post-pandemic perspective, the activities of daily life are still condensed in the domestic space of the house, whose functional areas are mixed and overlapping: the bedroom is a study, the kitchen a classroom, the living room is a gym and cinema. Besides, the deprivation of opportunities for recreation and leisure sharpens the need to improve the provision of

Fig. 1 | Grass inserts divide driveway from bicycle lanes and tramways in Rotterdam (credit: L. Errante, 2018).

Fig. 2 | Pop-up bicycle lane in Berlin (credit: P. Broytman, 2020).

green spaces and equipped, often denied by the urban and architectural forms of residential neighbourhoods. In this sense, the concept of the ideal home[4] is reconsidered accordingly to the presence of common balconies, terraces, and the overall relationship with outdoor space and nature, which in Italy is found to be lacking compared to other European cities (European Commission, 2018).

Hybrid Communities of Place | During the lockdown, digital space constituted the privileged dimension to satisfy the need for social relations despite the necessary distancing, transferring online everything that the level of digitization allowed individuals, not without contraindications (Manzini, 2020b). From the relationships born in this virtual space, activities of support and solidarity emerge, from the Italian Anthem at 18:00 to the local distribution of goods and services. With this premise, the constraint of spatial proximity at the basis of relationships and social forms breaks down, replaced by the quality of conversations (common interests or purposes) around which new forms of community are built (Manzini, 2018). This is the case of Hybrid Communities of Place, relationships cultivated in digital space that relates to a localized group of interlocutors (Manzini, 2020a).

According to Agamben (2008, p. 9), a Hybrid Community of Place can be defined as a contemporary social formation because in a singular relationship with its own time it adheres to it and, at the same time, distances itself from it through a displace-

Figg. 3, 4 | Tactical urbanism interventions implemented during the lockdown period in Milan (credit: City of Milan, 2020).

ment and anachronism that makes it capable more than others of perceiving and grasping its time. In this sense, these communities are fluid, light, and open, able to oscillate between loneliness and connected individuality and the reactionary attempt to repurpose the closed, identity-based communities of the past (Manzini, 2018). They are hybrid, as their relationships are formed in both the physical and virtual worlds, and they are of place because of a particular interest related to the care, precisely, of a place (Manzini, 2020b). They are the expression of a choice, of a conscious life project around a shared value, something that no one can produce individually but that is made together over time (Manzini, 2018, p. 17). The social innovation constituted by these types of communities lies in being a political and cultural counter-trend to the dominant one based on the desertification, erosion, and commodification of social commons (Manzini, 2020a). Such communities critique 'high viscosity systems' based on material culture and a demiurgic vision of change that degenerates into the environmental and social disaster we find ourselves in (Manzini, 2018, p. 23). The pandemic crisis has shown how the resilience of individuals, society, and the planet derives from the self-critical capacity of a community and the predisposition to change-oriented towards new, happier, and more sustainable lifestyles.

This phenomenon, due to its contemporary character, still has too vague contours whose characters will have to be monitored and verified over time (Manzini, 2020b). Nevertheless, the production of such a fabric of relationships between people, things, and places and their strength and duration over time depends on the stability of the boundary conditions that generated them (Manzini, 2018) hinting at a balance between the virtual and physical dimensions. If the former can reset physical distances by providing support through which to organize, in the latter, the care of places and the preservation of their functional and aesthetic qualities are practised. Ultimately, Hybrid Communities of Place can cope with catastrophic events because, working for the care of each other and the environment in which they live, they can act and self-organize in the face of adversity. Building these new communities requires social, design and institutional experiments that question the relationships between us (human beings) and places (nature in the broadest sense), which cannot be predetermined but

helped through the design of 'enabling ecosystems', socio-technical systems made of activities and opportunities for encounters (Manzini, 2018). It is, therefore, necessary to continue the reflection not only on the level of social innovation but also on that of innovation of design processes.

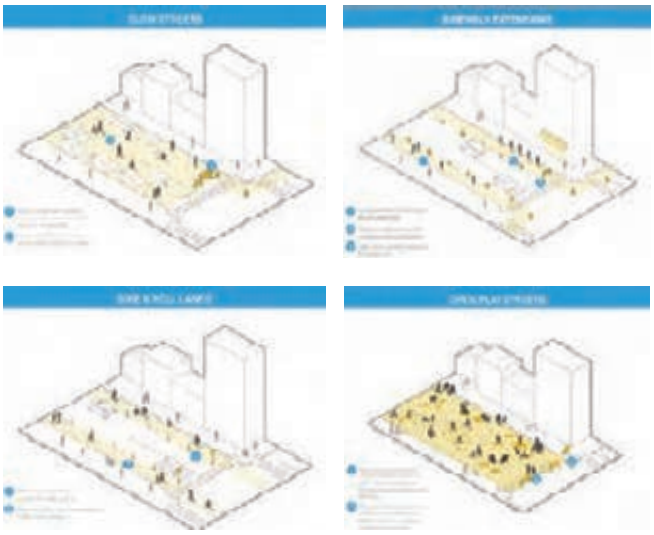
Designing resilient places | The outlined framework implies a change in the sustainable design process to meet functional (problem-solving) and ethical-aesthetic (sense-making) required to create 'enabling ecosystems'. This perspective finds a place in the broader discourse on the socio-spatial analysis and the design outcomes that may derive from such findings (De Capua and Errante, 2019), supporting the creation of a 'socio-technical' environment in which individuals are engaged in a variety of activities. In this way, people produce social and relational values within themselves and the place. The socio-spatial dynamics and the socio-technical environment have reciprocal and mirror-like behaviour in which the care of the place is pivotal to the creation and continuous regeneration of social commons and vice versa. In this sense, the practices and design approaches mentioned in this contribution represent examples of 'design for social innovation' that also arise in response to the pandemic crisis.

The focus on the urban environment concerns the reduction of consumption, emissions, and environmental impact of the city in terms of sustainable mobility, air quality, and urban healthiness. The issue is approached from two temporal perspectives, long-term and short-term, requiring distinct design approaches. The first, long-term, mobilize actions and principles of urban regeneration proper to the Green City or Ecosystemic Services[5] (environmental and/or ecological) at the urban scale: the improvement of urban quality through the reduction of land consumption, climate mitigation, and adaptation, and the renewal of the built heritage and infrastructure. The short-term perspective is based instead on the need to provide immediate responses: areas with clean air in built-up areas, pedestrianization, and reduction of cars planting of grass surfaces that trap particulate matter (Fig. 1) along the busiest roads, the adaptation of public spaces, parks, sidewalks and bike paths to the needs of distance.

The urgencies posed by the pandemic crisis have been responded to through short-to-medium term design approaches, oriented towards Tactical Urbanism, i.e., able to provide 'short-term actions for lasting changes' (Bazzu and Talu, 2017) also for the benefit of urban healthiness (Rojas, 2020). The outcomes of these tactics can be found in numerous international examples, such as the pop-up bike lanes in Australia, Ger-

Fig. 5 | The intervention of tactical urbanism in Milan after the phase 2 of the pandemic (credit: F. Romano, 2020).

Fig. 6 | Road section: extract of the Open Roads Plan of Milan (credit: City of Milan, 2020).



Figg. 7-10 | Extracts from the Streets for Pandemic – Response & Recovery Plan on which the urban transformation interventions in Figg. 3-6 are based (credit: NACTO and GDCI, 2020).

many, Spain, (Fig. 2) or the Italian case of Piazze Aperte (Figg. 3-5), Strade Aperte (Fig. 6) and Zone 30, promoted by the City of Milan in collaboration with Bloomberg Associates, National Association of City Transportation Official (NACTO) and Global Designing Cities Initiatives (2020). These initiatives aim to reduce flows and increase spaces for micro-mobility and active mobility (Figg. 7-10). Similar to other radical actions of temporary pedestrianization, they are based on accessibility, flexibility, adaptability, economy, and democracy criteria (Fig. 11), being consolidated by the formal tools of planning and urban design when considered effective.

In this sense, outside the urban policies framework, these design principles can be jeopardised by many potential risks related to ethical, aesthetic, practical, and economic issues. The most common risk appears when the transformation results in an urban make-up operation having no positive social impact in the long term. These risks could be prevented for actions included in the orderly planning of the territory, such as those mentioned for the city of Milan. On the contrary, the case of Tactical Urbanism actions is more complex, even when they are solicited by local governments. The main reason is the participation and active involvement of citizens who are the main protagonists of these interventions, from the idea to the management of places, contributing to their effectiveness and sustainability over time. Such interventions could instead provide an opportunity for the regeneration of urban commons, reconciling the needs of PAs with the involvement of the community. Another aspect of criticism relates to issues of environmental sustainability concerning urban mobility. Although the transformation of the roads and their accessibility and safety are pivotal for the use of greener means of transport, the approach proposed by NACTO (2020) cannot constitute a universally applicable paradigm, finding instead more viability in boulevards.

The heterogeneity of the urban forms of Italian cities requires specific studies concerning the overall modification of traffic flows associated with other mitigation interventions of air quality improvement.

At the scale of the built environment, the reflection focuses on residential neighbourhoods, where the technological obsolescence of public housing (Paris and Bianchi, 2019) and the provision of spaces and services are among the most frequent problems. Social, architectural, and technological meanings are linked in the improvement of spatial and living quality implying an ideological and methodological change in sustainable design. In the opinion of the author, the main leading theories are the Soft City concept and the recent Public Space Site-Specific Assessment – Guidelines to Achieve Quality Public Spaces at Neighbourhood Level developed by UN-Habitat (2020).

The first one is based on urban density strategies to ensure access to green spaces and neighbourhood services to the residents (Sim, 2019). As a thematic deepening of Jan Gehl's method on public space (Gehl, 1971; Gehl and Svarre, 2013), the Soft City approach proposes heterogeneous, diverse, flexible, walkable, easily controllable, and green spaces to contribute to the microclimate of the residential block and reduce the environmental impact (Sim, 2019). The second, in continuity with the Global Public Space Toolkit (UN-Habitat, 2016), provides a methodological framework to understand, analyze, and evaluate residential contexts through qualitative methods and propose site-specific solutions (UN-Habitat, 2020).

These examples are configured in their respective fields as process innovations, to be considered as methodological references in the formulation of urban transformation programs based on an evidence-based approach, i.e. structured in a dual analytical and strategic phase. In both cases, these principles need to be revised in light of appropriate adaptations and specific design translations to be adopted on a case-by-case basis. For example, to adopt the analytical approach proposed by UN-Habitat to an Italian public housing district and orient interventions towards a Soft City principle, we would find ourselves using toolkits designed for contexts very different from ours and each other. In the first case, because the indicators, criteria, and proposed actions are designed for extremely complex socio-economic contexts, such as those of developing countries. In the second case, because the experimentation of this project approach

Fig. 11 | The famous pedestrianization of Times Square in New York City, spring and fall of 2009 (credit: NY DOT, 2020).

Figg. 12, 13 | Transformation of 530 homes in the Grand Parc neighbourhood by Lacaton & Vassal, Bordeaux 2016 (credit: P. Ruault, 2020).

refers to geographical, climatic, environmental, urban, and morphological contexts located mainly in northern Europe.

Nevertheless, these principles can be used to identify, even outside of specific strategies or programs, examples of urban and architectural transformation aimed at the overall spatial and technological improvement of living. The characteristics of sustainability, found in numerous examples of contemporary residential, social and co-housing architecture (Figg. 12, 13) can be summarized as follows: constant and rational maintenance of the existing as opposed to demolition and reconstruction with the related energy, economic, and resource savings (Paris and Bianchi, 2019); soft, low-cost and low-tech approach (Paris and Bianchi, 2019; Sim, 2019); orienting the project according to uses and ways of living consistent with the real needs of consumption and indoor environmental comfort of the inhabitants, to contain their impacts; material and technological choices, in wet work or prefabricated, traditional or innovative, which should not be mere technical exercise but contribute to the overall performing, aesthetic and formal value (Figg. 14, 15); evaluate additions and thicknesses that can combine environmental benefits and common spaces for residents.

Fig. 14 | Typological section of the Self-sufficient Neighbourhood housing designed in a post-pandemic perspective (credit: Guallart Architects, 2020).

Fig. 15 | The 'Self-sufficient neighbourhood' winner of the international contest for mixed-use community in Xiong'an, China (credit: Guallart Architects, 2020).

The interpreter of this change is the 'bricoleur', on whom design for social innovation and urban, architectural, and technological design converge (Manzini, 2018; Paris and Bianchi, 2019). The bricoleur performs two actions. On the one hand, according to Manzini (2018, p. 80), he designs by listening to objects and people drawing on a supply of pieces made of products, services, infrastructures, ideas, programs, ways of doing things, formally defined methodologies that can be observed in the socio-technical, cultural, and political ecosystem; on the other hand, he formulates the project and evaluates its outcomes based on the resources internal to that system, such as more or less shared knowledge and values. The bricoleur proposes additions, integrations, grafts of volumes and thicknesses, and simplified constructive and technological choices in aggregation, construction, management, and maintenance. In all cases, he acts respecting the places and the presence of the inhabitants, taking care of the common good and producing heterogeneous living spaces, relational, environmental, and

social. This design attitude, critical and politicized (Marcuse, 2009) is reflected in the sustainability strategies that guide the design choices mediating between the dimensions of sustainability.

Conclusions, criticalities, and future perspectives | The transformations threatened by environmental, energy, and climate challenges and more recently pandemic, the socio-economic conditioning in the definition of lifestyles, require the activation of unconventional design skills and attitudes. In light of what has been said, the project is the pivot of sustainable innovation, social and architectural, equal and proportionate to the tools and more or less institutional actors in the field for the transformation of the urban and built environment. In this sense, the achievement of sustainability goals in the different spheres of public affairs, such as the management of urban space and mobility and social housing, requires institutional restructuring. A revision of the modus operandi also includes investments in support of local, specific, and collective actions of transformation and management of the existing. This aspect reveals the particular research interest, regarding the activity conducted by the writer, in the experimentation of innovative forms of urban and architectural transformation, care of places and common goods, and the integration of these processes in the context of ordered planning.

The approaches described so far do not constitute an innovation in themselves, configuring themselves as established practices or at least widely studied. Nevertheless, from the reflections advanced in this contribution, the opportunity of experimenting with new combinations emerges, according to the peculiarities and specificities of the different urban and territorial contexts. Specifically, the public residential districts are extremely interesting as places where to find multiple levels of socio-cultural, typological-spatial, and technical-environmental complexity. The future research of the author will be specifically oriented on social housing. In particular, the interpretation of the renewed needs that emerged during the pandemic, the criteria that may lead to a transformative scenario, and the optimal condition for the creation of socio-technical systems. All these considerations aim to understand how to increase the quality of life of social housing residents. The complexity and the overlapping of multiple dimensions, scales, and needs outlined here, have always been an inexhaustible source of design material, useful to guide objectives, priorities, and strategies of transformation. The contemporary historical moment is characterized by rapidly changing and mutability as the only certainty (Bauman, 2005) and the designers are called to propose flexible and trans-scalar solutions, both in the intervention and in the expected results. This flexibility is realized in the reversibility and transformability of the proposed design solution and in their ability to interpret the different opportunities and potential offered by each context, the values, and reasons that it represents concerning the time of its implementation and in the contemporary world.

Notes

1) By post-pandemic perspective, the contribution means the immediate present and the near future in which social and spatial practices of normalization of the dynamics connected to the containment of contagions during the pandemic will be tested and progressively consolidated.

2) Overall, the turnover of Italian e-commerce companies is growing, but with difficulty keeping pace with the volume of orders. Small merchants, converted to home deliveries, use social networks to support the local reality and ensure customer service. Source: ilsole24ore.com/art/e-commerce-17percento-2019-ma-coronavirus-stravolge-settore-ADA4HcR [Accessed 18 September 2020]. For further information see: Casaleggio Associati (2020), *E-commerce in Italy 2020 – Selling online at the time of the Coronavirus*. [Online] Available at: casaleggio.it/e-commerce/ [Accessed 24 November 2020].

3) The regional Volunteer Service Centers register an increase in the availability of new volunteers, while the most requested services are home delivery and telephone listening for the elderly and the lonely. To these activities are added those of the non-profit organization Banco Alimentare and the Italian Red Cross. For further information see the webpages: csvnet.it; bancoalimentare.it/it/emergenza-sanitaria; cri.it/Coronavirus [Accessed 18 September 2020].

4) After the lockdown + 5% of Italians want to change home for reasons of overall quality and location, 46% are ready to renovate to improve furniture and space organization but only 11% will invest in energy efficiency. The concept of comfort is linked to multi-functionality and relaxation of environments, enjoyable outdoor spaces, and support and service rooms. For further information see: BVA Doxa, (2020), *2020 – New Market Scenarios*. [Online] Available at: bva-doxa.com/wp-content/uploads/BVA-Doxa-Nuovi-Scenari-2020.pdf [Accessed 18 September 2020].

5) The Millennium Ecosystem Assessment (2005) defines Ecosystem Services as «[...] the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling».

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RESILIENCE, BUILT ENVIRONMENT, BUILT HERITAGE, CULTURE AND DESIGN IN THE ITALIAN CONTEXT

Federico Puggioni

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ABSTRACT

For some decades the pure concept of resilience had been the only declination of a little-explored field of research. Nowadays the notions of urban and cultural resilience, socio-economic systems, adaptive circles are part of different academic languages, but their application to urban systems is still limited to a predominant environmental view. This text highlights a possible reading of the aforementioned concepts in the historical urban heritage and in the cultural legacy of the Italian context, taking as examples the protected built heritage and the traditional craftmanship ability – lately evolved into 'industrial design'. These fields, bonded among themselves, will be studied empirically in order to find tangible evidence of the resilient systemic dynamics and adaptive circles, setting up the basis for broad ranges of future researches.

KEYWORDS

urban resilience, cultural resilience, cultural heritage, design, Italy

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The starting point in the development of the study on the resilience is notoriously attributable in the literature on the studies on biology and materials engineering. The pioneer text (Holling, 1973) express resilience as measure of the persistence of systems and as ability to absorb change. Lately, the field of study has been highlighted by the author and other fellow researchers; in particular, decades of further consequent studies led to a differentiation between the engineering resilience, characterised by the 'efficiency of function' (factor related to a material's recover capacity, for instance) and the ecological resilience, whose existence is influenced by the maintenance of its functions (Holling, 1996). The ecological resilience is a dynamic deeply influenced by actions and feedbacks within a context, and its survival can create new balances among a system. The ecological resilience is a framework which allowed the development of studies in numerous disciplines as «[…] technology, economics of innovation and competition, cultures, human psychology, history» (Gunderson and Holling, 2002, p. 13), and constituted a first step towards the academic definition of the existing bond between the ecological resilience and the social system, reached also through other studies that focused on the nature of complex systems and on their capacity to be ready to change (Folke et alii, 2010) under external solicitations. By definition, all resilient systems are capable to absorb shocks while maintaining functions (Holling, 1996; Gunderson and Holling, 2002): the value of these systems' resilience is unfixed during time and changes under single or multiple perturbations (called shock or stresses). Perturbations reduce the resilient capacity and increase system's 'vulnerability', a measure of exposure to the stress and of «[…] the sensitivity of people, places and ecosystems» (Kasperson et alii, 2005, p. 146) towards and in perturbations. Only recently the field of the urban-based disciplines included this measure into their domains and due to the network-based nature of the urban scenarios and their continuous exchanges among the parts. A well-known definition of urban resilience considers it as 'theory, practice and analytical tool' to understand and explain social behaviours in the city (Vale, 2014).

This transfer of concepts allowed different new research lines for the urban studies, such as, but not limited to, the relationships of the historical places with the cultural fragility of the touristic dimension (Cuccia, Guccio and Rizzo, 2016), the investigation on the cultural resilience among a context's local people, their identity and their «[…] set of social-ecological relationships within which this identity was founded» (Rotarangi and Stephenson, 2014, p. 1). The further development on the studies on cultural resilience is part of this essay, in order to evaluate the deep bond between cultural resilience, built environment, cultural heritage and the products of craftsmanship and tradition.

Cultural Resilience | Cultural resilience is intrinsically a hybrid concept which reads under a resilient key how the permanence of cultural values and their relationships with the context work (Clauss-Ehlers, 2004). The concept is also defined as the ability

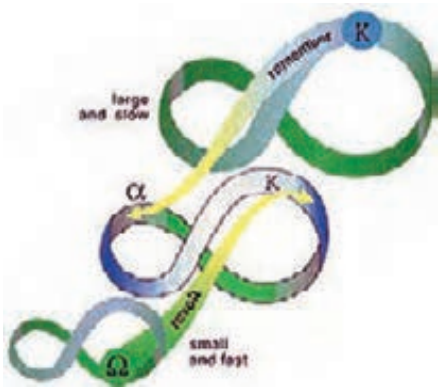

Fig. 1 | Panarchy's connections: linked adaptive cycles at multiple scales (credit: originally published in Gunderson and Holling, 2002; source: www.resalliance.org/panarchy).

of the species «[…] to maintain livelihoods that satisfy both material and moral (normative) needs» (Crane, 2010, p. 1). Another definition implies its existence in a system whose factors are constantly mutating: cultural resilience is identified as a cultural process able «[…] to absorb adversity, deal with change and continue to develop» itself (Holtorf, 2018 p. 639). Under all definitions, it emerges the need to frame cultural resilience as a matter of 'actions' and 'feedbacks': the notion of social-ecological system (SES) supports this, altogether to transfer the resilience's theory in the urban scenario (Walker et alii, 2004). The SES is not a concept influenced by a sole factor, but by multiple ones: 'adaptability', 'transformability' and 'resilience'. Adaptability is the capacity of the actors of a system to manage and influence the resilience in a scenario, while the 'transformability' is a measure of the system's ability of creating new systems (also of different scales) during a change of the factors – ecology, economy, political, social, etc. The third factor is the 'resilience' itself, demarcated in turn by four interrelated components: 'latitude', 'resistance', 'precariousness', and 'panarchy' (Walker et alii, 2004).

The interactions among the first three components define the general degree of resilience of an SES; panarchy relates an SES's influence and connection among other SES in other scales. More specifically, latitude represents the maximum amount of change the system can stand before losing its ability to recover from stresses and gain again balance; the resistance indicates the amount of resistance to stand a perturbation; the precariousness is the current status or trajectory of the system, how close is it to the limit of impossible recovery of the system (Walker et alii, 2004; Gunderson and Holling, 2002). The relations of all these factors determine adaptive circles, which are 'useful metaphors' to understand how the levels of the overall resilience of an SES changes (Carpenter et alii, 2001) following a specific recurrent pattern – which doesn't tend to the equilibrium but to a continuous constant sequence of four phases (Gunderson, Holling and Light, 1995; Gunderson and Holling 2002; Fig. 1). The four phases have specific names and roles: 'rapid growth and exploitation' (r), 'conservation' (K);

'collapse' – or 'release', 'creative destruction'; 'renewal' – or 'reorganisation'. The last two phases are the moment where the profound changes occur: some value can be lost in the phase, while in the following phase, 'novelty can arise' (Carpenter et alii, 2001). With the (r) phase, the system is settled in a new equilibrium, longer but slowly in transition towards the end of the conservation phase (K). During these changes, the values of resilience, adaptability and transformability are in constant change.

The metaphorical nature of the adaptive circles' mechanism allows this concept's transfer into the field of the urban studies (Clarke, 2016). The knowledges of urban studies suggest from chronologically and spatially diverse perspectives how much the city is a comparable to an adaptive system. Firsts in this direction are the remarkable 1960s American intuitions of Jane Jacobs on the power of the social relationships in the street level, altogether with Whyte's pioneering studies on the social and physical dynamics of the placemaking. For the European contexts, are particularly influential the broad studies on the unificatory role of the Mediterranean Sea's in the different coastal areas (Braudel, Matvejevic among others), capable of suggesting transnational and

Fig. 2 | The view of the Mediterranean common spaces and places in the Medieval Age (credit: The Catalan Atlas, 1959 digitalised copy of the Western side of the 1375 Atlas Catalán de Cresques Abraham, via wikicommons).

rooted deep connections with geography, anthropic tracks and history (Fig. 2). More recently, the role of the Mediterranean Sea had been investigated also in regards of the urban character of its territories (Bultrighini, 2013) and under its dwelling morphology, focusing on the similarities of the sequence of public/semi-public/private spaces among the different Mediterranean peers contexts (i.e. the North African's Kasbah, the Spanish pueblos, the hilly Greek villages, etc; Maricchiolo, 2015). In the Italian context are relevant in this logic Turri's investigations on the anthropic and historical dimension of the landscapes (Fig. 3), on the archaeological urban permanence and the urban transformation during the centuries of the built heritage (i.e. the well-known urban cases of the Roman theatres of Lucca and Verona, among all; Fig. 4). Lastly, are noteworthy in this systematic view also the various specific anthropologic and spatial-urban studies that were developed in the local or regional contexts in the previous century, as the geographic, anthropologic and territorial researches of Le Lannou and the architectural morphological research of Mossa (Fig. 5) in the island of Sardegna, for instance.

All these mentioned sources suggest the existence of an intense system of interrelations among the layers which constitute the urban scenario. Considering the Italian cultural context as a unique SES (notwithstanding and acknowledging the regional and local differences), it is possible to evaluate empirically in the Italian context the presence of an urban and cultural resilience system through two specific different manifestations of cultural assets: the physical transformations which occurred in the historical urban scenarios and the role of the artisan and manufactural activities in the applied arts. Both correspond to diverse adaptive circles.

Cultural resilience effects on the Italian context | We can perceive the cultural resilience, in the focus of this research, as bonding agent on different cultural, physical and conceptual processes on given places, the Italian historic centres[1]. In these areas, there is a deep bond between two separate set of values: the urban and the cultural values. In those areas, protected by the laws, they are still visible and survive.

The urban values display common traits among them. The scale of the built environment is minute, and the urban fabric is mostly made by aggregations of cellular units built with traditional materials of diverse qualities (Fig. 6); the ground floors are occupied by traditional craftsman workshops (often hereditary family-businesses) or commercial activities of modest sizes, constrained in their dimensions by the constructive metric of the previous centuries (Fig. 7) and limited in their expansions by a set of conservative law bodies (of National and local frameworks). This fabric is interspersed by a limited number of contemporary buildings (seldom related to a dynamic of demolition-reconstruction), and by the old built heritages, symbols of the past religious and temporal powers. In many cities, these represent the landmark and identity of the town itself: the Church, the Cathedral, the Town Hall, the Tower, the Port, the Dome, the monument (Fig. 8), etc. Frequently, these places represent the social, representative, economic centre of a whole province or region; often, in and around them,

Fig. 3 | Overlapping of agricultural, productive, sacred, built and archaeological landscapes in Sardinia (credit: photo by the Author, 2016).

Fig. 4 | External view of Arena di Verona's iconic Ala [Wing], the only remanent part of the third outer ring of the monument; note the urban layout of the neighbouring street, which follows the circular shape (credit: photo by the Author, 2016).

there are public spaces recognised by the local daily routines and by society's behaviour (i.e., shores, sea-sides, walls' passageways used as public streets, squares, porticoes, etc; Figg. 9, 10). There is diffused attention to the context in terms of social bonding and care to the context's relationships; often the areas are subject to demographic/social shifts, with even complete substitution of the social-ethnical context.

The cultural values are deeply related to this. As expression of human's productive activities, they will be studied in this essay considering the link between the Italian historical political-historical backbone, the hand-made production of the manual craftsman labour. This had been stated by many renewed designer (like Mari, among others), it had been identified organically (Brusatin, 2007) and showed in extensive researches with case studies (Filippini, 2013). According to these authors, the origins of the industrial design in Italy are the artistic classic culture and the old craftmanship tradition and legacy (Figg. 11, 12) – rather than the technical or manufacturing industry of the XIX century, as happened in other European Countries (Baroni, 2011). The typical different categories of industrial design (anonymous, authorial, anonymous authorial, as defined in Bassi, 2007) explain further how the daily, common and shared diffused knowledge and production have deep connections with the fine applied art and the artistic production system of the 'bottega artigiana' [craftsman's workshop] that characterised all the artistic production from the Middle Ages through the fruitful Renaissance Age until today. The so-called Made in Italy, the well-known world brands, contemporary cultural products, art and design production, industrial design activity, fashion and style industry, agri-food products normatively protected by various labels (DOP, IGP, IG – as per Italian reception of the EU Quality Scheme's laws) are born from the tradition and the background of small-scale artisanal artistic dimensions or territorial know-how. Mostly this happened throughout a centuries-old

Fig. 5 | Cover of Vico Mossa's Vicende dell'Architettura in Sardegna [Events of Architecture in Sardinia], 1994 (credit: C. Delfino Editore).

Fig. 6 | Aggregations of residential and mixed-used buildings in Otranto's city center (credit: photo by the Author, 2015).

process embodied in the actual historical built heritage of the city centre or also in the landscape's productive activities. However, the transition from the so-called 'bottega artigiana' to the actual SME (Small-Medium Enterprise) and the delocalisation of it in the cities' peripherical productive zones have to be acknowledged, whereas it is excluded from the purposes of this essay.

These urban and cultural resilient assets proper of the Italian context can be interrelated in a unique resilient system which can consequentially be read under the resilience framework previously mentioned. Within it, the life and the mutual interrelation of the aforementioned factors result in different adaptive circles which mutate the values of the resilience and its key factors (transformability, latitude, precariousness, resistance). This system is characterised by high levels of adaptability and lower levels of transformability because during the centuries the built heritage was experienced different events and stratifications. The permanence and the overlapping of events in the forma urbis were always oriented towards conservation over demolition, modification and implementation over total alteration, conservation over transformation (Fig. 13). Last decades' dynamics (in terms of abandonment or renewal of the centres, urbanization of the surroundings) allowed the rediscovery of some lost assets, experience and valorisation of the cultural heritage – following the principle of the recognisability/restoration over loss of identity/reconstruction.

Another general resilient feature is the latitude, present in high values. The reason is related to the small-scale's physical fabric of the urban cultural context, which allowed a strong social mutual control in these contexts (Fig. 14). This balance of private and public spaces and relationships is common in the Mediterranean City; this process had been pointed out (Braudel, 1987) as spontaneous and natural condition until the XX century. Conversely, urban laws and regulations are often seen as limitation of this spontaneous appropriation and participation to the public space by its citizens. The value of resistance is high for similar reasons. World War II physically threatened the urban historical structures, but the subsequent post-war requalification coincided with the deliberate edification of the peripheral areas of the cities and a general loss of identity (Fig. 15). The population displacement in these new areas and the successive abandonment of the historical 'old' centre has created in some cases minor losses than a maximum-profit logic of total demolition and reconstruction. This guaranteed the transmission of the built heritage to the future.

Precariousness: the civic life of the historical centres is still existent, with some particular good-practices of identity's creation, quality of life, world-wide fame quality-fame. Nonetheless, the success and the worldwide recognition reached negative critical effects in many cities, with situations close to the limit of collapse. However, the touristic vocation itself can be a measure of precariousness. Precariousness level stands at a critical point: in those contexts, material and social conditions' improvements are deeply auspicated especially in regards of the onerous physical maintenance of the heritage, the relationship with the private stakeholders and especially in the ap-

Fig. 7 | Bari's old city center: semi-private street and a mix of residential, commercial and handicraft activities (credit: photo by the Author, 2015).

Fig. 8 | Visual, cultural, architectural, historical and urban landmark: view of Brunelleschi's Dome in Florence (credit: photo by the Author, 2015).

proach to it. The public and civic values of the heritages – as established by the normative framework (Settis, 2012; Montanari, 2015) are usually left aside by phenomena of commercialisation and real estate-based dynamics, touristic exploitation and only rarely by the creation of a new paradigm of heritage discovery – which can be intended as an indicator of the panarchy in the system. The role of the panarchy can be seen in this framework as the factor able to create other and new resilient systems of different dimensions, entity, nature. An example of this previous point can be the differentiation of the touristic offer in terms of parallel itineraries, new routes, other discovers, slow and sustainable tourism, etc, which can coincide with the birth of new adaptive circles (Fig. 16).

The system delineated is not fixed and static by definition, but also because external factors can be issues. These issues are called perturbations and they – with their different speeds (Walker and Salt, 2006) – request alternative approaches. Practically, the nature of the perturbations is anthropic or natural (or combined) and it has different levels of traumatic effects. Extremely well-known physical perturbations are the

deep destructions in the physical layout of the historic built environment that occurred in the earthquakes of 1981, 1997, 2009, 2016. An indirect perturbation which affected the physical dimension of the urban layout is the Covid-19 pandemic scenario, whose medium-long term physical effects are still unknown. However, the structured study on the perturbations and their effects go over the scope of this essay.

Practical effects and problematics | The focus of the article is on several relevant practical misinterpretations of the concepts of the resilience which act as perturbations themselves. The first, the main one, is about the role of the resilience and its positioning in the scientific debate. Urban resilience is at present a structural theory in different levels of policymaking (International, National, Regional, Local and even Urban). Present in the UN Sustainable Development 2030 Goals, also the European Union's Cohesion Policy (Policy Department Structural and Cohesion Policies, 2014) promoted the inclusion of the resilience in the local frameworks, specified lately in further studies as capacity of urban systems, businesses and various stakeholders to «[…] recover maintaining their function in case of shock or a stress, regardless its impact, frequency or magnitude» (Frantzeskaki, 2016, p. 6). All the European States consequently refer to this framework, indicating urban resilience mostly as practical tool to define and solve the contingent need of cities and territories to cope with natural tragic perturbations as earthquakes, floods and other calamities in their city plans or programs (Italian's geographical fragility as expressed on Trigila et alii, 2018).

This approach became diffused also in the Italian academic scene (Moccia and Sepe, 2015), canalising several energies on a unique plan of discussion characterised by the need and the contingency of some practical solutions for cities and territories. Consequentially, the cultural role of the historical built heritage and the possible future scenarios shift to the background. Limiting the analysis only on the UNESCO numbers in Italy (The Organisation features in its lists 55 sites and 12 immaterial cultural assets; UNESCO, 2020, 2019), the presence of museums and their concentration in terms of inhabitants and geographical diffusion on the National territory (4,908 muse-

Fig. 9 | Public-access terrace in Castel Dell'Ovo, Naples (credit: photo by the Author, 2015).

Fig. 10 | Genoa's porticoes in the Port area (credit: photo by the Author, 2017).

Fig. 11 | Paolo De Poli in his 'bottega artigiana' (credit: Filippini, 2013; original from APV, De Poli, archivio foto).

Fig. 12 | Detail from Carlo Scarpa's layout for the Galleria in Castelvecchio, Verona: between design, tradition, architecture, craftmanship knowledge (note the use of the red Venetian 'stucco' and the metal bent iron), history (credit: photo by the Author, 2016).

ums, 1 every sqkm 50 and every 6,000 inhabitants, with the 93% of the Municipalities have at least one cultural heritage good – moveable or unmoveable – in their territory; ISTAT, 2019), we have the weight of this historical cultural legacy in Italy. The historical centres and the protected heritage represent an extremely limited surface of the national territory (ANCSA and CRESME, 2017) but they contain the majority of these heritages and the historical irreplaceable core of the whole tradition. The different local public and private institutions committed on the cultural heritage and on the cultural assets are operating among between the two main National Constitutional concepts of the cultural heritage: 'protection' and 'valorisation'. Hence, some problems connected to the cultural resilience in those two main fields are expressed.

Protection. The physical action of preservation of the built heritage is a complex matter, carried out with numerous degrees of normative and technological support: with the actual National framework, The Ministry of Cultural Heritage, Tourism and Activities and The Ministry for Environment, Land and Sea Protection have shared competences in the topic in their local offices, but the responsibility in terms of buildings is formally held by The Ministry of infrastructure and Transport. In addition, at each territorial level there is a varied degree of control: regional level typically involves the territorial planning and land use; provincial level is strongly depowered nowadays, but still involves mainly the maintenance of services of the rural areas; city levels and Metropolitan Areas involve the urban planning, the use of the spaces and the executive level. Besides this issue, after the physical permanence of the built heritage after the post-war reconstruction, the richness of the cities, the chronic national lack of unity (legacy of the old historical territorial divisions) caused different diverse

Fig. 13 | Protective structures outside 'E. De Amicis' Primary School in L'Aquila. Its full heavy temporary preservation occurred as per the normative framework – besides the extreme damages suffered after the 2009 earthquake – and lasted unmodified for almost a decade after the event (credit: photo of the Author, 2018).

Fig. 14 | Social balances, social control: youth and elderly together outside Ardara Romanesque Cathedral, local landmark for the Logudoro area of Sardegna (credit: photo by the Author, 2017).

situations along with the Country. Some Italian historical centres report high grades of residential density and have the 7.5% of estate vacancy, while others reach 52% (ANCSA and CRESME, 2017). This significant factor corresponds to a broad and diverse mosaic of the Italian historical built heritage, correspondent in diverse degrees to the original National cultural purposes of urban protection and valorisation – represented legally by the Cultural Heritage law framework and symbolically by the values and the purpose of the Carta di Gubbio [Gubbio's Charter], 1960.

Valorisation. The cities and the built areas seem under very diverse indictors to have a deep tie with the weight of this heritage. The number of touristic visits of the main monuments, the role of the mass tourist in fragile contexts (i.e. Verona's City Centre or the case of Venice) created by reaction a broad supply of touristic services (also in form of digital shared-economy systems, i.e. Airbnb). The side effect of these decades-long dynamics of the demand had been reflected in a competition among the centres to maximise the share of the incoming tourists. This also helped a strong differentiation of the internal National touristic competitivity: is recent the differentiation of parallel itineraries to discover territories, heritages, landscapes, tradition. Consequentially, the touristic offer tried to expand itself, reduce the density and providing different tourist offers throughout the year. This played in favour of minor and peripheral realities, often equipped with fewer human and economic resources to be allocated to enhancement, growth and research. The technological side and the challenge for the digitalisation are a new frontier of development, whereas the global pandemic scenarios and the limit of the physical contact threatened in a serious manner.

Fig. 15 | Pier Paolo Pasolini's reflection on Orte's post-World War II urban development (credit: A. Zanioli and P. Brunatto).

Fig. 16 | New adaptive circles and the re-invention of the tradition in a different key: the symbolic image of Parma's admission in UNESCO Creative City Network's as World City of Gastronomy in 2015 (credit: en.unesco.org/creative-cities).

Conclusions | The cultural adaptive circles' discovery in the built environment is at its initial stage: this broad paradigm of interpretation of cultural and built resilient assets can develop new research fields. Systems and adaptive circles, with their different phases, are a tool able to oversee and to explain urban, social, cultural and economic dynamics that happens in the common space of the city. More specifically, future studies of these cycles can help to frame invisible patterns of survival, transformation, death and rediscovery of places, habits, traditions, customs proper of the historical built environment and the traditional craftmanship's knowledge (which evolved lately into the design). These two main elements which the research looks at are related in their origins and meaning. Nonetheless, they are the two faces of the historical evolutions of times, habits, knowledge. The particularities of the Italian context, the codification of the Made in Italy system, the importance of the stratification in the Italian physical built environment and the cultural relevance of the Italian design's canon in the second half of the XX Century are a complete and exhaustive set of data, facts and topics to research in the future. Consequentially, many and diverse can be the possible future research outcomes.

One practical outcome is related to economic weight of the contemporary production of design, culture, art. New economic paradigms can bring renovated economic

turnover or further business assets for the SMEs considering to look in the tradition to find new ways of expressing the heritage, the knowledge and the roots of their activities into a more culturally sustainable, resilient and aware sphere of existence. The most evident theoretical outcome is about the digitalisation and the dematerialisation of the processes proper of the contemporary situation: it should be taken into account; it shouldn't be separated to the practical application of the technologies to the cultural heritage. This loss of the physical dimension can allow further unexpected scenarios able to improve, strengthen, highlight and making the cultural features more resilient, while expanding the shared knowledge of the heritage, aiming possibly at the same time towards the civic values of the shared common cultural heritage.

Note

1) These zones are intended to be the zones which uphold historical relevant value; consequentially, as working hypotheses, these zones correspond with all the 'zona A' as established by the National zoning fundamental laws (Italian Law 765/67 and DM 1444/68) altogether with all the areas identified as 'patrimonio culturale immobile e paesaggistico' [cultural immobile heritage and landscape] as stated in the art. 2 of the 'Codice dei Beni Culturali e del Paesaggio' (Italian DLgs 42/2004 ss.mm.ii.), the National Law on the Cultural Heritage.

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THE ROLE OF THE ARCHITECTURAL PROJECT IN THE URBAN REGENERATION PROGRAMS
Prospects and potentialities for smaller villages

Veronica Strippoli

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ABSTRACT
The paper develops the topic of urban regeneration starting from the peculiarities, both in terms of value and criticality of the smaller settlements and villages, supposing the size and shape as a term of comparison with the vision of a 'parcelled' city. Possible regeneration paradigms, processes that are scalable and adaptable to urban realities with different dimensions and qualitative characteristics, are therefore investigated. This assumption determines a model both for the re-appropriation of smaller settlements and villages, strong in a proclaimed and no-longer valued identity, and of the suburbs, centralizing problems and degradation. The current urban scenario is configured as a container of complexity in which the project loses its self-referentiality and assumes the role of coordinator in the urban regeneration programs, decreeing the importance of the interdisciplinary process.

KEYWORDS
urban regeneration, smaller settlements, city, urban project, interdisciplinarity

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Urban countryside or rural city? Two diverse viewpoints for two complementary but inseparable concepts either a city-countryside or a countryside-city: a countryside built with the city or a city shaped by the countryside (Donadieu, 2013, p. 77). The scenario to which we refer is a complex territory, the narrator of confused traces between rural and anthropic signs, in which the plots lose their sense of regulatory matrices, from uncontrolled urban expansion. Morphologies with fragmented margins, in which city and countryside permeate, towards the progressive loss of the clear identity distinction. The smaller villages (Fig. 1), as urbanized areas formed following the birth of agricultural, industrial or commercial centres, are generally located outside the city or on the edge of the hamlets. Inattentive functional systems, irreverent towards the rooted rural context, assailants of a rarely man-made landscape. The graft of these urban poles takes place in response to the growing condition of housing need, a settlement mechanism, however, orphan of qualifying design fundamentals, rather outlined by a process not yet concluded, that lives in expectation of fragments of urbanization aimed at providing services for inhabitants. A recurring paradigm that in many cases remains only a will that does not evolve in planned transformations, a limitation that turns into a constant condition of lack, a trait now considered characteristic of the smaller villages.

Their constituent characteristic makes them morphologies suspended between urban and rural devoid of contextual value and coherence, in which the reasons for their aggregation have found their own structure with a provisionally definitive flavour (Falzetti, 2014, p. 42) surviving in a marginal condition that has lost the sense of limit, understood as the division between two essences of different nature and matrices. Signs of a 'city in extension'[1] that emerges against the background of the rural landscape, an agricultural countryside that has gradually undergone the expansive action of urban micro-consistencies rooted in it. As background to this blind settlement growth, dissonant with respect to its original traces, the villages emerge, clusters with the soft lines of the pre-existing natural landscape. The hamlets (Fig. 2), although often associated with the smaller villages by a similar surrounding settlement condition, appear as characteristic signs in the natural landscapes, witnesses of anthropic pre-existence in rural contexts. A prerequisite made possible by their strong historical-cultural value, the effect of yesteryear events and subsequent ones throughout history. A property that favours them over more recent rural settlement contexts, less charged with feelings so clearly expressed. They play the role of narrators of a qualifying virtue capable of producing a substantial differentiation from the smaller centres, invested only by the fate of anonymity and by an occupation of land that took place without an evident generating and regulating fundamental, regardless of the marked lines of strength of the territory.

These realities scattered in the extra-urban territory, be they villages or minor settlements with recent origins not always rooted in a context of historical-cultural value, are characterized by a low population density, destined to decrease over time in favour of the migratory phenomenon towards metropolitan contexts. These local wounds affect villages and smaller settlements in equal measure, despite the explicit qualitative differ-

entiation, producing as inevitable consequence, the loss of quality of the landscape and territorial identities. From this double typology of urbanization of the territory, varying between value and heritage, diffusion and fragility, the search for a model of transformation emerges. We start from the two contingent realities: the village whose main problem is due to the partial lack of functions and services that leads to the progressive abandonment, and the smaller settlements with inadequate functions and services, insufficient to demand (Francini et alii, 2012).

United by the condition of lack, the two described realities lend themselves to the analysis of the criticalities that mark the territory and to the observation of how the urban regeneration program can operate on them. The reappropriation and reactivation of the territories become the objectives of this program, achievable through the mediation of the urban project, used as a formal and social tool of an integrated process. It investigates the role of the architectural project as a container of 'actions' aimed at revitalizing the local territorial context, allowing the integration of multiple levels of knowledge operating for the regeneration of compromised urban realities. The described investigation is aimed at identifying implementation paradigms of a design matrix, capable of working on the territory to obtain the about-turn, the result of the enhancement of smaller villages and the revaluation of hamlets. Therefore, a possible transposition of the urban regeneration model from cities to small-scale territorial contexts is hypothesized, a subject of great interest today for metropolitan contexts but also fitting for smaller settlements and villages. So, the study is developed both in formal terms, aimed as mentioned at the identification of paradigms measured to the dimension of the realities in question, and in social terms, to identify which is their connection and their action on the territory; an interdisciplinary program that aims at the regeneration of the measured urban system.

Paradigms for the integrated regeneration | Starting from the recurring condition of 'lack' that compares the two realities, the denied elements are assimilated as critical areas from which starting to plan the regenerative actions. The deprivation of functional hinges, identifiable in everything that becomes a service for the inhabitant, determines a condition of depletion articulated in form and substance, while the lack of physical systems results in an ineffective solution to the needs of the city user. According to Ramazzotti (2014b, p. 20), we read the criticalities of the territory: due to the settlement dispersion, or in the countryside, or the building densities of the two polarities; still due to the residential architecture and its relationship with the soil, the methods of agricultural production, urban planning rules, industrial dislocations generated by administrative fragmentation and the lack of an overall vision. In this context, the smaller settlements (and the villages) are a weak element to be reinserted in a delicate balance between protection and regeneration. In anticipating an action aimed at filling the shortcomings found, we rely on the process of enhancing local identity strengths, incisive for their historical-cultural-traditional character, distinguishable in urban micro-realities. The contained dimension that characterizes them is assumed as a condition that facilitates localized ac-

tion, proposing the resolution of critical issues through a process that can be identified in three types of implementation: punctiform, linear and superficial (Figg. 3-5).

The actions to be taken must necessarily be based on the 'deteriorated urban body', in response to the needs declared by the physical place and by those who use it. The condition of punctual criticality is attributable to the identification of urban voids and the presence of disused buildings in the settlement fabric. In this precise circumstance, the regeneration project can provide a punctual formal solution consisting of a set of localized interventions connected in a collaborative network. A network of serial interferences aimed at the redevelopment of limited areas, capable of extending the revitalizing action to the entire urban context through connections. A series of gauges identifiable in evident architectural signs, with a strong formal value, physical connections that give back a sign in the urban territory; or as context connections that relate interventions characterized by the same architectural language.

By maintaining the observation on the form of the criticalities, further cognitive actions are implemented, actions that work on the linear components of the urban structure: the edges. The design action tries to recompose the discontinuities between the built and the open space. Urban layouts that are configured as redevelopment paths aimed at reorganizing and reconfiguring the marginal identity, restoring the sign of a limit that is often missing in these cases. Project actions aimed at providing a continuous or discontinuous footprint, which materializes in plan and elevation, to rebalance the relationship between buildings and agriculture. In contexts where the urban criticality is configured on extended parts, for which punctual and linear intervention is not able to guarantee effective rehabilitation, the regenerative action must increase its boundaries of intervention. In this case, the project proposals must also include soil interventions, capable of re-forming a unit of language. An action of this type turns out to be the most invasive but also the most innovative since it proposes a radical transformation of the existing structure and at the same time respectful of the original traces.

The expressed critical issues are the manifest of binding wounds, which are formalized in the lack of support architectures, transferring the problem from function to form. The punctual, linear or superficial design solution should not be evaluated in a condition in its own right, but rather accepted in a propositional perspective of implementational suggestions capable of interacting and living together in the same urban context; a progressive process adaptable to realities with different qualitative characteristics. In these circumstances, the urban project proclaims itself as a regeneration activator to restore the qualifying identity, affected by the condition of abandonment and degradation in which the urban micro-dimensions live. Their spatial and functional reconfiguration is feasible through focused action, a process of re-appropriation of the territory aimed at making minor realities resilient. The first step towards the goal is certainly working on the signs of alteration to break the isolation in which the smaller settlement and villages are crystallized. In these terms, an operation of appropriation of the territory is therefore necessary, made possible through the multidisciplinary overlap of implementation levels. According

Fig. 1 | The smaller settlement: the signs of a rural and man-made territory (credit: V. Strippoli, 2020).

Fig. 2 | The villages: the historical tracks of the anthropic presence in the rural context (credit: V. Strippoli, 2020).

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Fig. 3 | Punctual regeneration paradigm (credit: V. Strippoli, 2020).

Fig. 4 | | Linear regeneration paradigm (credit: V. Strippoli, 2020).

Fig. 5 | Superficial regeneration paradigm (credit: V. Strippoli, 2020).

to Falzetti (2014, p. 45), starting from this representation of 'parallel levels', we can launch a 'landscape figure' that is compared with the compliant figures slowly installed based on the needs of the inhabitants, that reflect the rhythm and character of the place in which they are inserted, where the 'actors', who, in representing the scene perform the role assigned to them, are necessarily involved in a process of continuous cross-referencing, in the sign of what is essentially the time they come from has transmitted to them. For this reason, the meeting and the wedge between them can result, in the scalar relationship between the parties, the stronger the more incident will be the operation of re-involvement in the territory of the elements of contrast and fragmentation, such as the infrastructure, widespread urbanization, non-hierarchical connections, inadequate services.

Thus, appear territorial signs to act on, urban presences and absences of design derivation, whose formal attitude finds correspondence in different disciplinary applications. A relationship of coexistence between multidisciplinary issues, in which urban design represents the graft matrix of socio-economic and psychological-cultural processes typical of urban regeneration (Vicari Haddock, 2009). An analytical approach through which it is possible to highlight the potential of smaller settlements or villages, linked both to the enhancement of identity architectures and to the enhancement of services. The implementation of the potentialities is aimed at increasing the local economy and the offer of services for the inhabitant; solutions capable of converting the isolated smaller settlements into individualities of rural tourism; witnesses of a rediscovered will aimed at rediscovering the origins, places of relaxation following slow time and rehabilitated contact with the territory. The revitalization of the villages and minor settlements for tourism is one of the possible developments addressed by a declared will, that hopes to re-inhabit the rural areas and re-establish the interrupted contact with the original nature.

The strategy for reactivation is linked to hospitality, to a slow model to be contrasted with the fast paces of the metropolitan city. The conscious and sustainable use of local resources is the promoting factor, heir to a culture of enhancement and care of the surrounding area, curator of ancient artisan knowledge capable of promoting the use of local, organic and typical products of the host land, today renamed '0 km products', poles of attraction for a sought-after agri-food tourism. Therefore, new forms of slow tourism made possible by the presence of architectures that restore the ancient guesthouses. Domestic hospitality is preferred to luxurious but sterile accommodation systems, a way to taste the veracity and authenticity of the territory. In response to this need, a 'widespread' method is disclosed, which is grafted into the pre-existing, a type of accommodation that is present but hidden within traditional urban signs. A model that allows the reuse of existing buildings even in partial form, revealing itself as an example of connected and integrated punctual regeneration, capable of responding to precise architectural and economic needs. The implemented mechanisms are therefore innovative in the form but conservative in the content, becoming traditional receivers, declinable according to contingent tourist trends.

An unfinished debate in which characterizing disciplines carry out a contaminating action, coordinated by the skilful planning knowledge of the architectural project, which

Fig. 6 | A hypothesis of splitting up on suburban metropolitan areas of Rome (credit: V. Strippoli, 2020).

can enclose in the intervention the answer to different requests. It is clear how fruitful connections are realized in a single design container, capable of generating a complete implementation program, that fulfils the needs of different nature expressed by the city user. The declared prospects can enhance the potentiality of the area through complex programs with defined prerequisites, through an integrated action for the redemption of smaller villages. The internal realities as faithful conservatives of traditional essences and custodians of ancient values, in evolving into a renewed urban organism have restored their original attitudes. A transfer process that starts from the promotion of ancient skills and crafts and reformulates them in a contemporary key, placing the technological and innovative means as a tool to achieve the goal (Berizzi and Rocchelli, 2019).

Regeneration strategies shifted from micro to macro: a hypothesis to be explored | The intervention paradigms presented are assumed to be scalable to dimensionally larger realities. This statement starts from the assumption that the metropolitan city is comparable to an organism, the result of the sum of smaller realities. To realize this regeneration strategy, it is necessary to define the intervention areas where to explore the response of the paradigms described above, grasping those reactivation mechanisms that have been qualifying for the villages and smaller settlements. Through a process of fragmentation (Fig. 6) of the urban fabric, we can determine the limited areas that can be assimilated in size to those of smaller urban contexts.

The smaller settlements become the reference system, as they are distinguished by the obvious possibility of being physically identifiable due to their small size, not comparable to the extension of the city. Examples with a morphology outlined and distilled by perceptible territorial signs, highlighted by a clear separation between built and non-

built. The line to follow, although conceivable, is not feasible to the metropolitan context with a single immediate step. The peripheries constitute the terrain in which to experiment this strategy, as they are identified as enclaves, marginal and fragmented areas, apparently born without a regulating fundamental, places of manifestations of the urban decay and social discomfort (Francini et alii, 2018). However, according to Falzetti (2017, p. 93), the suburbs are not just uncertain and vague territories, in which the apparent absence of rules reinforces 'a condition where everything is possible, therefore allowed, and every rule is doomed to failure'. Even these territories become the noble objects of a research that aims to know the training rules, to establish the project in procedural terms, placing itself in continuity with the verified training mechanisms. No longer 'fragments without quality' the suburbs, the city-countryside margins, the paths, the urban units of the small towns return as problem data.

A necessary prerequisite is, therefore, the reasoning on the urban morphology of neighbourhoods and suburbs, which constitute occasions for parallelism between the concept of margin, typical of the smaller settlements, and that of the limit between urban districts. An evident sign in some cases, distinguished by the presence of a physical limit in the ground and/or in elevation, an anthropic or natural track, recognizable in a road, in a row of trees, in a building, etc. A presence, however, is not always identifiable through a physical sign, as the city presents itself as an urban form with an identity that is not clearly marked, of which it is difficult to guess the beginning and the end of the entity to be defined. In this sense, the process to recognize the district, as a delimited area, must follow the recognition of focal points of identification: the civic and/or administrative place, the building for sacredness, for training and areas for primary commerce. Legitimate presences of a localized and distinct territory, which through their areas of influence limit and identify the neighbourhood identity. A clear process that is completed with the recognition of specific areas of intervention, in which problems actualize. Weakening signs of a progressive loss of quality, caused by the presence of disused buildings, squares that have lost their reason to be, parks in a state of neglect, which become manifestations of evident degradation and catalysts of social problems. These are the demanding opportunities for regeneration in the city, fertile ground for the implementation of paradigms already tested in smaller villages, in which the transition from micro regeneration to macro regeneration is finalized (Carta, 2013; Figg. 7, 8).

A prospect of future development | The observations made show the possible analogies of the application of regenerative processes to urban realities of different qualities and sizes. Therefore, it is possible to make a subsequent step, which puts in parallel places far from each other for morphological, dimensional and geographical characteristics. A new interpretation of urban regeneration programs is therefore provided, focused on the sociological perspective of the project. For this to happen, the project, in its entirety, must be able to listen to the needs and requirements expressed by the inhabitant with a fruitful discussion between the parties. Villages, smaller settlements and cities are

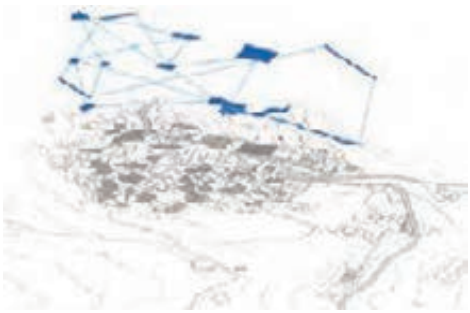

Fig. 7 | Regeneration paradigm on smaller settlements and villages (credit: V. Strippoli, 2020).

Fig. 8 | Regeneration paradigm in the metropolitan city (credit: V. Strippoli, 2020).

generally already equipped with spaces for socializing, with architectures designed to be the places of sharing that the city user enjoys. Too often, these widespread realities reach levels of absolute imbalance, involved in social depletion and low levels of security: the only characteristic is to belong to places without belonging to men.

In this reading, the participatory design is seen as a success factor for the redevelopment of territories inside and outside the city (Bertell and De Vita, 2013). A process that appears more accessible in the limited contexts of smaller settlements or villages, as the level of sociality, sharing and active participation is an element that naturally belongs to it. The measure becomes the key to conduct the research with. The repeatability of these processes is hoped in the neighbourhood dimension, although the level of genetically nuzzled sociality is much lower in metropolitan contexts. A two-way relationship is es-

Fig. 9 | Superficial regeneration paradigm (credit: V. Strippoli, 2020).

tablished between man and city, an ever-changing dialogue subject to the variable needs of the citizen. Thus, a new way of living, of experiencing the urban reality and interacting with it is manifested.

It is therefore evident how urban regeneration can also open to new paradigms of living, through the adoption of the policy of reuse and the sustainable transformation of the urban organism; implementation models aimed at improving the context and its social use. A double perspective of reuse is therefore expressed, materially linked to the functional aspect of the building, as regards the building recovery and ideally connected to the reinstatement of the use of the urban area for social sharing. Aspects of different nature match in the container of urban regeneration (Fig. 9), making it an effective means for the sustainable rehabilitation of cities and to improve the quality of life. It is equally evident how this requalifying step can be obtained through intervention systems valid for smaller villages and conceivable for cities, which provide design solutions of different extension applicable to different scales: interventions with a punctual, linear or extended character to a larger surface.

It is feasible to express a hypothesis of development of the model in metropolitan contexts, implemented in localized areas limited to the extension of the district. However, this application leads to different outcomes, determined by the different urban matrices and by the various objective characteristics, expression of the areas taken into consideration. A non-deterministic application method that should still be deepened and investigated, examining the possibility of new contaminations of different professional sectors. The complexity of the city, therefore, does not allow to respond to regeneration through a single study, it demonstrates the presence of a debate not yet concluded, open to future interactions aimed at improving the application process. The hypothesized outcome sees the application of possible solutions deriving from a fruitful interdisciplinary interaction, that can provide the answer to the problem, contributing to the drafting of the program for the regeneration of the territory. The urban re-

generation thus assumes the role of a multidisciplinary container, a place for the coexistence of sectoral issues of which the project has assumed the role of coordinator. A system of synthesis applicable to the different contexts of the variable historical-urban configurations of the territorial realities, which is defined through an organized and clear model, tracked by main guidelines but still open to future experimentation among different disciplinary fields.

Notes

1) According to Ramazzotti (2014a, p. 7) the city in extension is a conjecture about a new form of city, as latent as possible. The term coined by G. Samonà constitutes a hub for the PRIN research entitled 'From the Urbanized Countryside to the City in Extension – The Planning Rules of the Territory Architecture of the Minor Settlements' carried out at the 'Tor Vergata' University of Rome (2011-2014). About forty years after Samonà's writings, the term refers to an urban condition that is still current and represents a possible hub for developing topics relating to the present critical issues of villages and smaller settlements.

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ADAPTATION, MITIGATION, AND SMART URBAN METABOLISM TOWARDS THE ECOLOGICAL TRANSITION

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ABSTRACT
The paper discusses the relationship between adaptation and mitigation in different dimensions (temporal, spatial, economic, political, psychological, social, and finally architectural), to highlight the existing or potential links. The perspective the one of the systemic and multi-scale design approach, capable of integrating its benefits. This strategy is based on widespread technological awareness, on smart metering, and on available IoT technologies, which can be integrated into buildings to govern the metabolism of matter and energy of the urban system. The essay relates disciplinary and specialized scientific approaches, making a synthesis focused on the theme of the relationship between global warming, ecological transition, enabling technologies, and perception of the risks associated with climate change in progress.

KEYWORDS
adaptation, climate mitigation, smart urban metabolism, climate change, ecological transition

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The global crisis induced by the current pandemic event made the fall of trust in the consolidated relationship of domination of humanity over nature evident. The artificial world and the biosphere have manifested themselves in their profound interconnections, which even the advanced technological available means cannot govern. In fact, with the advent of the Anthropocene (Crutzen, 2002), the manipulations induced by the ongoing globalization have made processes governed by biology and chance increasingly accelerated. This acceleration coincides with the ongoing global warming induced by changes in the atmosphere, which are essentially linked to energy production based on fossil fuels and began at the end of the 18th century. To date, on a planetary level, it is estimated that urban areas contribute to at least 70% of the global emissions of carbon dioxide induced by the final use of energy (Seto et alii, 2014). With the growth of cities underway, this phenomenon is inevitably destined to intensify, given the confirmation of the current development models and exploitation of resources.

The urbanization process that involved cities in the twentieth century has intensified since the 1950s (Cui, 2018). In mid-2009, significant was the moment when, for the first time, the population living in cities exceeded that living in rural areas (United Nations, 2010). According to the projections contained in the Report of the Department of Economic and Social Affairs, in 2050 the population that will inhabit the planet will reach 9.7 billion people and 11 billion in 2100, and then will stabilize and, probably, begin to decrease (United Nations, 2019). They forecasted that almost 70% of the world population will live in cities in 2050 (Dijst et alii, 2018). With this scenario in mind, it becomes clear how structural urban planning for the sustainable development of cities (Conke and Ferreira, 2015) – which in many cases will increasingly assume the characteristics of 'megacities' (Kennedy et alii, 2015) – is already today a central issue in the economic and political agenda of all the countries involved, from here to the next decades, in the so-called 'ecological transition'. The concentration of the population in the cities, on the other hand, will make the need to adapt the man-made environment to the sudden and violent changes induced by the global increase in temperatures even more evident.

This scenario requires the architectural project, in all its components and at different scales, to become a synthesis of requests of a profoundly heterogeneous nature, which are correlated by complex interactions, not always tangible or quantifiable. In other words, the project can represent an intervention immediately accomplishable at the social and economic level of policies for long-term mitigation. Although they are still often distinct in national and supranational bodies' strategies, adaptation and mitigation – here intented in the specific meanings of environmental studies and policies – appear in this perspective as closely interrelated (IPCC, 2007a; Locatelli et alii, 2015). The objective of the contribution is to investigate, in a synthetic and non-exhaustive form, the relationship between adaptation and mitigation in their various dimensions (temporal, spatial, economic, political, psychological, social, and finally architectural),

to highlight existing or potential links, in the perspective of a systemic and multi-scalar design approach, capable of integrating the benefits deriving from a combinatorial process rather than disjoint or episodic one.

Adaptation 'versus' Mitigation | The analysis of the relationship between adaptation and mitigation is increasingly at the center of the academic debate (Lee, Yang and Blok, 2020): it has been defined as synergistic and conflictual (McEvoy, Lindley and Handley, 2006), dichotomous (Biesbroek, Swart and van der Knaap, 2008; Huang-Lachmann and Guenther, 2020). With the term 'adaptation', we mean the regulation in human or natural systems to the stimuli or their effects (actual or foreseen/foreseeable) coming from the climate change in progress, aiming to moderate its damage or exploit its benefits (IPCC, 2007a). On the other hand, through 'mitigation' policies, the action is taken directly on the causes of climate change; efforts in this regard aim to reduce the release of climate-changing gases into the atmosphere. Mitigation and adaptation have long been dichotomized at the academic and political levels. However, identifying the link between the two fields of action is complex (and sometimes not even evident in a given space-time dimension). Even when the mitigation produces the desired effects, a certain amount of specific adaptation actions would seem necessary, for example, at the micro-urban scale (McEvoy, Lindley and Handley, 2006).

Essentially, adapting means making the built environment resilient to events, in some ways, inevitable, while mitigating means preventing and, by extension, decarbonizing. In the built environment, this concretely translates into the improvement of buildings' energy efficiency, the reduction of demand peaks, the use of alternative resources for energy needs, the densification of buildings, and the implementation of greenery with a view to carbon sequestration. On the other hand, this excessive simplification runs the risk of posing the question in reductionist terms. For instance, on the one hand, the densification of buildings is desirable for the objectives of mitigation, both directly, since it contributes to improving the energy efficiency of buildings; and indirectly, by shortening distances in the city, promoting healthier lifestyles through less use of private means of transport and with the consequent reduction of the emission of climate-altering gases into the atmosphere. On the other hand, the densification is inevitably destined to subtract areas potentially usable for adaptation in the short term (floodable squares, gardens, green areas). Furthermore, many studies highlight the complex role of vegetation in improving the air quality of urban areas, highlighting the specificities linked to the climatic conditions of the sites, the availability of water, the ability of tree species to affect pollutants (Pollo et alii, 2020; Air Quality Expert Group, 2007).

From these considerations, and because the permanence in the atmosphere of the GHGs already emitted may be more than a century, as in the case of nitrous oxide N_2O – whose permanence in the atmosphere is equal to 114 years and whose concentration, compared to the pre-industrial levels, is now 16% higher (IPCC, 2007a; Treccani, 2007)

– it follows that the effects of climate mitigation are mostly visible in the medium-long term and on a national, if not global scale (Klein et alii, 2007), requiring short and long term economic commitments and global political agreements (Goklany, 2007). Actions for city adaptation require (almost exclusively) short-term investments, but their effectiveness is immediately noticeable. In this sense, adapting the built environment requires a greater economic effort, as large sums of money are needed immediately. On the other hand, even the deferral of expenses to support mitigation policies can cause an increase in the risk linked to the more and more frequent manifestations of the global rise in temperatures, with consequent repercussions also on the same costs in the long term (Kristl, Senior and Temeljotov Salaj, 2020). Besides, mitigation requires the participation of key players responsible for global greenhouse gas emissions, while adaptation occurs from the local to the national level (IPCC, 2007b). Therefore, mitigation and adaptation present significant additional differences concerning the stakeholders involved in managing short- and long-term risks (Table 1).

Adaptation 'feat.' Mitigation | If, on the one hand, mitigation and adaptation appear to affect irreconcilable spaces and times, on the other hand, this dichotomy is denied when both domains are classified as anthropogenic responses to sudden changes, also of human origin, that global warming entails. As such, the combined action of adaptation and mitigation appears to be the answer – the best possible one – to the ongoing climate crisis (Tunji-Olayeni et alii, 2019). It is therefore evident that the scale at which the combined action of adaptation and mitigation policies manifests completed forms of synergy is the micro-urban and local one, as capable of unifying the identification of the causes, actions, and aims of the policies (Grafakos et alii, 2018; McEvoy, Lindley and Handley, 2006). Despite this, few scientific contributions have analyzed the potential deriving from the combined action of adaptation and mitigation policies in the urban environment yet (Grafakos et alii, 2019). Among these, the study by Demuzere et alii (2014) identifies in the realization of green urban infrastructures the way in which the greatest benefits deriving from the combination of adaptation strategies and mitigation policies are manifested, while Grafakos et alii (2019) have identified three areas within which the project of the space, combining the two, obtains significant repercussions, at the local scale, for the management of the risks deriving from global warming.

Among these, in the field of urban greenery, the installation of green roofs is one of the most effective adaptation responses – as it can retain water during violent climatic phenomena, making it possible to decentralize water management (Grafakos et alii, 2019) – and mitigation at the same time (Geneletti and Zardo, 2016) – as an effective tool for the reduction of long-wave radiation that determines the urban thermal field, as well as for the improvement of air quality (Pollo et alii, 2020). Similarly, some green wall technologies are particularly effective for urban drainage (Lau and Mah, 2017), for lowering building surface temperatures – up to 24K (Bianco et alii,

Dimension	Mitigation	Adaptation	Adaptation 'feat.' Mitigation approach
Temporal	Long-term (future decades/centuries)	Immediate	Immediate and long-term
Spatial	From the national to global one	Almost local (micro-urban, urban, regional)	Local (micro-urban, urban, regional), national, global
Economic	Short and long-term investments, deferred over time	Mostly short-term investments	Short and long-term investments, deferred over time
Politic and collaborative	Involvement of the major GHG emitters (global level) and policymakers (national level) Conscious participation/collaboration of the populations is necessary Fields involved: energy production, transport, industry	Involvement of policymakers at local (urban, regional) and national level Fields involved: city project and territorial governance, coastal zone protection, risk and emergency management	Involvement of policymakers at local (urban) and national level Conscious participation/collaboration of the populations is necessary Fields involved: city planning and territorial governance, coastal zone protection, risk and emergency management
Psychological and social	Barriers related to: Limited cognition; Ideological beliefs; Comparison with others; Sunk costs; 'Discredence', radical scepticism; Perceived risks; Limited behaviours (see Gifford, 2011)		Need to adopt an intergenerational approach (Giovannini, 2016) Possibility to overcome some of the barriers thanks to: Perception of the immanence of risk and the effectiveness of actions undertaken to contrast it; Perception of the need to 'cure' the territory; Awareness of the influence of mitigation policies on future scenarios; Involvement of the inhabitants in solidarity actions beyond the emergency
Design	Urban densification Retrofitting Integration of renewable energy sources Blue infrastructure for the abatement of surface temperatures Green infrastructure for the extraction of carbon and the abatement of surface temperatures	Use of urban voids and green infrastructure for decentralized water and risk management Reconfiguration of the public space as the heart of the city (De Carlo, 2019)	Ecosystem services (NBS) Urban and peri-urban green areas (green roofs and walls, urban forestry, forestry) for the decentralization of water management and carbon withdrawal Urban and peri-urban agriculture (urban gardens, vertical farms) for the reduction of the carbon footprint of food Infrastructure scope (redesign of road sections) Balance between densification and public space/areas for adaptation

Tab. 1 | Characteristics of policies for mitigation, adaptation actions and combinatorial approach in the dimensions and fields identified.

2017) – and for air temperatures on the soil, although these effects are quantifiable in buildings higher than 10 meters (Ouldboukhitine, Belarbi and Sailor, 2014). According to the area's risk exposure, once the local balance between densification and urban voids for adaptation purposes has been identified, one of the most effective win-win practices is related to urban forestation. In fact, horizontal and vertical greenery makes the environment more resilient and, at the same time, mitigates the causes of climate change through the absorption of carbon and the cooling of air and surface temperatures. The preservation and enhancement of the urban and peri-urban natural capital are of strategic importance, intending to reduce the risks associated with global warming, contribute decisively to reducing pollution, improve air quality, and safeguard the biodiversity and waters (Tucci and Battisti, 2020).

In the field of urban agriculture – also intended as able to guarantee a vital circle based on the integration of work, innovation, production, energy, and resources (Negrello, 2017) – it allows for greater sequestration of carbon dioxide from the atmosphere and the reduction of the carbon footprint of the food produced – mitigation (Grafakos et alii, 2019); to allocate areas of fertile soil to manage the risk of sudden floods – adaptation. In the field of water management in the buildings, the energy retrofit of the built heritage allows a more virtuous use of water, as well as the reduction of the energy used for the operation of the distribution, pumping, and heating systems of the fluid (Grafakos et alii, 2019). Finally, we add that, in the field of urban mobility, the redesign of road sections would make it possible to allocate a greater surface area for urban green, with a view to the renaturalization of the surfaces and the decentralization of rainwater management mechanisms (adaptation), to allow a greater sequestration of carbon dioxide from the atmosphere and, indirectly, to prevent the emission of the share of GHG due to vehicular traffic, encouraging the use of soft mobility (mitigation).

Adaptation, Mitigation and Smart Urban Metabolism | The complexity of unambiguously defining the relationship between mitigation and adaptation strategies derives from the intrinsic articulation of the urban system, a field in which the two's combined action finds the widest possible range of action (Beery, 2019). In particular, the presence of 'core drivers' (Lee, Yang and Blok, 2020) of a political and economic nature determines the effectiveness of the mitigation policies, more evident in the medium-long term, and the need/possibility of combining these with local adaptation actions, whose effects are instead immediately recognizable. As highlighted by Dijst et alii (2018), the presence of these drivers is partly due to consumption patterns consolidated over time; the same drivers, in turn, can influence the future metabolism of cities.

The notion of system complexity is deeply inherent to the urban system. It is well represented in the holistic approach of Urban Metabolism, which looks at cities as a set of complex processes of transformation of matter and energy of the settlement sys-

tems in a space-time dimension. In the perspective that associates the concept of urban metabolism with that of 'organism' (Kennedy et alii, 2015), the latter exerts continuous pressure on the environment, depending on the number of its inhabitants, their consumption and lifestyles, its geographical position and the socio-economic and regulatory context within which it is located (Trane, 2020). In this sense, the urban system components are the 'drivers' of a political, economic, and, therefore, regulatory nature, which influences the manifestation of specific communities' needs by acting as potential 'facilitators' or 'constraints' (Dijst, 2013).

From the perspective of Urban Metabolism, activities of a heterogeneous nature occur through the presence of 'flows' (and 'stocks') of matter and energy. Therefore, drivers, needs, facilitators/constraints, activities, flows/stocks represent the constitutive elements of an urban system's political, social, economic, and regulatory framework. Together, these factors impact cities' institutional and governmental capacity to address the challenges related to mitigation and adaptation, although not necessarily to the same extent or extent (Lee, Yang and Blok, 2020). The drivers that determine the implementation – and the effectiveness – of adaptation actions and mitigation policies may be of a different nature (Burkeley et alii, 2011), considering that they are linked to the socio-cultural, economic (growth or impoverishment), demographic, and climatic sphere of the context considered. The attempt to bring this complex framework back into a set of regulations to contain and prevent the risks associated with climate change is the subject of increasing efforts from a regulatory point of view in many contexts (Lee, Yang and Blok, 2020).

As highlighted by the literature, mitigation policies require constant monitoring (Kristl, Senior and Temeljotov Salaj, 2020); the effectiveness of the adaptation is instead more difficult to monitor or quantify a priori (Huang-Lachmann and Guenther, 2020), as it is essentially linked to sporadic and unpredictable episodes, although increasingly frequent. The adoption of policies related to the mitigation of the causes of climate change, present in much greater numbers on the political and economic agenda of the main European cities than the initiatives aimed at containing the effects of global warming already underway (Lee, Yang and Blok, 2020), therefore introduces the issue of monitoring the effectiveness of these policies, made possible today thanks to the support of widespread and pervasive technologies. This seems essential to optimize the flows of matter and energy into (and out of) urban systems.

With this in mind, Urban Metabolism becomes 'smart' (Shahrokni, Lazarevic and Brandt, 2015), and it is intended as a necessary tool for monitoring flows (aimed at their reduction/optimization), energy and environmental performance of the built environment, together with the real effectiveness of mitigation policies. On the other hand, the introduction of digital technologies in the design and management processes of urban environments allows nowadays to significantly increase the knowledge of the spaces we live in (Giovanardi, Giusto and Pollo, 2020). Consequently, data is intended as a cognitive element for urban design and as widespread and accessible information

on elements, infrastructures, and places of the city itself (Losasso, 2015). In the field of architecture and technological design, the issues related to the management, ownership, and resolution of data appear nowadays as a real possibility to analyze the responses coming from the built environment to violent climatic stimuli. Besides, they are a way to measure the effectiveness of policies and actions undertaken to contain these environmental inputs. Finally, they are intended to be an opportunity for dealing with the emerging scenarios of the digitization of the construction sector, which contribute to determining logics of greater efficiency, linked to enabling technologies for the management of intangible components and information (Losasso, 2018).

The future paradigm of data as a constitutive element, albeit immaterial, of the built environment, capable of influencing its dynamics, processes, and way of use, has an intrinsic link with the social dimension of the architectural project for adaptation, as well as with the more extensive monitoring of the effectiveness of decarbonization measures, and therefore of mitigation.

Adaptation, Mitigation and psychological-social dimension | The pervasive diffusion of technologies for the aspects related to simulation, modelling, digital design, digital fabrication (Losasso, 2018), and the real-time monitoring of urban systems presupposes an integrated systemic and procedural approach (Losasso, 2018). The need to mitigate/adapt is closely related to the approaches of governance, knowledge, designing of physical aspects, but also intangible and behavioural values of relational aspects between individuals and the environment (Losasso, 2018). With this in mind, the environmental psychologist Robert Gifford (2011) underlined, in an eloquently titled contribution (The Dragons of Inaction), the psychological limits to full individual awareness of the risk deriving from climate change, as well as to the social acceptance of urgency of the adoption of policies related to climate mitigation and the adherence to 'pro-environmental' behaviours (Lacroix and Gifford, 2017).

For instance, the category of cognitive psychological limits includes barriers related to ignorance concerning the very existence of the problem or how to deal with it once greater awareness of these issues is achieved. Besides, it includes indifference to the need for the problem's solution, especially when it does not have repercussions that can be placed in a dimension close to one's perception, in spatial and time terms. It finally includes an excess of optimism or, on the contrary, a sense of powerlessness for dynamics that take place on a global level. Alongside this, the category of ideologies and individual views (political and religious ones) constitute another major limitation in this sense.

In particular, those linked to the excessive and mystifying trust in the 'self-regenerative' capacity of the natural ecosystem, or in a sort of false self-regulating equilibrium of current production systems (a kind of 'derivate' of the capitalist economic dimension in ecological key), often involve an overestimation of the ability of technology to make up for the lack of contribution that each individual must pro-

vide in behavioural terms from an environmental point of view. Finally, as regards the purely social dimension of 'non-action', complex dynamics come into play that concern the category of competitive confrontation with other individuals (which often leads to reduce or deny pro-environmental attitudes), as well as the tendency 'man to seek certain behavioural stability, avoiding the risks associated with the demolition of his own cognitive-relational comfort zone (among which the possibility of being derided following the adoption of a virtuous behavioural dimension from an environmental point of view), with evident repercussions also on the individual or collective psychological level.

Another interesting study links the theory of cultural cognition to the risks associated with climate change and psychological barriers previously introduced. Starting from an analysis of the literature, this research showed that there are no substantial links between adopting virtuous behavioural dynamics and age or gender differences. At the same time, higher education is more closely correlated with greater awareness of these issues (Lacroix and Gifford, 2017). The removal of structural barriers that do not allow the adoption of behavioural dynamics aimed at reducing GHG emissions into the atmosphere (such as, for example, widespread access to public transport) is, on the other hand, considered necessary but not sufficient for purposes of mitigation, made possible only through an effective change in individual behaviour.

The research, also conducted in an experimental form on a Canadian population sample, also highlighted how people who identify themselves in a 'community' dimension, which emphasizes the connection between the individual and the community to which they belong, perceive more the risks associated with the changes induced by the global rise in temperatures. Also, the aforementioned psychological barriers identified by Gifford seem to partially decrease in intensity to the tangible perception of the risk linked to climate change; in the same way, individual faith concerning the anthropogenic climate changes underway is closely related to the perception of the risks that derive from it (Safi, Smith and Liu, 2012).

With respect to these considerations, the well-known analysis by Alexander Langer (1994), according to which ecological conversion can only succeed if it appears socially desirable, underlines the interrelationships between individuals, society, technology and the environment, thus identifying the field of the urban and architectural design as a component of that 'social desirability', between adaptation and mitigation, risk reduction and improvement of the quality of the living environment. However, such recognition would require a major change in many sectors, making it difficult to be implemented, even if necessary. Only in a radically changed economic and social context – and, therefore, socially accepted – the action of the architectural project will will be possible and effective.

Adaptation can therefore be understood as implementation and prefiguration of the transformation and governance of space, capable of significantly affecting environmental quality through its ability to clearly contain the effects due to the occurrence of

discomfort phenomena in the urban environment. Thus, the perspective of mitigation becomes intrinsically systemic and no longer episodic, pursued through integrated interventions, which can be effectively measurable. In other words, the tangibility of the effectiveness of the adaptation of cities to the changes already underway (close to the user in spatial, economic, temporal, functional, and sensorial terms) could be configured as a 'flywheel' for the promotion of 'pro-environmental' behavioural dynamics and in terms of mitigating the causes of climate change finally.

The conscious contribution of the populations to achieve the decarbonization objectives set by national and/or global bodies could thus be more encouraged and shared. The effectiveness of adaptation at the local (micro-urban) level, also obtained through a conscious architectural project, would be maximized when this coincides with achieving the objectives related to mitigation (Tab. 1). However, it is clear that this perspective needs to be pursued radically and at a level that, in the first instance, is independent of the architectural project, but actually concerns the development of alternative economic models, territorial governance, policies for the ecological transition.

Conclusions | Although research in the field of climate change, as well as global political agreements (United Nations Framework on Climate Change Convention), have often understood the mitigation of the causes of climate change and adaptation to climate change as separate domains (Huang-Lachmann and Guenther, 2020), the complexity of managing the climate crisis, that cities will have to face in the coming decades, requires the synergistic combination of the two approaches. The effects deriving from the coexistence of adaptation and mitigation allow a more effective reduction of the flows of matter and energy in the urban environment. However, this result necessarily needs a monitoring phase that requires the collection and management of data, capable of highlighting, stimulating, and governing the patterns of consumption and exploitation of resources, connecting them with habits, lifestyles, social instances, technological and urban context.

On the other hand, as Enrico Giovannini (2016) recalls, what we cannot measure, we cannot even manage. Although it is a field clearly identified and described in scientific literature, actually, sustainability is challenging to measure (Giovannini, 2018). In other words, it is tough, both for citizens and for political decision-makers, to know and evaluate the consequences of choices, behaviours, and ways of producing on the urban environment. In this context, the development and refinement of the concepts and tools of Urban Metabolism can provide an important contribution to the ecological transition project. From this point of view, 'Smart' urban districts in a 'Smart' Environment describe a 'Smart' Urban Metabolism: the coexistence of ICT and 'stone cities' produces 'urban assets' which are constitutively different from those that history has given us (Faroldi, 2018).

Adaptation and mitigation together can allow decarbonization and orient the economy towards the change in the energy paradigm. To be clear, recent studies by Stanford

University (USA) have shown how the decarbonization of energy production is now technologically feasible on a planetary level (Jacobson et alii, 2017). However, effective climate neutrality can only be achieved through a radical transformation of current socio-technical structures, including energy and urban ones (EEA, 2019; Kristl, Senior and Temeljotov Salaj, 2020). Cities, in fact, constitute the place within which this transition must necessarily assert itself: « [...] There are no doubts cities play a decisive role both in the unsustainable aspects of current development and in the changes dictated by the transition to a green economy» (Tucci and Battisti, 2020, p. 1).

On the other hand, the energy transition requires a reversal of the current economic models since it is evident that there is a close connection between the practicability of mitigation strategies, which can no longer be postponed, and the transformation of the way of producing, therefore of living. In this sense, it is necessary to overcome the paradigm of growth at all costs. The key-point, emerging in the disputes between economics and health that fuel the public debate in this pandemic period, is represented by the inadequacy of an economic model which is now exclusively based on the quantitative growth of production and consumption. Without any social development, the changes in society are more apparent than real (Lefebvre, 2014). From this point of view, the general improvement of living and health conditions can become a key element with respect to the full effectiveness of mitigation strategies, as a promoter of a radically changed context, in which the 'pro-environmental' behavioural dynamics can find greater diffusion and consent. The energy and ecological transition, in fact, cannot fail to be based on an individual and general consensus, which overcomes the current condition of division between increasingly restricted economic and cultural elites and impoverished middle classes. Therefore, it appears unlikely that this process will start without overcoming the current concentration of wealth and political power (Milanovic, 2019).

Finally, the planetary scale of global warming processes requires a renewed vision of the relationships between nations, communities, and groups. As Bauman (2017) stated, a relationship between 'us' and 'them' takes note of the communion of interests that marks the Anthropocene era. The perspective through which the climate crisis must be faced can no longer be local (attachment to the small group) or global (progress that cancels diversity), but, as Bruno Latour (2018) would say, 'terrestrial', conscious the nature and extent of the ecological problem. Therefore, we can consider adaptation actions as a local expression of global mitigation strategies. Pursuing the objectives of mitigation requires, on the one hand, integration with specific adaptation actions, and on the other hand, the adoption of shared policies in a perspective of community development.

This development, put in crisis by the impact of global growth on the environment, brings into play widespread and diversified projects, including architects and urban planners' ones, which must find stimulus from transforming the economy towards decarbonization and closing the matter cycles. These are ambitious objectives,

not autonomously oriented by the economic system in its various contemporary declinations, from Western liberal capitalism to the Asian political one. In this context, the contribution of Smart Urban Metabolism to territorial governance and environmental design in the field of architecture (Losasso, 2018) can constitute an element of advancement towards this complex challenge. In this context, both the possibility of measuring and evaluating the effectiveness of adaptation and mitigation through the adoption of the concept of urban metabolism and the use of enabling technologies of Smart Urban Metabolism perimeter the field of action of the urban project. Therefore, it represents the most promising areas in the research development in the field of environmental design.

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INTELLIGENT INFORMATION SYSTEMS FOR THE REPRESENTATION AND MANAGEMENT OF THE CITY
Urban survey and design for resilience

Maurizio M. Bocconcino, Massimiliano Lo Turco, Mariapaola Vozzola, Anna Rabbia

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ABSTRACT
Recent emergencies have triggered a series of proposals, revisions and regulatory updates. In Italy, as part of the Italian Decreto Rilancio, a proposal to introduce a compulsory building file seems to have been accepted. If this proposal is followed up, we could soon see the collection of a series of data and information on the building stock of our cities. This contribution defines a proposal for the organisation of this systematic collection, suitably supported by advanced IT tools, to make possible the start of a renewed season of monitoring, management, planning and development of more resilient buildings and cities. The proposed idea is to channel the information and data on individual buildings into a single database that can provide a comprehensive, unambiguous and multi-scalar picture of the urban system.

KEYWORDS
integration of GIS and building models, representation and analysis at the urban scale, integrated planning, BIM, CIM

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Looking at the development and the changes that the urban environment is going to experience soon, it is clear that Italian cities need to be equipped with the technological and digital tools to face the management processes of the emerging model called 'smart city'. Modern cities will have to be able to plan new policies of expansion, conversion, requalification and improvement of the urban environment – starting from principles aimed at environmental, social and economic sustainability – and support the dynamic character of the socio-economic model that distinguishes our era. In this regard, modern 'smart cities' will not be able to do without management tools that provide integration between different methodologies, different technological tools and specific procedures that can provide digital models based on real data, on which to build development scenarios. The proposed idea is to convey the information and data related to individual buildings in a single database that can provide a comprehensive, unambiguous and multi-scalar picture of the urban system: from the individual building, the individual criticalities/opportunities, up to understand the entire urban organism in its entirety. This would allow the promotion of future targeted interventions, but well inserted in a systemic way in the urban and territorial context. Specifically, the discussion will analyze the possibility of managing the existing Italian building stock through the integration of geographic information systems (GIS) and building models (BIM).

With the so-called BIM Decree, Italian Ministerial Decree 01/12/2017 n. 560, in the short term we will gradually come into contact more and more with numerous digital building information models (Building Information Model), models that can monitor and hold together all in the phases of the life cycle of buildings (Fig. 1). As is often the case following traumatic events, the pandemic spread of Covid-19 has triggered a series of proposals, revisions and regulatory updates. In particular, in Italy, as part of the Italian Decreto Rilancio, it seems that a proposal to introduce a mandatory building file has been accepted. If this proposal is followed, soon we could see the collection of a series of data and information on the consistency of the building stock of our cities. This data collection, if combined with the use of BIM integrated with a geographic information system, would make possible the start of a season of monitoring, management, planning and computerized development of more resilient cities. From this point of view, the outline of the building file should contain a description of the building from a technical and administrative point of view, with information relating to the state of fitness, safety, plant equipment, maintenance actions, types of construction and energy efficiency parameters. A mass of data that, if put into a system, can provide, appropriately treated, a solid basis for decision-making.

The reflections towards an increasingly integrated management, and aimed more at the digitization of information relating to the urban environment, would marry the smart city philosophy, also aligned to the regulatory updates mentioned. Considering then that the mandatory BIM will allow to implement and complete the 3D database of the city, it would be appropriate to update and/or create integrated cartographic databases geo-referencing parametric digital models, ensuring a global vi-

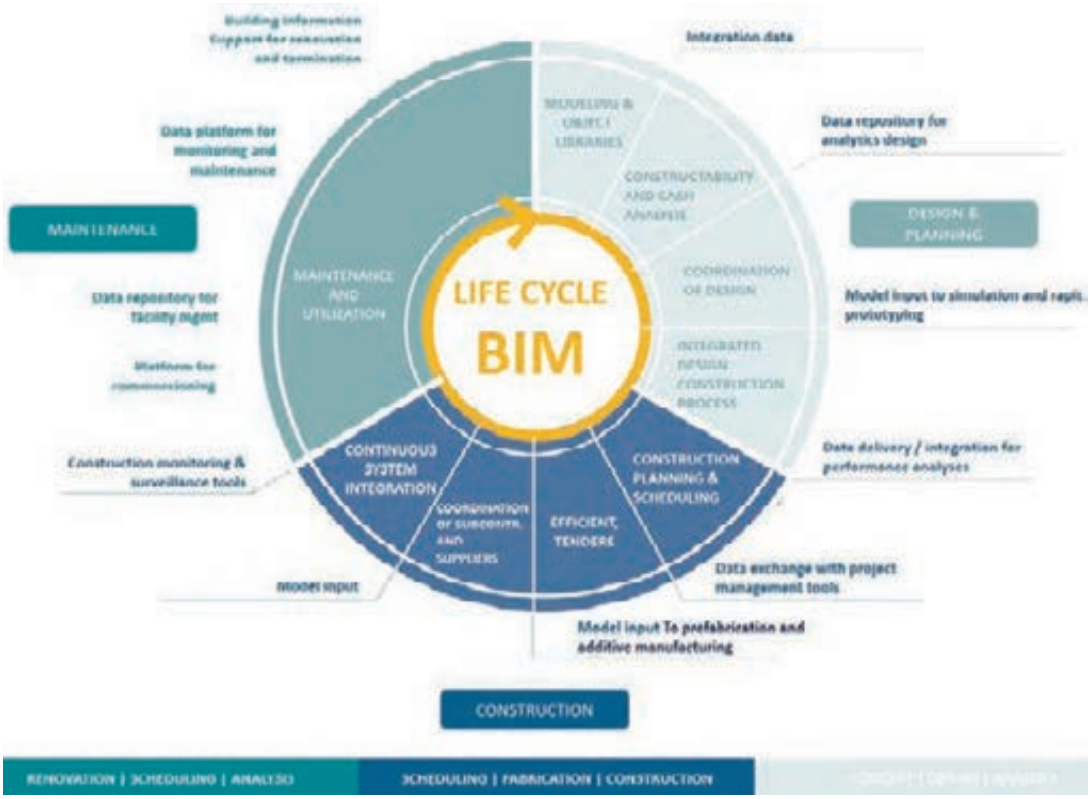

Fig. 1 | Diagram of the BIM model during the design, construction, and maintenance phases of the building artefact.

sion and monitoring of the city. In this scenario, the spatial context would be managed technically and technologically with GIS tools, a powerful set of tools capable of acquiring, storing, retrieving, transforming, analyzing and reproducing spatial data related to the territory (Burrough and McDonnell, 1986). The difficulty in retrieving data, to date, remains one of the most expensive obstacles in terms of energy and time, making the planning, programming and control of interventions cumbersome. The building file linked to the BIM model, inserted in a GIS environment, available and queryable in the different scales of representation, could instead be a real and new key to solve the problem of 'as-built' documentation (Vacca et alii, 2018), as well as to make the same processes of planning, programming and control of interventions more efficient. An interesting example of urban environment analysis is the Sun Solar City project in Bolzano (Comune di Bolzano, 2013). A WebGIS mapping in which the potential exploitation of building roofs is represented if photovoltaic panels for electricity production were installed there, to reduce per capita annual CO_2 emissions by 80% by 2030.

The case of asset management[1] | The implementation of the asset management process requires a significant amount of continuously updated information and data related to the different phases of the artefact's life cycle: data related to the design and review phases, correspondence between the actors involved in the decision-making process, maintenance records, information about modifications, and information on maintenance works are necessary to provide asset managers with a complete picture of the extent of the existing data archive for each architectural artefact (Kyle, 2001). This means that building asset managers should use a comprehensive and up-to-date system consisting of a digital data set that reflects the history and current state that has characterized and characterizes their building assets. Data collection is critical to the implementation of an asset management system, and the ability to collect detailed data enables effective asset management (Woodward, 1997; Vanier, 2001).

Building life cycle management needs to be supported by a precise and detailed set of information that differs from that contained within the traditional construction process (Häkkinen, 2007). To be able to analyze and interrogate data and information that characterize buildings within a single environment, it is possible to use work environments that process and make available all the information that characterizes the building in the different temporal phases of the life cycle, from the design, material procurement and construction phases of the building, acting as a collector of all the information needed for operations and maintenance (Howell and Batcheler, 2005; Campell, 2007). A BIM[2] model addresses these needs by allowing different hierarchies of information to be captured and managed depending on the time phase of the building (Fig. 2).

When dealing with the theme of management as a crucial moment for the maintenance and conservation of an artefact, the problem of the organization and diffusion of knowledge represents one of the fundamental methodological and conceptual aspects (Calabrese, 2020; De Pasquale, 2020). The analysis of the traditional procedures leads to an understanding of how the problem has been faced until now considering separately the two fundamental factors: the representation on one side and the description on the other side. Currently, it is no longer conceivable to analyze and manage a building heritage without a series of descriptive data and other data related to representation. In this regard, the BIM represents an immediate and continuous biunivocal contribution between descriptive data and graphic data related to the geometry of the buildings under analysis. It also allows to modify the collected data and to insert them in the database both in the alphanumeric and in the graphic field. On the contrary, the two descriptive frameworks are directly related to each other and therefore, regardless of whether the modelling or the changes occur in one framework or the other, they are updated automatically and simultaneously in both.

The tools to support the management of the built heritage | When you need to manage an existing building, or better still with an asset composed of several buildings, often fragmented, you have to face a series of problems quite different from those that must be

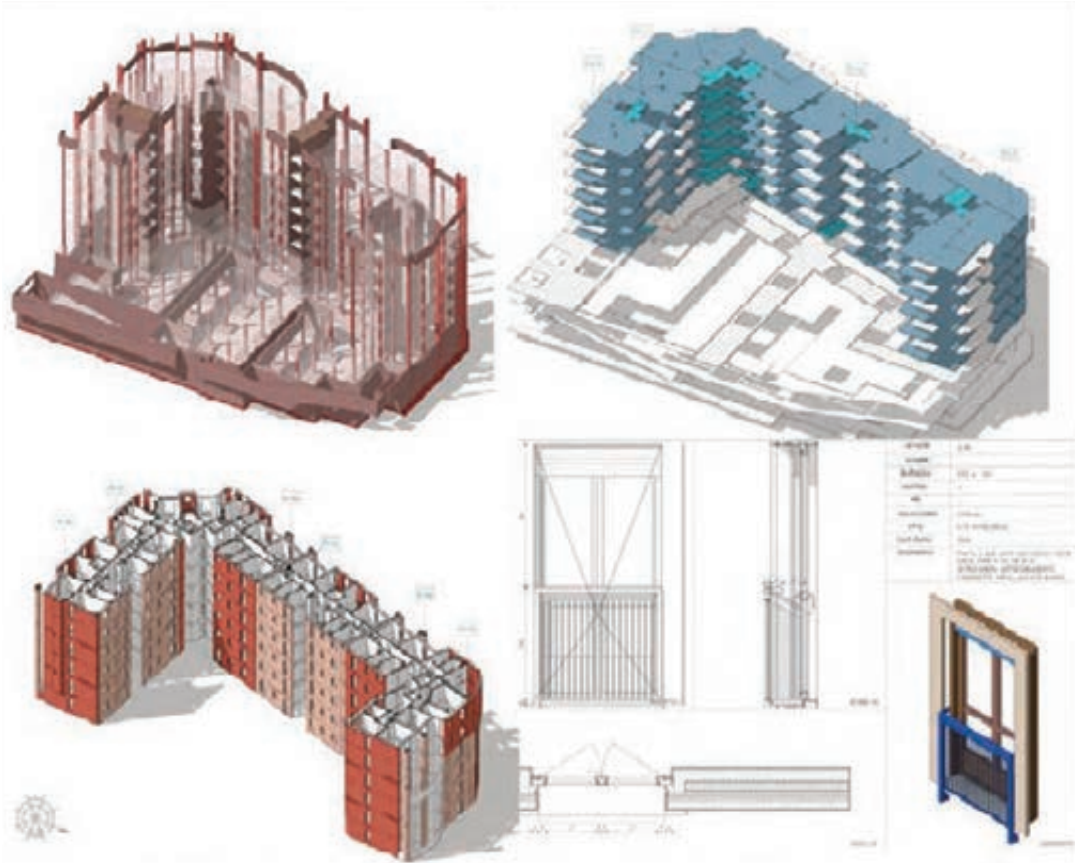

Fig. 2 | The project information within the BIM model (graphics by A. Alberti, 2014).

faced during the design and construction phases. Among the main difficulties, the management of information to be historicized and the plurality of technical and non-technical users involved in management and maintenance operations play a fundamental role. The two problems exposed can be solved by linking the BIM model of one or more buildings to a database or building management systems, such as BMS (Building Management System) and CAFM systems – Computer-Aided Facility Management (Dejaco, Re Cecconi and Maltese, 2017), or by linking the BIM model to the CIM[3] (City Information Modeling) model of the city in which it is inserted. The City Information Modeling represents the 3D model at the urban scale of the city, which within it collects the BIM models of individual buildings, the open-source information made available by the Municipality, related for example to public spaces, such as green and infrastructure networks, data related to roads, and also integrates within it all the information generated and implemented by the IoT through the sensors installed within the city territory (Fig. 3).

By linking BIM to CIM, users are provided with an interactive environment, rich in information and data, which can be communicated through ad hoc elaborated representations, such as 3D city models, alphanumeric graphs, thematic tables, etc., where the information in addition to being accessible to all, can be analyzed, queried and shared in real-time (Hisham, 2018). Internationally, some cities, such as the city of Singapore, are implementing CIM models of the city's urban fabric to improve land management and planning. The Virtual Singapore[4] project aims to collect in a single environment all the information related to the buildings and the context in which they are inserted: a dynamic three-dimensional model of the city area is being created, connected to a collaborative data platform, where all users, can enter data and BIM models of the buildings, to obtain a single working environment for public agencies, private citizens and researchers (Fig. 4).

The implementation of a CIM realized through the contamination of public and private information, as in the case of the city of Singapore, has great potential to address problems related to city planning and management both at the urban scale and at the architectural scale, related to the individual building. From a first analysis, depending on the type of user, the following advantages can be highlighted: a) professionals and Public Administration operators have the opportunity to collaborate in the decision-making process on urban planning, through the use of the data that populate the platform, which are dynamic, since they are constantly updated, returning a reliable snapshot of the urban and building fabric investigated; b) citizens have the opportunity to check in real-time the updates related to their real estate assets and receive timely feedback from the agencies and competent bodies in case of need; In addition,

Fig. 3 | Example of visualization of a CIM model (source: geospatialmedia.s3.amazonaws.com/wp-content/uploads/2018/05/CIM1.png).

Fig. 4 | Some visualizations of the Virtual Singapore project: from the analysis of roofs with solar panels to the identification of routes without architectural barriers (source: www.nrf.gov.sg).

Fig. 5 | Some images related to the City Model of the city of Zurich: the project developed by ETH scientists was realized through the combination of millions of images and videos (source: ethz.ch).

within the model at urban scale it is possible to evaluate the accessibility to public spaces, through the visualization of geometric data of the land, you will then have the identification and visualization in real-time of barrier-free paths for the disabled and the elderly; c) researchers and scholars will have the opportunity to query the system and create ad hoc thematic tables, in order to display information related to specific analysis, such as the analysis of the potential production of solar energy. The implementation of a CIM model today is, therefore, an instrumental prerequisite for the realization of sustainable city development, as has been widely documented by many scholars (Fig. 5).[5]

The realization of the file of the building: an example of case applied to the public heritage | Models are built to better understand and communicate complex realities: the organization and processing of data and information of the studied system need to build models capable of understanding and correlating document types, defining a series of attributes and qualities useful to the knowledge of the investigated area. During the design process, many models are built, for example, the architectural, structural and energy model, each of which represents, from a precise point of view, a semantically complete view of the system. In addition to being a fundamental aid to understanding, modelling is also a communication mechanism that allows different expertise to interact using a common language and to break down complex problems into smaller, manageable portions. The project modelling process provides an infrastructure and a set of methodological tools for understanding basic concepts and determining how and when a specific model, a precise view of the system, should be implemented and with what level of detail.

The application of the theoretical principles of the research to a significant case study, such as the social housing building designed and managed by ATC – Agenzia Territoriale per la Casa del Piemonte Centrale, consisting of 78 dwellings, built along the axis of Spina 4, in Via Fossata in Turin (Alberti, 2014; Fig. 6) was fundamental for the applied experimentation from which the problems to be solved and the proposals for innovation emerged (Fig. 7). This methodological approach will allow the subsequent export of the innovative results obtained to other public or private realities that daily manage huge real estate assets (Pesce, 2019). Today, BIM systems make it possible to draw great benefits from a wide-ranging evaluation of the interventions that can be programmed on public and private building stock, and therefore to analyze the effects that these interventions have in terms not only of architecture but also of urban planning. Through this tool, it will be possible to monitor the building resources and the prefiguration of architectural and/or urban planning solutions, to allow preventive evaluations of management and construction hypotheses.

From BIM to the Digital Building File | The Building File was introduced at the end of the ’90s with the Draft Law n. 4339-bis 30/11/1999 entitled Provisions on the Reg-

ulation of the Construction Market and the Establishment of the File of the Building. Within article 1 are collected the definition and contents of the file[6]. In February 2019, the Government introduced several new features on its contents: starting from the assessment of vulnerabilities from natural hazards to get to the reconstruction of the history of each building, analyzing the interventions of seismic and energy adaptation, to collect within a single document all the information to date in possession of different entities. The new demands have pushed the scientific community to look for possible solutions to draw up the document with the help of virtual work environments that contained within them all the data of the building during its entire life cycle. The BIM, in its meaning of AIM model, represents a possible answer to the new needs: the elaboration of the digital building file, in BIM environment, requires the definition, structuring and hierarchy of the data that characterize the artefact to translate them into informative attributes associated with the elements that make up the model. The same possibility of communicating information and data with different representations, such as two-dimensional, three-dimensional and abacus graphic representations (Fig. 8), will allow to dynamically manage information and data useful for the realization of parts of the file. The possibility of managing information related to spaces, with the automatic mapping of areas and destinations of use, finds multiple functions within the building file: from the management of areas for leases to the mapping of destinations of use up to the analysis of the exploitation of spaces (Fig. 9).

However, although the use of BIM for the realization of the digital building file turns out to be very easy and immediate, the BIM environment still turns out to be too rigid for the temporal management of the building process, and the realization of the project phases, turns out to be insufficient for the daily management of the building[7]: to meet this need it would be necessary to create a temporal phase for each day. It is possible to overcome this system rigidity by connecting the BIM model to a database or to a building management tool, such as BMS or CAFM, working environments in which the time attribute can be easily managed. The BIM model can be connected to the database through API[8], Application Programming Interface, creating a bidirectional link between the two working environments, which will allow for up-to-date and aligned working environments. If you connect model and database to a web service created ad hoc, i.e. a software able to share data between different systems that allow the exchange of data between the BIM model and web pages, you can create an interface for consulting data that is more immediate in updating and reading by various users (Fig. 10).

Conclusions | The contribution is intended as a brief overview of integrated tools capable of combining, integrating and exploiting the full potential of existing representation and monitoring systems. The conventional approach foresees the application of information systems – BIM and GIS – mainly in a sectoral way, addressing specific areas and departing from the principle of globality of the ‘smart city’ model. Promoting a combined use of these approaches, and thus outlining the features of the method-

Fig. 6 | Two images related to the building site of the residential building in Via Fossata in Turin (source: www.atc.torino.it).

Fig. 7 | The complete architectural model of the building for residential use of the ATC, located in Via Fossata in Turin (graphics by A. Alberti, 2014).

ology, would open the door to new design and planning methods capable of integrating interventions on a building and urban scale in a systemic way, favouring the interoperability of information (Avena, 2020; Mangon, 2020).

The coordinated use of information technologies for data and information management guarantees the restitution and monitoring of the human environment in the form

of a dynamic inter-scalar model. These representations would provide a concrete opportunity to serve the programming, planning, design and control of urban development interventions. By aligning with European directives, which promote the use of BIM methodology as a single tool for design, it demonstrates by extension the possibility of using privately produced models, not only to manage and monitor the building stock but also to plan future urban development according to the principles of sustainability. In fact, it would provide a tool that is consistent with the Smart City model, capable of reducing the timescales of the various processes, guaranteeing a more detailed level of information and ensuring the possibility of putting together elements that are difficult to compare. The parametric information model simultaneously 'records, archives, preserves' and 'represents, simulates, prefigures'. It does so at the same time as we operate, reflecting changes and variations in real-time. For this reason, a substantial part of the time dedicated to setting up the model is devoted to the study and preparation of the graphic codes and the sensitivity of the representation.

But the model also has limitations. One has to think about the boundaries of the model and keep them in mind. It does not operate in the round on the building process. An example: the first boundary is related to the use and implementation of the model in its geometric aspect, these are only open to a certain kind of skills; if I have to intervene in a designed way on the form, attributes and relations of the model, I have to have a certain skill. The first boundary is therefore related to 'competence', 'I must know how to do'. How can this first boundary be overcome? The preparation of the process must involve skills that do not necessarily have to operate directly on the geometric component of the model. I have to make the system 'more democratic', i.e. open up the BIM model to skills that might otherwise benefit from it.

A second edge of the boundary concerns this next aspect: from the moment in which I face a great cost for the production of the model (in terms of resources, tools and procedural apparatuses that govern the information flows), this must reverberate its effects, it must be reflected, in its use as widespread as possible (in the project, in the construction site, in the life of the work, in the file precisely); it is necessary to amortize the investment, and we do this at the moment in which we make the model accessible, appropriately approximated and reduced to only the aspects of interest) to the activities of maintenance and management of the built environment: we dilute the cost of building the model, we amplify its benefits. Finally, the digital information model presents, in this rapid and non-exhaustive treatment, another important margin of its boundary, connected to the risk of proliferating the number of parameters that must be associated with it, with a consequent reduction in the overall efficiency of the process.

Therefore, the need to overcome these limits becomes imperative, by associating another paradigm to the object-oriented one, the relational one, linked to the management of databases (Zhang et alii, 2009). This is the meeting point between model and database, this is the challenge that the setting up of a shared system of knowledge must face: the virtual exploration of the artefact within shared environments, such as

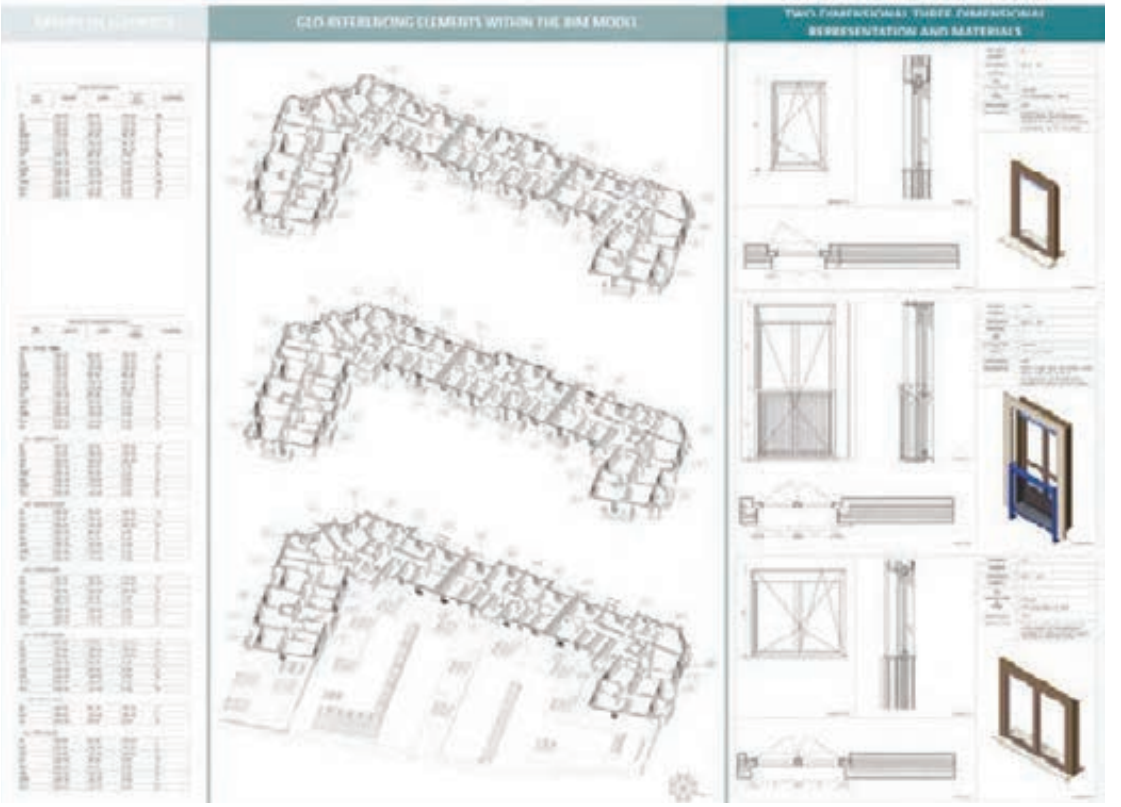

Fig. 8 | Example of the possible representations of the elements in the BIM environment: abacus of the external doors and windows, visualization of the elements within axonometric cutaways of the building levels and bi-dimensional and tri-dimensional representation of the doors and windows (graphics by A. Alberti, 2014).

the 'network', requires the identification of representation techniques dedicated to the interaction between professional and artefact: the possibility of exploring the model in spatial-perceptual terms (central projection) does not necessarily translate into speed and ease of access to the individual parts and therefore to the documents related to them. The information apparatus, in particular, that relating to the internal spaces of the artefact, is often more simply accessible by using parallel projections and planes that cut through the object (sections) or appropriate methods that allow parts to be made transparent for others. These aspects, which can be defined as navigation and data access within information systems, must also respond to standardised methods and procedures, and this is a frontier for future development.

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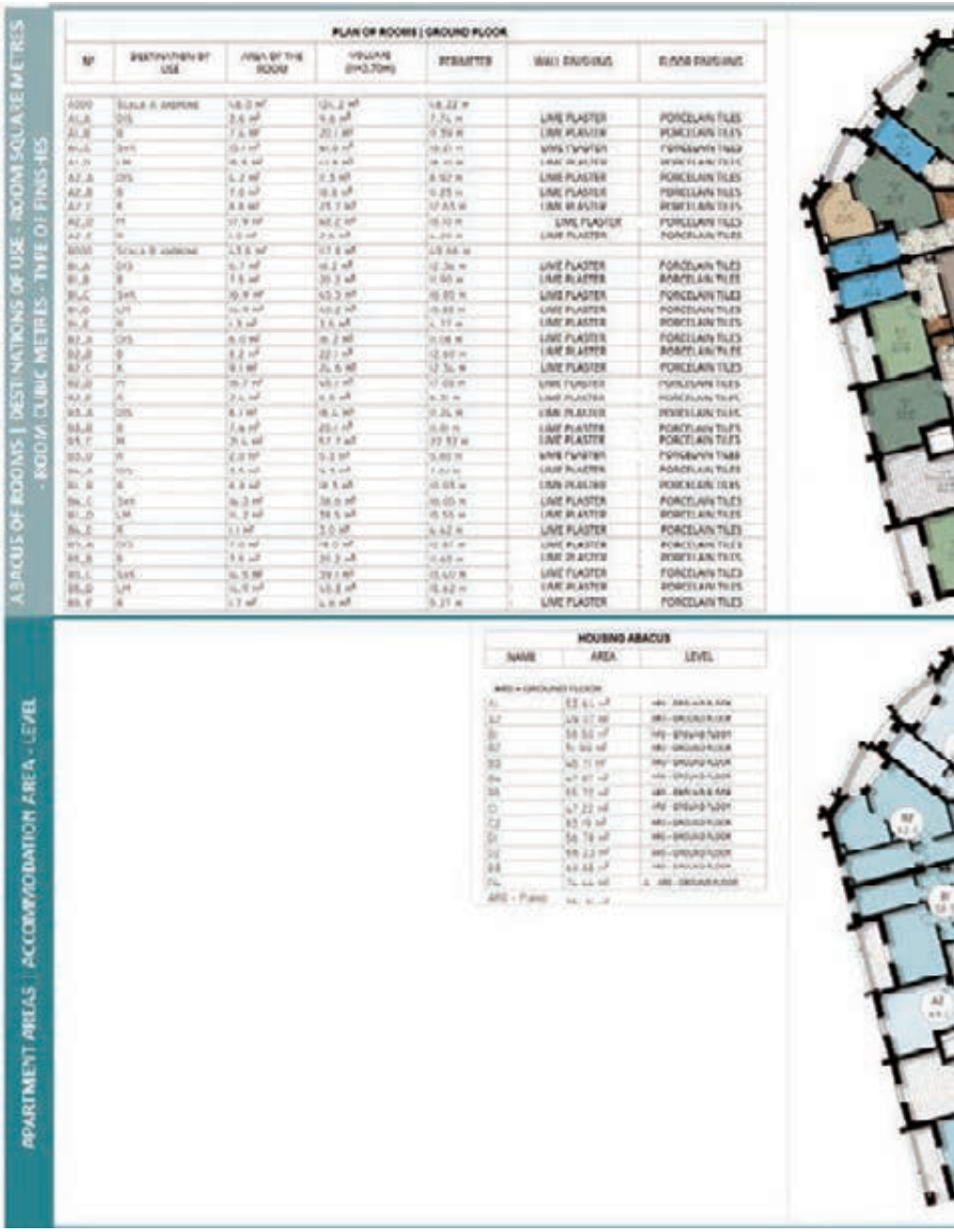

Fig. 9 | Abacus of rooms and abacus of accommodations in the BIM environment (graphics by A. Alberti, 2014).

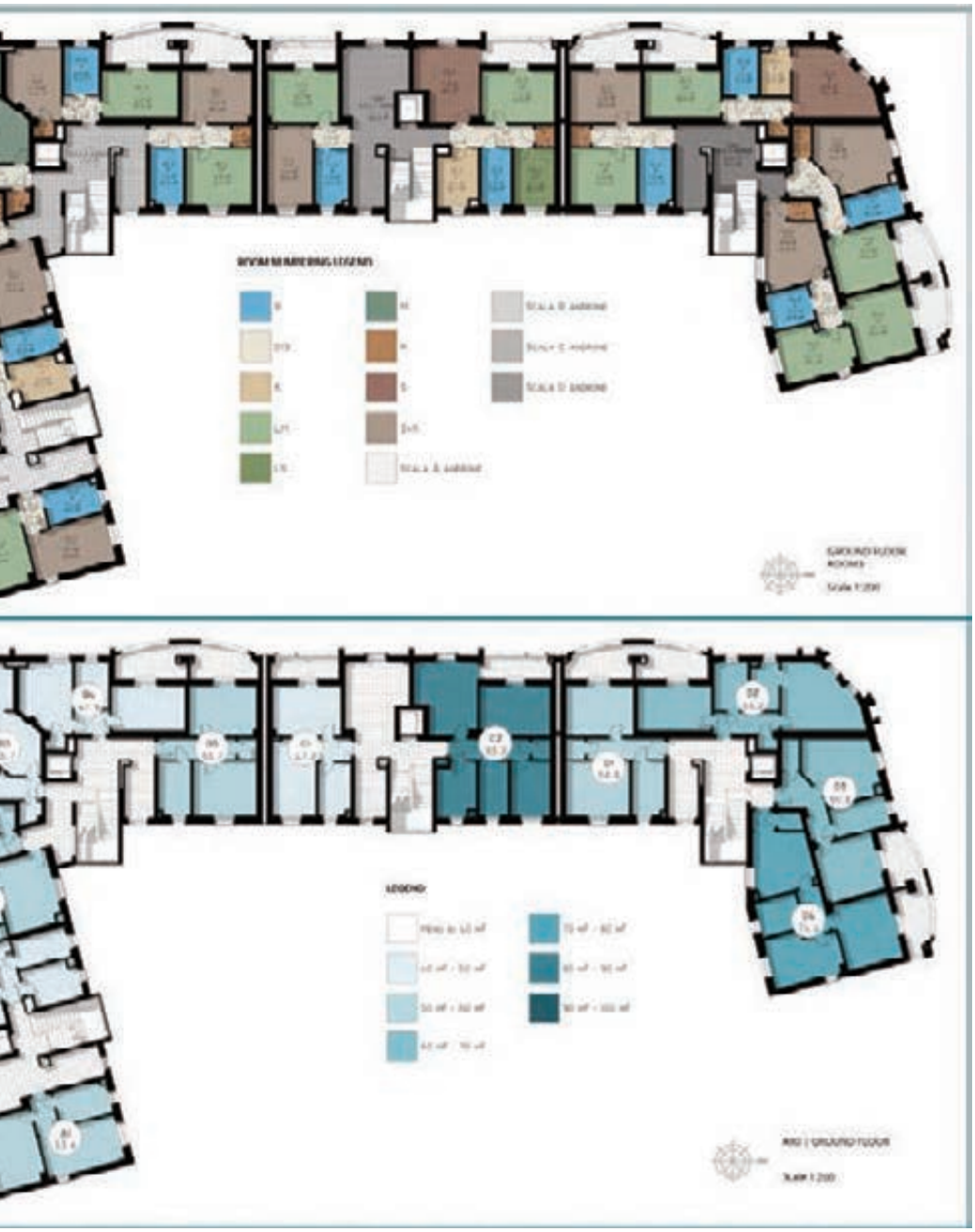

Fig. 10 | The artefact file: from BIM to CIM, with database and GIS support.

itage', 'From BIM to the Digital Building File' by M. Vozzola, the paragraph 'The realization of the file of the building: an example of case applied to the public heritage' by M. Lo Turco and M. Vozzola, and finally the 'Conclusions' by M. M. Bocconcino.

Notes

1) Asset Management is a term that refers to the management of assets, whether this is understood as asset management, resource management or administration of assets. The meaning we refer to in our text is the management of real estate assets.

2) At least 30 definitions and interpretations can be associated with the term BIM (Building Information Model) in the literature (Matějka and Tomek, 2017). As presented within the study conducted by P. Matějka it is possible to define three categories to classify the meaning of BIM. The first category corresponds to the basic understanding of BIM as a 'product', understood as a virtual building model, and the acronym BIM is interpreted as both Building Information Modeling and Building Information Modelling. The second category associates the definition of BIM with the introduction of a new 'method' of working, understood as a set of tools and processes for workflow management. The third category defines BIM as a 'methodology' for managing a building throughout its life cycle.

3) The term CIM was first introduced by Khemlani (2016) envisioning a digital representation of the city that would effectively support decision-making and analysis during natural disasters. It was later taken up first by Xu et alii (2014), who define CIM as a system for efficient city management to achieve real-time, centralized, and accessible sharing of information about various urban systems to improve the overall efficiency of urban management; and then by Amorim (2016) introduces City Information Modeling (CIM) as a system focused on city management, building design, planning, and monitoring, and is addressed as supporting the management of smart city infrastructure (de Souza and Bueno, 2019).

4) The Virtual Singapore project is available at: nrf.gov.sg/programmes/virtual-singapore [Accessed 25 November 2020]. Virtual Singapore includes 3D semantic modelling of buildings and infrastructure, including detailed information such as material representation; geometric attributes of terrain, water bodies, vegetation, transportation infrastructure, etc.

5) For example, in addition to the case of the city of Singapore, we cite the study by Dantas, Sosa and Melo, 2019.

6) The Italian Draft Law n. 4339 bis, of 30/11/1999, 'Disposizioni in materia di regolazione del mercato edilizio e istituzione del fascicolo di fabbricato' (Provisions on the regulation of the construction market and the establishment of the file of the building), in Article 1 states: 1) It is established, concerning each building, the file of the building. This file is prepared, updated no more than ten years and kept by the owner or administrator of the condominium. On the file are noted the information relating to the building of identification, design, structural, plant, to achieve a suitable framework of knowledge from, where possible, the construction phases of the same, and are recorded changes made compared to the original configuration, with particular reference to the static components, functional and plant. 2) The production of the file of the building, duly updated, is a prerequisite for the issuance of permits or certifications of municipal jurisdiction relating to the entire building or individual parts thereof. At the time of the conclusion or renewal of lease agreements, as well as in case of alienation of the building or individual building units is made, by the owner and the administrator of the condominium, a declaration about the fulfilment of the obligations under this law. 3) The compilation of the file of the building provides a qualified technician based on technical-administrative documentation provided by the owner or administrator of the condominium or, if necessary, after the acquisition of additional knowledge, surveys and measurements. 4) The acquisition at public offices, at the central and local level, of the technical-administrative documentation necessary for the preparation of the file of the building, takes place without charge for the party concerned. For more information, see: senato.it/leg/13/BGT/Testi/Ddlpres/00004628.htm [Accessed 25 November 2020].

7) BIM technology is based on the 3D modelling of the building and the possibility of expanding the representation of the building to 4D, 5D, 6D and 7D, as also defined within the UNI 11337 standard. In particular, the dimensions added to the 3D model can be summarized as: 4D – Temporal Management – the introduction of the time factor, allows to plan the phases of life that characterize the artifact; 5D – Economic Management – the quantification of costs: through the 3D model and 4D it is possible to have control over the costs in the different phases of life of the building; 6D – Life Cycle and Maintenance – the management of the artifact during the phases of the life cycle, useful for the evaluation of the components that constitute the artifact: from systems to finishes; 7D – Sustainability – Sustainable Development – with this dimension there is the possibility to introduce the analysis of energy consumption of the building; analyzing from the earliest stages of design the energy performance that allows to adopt more efficient and effective technical solutions in order to obtain a manufactured product with the lowest energy consumption and ensuring the sustainability of the project (Barbagallo, 2018).

8) To link the BIM model to the database, it will also be possible to use plugins made ad hoc by the different software houses – for example for BIM models processed in Revit Architecture, it will be possible to use Revit DB Link, which allows managing a relationship between a Revit project and a Microsoft Access, Microsoft Excel or ODBC database.

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THE SUSTAINABLE PROJECT
Requirements and design strategies

Cristiana Cellucci

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ABSTRACT
Although sustainability has become a key concept in many fields in recent years, its definition is possible for various misunderstandings that have fuelled 'specialisms' on issues of ecology and the environment. The emergence of a systemic vision of sustainability and an approach anthropocentric/global that place the psycho-physical-social well-being of the user and the ecological-environmental well-being of the planet at the centre of the transformation processes, has led to a convergence between Sustainable Design and Healthy Design. The paper, therefore, wants to argue that sustainable design can be defined as appropriate participation (salutogenic) in the process of social, ecological, and environmental development of a particular place. Starting from these considerations, the paper identifies tactical macro-requirements at the methodological/theoretical level as drivers/vectors of sustainability and the tactical/operational level families of project actions.

KEYWORDS
biocentric approach, anthropocentric approach, bio-psycho-social approach, psycho-physical-social well-being, environmental well-being

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Sustainable is one of the most abused adjectives in contemporary culture and, more generally in mass communication, which finds a multiplicity of misleading interpretations in architecture and development policies, sometimes excessively unbalanced on the performance capabilities of individual interventions and on the application approaches based on the philosophy of the Performance-Based Design (LCA, UNI/EN-ISO, protocols, LEED certifications, BREEAM, ITHACA), and little rooted in the social and human factors which form the support fond active (User-Centred approach, Universal Design, Inclusive Design, Design for all). The first position on sustainability open to socio-economic issues was taken by Shaler in 1905, when he emphasized the moral obligations of each generation towards the future and linked the sustainable urban environment to a built environment process that promotes economic development while safeguarding the health of individuals, society and the ecosystem without wasting resources, or rather a collective process through which the built environment reaches new levels of socio-ecological balance (Shaler, 1905).

If despite these reflections have opened to a more mature sustainable architecture season that explores the space we inhabit as a habitat in which interacting components – ecological, social, technical and economic able to improve the livability, the inclusiveness, the psycho-physical well-being, the health of its people and ultimately the quality of built environment – this more comprehensive view of sustainable design seems, however, seems to show a less effective within urban contexts in which it could play a strategic role. The consolidated city, while continuing to attract population, continues to lose healthiness: 1) in the collective spaces often unable to cope with the phenomena of environmental vulnerability (problems related to the impermeability of the soils, urban heat islands, etc.); 2) in enclosed spaces (often disabling in the face of the vulnerability of user needs and to the evolution/involution of his skills); 3) in social relations (considering the users as simple 'consumer' and not active 'participants' in the processes of transformation of the built environment).

The paper starting from a reading of the evolution of the theoretical approaches to sustainability outlines a possible convergence of Sustainable Design and Healthy Design. According to this integrated model of 'sustainability-health-well-being', the object of sustainable design is, therefore, the human-designed system-environment interactions, whose relations with the conditions of economic, social and environmental vulnerability can favour or hinder conditions of anthropo-dimensional and psycho-physical well-being, anthropo-dynamic and social well-being and ecological-environmental well-being. Compared to these three classes of requirements intended as the main objectives sustainable design, the paper aims to identify tactical macro-requirements at the methodological/theoretical level as drivers/vectors of sustainability and families of project actions (that they act at the scale of the public space and at the scale of the building) at the tactical/operational level. The requirements and families of actions identified constitute some first indication not to describe all possible lines of intervention to reorient project interventions in urban areas towards the healthiness and sustainability.

Approaches to sustainability | The concept of sustainability is today – as to quality has been about twenty years ago – vague and difficult to define but crucial to the development and competitiveness. In recent years, sustainability has become a key concept in many fields: this term summarizes the tone and meaning of the experiences that take place in the sphere of economics, finance, production, advertising and architecture. The broad consensus has not prevented the issue of sustainability to be the centre of many debates, because its definition can be the object of various misunderstandings and this lack of clarity background has fuelled numerous disputes on the subject (Engelman, 2013). Misunderstandings that can occur: 1) at the level of communication, since the communication (for its persuasive and evocative nature) has simplified and trivialized the concept of sustainability by identifying it with a hypothetical 'environmental value' which calls for a correction of the dynamics of economic development (greenwashing marketing, sustainable production, sustainable market, sustainable building); 2) at the interpretative level of the term, linked to the different definitions and translations in the individual languages. Relevant is the difference between the English term 'sustainable', the German 'nachhalting' and French 'durable' (lasting), generally used to describe the same concept. While the ideals of sustainability can historically be traced back to a harmonious balance among people, nature and society (Gottlieb, 1996), the modern concept of sustainability has evolved according to two approaches: biocentric and anthropocentric approach.

The biocentric approach was undoubtedly dominant in the evolution of the concept of sustainability, starting with Malthus's essay titled 'Essay on the Principle of Population' (1798) and in subsequent studies, by David Ricardo (1772-1823) and Kidd (1992), it states the complementarity between 'human capital and natural capital' which is the basis of the theories on 'limits to growth', on the 'scarcity of resources' on the salvific role of 'technical innovations' to compensate for any imbalances (Kidd, 1992; Meadows et alii, 1972; Ordway, 1956). This approach leads, in more recent times, to an interpretation of the relationship between man and environment, generating products (of the green economy which is replacing brown economy) and currents of thought/movement (the environmentalism, ecology, ecosophy, the bio-architecture, green building; Valle, 2011), unbalanced, in general, on environmental issues, particularly in construction on the efficiency of individual devices (energy-efficient buildings entities) and little on the effectiveness of the measures taken (increase in built-up space in the face of a demographic decrease). In the words of Ian McHarg (1989), this type of attitude leads to 'misunderstand the map with the territory' and to describe through empirical and normative data (LCA, UNI/EN-ISO standards, protocols, LEED certifications, BRE EAM, ITACA) only a part of a much more complex reality.

The first anthropocentric position was taken by Shaler in 1905, when he emphasized the moral obligations of each generation towards future generations, anticipating the more commonly accepted definition of sustainable development, formulated many decades later (WCED, 1987). Other scholars have extended this line of reasoning by

emphasizing the role of man not only in consuming resources but also in degrading them (Kidd, 1992), juxtaposing humanity's 'ethical duty' with the scientific observation of its negative impacts. With 'the principle of responsibility' (Jonas, 2009) the need to consider the future consequences of his choices for each human gesture is underlined. In several studies (Schumacher, 1973; Kidd, 1992; WCED, 1987) sustainability becomes inclusive not only of environmental objectives but also of economic and social issues, passing from a specialized approach to an anthropocentric/global approach that positions user at the centre of transformation processes. In 1978, Sachs provides the most comprehensive view of sustainability and sustainable development (which he calls 'eco-development'), arguing that social, economic and environmental values are intrinsic elements of sustainability (Kidd, 1992) understood both as a descriptor and as an objective of sustainable development (Bell and Morse, 2008). The Brundtland Commission adopts Sachs'definition (1978) of ecological development to define sustainable development as «[…] is development that meets the needs of the present without compromising the ability of future generations to meet their own needs» (WCED, 1987, p. XXXII).

The expansion of the concept of sustainability has led to a diversity of views and 'specialisms' on the issues of ecology and the environment rather than considering the environment as an organism and its functioning as that of a system, in which every single part participates to global equilibrium and interferes with it. With the affirmation of a systemic vision of sustainability and the awareness that the changes imposed by sustainable development have a material (biophysical and ecological) and immaterial (psychosocial and conscious) dimension, it emerges how the complexity of psychological, social and ecological problems, that interact dynamically and drive the growth of an unsustainable human civilization, cannot be properly understood or resolved by fragmented and specialized thinking. It materializes the need to define interpretative models that help to formulate a synthesis of meta-level in that they draw insights from a wide range of disciplines and connect theory and practice. In this compound, the Integral Theory (Wilber, 2001) and the Integral Ecology (Hargens, 2007; Zimmermann, 2007) is the first attempt to multidimensional approach that considers in their mutual interdependence four perspectives (objective, inter-objective, subjective and intersubjective) that must be consulted when trying to understand and remedy environmental problems (Fig. 1a). The prospects correspond to four quadrants: the inside and the outside of the individual and collective realities – representing the intentional aspects (I), cultural (we), behavioural (it) and social (its) of ecological issues (Fig. 1b) – supported by un multidimensional approach (Fig. 1c) that integrates subjective (e.g. psychology, art, phenomenology), interpersonal (such as religion, ethics, philosophy) and objective realities – e.g. behaviour, science, systems analysis (Fig. 1d).

A new biopsychosocial approach to sustainability emerges which, if applied to building and urban design, leads to consider the designed systems (open, closed and

produced spaces) as dynamic/complex organisms, in which each part is related to everything, according to a holistic model with respect to which each design action on such systems produces an echo or a cascading effect on the well-being of users and the health of the planet. In conclusion of this reading on the evolution concept of sustainability, a synergy emerges between sustainable planning and planning for the well-being of man and the health of the planet, so that what we try to 'support' is the underlying model of health, resilience and adaptability. Therefore, sustainable planning activity, both in its more experiential (physical and perceptive) aspects and in its performative (Ryff, 1989) and formal (Olgyay, 1963; Arnheim, 1977), and finally in operational/participatory terms (Friedman, 1971), it aims to explore, understand and systematize 'human experience' and user expectations; adopting design solutions based on inputs referring to a plurality of disciplinary sectors (anthropometry, ergonomics, proxemics, physiology, sociology, psychology, etc.) to ensure the best living conditions and well-being for users. Systemic health is a property of complex dynamical system and because the complex systems on which our lives depend – ecological systems, of community, economic and our bodies – they all have emergent properties, one of which (the first) is health and well-being, the theoretical contribution that this paper wants to support is that sustainable design can be defined as appropriate (healthy) participation in the social, ecological and environmental development process of a given place.

Design for human and planetary health for the transition towards sustainability | Well-being and health represent a key objective of sustainable development to achieve a good quality of life for all people as underlined by the World Health Organization, which highlighted the conceptual transition from health as the absence of disease to that of psycho-physical and social well-being (WHO, 1998, 2007) and the central role of design in making the physical/social/economic environment favourable to health (WHO, 1991; Fig. 2). The health not only of the individual but the ecological/social health allows diversified cultural expressions (Norton, 1992), facilitates the development of a healthy and learning community to co-create modes of interaction and of sustainable relationships within the limits and the opportunities established by the local ecological and social conditions of a context. There is a powerful synergy between health, environmental protection and sustainable use of resources. «Individuals and societies who share the responsibility for achieving a healthy environment and managing their resources sustainably become partners in ensuring that global cycles and systems remain unimpaired» (WHO, 1992, p. XXX).

The health of people and the planet depends on the ability to understand and manage this interaction between human activities and the physical/biological environment, «[…] we have the knowledge for this but we have failed to act on it although we have the resources to meet current and future needs sustainably» (WHO, 1992, p. XIV). Such inability of humanity to engage in healthy planning (generating health)

fig. 1a The four quadrantes

fig. 1b The four terrains

fig. 1c . Some schools of ecology organized by the four terrains.

fig. 1d . Eight methodological zones.

Fig. 1 | Integral Ecology Approach by Sean Esbjörn-Hargens and Michael E. Zimmerman, 2007 (credit: reworked C. Cellucci).

and to cooperate globally and locally, aimed at the development of a sustainable civilization, is mainly due to the prevalence of 'the individual' over the 'collective', to quantitative rather than qualitative growth, to the lack of participatory and co-creative involvement of users in the complex design process. This challenge appears necessary above all in the urban environment where the balanced development of People/Planet/Profit must, more than anywhere else, deal with the change, vulnerability and fragility that characterize today: people (the ageing of the population, the crisis of the family structure, the temporary use of the city and living spaces, the socio-cultural mix and the change of needs and priorities); the planet (urban heat island effect, air pollution, landslides, drought, water scarcity, violent and short-term rainfall); and the profit (changes in employment relationships, labour market crisis, the

advent of new low-cost and increasingly mobile communications technology rapidly on a global scale).

More generally, sustainable design can be defined as appropriate participation in the social, economic and ecological process, the adequacy of which should be judged on the extent to which a given project guarantees flexibility, adaptability, health and ultimately the resilience of the system as a whole. From this perspective, which aims to integrate social and economic realities into their wider ecological context, the notion of sustainability and the idea of maintaining and restoring a healthy and therefore resilient environment – at the community and ecosystem level – are inextricably linked (Fig. 3).

Design requirements | The object of sustainable design is, therefore, the human-designed system-environment interactions, where the designed system can be a technological system, a building component, a domestic tool, a service, and the environment is a place or a situation in which it takes place the activity. These relationships depend on a series of factors, some of a subjective nature that are difficult to control, and others that can be influenced by the project. We can identify two groups of variables that influence these relationships: 1) Internal variables: the uncertainties regarding the social and economic context, relating to the variability of user needs and the satisfaction of cognitive and functional needs; 2) External variables: the uncertainties on system performance about the vulnerability of the context (environmental disasters such as earthquakes, floods, hurricanes, effects of climate change).

The set of relationships that develop between these two groups of variables can favour or hinder the conditions of: 1) Anthropo-dimensional and psycho-physical well-being understood as an attitude of a system designed to facilitate the use, through sensory perception (visual, olfactory, tactile and acoustic) of the environment by the user in the performance of activities and through the aspect anthropo-dimensional space and its equipment to ensure the ease of use of the designed systems; 2) Anthropo-dynamic and social well-being understood as an attitude of systems designed to become a privileged place of social exchange or 'healthy environment' as places that support healthy lifestyles and behaviours; 3) Ecological-environmental well-being understood as an attitude of system designed to develop maintenance capability, systems mitigation and regeneration continuous of biotic components even in the presence of variations (extreme and/or extraordinary) induced to the system from internal and external factors/agents. From these considerations, it is possible to define a methodological/theoretical level of macro-tactical requirements as drivers/carriers of sustainability articulated compared to three main categories of needs. In the classes of requirements of anthropo-dimensional and psycho-physical well-being the relationship between the following macro-requisites can be placed:
– Usability, Universality, Adaptability for Identification – Aptitude of a system designed to allow the carrying out of activities as it is appropriately sized (ergonomics, anthropometry), usable by an increasingly wider user (Universal Design, Design for

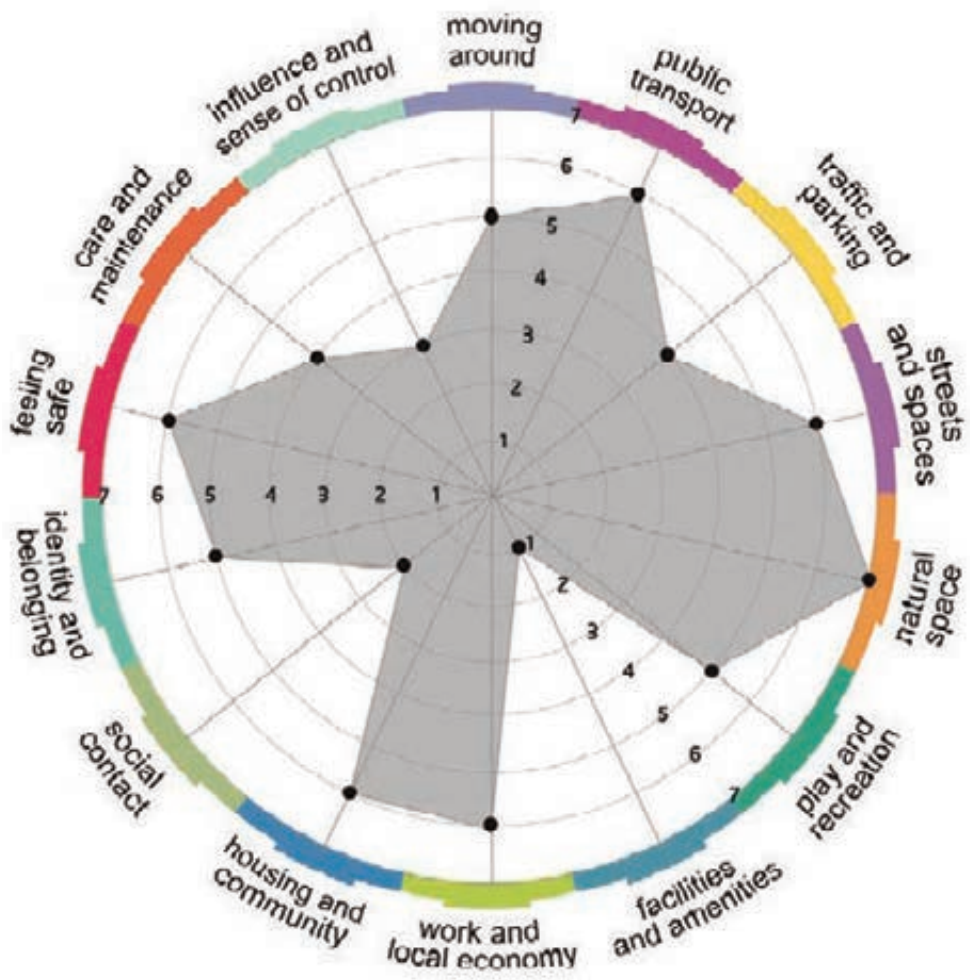


Fig. 2 | The Place Standard tool used to evaluate the quality of a place (credit: www.placestandard.scot).

All, Inclusive Design) and adaptable over time to the variability of user needs and consequent changes of use (Flexible Design, Adaptive Design); the correlation between these requirements allows the affirmation of the principle of identification by which the user recognizes the system of object spaces as an expression of his own identity and culture;

– Well-being, Safety and Liveability for the Centrality of the User – Attitude of a system designed to enable the performance of activities in conditions of the comfort environmental desired independently of the variation of the external factors, through the consideration of the physical and psychological reactions consequent to environmen-

tal stimuli of luminous nature, aural, spatial and biological investing subjects in the use of the built spaces, in order to guarantee psycho-physical well-being, the protection conditions (safety of use and perceived safety) with respect to the incidence of particular external factors and ultimately the liveability of the spaces; the correlation between these requirements allows the emergence of a user-centred design capable of dealing with the 'human scale', understood as the ability of the physical elements to relate to the user not only in proportional and metric terms but also in metabolic and physiological terms (User Centered Design).

In the classes of requirements of anthropo-dynamic and social well-being, we can place the macro-requisites of:
– Correlation, Flexibility and Evolution for Creativity – Attitude of a system designed to allow programming of its life cycle and its degrees of transformability to adapt it to any living dimension, from the individual to the collective one; this involves the provision of spaces that can be used for different functions over time and the preparation of plants and technical systems compatible with the variability of the possible distribution structures, the alley relations between equipment and spaces, the redefinition of surfaces within the limits of structural constraints through phases of extension and contraction of the space designed according to the variability of user needs; The correlation between these requirements favours the user's creativity, therefore, the ideation, experimentation, development and implementation of new organizational forms, procedures and production processes to face the change (the concept of prosumer formulated by Marcel Mauss);
– Co-creation, Co-responsibility, for Co-design and Co-production of value – Attitude of a system designed to allow the development of forms of co-creation with collective actions through which citizens transform the space in which they live to adapt it to their needs by sharing responsibilities, through Self-Help actions (small interventions promoted by the local community), Partnership (collaborations with public institutions), Consultation (mild participation in the decision-making process); the correlation between these requirements favours the co-design and co-production of value.

In the classes of requirements of ecological-environmental well-being, we can place the macro-requisites of:
– Reversibility, Maintainability, Disassembly, Recycle, Reuse for Environmental Compatibility – Attitude of a system designed to allow its disassembly, through the use of constructive solutions and innovative-sustainable building components that can be easily modified, upgraded or replaced at cost and in a short time and ready to vary in their structure to redefine dynamic conditions of equilibrium with the environment and with the needs of the user; the possibility to disassemble the component at the end of its operating phase, using the minimum amount of work and energy and generating the maximum amount of reusable and/or recyclable materials and the minimum amount of heterogeneous waste involves the possibility to activate new cycles use, through natural functional cyclical processes and to favour supply chains/cycles

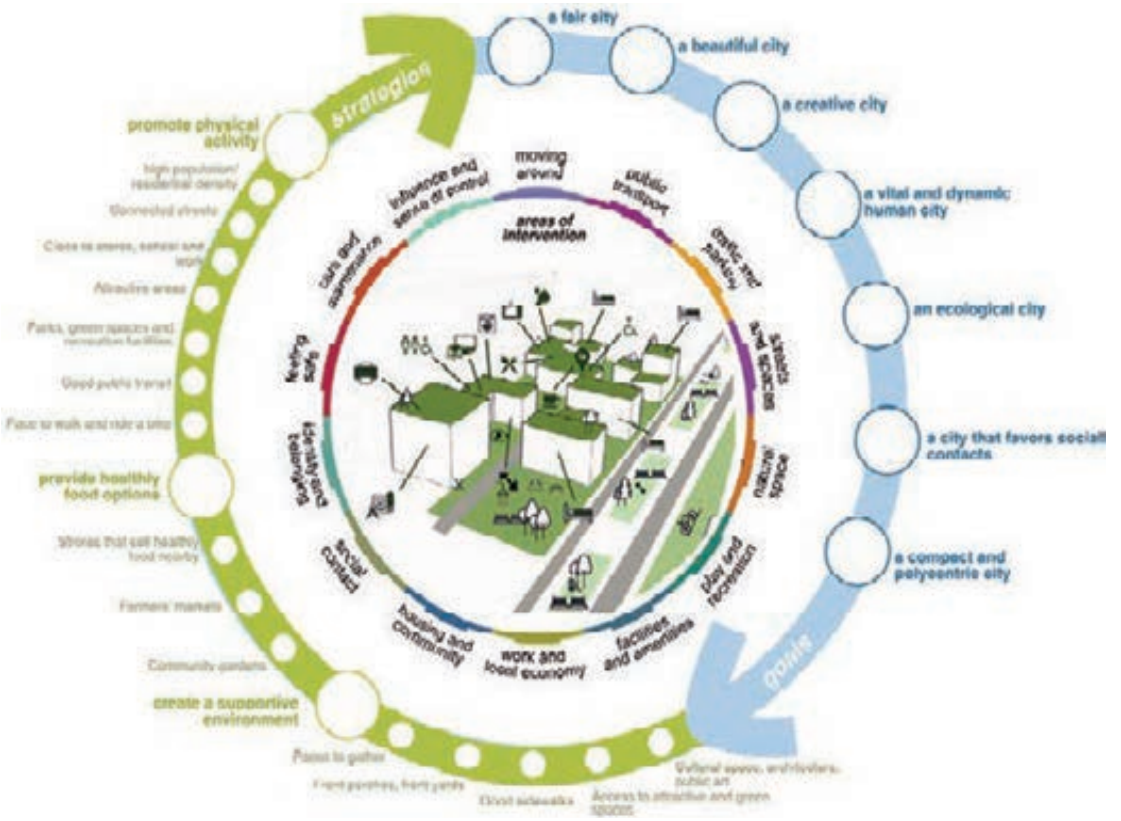


Fig. 3 | Relationship between goals/strategies/areas of intervention for a sustainable/healthy design approach (credit: C. Cellucci).

Next page

Fig. 4 | Diagram of design actions at the urban and building scale (credit: C. Cellucci).

of reuse, recovery and recycling of materials and energies in artificial processes; the correlation between these requirements favours the protection of the environment as a function of sustainability that goes from energy saving to control the reuse cycle (Bologna, 2002; De Capua, 2002);

– Connectivity, Heterogeneity, Mitigability, Coevolution for Reactivity – Attitude of a system designed to establish a dynamic interaction between natural/artificial components and systems to ensure on the one hand the maintenance of biodiversity and structural complexity of natural components and systems through actions to mitigate external vulnerability phenomena and on the other hand evolution collaboration of natural/artificial components of the urban environment able to guarantee processes and organizational forms to face changes; the correlation between these require-

Anthropo-dimensional and psycho-physical well-being

Usability

Identification · Universality

Adaptability

Well-being

Centrality of the user · Safety

Liveability

Anthropo-dynamic and social well being

Co-relateability

Creativity · Flexibility

Evolutivity

Co-creation

Co-design · Co production · Co responsibility

Ecological-environmental well-being

Reversibility

Reuse for Environmental Compatibility · Disassembly

Maintainability

Recycle

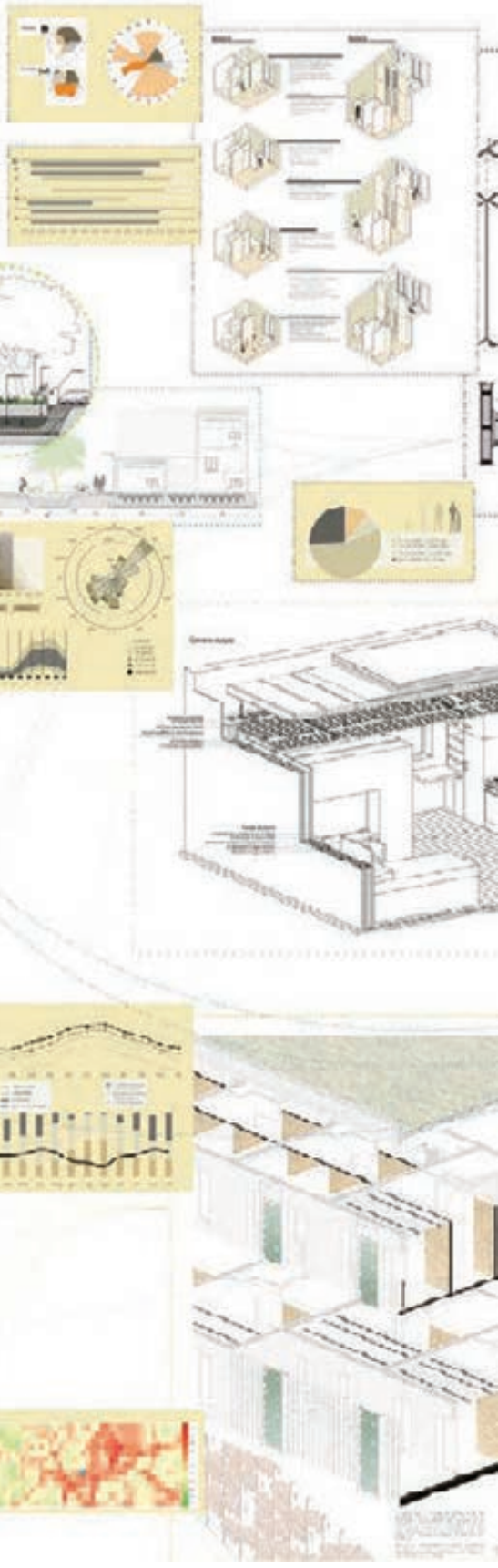
Reuse

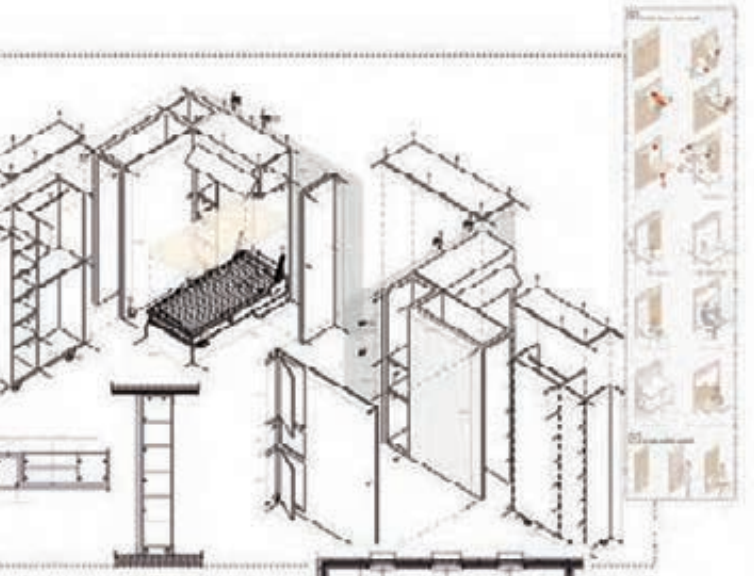
Connectivity

Reactivity · Hetorogeneity

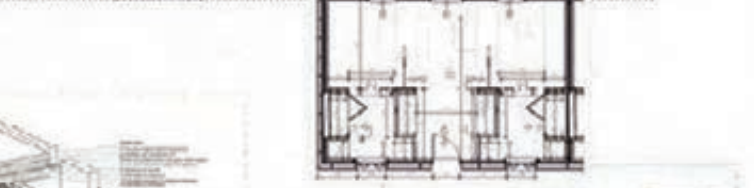
Mitigability

Coevolution





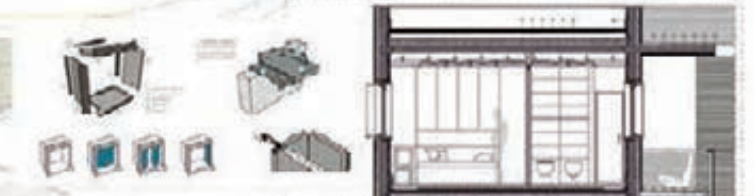
facilitate the transformability of the space according to the different users



hinder the processes of technological obsolescence through the replacement / updating of components

absorption of fine dust, oxides and nitrates, carbon and other harmful gases

storage and drainage of excess rainwater



compensation of solar radiation

alteration of the Albedo of surfaces

attenuation of the wind speed on external surfaces and consequent reduction of heat losses

improvement of thermal resistance

ments favours the development of reactive systems to ecological, social and economic changes.

Project actions | From a tactical/operational point of view, the requirements are applied in design actions aimed at achieving a condition of comparison, on several scales, between physical elements and users, acting not only in a spatial-three-dimensional sense but also in metabolic and physiological terms, through enhancement and improvement of psychophysical relationships between the bright environment, sound, spatial, biological, social and people (Schiaffonati, 2011; Friedman, 2014). Concerning the consolidated city that is increasingly the object of loss and in terms of health it is possible to identify families and project actions (Fig. 4).

At the building level, the project actions will concern: a) Respond to the variability of user needs. Working through flexible, extensible and integrated to the building scale, favouring planning actions to promote the 'adaptability and supporting extensibility, extension/reduction of the living space according to the evolution of user needs, giving back all at present an organizational 'spontaneous luxury' (Druot, Lacaton and Vassal, 2004); b) React to the variability of external conditions by welcoming regulatory solutions (brise soleil customizable) and modular components that can be easily maintained, replaced and integrated with the changing needs of users, internal functions and external climatic conditions, according to an idea of mass customizable building and self-help building that allows users to directly manage the housing assembly and the shielding.

At the urban-territorial level, the project actions will concern: i) Mitigate the potential impacts of climate change through integrated solutions (agro-geo-hydraulic, landscape) to compensate for the effects exceeding the performance capabilities of the built environment through 'green infrastructures' (with structured ground, maturbanism, drosscape, thick infrastructure, old operations, machine landscape, synthetic surfaces) and Water Sensitive Urban Design systems, to re-integrate the water cycles in the urban landscape – these actions allow you to restore the natural- hydrologies and activate new ecological cycles of biodiversity and productive chains, combining the well-being improvement with the adoption of styles of life more acts will; ii) Reactivate the traditional alliance between components of natural and human as forces co-agents through rebalancing strategies between densification and greening as new holistic thinking that produces a Capitalism 4.0 able to get new value from the processes, re-cyclic the new urban metabolism – start-ups, makers actions, circular economy creativity, reuse, recycle and creative evolutions (Kaletsky, 2010); iii) Encourage participatory processes through the promotion of spaces intended as universal containers adaptable-expandable to the urban scale (incubators of forms of enterprise, collective-intelligence, co-planning and co-production of value; Ratti, 2014) to configure spaces 'open' to the concreteness of living – these actions can involve forms of 'design re-appropriation' of living spaces, in which users become environmental administrators.

To intervene, therefore, to support the adaptability of spaces to upgradeability of the environmental variables and needs, triggering innovations and possible investments (Campioli, 2009). Therefore, adaptability is not considered a reactive capacity but a competitive weapon that allows not only to respond to changes in the current context but also to trigger change by introducing a novelty on the market and consequently setting up a continuous production of innovation (Giallocosta, 2004).

Conclusions | The correlation between the macro-requirements and the project actions identified certainly constitute some first detection not describe of the all possible lines of intervention which have as their goal that to reorient the projects in urban areas towards the healthiness and sustainability. Convergence (between Sustainable Design/Healthy Design) within which to seek a rebalancing technological-environmental approach, as an alternative systemic approach that can be useful in the design experiments in the urban area, within a reasonable perspective of intervention in the short, medium, and long-term. This means moving away from specialized and punctual projects towards a systemic vision of the habitat, which has as their goal to research levels of the balance resilient between objective qualities of the city, measurable and programmable and quality subjective of living the city, expectations and views by users, transforming the design experience into a moment of common commitment and urban quality into the qualities of living together (Zaffagnini, 1980). A further innovative aspect is offered by the possibility to work with systems of macro-requirements of sustainability (levels of sustainability) with respect to which it will be possible to identify PBA and EBD indicators (extrapolated from ongoing experiences/research) and systems of evaluation/control. The paper, still in its initial phase of analysis, can be further developed, by selecting and analyzing other requirements and project actions. Further multidisciplinary researches are encouraged to validate the presented requirements in case studies and empirical settings.

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VISION AND PROJECT OF THE SOCIAL SPACE
Reconfiguration of the Tiberius Bridge basin in Rimini

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ABSTRACT
In 2010 Rimini adopted a strategic plan whose main purpose, in addition to the redevelopment of the suburbs and the hinterland, is to strengthen the role of the historic center through the recovery of distinctive public buildings and restoring the dignity of the various forgotten urban spaces. The Tiberio 3 project, this is how the recent project for the reconfiguration of the spaces pertaining to the basin of the Tiberius Bridge (14 AD) was called, is located in this climate of regeneration. The place is characterized by a strong archaeological context and by an urban palimpsest that has seen the succession of important transformations. The survey carried out through discussions with technicians and designers, aims to highlight the relationship between the park and the city as the central theme of the intervention; identifying the socio-cultural influences and the design implications of urban solutions aimed at expressing the values of a constantly evolving society.

KEYWORDS
contemporary city, regeneration, social space, landscape

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The recent phenomena triggered by the worldwide health emergency are the base of a renewed reflection by architectural culture on the role of the urban project in the city transformation processes and more specifically on the definition of social space. The repercussions of these phenomena, in addition to the health plan, affect, in a local dimension, the city social structure connected to the living space intended as a physical place and support for life and exchange between the people who cross it. The mechanisms designed to face the spread of the Covid-19 virus have mainly affected social behaviours, inducing distancing, avoiding the formation of gatherings in closed places but also outdoors and in the most critical phase, excluding the possibility of travel and to enjoy public places.

These restrictive measures have pointed out a series of questions relating to the quality of the spaces in which we live. First, it was during the 'lockdown' phase that the limits of domestic environments emerged. Inevitably, people recognized that the quality of these private spaces is linked not only to their size but above all to the flexibility and the opportunity to create divided environments that can accommodate different functions from work to study, from game to physical activity. Natural light, as well as the presence of greenery and connected external spaces (gardens, internal courtyards, terraces, balconies) has assumed particular importance for psychophysical wellness. At a later stage, attention shifted from dwell to the city. The difficulties experienced within the private residences have re-emerged, on a larger scale, in the cities, leading to the experimentation of concrete problems, until now only intuitions related to the lack, but above all to the quality of public spaces.

The interest in the recent intervention carried out in Rimini fits into this context, proposing itself as a model in a balance between tradition and openness to future scenarios. This essay focuses on the presentation of the project of an urban space characterized by the strong archaeological presence of a Roman bridge and by the particular relationship through which it reconnects different parts of the city, establishing a singular case study for its ability to respond to people needs, for its relationship with history and with the changing social needings. The city, as a place for the stratification of the signs left by the succession of communities and different generations, is assumed as an expression of collective identity and historical memory. The new transformations overlap the traces of the previous mutations; as in a palimpsest, the text deposited over time by the work of man is scratched away to make room for a new one that responds to contemporary needs and which is bearer of new meanings (Corboz, 1998). According to Gregotti (1966), the city represents the most notable effort by human civilization for a complete transformation of the natural environment, the most radical transition from the state of nature to the state of culture with the creation of the 'microclimate' particularly suitable for the development of some fundamental relationships for human life.

Starting from the assumption that the space is not given, but it belongs to the community and constitutes its most direct and genuine representation, the territory can be seen as the result of a choral work, produced through a dialogue, a relationship between

man and nature along the time of history. Focusing on the European city, we can see how the processes of modification are influenced by the tension between a general resistance to transformations, linked to the conservation of cultural heritage, and the need for a regeneration that responds to emerging social demands. Preserving the physical and cultural identity of the city is an essential issue that raises numerous questions when this dual phenomenon becomes a symptom of the vulnerability of the city itself. In this regard, Raffaele Federici emphasizes that the future exists, as a project, only where it is possible to creatively recompose the elements that constitute the social, cultural and economic fabric of a given space, beyond the possible exploitation of the logic of interest. The future, according to Federici, exists as the attitude of a given geographical context to produce wellness, not only financial, for the local community (Federici, 2020). The definition of an integrated development plan, through a careful analysis of the social phenomena that trigger the processes of urban transformation, is an opportunity to convert the vulnerabilities present in the area into a potential regeneration agent.

The Strategic Plan: projections for the future of the city of Rimini | Since 2010, the city of Rimini has equipped itself with an important urban planning tool through which to guide the development processes of the territory. The Strategic Plan consists of observations aimed at a smart, sustainable and inclusive growth of the city, through actions of intervention at different scales, in the medium and long term. The document shared between the institutional bodies and the representatives of the economic, social and cultural associations of the territory. It foresees the gradual development of specific projects in different fields of intervention: from urban planning to social, from culture to business from tourism to landscape enhancement.

The Strategic Plan focuses on the consolidated city, in the awareness that it is precisely the best quality of the existing that represents the most important challenge for the future of the city. Urban regeneration is the main strategy among those implemented by the Plan and is achieved by interpreting the demands of contemporary society through a way of thinking in a sustainable and integrated way both physical and social space. The response to growth needings acts according to the principles of densification and regeneration of urban voids, abstaining from the consumption of new surfaces. Public space and green areas play a key role in the vision of a better-connected city. The public space network is functional to the organization of the city and the neighbourhood precisely because it joins the places of daily life, the services, the collective equipment, with the places of living and working. The open spaces quality is at the base of the city regenerative process, not only because it ensures movement and leisure, but precisely because it is the very essence of the urban landscape.[1]

The Plan observation objects are those places that, for a long time, have remained devoid of functions and roles; places that have lost their physiognomy due to the disso-

Figg. 1, 2 | XXV April Park, Rimini (credits: G. Corda, 2019).

lution of the relationship between their physical form and the social character of the activities and inhabitants but which, even now, are repositories of collective memory. One of the selected areas is the Porto Canale system, a water axis that connects the sea to the historic centre and ends in the basin below the ancient Tiberius Bridge, a Roman monument (14 AD). The area, which includes a large public entrance to the park, has recently been returned to the city through a major redevelopment intervention (Figg. 1, 2).

The new square on the water | The studies for the area surrounding the Tiberius Bridge began in 2014 following the designation of the new manager of Anthea, a municipality affiliated company in charge of the management of Rimini's green areas and public heritage maintenance. The assignment of the task is an important phase of the project; all the projects included in the Strategic Plan, in fact, were entirely managed by the Municipal Technical Office. In this occasion, it was Anthea's manager Andrea Succi who delegated the design part to the landscape architect Marialuisa Cipriani, relying on her also for the construction of the project. All the bodies responsible for the heritage protection have been invilved in a dialogue and in a path of sharing that accompanied the project in all its phases. Succi puts in place a series of actions aimed at realizing the vision of the area as a place suited to becoming a centre of the city and together with Marialuisa Cipriani (2018) they build a path of consultation that involves a plurality of professionals and specialized offices. The area, which is configured as a very delicate part of the city, has numerous constraints. A dialogue is triggered on the area that affects the archaeological, the landscape and the monumental superintendence, the basin technical service, the basin authorities, the maintainers and managers of the area. The discussion on the guidelines of the project extends to all stages of progress through the sharing of choices and the collection of requests by the parties involved.[2]

From the pier to the park to the river: a settlement continuum | The intervention insists on an area of about 7,000 square meters around the basin overlooked by the

Tiberius Bridge. The identity of the place is linked to the strong presence of Roman archaeology, to that of the medieval walls and the canal: the break element between the historic centre and the adjacent San Giuliano village. Its conformation is due to a series of interventions, implemented over the course of the twentieth century, aimed at the control and safety of the Marecchia and the Ausa rivers. The low altimetric level and the presence of two torrential rivers, in the tangency of the city centre, give rise to considerable territorial fragility[3]. The area indeed is subject to flooding. This problem was solved between 1927 and 1938 thanks to the construction of an artificial canal, called 'scolmatore', from which the rivers water flow into the sea in the northern area of San Giuliano. This operation, in addition to establishing a new relationship between the city and the river, leads to the desiccation and liberation from the hydraulic roles of large areas near the historic centre.

The fluvial nature of the land prevents its occupation, leading to its abandonment and its relative state of decay until the 1970s when the redevelopment project by the Milanese architect Vittoriano Viganò defines a new layout of the area, which persisted until today. Securing the old riverbed from the building boom of the 1950s allows it to support the growth of rich riparian vegetation. It soon becomes clear that these green areas constitute a precious reserve because of their compensatory properties against an at least unbalanced urban settlement trend.

Viganò's intervention, carried out between 1969 and 1982, aims to respond to a series of problems through a unitary project that affects the entire water system in a settlement continuum that connects the marine landscape, the urban landscape and that of the hinterland. The edges of the Porto Canale are defined with the construction of a water-level promenade on continuous longitudinal quays equipped with platforms and panoramic points. The canal connects the pier on the waterfront to the ancient Roman bridge, defining a large water basin that originally had to continue in the park, in the form of an artificial lake, up to the river, reconnecting inland (Viganò, 1975). The Lake was an essential unit in the system, necessary for the vivification of the canal water and the bridge protection from potential floods. The intervention designed by Viganò proposed the construction of an artificial landscape, functional to the particular use of leisure in a large open space, interpreting the Marecchia green-water system as a unit of which it highlights the specific environmental role as the green lung of the city (Viganò, 1990). Through the water mirror artifice, the image of the Roman bridge is symbolically and functionally redeemed (Figg. 3-5).

The missed construction of the accumulation basin leaves the park design incomplete and the area exposed to flooding due to the rising sea with the consequent deterioration of the basin edges and the weakening of the surrounding vegetation. Punctual and uncoordinated interventions, aimed at ensuring the safety and accessibility of the area, over time have ended up compromising the image of the area. The presence of furnishings, installations and artefacts not suited to the importance of the archaeological site gives the idea of a degraded place. The area, located at a lower level than the

Figg. 3-5 | Vittoriano Viganò, XXV April Park, Rimini 1975 (source: Viganò, 1975).


Figg. 6, 7 | Small square in San Giuliano village, Rimini (credits: G. Corda, 2019).

city, is identified as a residual space, indeterminate and devoid of a specific functional program, therefore underused and perceived with indifference.

The response to local needs through the design of open space | In the Strategic Plan vision, the Tiberius Bridge ambit was to become a new attractive pole for the city, through the implementation of actions aimed at enhancing archaeology as a focal element and centre of the urban scene. The centrality and attractiveness of the place are not sought through the use of scenic effects and the spectacular show off of the ruin. The intervention aims, on the other hand, to restore a unitary image concerning the monumental context. The first operation was to clean up the elements inconsistent with the place nature. It was a question of recognizing the presences belonging to the place and those that the place was not able to accept and which therefore constituted an interference in the landscape.

The project, edited in a single conceptual solution, was implemented in two successive excerpts. The first phase involves the redevelopment and arrangement of the 900 square metres area on the edge of the bridge on the side of San Giuliano village. Space, formerly intended for parking, was reorganized by defining a small square furnished with seats, lighting and illustrative panels that narrate the bridge story. The second section reinterprets the particular morphology of the park through the reshaping of the embankments and their arrangement for transit and rest; the setting of the route and access system; the inclusion of privileged visual points of the bridge on the edge of the basin with a large rest area and a promenade; the introduction of lighting systems with optic fibre connection cable (Figg. 6, 7).

A third unrealized excerpt included the setting of an archaeological garden in which to place the ancient stones of the bridge. This phase was part of the project built with the participation of the Archaeological Superintendency. The predisposition for future accommodation of the ancient Roman remains is still planned. Viganò intervention on the area included strong architectural choices that over time have become consolidated

and historicized signs in the image of the city. The project works on optimizing the assimilated function of the place as an urban park and occasional theatre of events, setting itself two fundamental goals. First, there is the assumption of the bridge as the central element of the scene; this meant that the interventions implemented should not dominate the image of the bridge. The materials and the sign adopt a minimal and contemporary language that detaches them from archaeology and makes them recognizable emphasizing their historical and monumental value.

The second goal is to give the existing use of the area a unitary and clear design. The area had a morphology on which the project worked with a geometric design that reconfigures the slopes by following the inclinations and curves of the terrain. The project aims to ensure maximum fruition of the area, from the city level to that of the water, optimizing the system of routes, reducing interrupted connections and obtaining, from the existing spaces, places for resting and enjoyment of the bridge view. The project adopts an organic design, it does not impose an aprioristic geometric design by superimposing it on the context, but it reinterprets the morphology already present on the area and reveals it through geometric tools. The privileged focal point is the Roman bridge, of which the project ensures its fruition through the views from the different levels of the park (Figg. 8-11).

Lastly, the project takes into account the fact that, beyond the detour and the 'drainage' carried out by Viganò project, the area still constitutes an arm of the Marec-

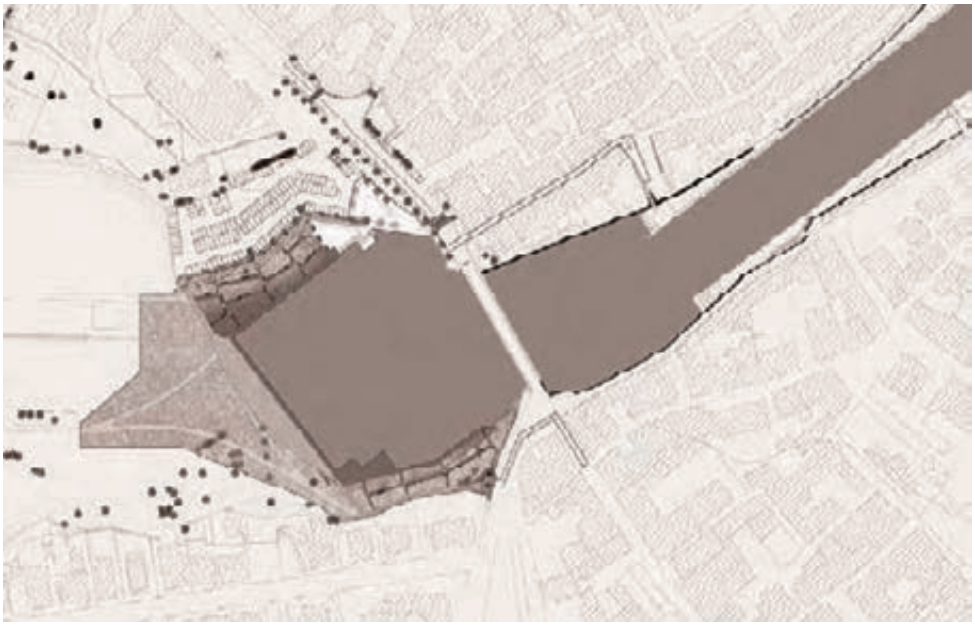

Fig. 8 | Marialuisa Cipriani, Tiberio 3 project, Rimini 2017 (credit: M. Cipriani, 2017).

Figg. 9-13 | XXV April Park, Tiberius Bridge, Rimini (credits: G. Corda, 2019).

chia river that can be activated in case of overflow. This requires particular attention to ensure that the components adopted resist the passage of water without obstructing its flow and allowing the safe crossing of the park. Water is an important theme of the project. The basin constitutes the head element of the park and is located at a lower altitude than the city, it becomes an important issue of the project to re-establish the relationship with water by making contact possible and transforming it into an element of value rather than a detractor or a danger.

Urban space/social space | The regeneration of the spaces surrounding the Tiberius Bridge arouses interest not only because of the particularly meaningful context or how

the project collaborates to re-emerge the identity image of the place but above all because it is not an isolated project; instead, it is part of an idea of the city that tends towards the definition of an overall urban project. Regeneration comes from a clear overview that restores value to the porous areas of the built city, promoting their growth from within. The residual voids, the discontinuous spaces, scattered fragmentarily within the urban fabric, are identified as a resource through which to trigger the sustainable development of the city. The voids contain a latent potential. These, as project material, are the basis of the generation of new spatial matrices which, like connective tissue, re-establish the dialogue between the parts of the city, the territory and the landscape.

According to Bernardo Secchi, the void is a design theme that cannot easily be traced back to conceptually simple solutions: to preserve, to renovate, to reuse, to promote. The difficulties are not only in finding adequate and proportionate functions, in an accurate exploration of the probable, as well as in identifying their possible meaning. The design of the void begins with its theming and this requires an expansion of the observation field (Secchi, 1984). The void referred acquire significance in its being an interval between different elements from which it derives its qualities. Working on the city voids requires an approach aimed at searching for the spatial continuity of a systemic context. To change a place it may be necessary to act on another. The urban landscape is a dynamic system that changes and evolves; rather than acting in contrast it is necessary to understand the reasons behind its transformation. During all the project phases, formalism gives way to the ability to think about a complex metabolic functioning in which every choice, every sign is verified on the spot. The project is not intended to impose its image on the ground but to interpret the place features, to understand the energies that determine its functioning and create a desire for transformation that fits into the flow of these same energies.

Conclusions | The square on the water is configured as a public and urban space, capable of attracting and at the same time perceptually extending its presence beyond its physical boundaries. The character of the place, strongly steeped in history, constitutes a fundamental piece of the city, the fulcrum between the arrival point of the Via Emilia and the first village outside the city walls; the link between the valley, the river, the historic centre, the canal and the sea. These are the aspects that contribute to defining the place identity, meaningful and rich in historical memory.

The project, winner of the City Brand&Tourism Landscape Award 2018, interprets the place identity through an unveiling operation that returns the image of a space that belongs to the city, a pivotal place that establishes new morphological, functional and perceptive relationships between the elements of a part of the city. The square becomes the compositional tool that gives order and readability to the various urban facts and to the different and isolated architectures which, through the structured presence of the water basin and the surrounding spaces, acquire meaning and recognition.

The redevelopment of the basin area takes place without determining a specific function for the spaces. Unlike what happens in the architectural project, in which the function is fundamental to establish the building role, in the open spaces design, the elements involved already contain an implicit function: a square, a street, a park are already prefigured entities and appointed to perform a specific task in the catalogue of the elements composing the urban fabric (Cipriani, 2015).

The regeneration of the Tiberius bridge surrounding spaces takes place precisely according to this idea for which the attractiveness of the place is not determined by the insertion of elements or scenic devices but through interventions aimed at making the place welcoming, revealing freedom and opportunities in which the functional aspect is secondary to the awareness of what the place can offer (Figg. 12, 13). The spaces of the new square on the water are the result of an intervention on a delicate place which, instead of clashing with the limits set by the protection bodies, was developed through a coordinated action in which each figure contributed to the definition of the most appropriate response to the local conditions.

The municipality played a fundamental role in the development of the intervention by inserting it among the strategic actions aimed at redeveloping the area and identifying the place as a node through which to reconnect detached parts of the city. There are no schemes or strategies that guarantee the success of a project if not the very fact that the result does not consist in a beautiful design or in the capacity to arouse wonder, but in the ability that this has to welcome life. What in the past was a place of passage to which little attention was paid after the new intervention, soon became inhabited by people. The square on the water has continued to be, even in recent periods characterized by the health emergency and the necessary social distancing, a theatre for musical events, gardening exhibitions, an outdoor gym and a location for art installations and much more.

It must be recognized that designing open spaces does not simply mean defining the design of the ground and the void between buildings, it requires a structured knowledge capable of working with the social fabric, interpreting intangible needs and responding to the local community desires. Each place, each city has its history, its memory and a way of being perceived that reverberates through different social dynamics. The social phenomena at the base of the transformation processes change from one part of the city to another and represent a fundamental component that becomes the theme of the project.

The public space is a civic element which contains the energies necessary for the regenerative process which is fundamental for the quality of the city; its project requires knowledge of the tools directed at building relationships that stimulate their fruition. People represent the litmus, the dimension that allows measuring the real quality of urban spaces. Nowadays urban regeneration should tend to evoke new ways of living in the city. Urban space as a space for leisure must be the interpreter the way of life of contemporary society, its new rhythms, in which the time of leisure, work, culture and

sports mix and overlap. A space open to the different declinations of its ways of use is a space that stimulates the sense of belonging of the community and in which individuals can identify themselves, collaborating in the creation of truly lived-in space, therefore safe and active in improving the quality of life of the community itself.

Notes

1) See Quaderni del Piano Strategico for more details at the webpage: riminiventure.it [Accessed 10 December 2020].

2) This has become an acquired method of the City's Engineering Department adopted in other areas of the Plan as well.

3) Marecchia River floods are not uncommon, but it was in September 1910 that the most critical episode occurred. The river had overstepped its banks and an exceptional mass of water conveyed into the strait of the Canal Port, causing a dangerous overflow at the mouth. The sudden flood swept away part of the city and the town causing huge damages (Masini, 2013).

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THE ROBUSTNESS OF CITIES
2030 Contended Visions

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ABSTRACT
The Robustness of Cities – 2030 Contended Visions will tackle the main dominant factors of 2030 agendas of different governments and institutions. These multiple factors can sometimes present a form of rivalry. As in La Città Contesa (lit. The Contended City), where Zucconi describes how, after the unification of Italy in 1861, it was necessary to define a new approach to Italian cities and territories with a succession of dominant criteria along half a century, raising the necessity to hierarchize different competing factors. The essay will expose the Robustness Theory – developed by Japanese engineer and statistician Genichi Taguchi – and how it could be applied in architecture. By adopting the 3-phases methodology Combinatorial Architecture developed by the author as Director of the Research Lab Non-Linear Solutions Unit (NSU) at Columbia University, C.A., the contribution will approach some of the 2030 most relevant factors in New Cities, Smart Cities, Small and Smart Settlements as well as how to combine Human Atmosphere and Cultural Heritage, Technology**,** Sustainability and Natural heritage and how to mitigate the difference between priorities.

KEYWORDS
combinatorial, atmosphere, cities, architecture, robustness

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In La Città Contesa (lit. The Contended City), Zucconi (1999) describes how, after 1861, it had been necessary to define a new approach to the cities and infrastructure of the young country, Italy. The book exposes how, between 1865 and 1942, different factors such as hygiene, viability, military control, social housing, cultural identity could vary in time. For example, at the end of the 19th century, in Naples, urban transformations were driven by the topic of hygiene associated to real estate, similarly to the Haussmann's interventions vividly narrated in Le Ventre de Paris by Emile Zola in 1863 (Zola, 2009). In the following chapters, Zucconi exposes a sequence of historical moments in which the different factors change their value in time. A significant factor approved in Italy by the law 1908 was the emergence of Social Housing.

Similar turning-points have vibrantly animated the last century's architectural debate. In Programs and Manifestoes on 20th century Architecture written by Conrads (2002) in the late 50s, the author exposes a testimony that many of the master builders of this century have held passionate convictions regarding the philosophic and social basis of their art and visions. In chronological order, the most influential visions from 1903 to 1963 are: van de Velde and Loos about ornament, Wright in 1910 Organic Architecture, Gropius's program for the Bauhaus founded in 1919, Towards a New Architecture, Guiding Principles by Le Corbusier, the basic principles of Constructivism formulated by Gabo and Pevsner, Universal principles by Buckminster Fuller, Mendelsohn, Van Doesburg, Mies van der Rohe, El Lissitzky, and Kahn. There are also many collective or group statements, issued in the name of movements such as CIAM, De Stijl, ABC, and the Situationists.

Analysing differences and similarities of the 2030 agendas from governments and international agencies such as the UN, UNESCO, NATO, EU, different topics are listed, amongst which zero hunger, good health and wellbeing, education, affordable clean energy, industry, innovation and infrastructure, crime prevention and criminal justice, narcotics, drugs, statistics, the status of women, sustainable development, and built and natural heritage. When analysed together, how can these factors be compatible? The following paragraphs will explore the theme of Robustness and the 3-phases methodology Combinatorial Architecture (C.A.) as a tool to mitigate possible incompatibilities between all drivers.

Robustness | The idea of Robustness concerns a system that can merge different requirements and offer a set of solutions, partially absorbing possible incompatibility between criteria, despite any unexpected noises and perturbations. According to Kitano (2004), Robustness facilitates the evolvability of complex dynamic systems. Evolution, given enough time, might select a robust trait that is tolerant against environmental perturbations. The author affirms that developing solutions with a solid mathematical foundation that can realistically represent complex systems is a difficult challenge. For this reason, the research into non-linear dynamics, control theory and non-equilibrium theory is relevant. Besides this, capturing the essential structural complex-

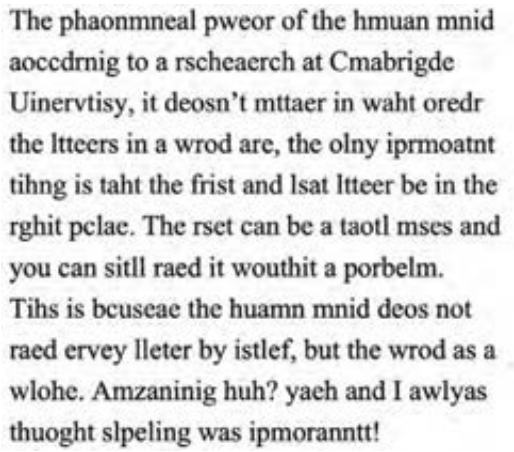


Fig. 1 | Robustness (credit: W. S. Y. Wang, 2005).

ity and heterogeneity of the systems is a critical feature that will be approached in the following paragraphs as Phase 1 – Creative Reductionism. Furthermore, the idea of Robustness is strongly present in business and management environments. According to Swan, Kotabe and Allred (2005, p. 1) «[…] With the increasing desire for products [as well as for building], suitable for widely varying markets worldwide, this study offers insight into capabilities associated with successful robust-design in the global environment. These robust-design capabilities (i.e., the possibility for success under varying circumstances or scenarios) are a potential organizational response to rapid change and uncertainty».

In the image Robustness of the Language by William S. Y. Wang (1976, 2004, 2015), Chair Professor of Language and Cognitive Sciences, Hong Kong Polytechnic University and Emeritus Professor at Berkley, the concept of Robustness appears as (Fig. 1). The image demonstrates how a word maintains readability as far as the proper factors are adequately settled. For example, the three fixed criteria: the first and last letters have to keep the same position in the original version of the word, as well as keeping the exact number of letters permits the achievement of a large variety of combinations. This idea can be defined as a kind of formula in which the level of freedom is N-3 Variables, where N is the number of letters, and -3 is the number of constraints. The first two are the correctness of the first and last letter position, and the third constraint is the use of the same letters, that further on in the text will be defined as Phase 2 – New Population of Solutions. This flexibility leaves open the freedom to fit other criteria or requests.

Transfer of methodology between Robustness theory and Architecture | The previous paragraph exposed the concept of Robustness based on the definition of some fixed variables as in the case represented by Wang: the initial and final letters need to

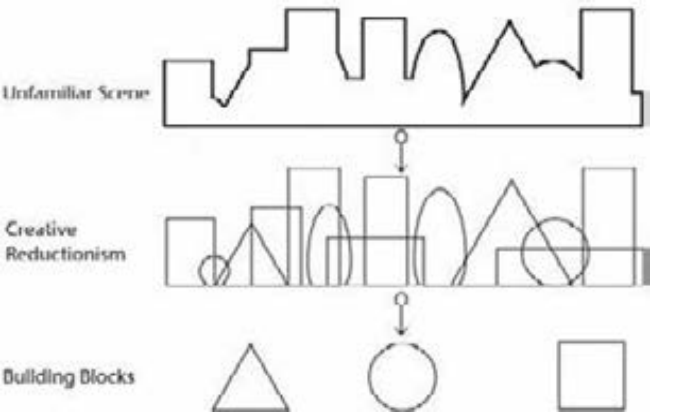
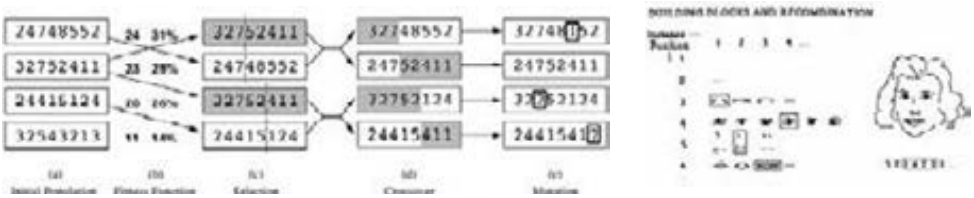


Fig. 2 | Phase 1 – Creative Reductionism (credit: C.Tiazzoldi, 2016).

be in the exact place, meanwhile, other parameters can achieve broader flexibility. This recalls Martì Aris (1993) definition of 'type' in architecture, where 'type' is a formal structure, an analytical key leading to the peculiarity and specificity of the project. This also permits to connect the research of Robustness to other fields such as philosophy, mathematics and linguistics. 'Type' exists from the moment in which the existence of 'structural similarities' is recognised – 'invariable factors' between architectural objects, beyond their differences on the most apparent and superficial level. 'Type' fosters the problem of form in terms of maximum generality (beyond eras and styles). 'Type' is not a mere classification; it describes differential features and establishes a 'classifier' of differences: 'Type' expresses the permanence of essential aspects and highlights the formal structures' variable character. Furthermore, Martì Aris's defines 'Type' as a structural mind-setting; such a fundamental tool can blend with the site and cultural specificities via a process of contextualisation.

The concept of uncertainty or factors adaptations recalls the Deleuzian notion of 'difference and repetition' (Deleuze and Patton, 2014): «Normally, the difference conceived of as an empirical relation between two terms each has a prior identity of its own ('x is different from y'). Deleuze inverts this priority: identity persists but is now a something produced by a prior relationship between differentials (dx rather than not-x)» (Smith and Protevi, 2018).

Combinatorial Architecture (C.A.) | Developed by the author as Director of the Research Lab NSU at Columbia University, C.A. is an educational and professional decision tool and heuristic device, assisting the decision-makers in fixing the priorities related to urban morphology, architectural design, functional, technological, or engineering problem. Combinatorial Architecture includes a method in which quantitative – predictable – and uncertain qualitative intangible and variable parameters (i.e., so-



Figg. 3, 4 | Genetic Algorithm and attributes manipulation to Create a New Population of Solutions by combining the different Attributes and Building Blocks (credits: J. Holland, 2008).

cial, physical, sensorial, cultural, and economic) lead to a structural adaptation, emphasising the concept of formal adaptation to include the intangible aspects of atmospheres. The objective of developing C.A. is to create a connection between specific expectations: functional, formal, aesthetic and also emotional. In fact, the method aims to include the design process, the impalpable conditions of urban atmospheres, with the capacity to influence our feelings. Making an urban atmosphere means creating an impalpable condition by executing a series of specific operations: spatial, geometrical, sound acoustic, and climatic. This operation signifies the qualitative feeling's transformation into the quantitative, the non-measurable into the measurable, and the intangible into the tangible.

From a methodological standpoint, Combinatorial Architecture process takes advantage of research carried out in other scientific fields. C.A. is a 3-phases process inspired by genetic algorithms. Phase 1 is the Creative Reductionism, Phase 2 creates New Populations of Solutions, and Phase 3 selects the Solution that better performs in a given context. Creative Reductionism recalls the 17th century Discourse on Method, Descartes (2019) and the late 60s Deleuze, G. and Patton, P. (2014) methodological guidelines in the field of philosophy, the 80s Munari (2017), Cache (1995), Mayne (2011) in architecture and urban design, Holland (1995), Nicolis and Prigogine (1992) Bertuglia (2000; Bertuglia and Vaio, 2005) as well as Jafari-Marandi (2017) in the field of sciences of complexity.

Phase 1 – Creative Reductionism. According to the Nobel Prize winner Prigogine, the transition from the determinist paradigm to the science of complexity implies a radical attenuation of the distinction between hard sciences (mathematics, physics) and soft sciences (biology, social sciences and architecture). Such a paradigmatic switch (Kuhn, 2012) blurred the limit between the subjective and the objective. In fact, after Boltzmann, Poincarré and Einstein, the sciences became subjective 'per se'. Hence, it is necessary to clarify the role of scientist and designer in every modelling process, a form of 'Creative Reductionism' according to Holland's definition (Holland 1995, 2000; Dye and Flora, 2015).

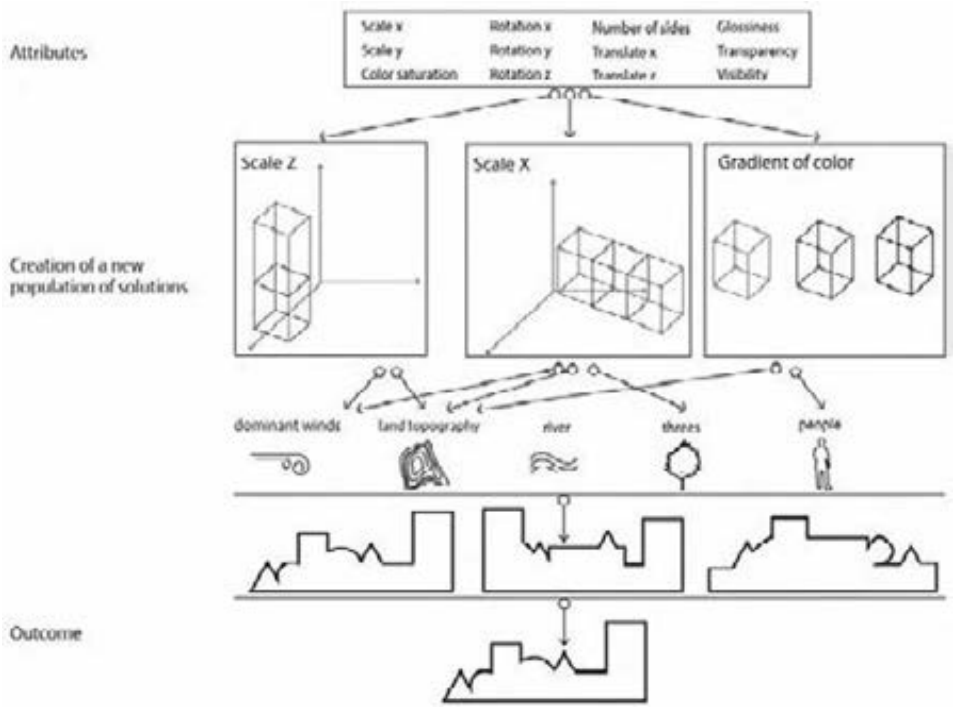
When applied to Cognitive Sciences, 'Creative Reductionism' consists in analysing some of the environmental conditions and in translating them into adjustable elemen-

tary units: attributes and 'building blocks' – reusable categorical parts. According to Holland (1995), it is possible to fragment a non-measurable item into a set of numeric data and to identify the logic connecting them and transforming them, to change the non-measurable into something measurable such as trees, buildings, automobiles, other humans, specific animals, and so on (Fig. 2). This quick decomposition of complex visual scenes into familiar building blocks is something that computers cannot yet mimic; introducing then the need of a human factor which leads to a creative process, rather than a deterministic one. Inoue, Rodgers, Tennant and Spencer (2015), in 'Creative Reductionism' describe how decreasing levels of information can stimulate the designer's imagination. This recalls Kitano's statement about the impossibility to have a pure mathematical approach and emphasizes the need to reduce a model in structural elements. In literature, Italo Calvino (2016) approached his work with a form of creative reductionism; writing is 'reduced' into five properties: lightness, speediness, exactitude, visibility and plurality.

When applied to Architecture and Design, the phase of 'Creative Reductionism' consists in decomposing a given reality into a set of elementary units: walls, windows, openings, slabs and their attributes such as thickness, length, XYZ rotation, scale, position in addition to reflectivity, transparency, porosity and sound absorbance. 'Creative Reductionism' permits to approach a given problem by unfolding new fields of the measurable, an approach also shared by Munari (2017) when he refers to the four Cartesian rules to divide each of the difficulties under consideration into as many parts as possible and necessary for its adequate solution. Also, Safran (2016) in 12 Dialogical and Poetical Strategies recalls Calvino's Six Memos for the Next Millennium methodology to analyse architectural properties applied to architecture.

Phase 2 – New Population of Solutions. It is the process by which Combinatorial Architecture creates a 'new population' of possible solutions by associating the different attributes and building blocks, and by defining a variety of rules and a proliferation of similar units (Figg. 3, 4).

Phase 3 – Selection. The third phase consists in the Selection of the solutions that better fit with a specific context, in response to the most relevant factors for a given culture and physical environment as listed in the 2030 agendas of different countries. The result of the third phase is to drive the Solution from generic to specific. By recalling the Robustness theory «[…] Consider a wooden table with 4 legs, each with a diameter of 20 cm and a tabletop that is 10 cm thick. 10 people are sitting at the table, telling jokes and having a good time. Suppose that the uncontrollable factors such as bumping and pushing against the table hardly moves the table. The table can be called robust since the desirable table properties such as stability and maximum weight support appear not sensitive to the considered uncertainties. Consider a similar table, where the mentioned dimensions are twice as big» (Olieman, 2008, p. 1). This phase identifies those configurations, among the solutions tested, which can provide an appropriate correlation between the input and the possible Solution of an architectural



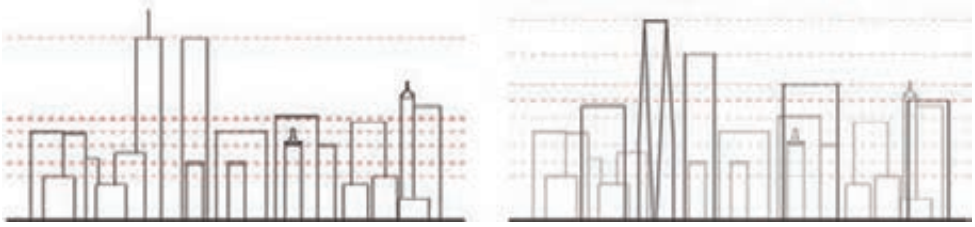


Fig. 5 | Combinatorial Architecture Phase 2 and 3 (credit: C. Tiazzoldi, 2008).

Fig. 6 | Creative Reductionism: analysis of the height variation in the New York Skyline (credit: C. Tiazzoldi, 2016).

Fig. 7 | Creative Reductionism applied to SAANA New Museum of Contemporary Art (credit: C. Tiazzoldi, 2016).

question and local priorities (Fig. 5). Ultimately, this phase focuses on the selection of the Solution that better responds to the qualitative or quantitative parameters defined by a given location, local priorities or resources.

The method presents several similarities in philosophy, for example in Descartes and Deleuze work. Descartes identifies four rules: «[…] the first is never to accept anything as truth which you did not know to be such; that is to say, carefully avoid precipitancy and prejudice and to comprise nothing more in one's judgement than what was presented to the mind so clearly and distinctly as to exclude all ground of doubt. The second cartesian rule 'the creative reductionism', is to divide each of the difficulties under examination into as many parts as possible. It might be necessary for its adequate solution – the creation of attributes and building blocks. The third 'creation of new populations of solutions', to conduct the thoughts in such order that, by commencing with the simplest and easiest to know objects, I might ascend little by little, and, as it were, step by step, to the knowledge of the more complex; assigning in thought a specific order even to those objects which in their nature do not stand in a relationship of antecedence and sequence. And the last, in every case to make enumerations so complete, and reviews so general, that you might be assured that nothing was omitted» (Descartes cit. in Watson, 2020).

For Deleuze, there are three rules: «1) Designation or denotation, which is the relation of a proposition to an external situation (theory of reference, with its criterion of truth or falsity). 2) Manifestation, which marks the relationship of the proposition to the beliefs and desires of the person who is speaking (with its values of veracity or illusion). 3) Signification or demonstration, which is the relationship of the proposition to other propositions (the domain of logic, with its relations of implication and assertion)» (Smith and Protevi, 2018). This method lends itself to address the work of architecture – also including some intangible aspects of architecture or some non-measurable qualities of the space – a topic that will be revisited in the next paragraphs and refers to the work on Ambiances and Urban Atmosphere initiated by the network Ambiances at the laboratory Le Cresson and including an international network of researchers, De Matteis (2019), Thibaud (2015), Tiazzoldi (2020), Tixier (2017).

The World Trade Centre and Twin Towers case studies in New York City are the first examples of the interpretation of an atmosphere with C.A. «[…] By this time, the Port Authority had decided that the trade centre should replace the 1,250-foot-high Empire State Building, built-in 1931, as the world's tallest building. To fulfil the Port Authority's requirement, architect Minoru Yamasaki designed two towers of 110 stories each» (History.com Editors, 2009) by applying the creative reductionism, outstandingness through the following equation: Outstanding = H1-H2, where H1 represents the height of the Twin Towers and H2 the average height of surrounding buildings (Fig. 6). The same set of variables (H1-H2) was used to achieve the opposite result in Daniel Liebeskind's project for the World Trade Centre. In the essay Ground Zero – The Socio-Political Minefield of Symbolic Architecture (Liebeskind and Cairns, 2013), the

Fig. 8 | Masdar City by Foster + Partners (source: www.fosterandpartners.com).

Fig. 9 | Masdar City by Foster + Partners: section (source: www.fosterandpartners.com).

Fig. 10 | South Sabah – Al Ahmad, section by Foster + Partners (source: www.fosterandpartners.com).

master plan and skyline were intended to merge the new project with the skyline of the city (Vinnitskaya, 2013). The design objective was to reach an 'unassuming' presence of the towers in the city. Oppositely to the Twin Towers, the 'un-assuming-ness' was achieved by strongly reducing the height difference (H1-H2) between the seven new towers and the surrounding buildings. With a small height increase of 100 feet per tower, the new skyline merged with the downtown landscape (Fig. 6). The case of the World Trade Centre shows the implementation of two opposite visions.

The New Museum of Contemporary Art designed by SAANA[1] presents two qualities almost incompatible: to be at the same time outstanding and unassuming. In other words, it is a building belonging to the Bowery neighbour and to the group of the tallest buildings in New York. The 'reduced' attributes are the building's absolute height, the relative height and the size of the intermediate partitions. The massing of the building is a sequence of polygons that respond to the surrounding buildings' rhythm. The horizontal partitioning and the horizontal dislocation on the 'x-axis', permit to perceive a vertical fragmentation, reducing the visual impact at the local scale.

The New Museum can be considered as an example of the Deleuzian concept in which, rather than the expression ('x is different from y'), the philosopher introduces the concept of variation and attributes modulation, described as (dx rather than not-x). The New Museum is an example where the idea of robustness and C.A. permit to merge two incompatible qualities of the project: being at the same time outstanding and unassuming (Fig. 7).

2030 Contended Visions: New Cities, Smart Cities, Broadacre City, Small Settlements, Smart Settlements | The previous paragraphs demonstrated that a Robust Design approach could overcome conflicts between factors. The 2030 agenda of several countries and agencies seems to conceal four main factors: massive urbanisation, safeguard of the cultural and intangible heritage, sustainability – preserving or creating an atmosphere of the city and biosphere – and hygiene – a topic that the Covid-19 pandemic has drastically reintroduced worldwide.

Massive Urbanisation. The beginning of the 21st century is characterised, especially in the pacific area, by a real need to design for massive urbanisation and the development of some rational often if not alienated abstract settlements. «[…] Between 2000 and 2018, the population of the world's cities with 500,000 inhabitants or more grew at an average annual rate of 2.4 per cent. However, 36 of these cities grew more than twice as fast, with an average growth of over 6 per cent per year. Of these, seven are located in Africa, 28 in Asia (17 in China alone) and 1 in North America. Among the 36 fastest growing cities, 25 have a long history of rapid population growth, with average annual growth rates above 6 per cent for the period 1980-2000» (United Nations, 2018, p. 7). This phenomenon is recurrent in different historical periods, like the

Fig. 11 | Urban Section by Nicolas Tixier, Video Installation (credit: G. Meigneux, 2017).

Roman Camps or Castrum between the 2nd and 1st century B.C. and during the industrial revolution. This massive urbanization required cities to provide a safe environment for the incoming population, as per the concept of 'zoning' by Tony Garnier (Garnier, 1918). Nevertheless, the massive housing and rapid urbanisation created relevant problems by transforming some city's areas into dormitories without any form of human atmosphere and often became an object of criminality.

At the beginning of the 21st century, the same question appeared in the development of Asia Pacific cities. If, in the beginning, the core issue was related to providing infrastructures, housing, hospitals, schools and universities, the topic of sustainability massively entered in the design of new urban settlements as per the case of Masdar City, developed by Foster + Partners. Masdar City was achieved by combining «[…] state-of-the-art technologies with the planning principles of traditional Arab settlements to create a desert community that aims to be carbon neutral and zero waste. The city is conceived as a centre for the advancement of new ideas for energy production, with the ambition of attracting the highest levels of expertise. Knowledge gained here has already aided Abu Dhabi's Estidama rating system for sustainable building. The masterplan is designed to be highly flexible, to allow it to benefit from emergent technologies and to respond to lessons learnt during the implementation of the initial phases»[2] (Figg. 8-10). The Masdar project is a revolutionary approach to the city from a sustainability standpoint, although it raises the issue «[…] to maintain the potential of the intangible components of daily urban life by transforming pure sensations in a design tool that can be elaborated with attributes and building blocks. These situations are defined by the need to move through the city, respect coding, queueing at the post office, sharing resources etc. Now, the question would be how to create a similar urban atmosphere; how to design new urban spaces allowing the connectivity to intangible heritage, creativity etc.» (Tiazzoldi and Elshater, 2020, pp. 199, 220).

For Francesco Bandarin, Special Advisor to the Director-General of ICCROM, Heritage is a priority and a guide in safeguarding the idea of collective identity. This issue also extends to maintain the potential of the intangible components of daily urban atmosphere (Bandarin and van Oers, 2015). In response to the topic and research on the urban atmospheres that the Laboratory CRESSON was founded in 1979. CRESSON is a centre focusing on time and culture-sensitive approaches to inhabited spaces. The research relies on original multidisciplinary methods at the crossroads between architecture, social science and engineering. With these considerations, nowadays, CRESSON's work questions social, ecological, aesthetic, numerical, political and ethical issues regarding the atmosphere theme and recently founded the International Ambiances Network[3]. It is in this context that Tixier (2017) developed the technique of the Transect Urban – Urban Section (Fig. 11) to represent and articulate the urban milieu components often considered separately: built objects, sensory realm and social practices. The increasing research of the quality of daily life is also visible in Foster's work in Masdar City and sections of the city South Sabah – Al Ahmad.

Fig. 12 | Map of Age from the Wuyuan Xanzhi (source: A. P. Pola, 2019b).

Fig. 13 | Topographical map of a tract of the rural landscape in Wuyuan county showing the villages of Datian (credit: A. P. Pola, 2019b).

Fig. 14 | Daily life in Sixi, Wuyuan county, 2018 (credit: A. P. Pola, 2019b).

The previous paragraph exposed the relationship between new settlements, hygiene and the urban atmosphere. According to Verdini and Ceccarelli (2017), while reporting the message of the Global Report Culture for Sustainable Urban Development, which UNESCO has coordinated for the UN-HABITAT III Conference «[…] Culture can play a fundamental role in fostering sustainable patterns of urban and regional development. The Global Report shows that a promising culture-based vision of urban development is flourishing in different forms in several cities across the world» (Verdini and Ceccarelli, 2017, p. 9) Even small and medium settlements located at the periphery of large cities or within their metropolitan areas, and generally associated with marginalization or deprivation, have the potential to fully utilise their cultural resources, in both tangible (urban and architectural heritage and cultural infrastructure) and intangible forms (skills, knowledge, competencies), as explored in Foster's case studies about radically new settlements. However, these small settlements and their communities require different analytical tools to understand their complexity, to develop ad-hoc policies and to manage their assets in a sustainable form.

This research report aims to show ways to understand Culture and Creativity in small settlements, by collecting a series of international case studies that form the backbone of chapter 10 of the UNESCO Global Report on urban-rural linkages and titled Culture as a Tool to Achieve Harmonious Territorial Development. The challenge

is to exploit smart technologies, initially envisioned in the sixties by McLuhan's (and Lapham, 1994) and Pierre Lévy (1997) with the concept of Collective Intelligence as well as Ratti's Senseable City Lab at MIT (Claudel and Ratti, 2015).

In fact, Pola (2019a, 2019b), a researcher at the World Heritage Institute of Training and Research Asia and Pacific under the Auspices of the UNESCO, affirmed that China's growing attention towards villages in recent years has contributed transforming the concept of built heritage and helped in disseminating a holistic idea of territory that has prepared the ground for the environmental turn the country is now experiencing. This conceptual transformation was carried on by several converging – although independent – initiatives from different governmental institutions and has been driven by multiple factors, of which the most important is the need to mend the development gap between urban and rural areas, and the wish to rediscover the cultural heritage of the country. «[…] The Chinese experience in village preservation was conceived as an important component of a much wider corpus of measures, driven by the rural revitalisation discourse, and should therefore be situated within this broader conceptual framework. This perspective leads to a distinctive approach to the concept of heritage and outlines a type of protection […] with Chinese characteristics' that will increasingly influence the international context» (Pola, 2019a, p. 64; Figg. 12-14).

Almost like a story, the map (Fig. 12) looks like a narration of the intangible heritage and human activity layering's, exposing like a poem the constructive details or tectonic inhabiting environments that can be still desirable for 2030 visions. «[…] The high walls surrounding the residence acted as firewalls protecting the wooden load-bearing structure as well as guaranteeing the safety of the family members – women, children and the elderly – left alone while their husbands and brothers travelled. The buildings, which usually consisted of two or three residential storeys on a relatively small plot of land, had […] private water gardens, wells and public pools structured the village's open spaces. […] The surrounding landscape is bounded by forest laden hills and mountains where tea plantations grow on relatively small plots of land. In the past, the management of the land and of its timber resources, which were so important for the local economy, was regulated by a complex network of ownership agreements that benefitted from a highly dynamic market governed by a business logic rather than traditional agroforestry practices» (Pola, 2019b, p. 171).

The previous idea to merge the reuse of the built heritage with new infrastructure and potential of smart-working (Pola, 2019a; Verdini and Ceccarelli, 2017; Bandarin and van Oers, 2015; Tiazzoldi, 2012) embeds multiple factors of 2030 agendas from different institutions. Although, younger generations are not yet ready for this step, as reported in a conversation between the author and Honchao Wang, Principal of the design firm Benwu Studio and a faculty member of Xian Jiaotong-Liverpool University. Educated in China, United States and Europe, and now working for local and international clients, the designer affirms that his international colleagues and clients often ask him why young Chinese generations do not desire to inhabit historical heritages.

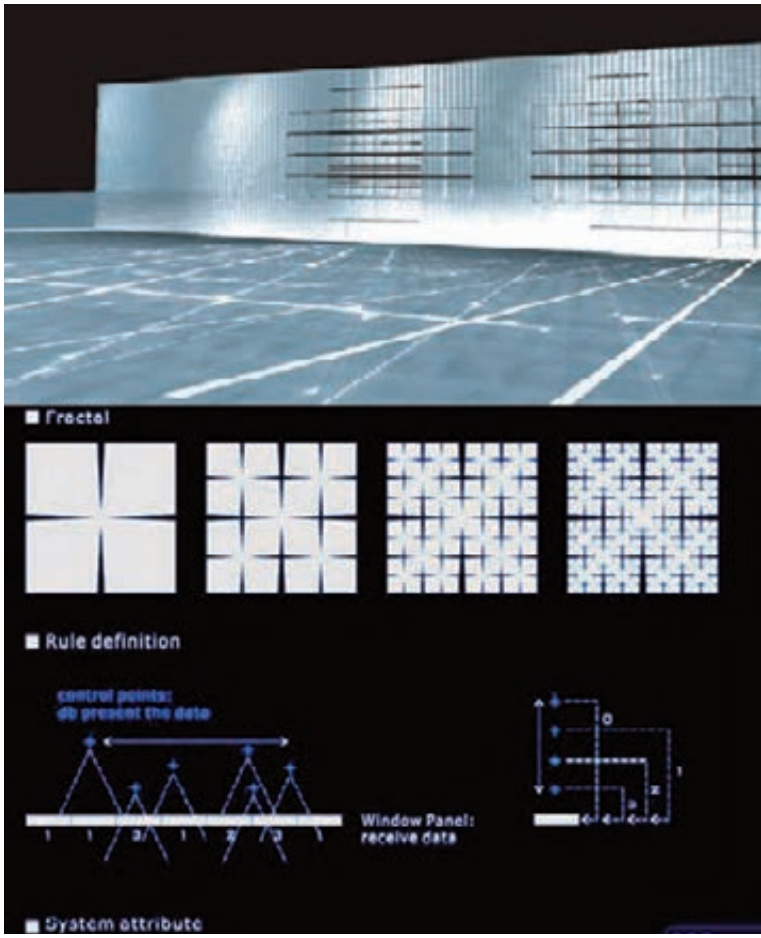


Fig. 15 | Northwell Health, Katz Women's Hospital and Zuckerberg Pavillion by SOM, 2011 (credit: E. Hueber).

Fig. 16 | Preparatory Drawings and Algorithmics by SOM and NSU – GSAPP Columbia University (credit: C. Whitelaw and C. Tiazzoldi, 2006).

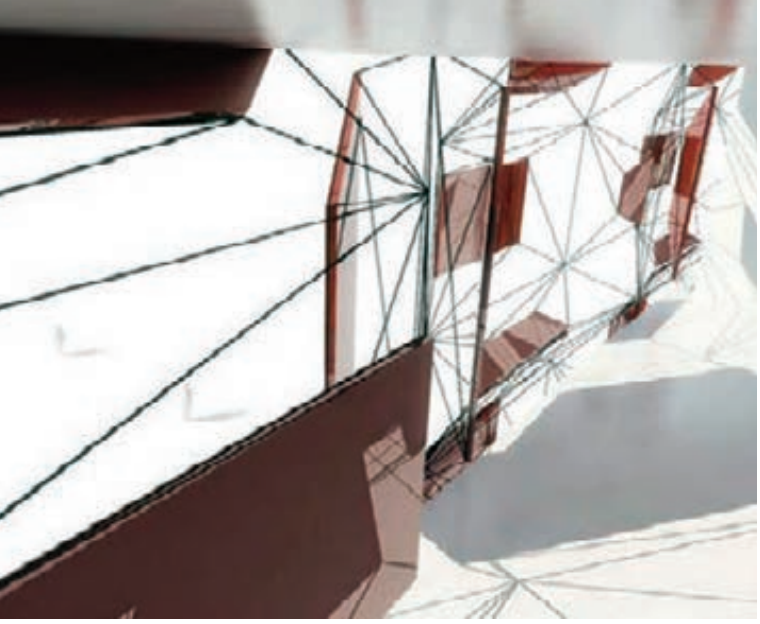


Fig. 17 | Diamond Shape with Solar Panels in the Centre by SOM and NSU – GSAPP Columbia University (credit: W. Tracy, 2006).

Figg. 18, 19 | Proposal of Po Chen algorithmic device modulating vertical glass partitioning and the shade requested by SOM and NSU – GSAPP Columbia University, 2006 (credit: P. Chen); Montage associating the vertical shaders proposed by Po Chen with the SOM final solution designed with vertical glass shaders, 2011 (credit: P. Chen, E. Hueber).

Nevertheless, he considers that his generation is not attracted to re-inhabit historical buildings, as what happened in Europe after the Second World War when the remembrance of poverty and the lack of hygiene were too strong to tempt communities to immediately re-inhabit historical heritages.

Technology and Tectonics | By recalling the topic of the need to build new habitats for the massive urbanization process, another question would be how to approach the relation between technology, habitat and local traditions. In fact, at the end of the 19th century, the impact of technology such as the first elevator installed by Otis in Chicago radically transformed Cityscapes world-wide (Frampton, 2007; Goodwin, 2001). Although, by introducing the topic of critical regionalism, Frampton in the early eighties criticised the risk of banalization of an architecture merely based on technology, non-relating to the site and culture or genius-loci (Frampton, 2007; Sassen, 1999). Such topic was recalled by Robert Maulden (1986) in his PhD theses Tectonic in Architecture – From the Physical to the Meta-Physical. There, he defines Tectonic as «[…] the science or art of construction, both concerning use and artistic design. It refers not just to the 'activity of making the materially requisite; construction that answers certain needs, but rather to the activity that raises this construction to an art form'. It is concerned with the modelling of material to bring the material into presence: from the physical into the metaphysical world» (Maulden, 1986, p. 1; Frampton, 1995). In this regard, this concept has been interpreted in different historical phases and contemporary exploration, including 2030 visions. For example, in the sixties, the Pritzker Prize winner Louis Barragan exploited the cement sharpness to emphasize the uniqueness of Mexico sunlight. Local temperatures and moderated rains also permitted to avoid some window framings, thus making sunlight even crisper, and embedding the attributes of the territory.

Similarly, in the 1930s, Konrad Wachsmann (1995) approached with a completely new language the wooden structures. He addressed the traditional US Balloon Frame with a contemporary language and plans. Wachsmann demonstrated how new forms can be achieved when modern manufacturing processes are adapted to traditional building material such as wood. Similar manipulation of a set of technological attributes was developed by the author with a group of students in the context of the Columbia University studio Formal Modulation for Light Mitigating in collaboration with architecture firm Skidmore, Owing, Merril in the project Northwell Health, Katz Women's Hospital and Zuckerberg Pavilion (SOM, 2011). The goal of the research directed by the author (Tiazzoldi, 2008) was to create a direct connection between advanced computational design techniques, studied in an academic setting, and professional reality (Figg. 15, 16).

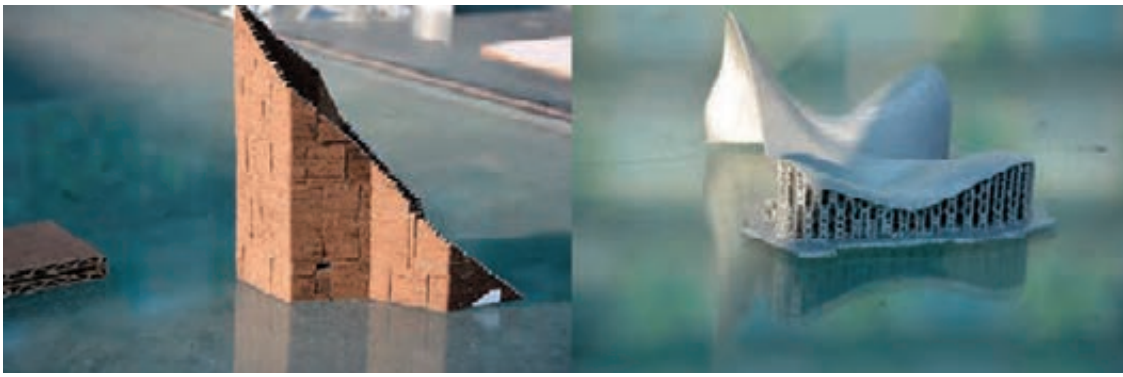
Each project developed by the students focused on the qualitative and quantitative understanding of algorithmic responsive devices applied to the constructive reality of façade systems. A curved glass façade with appearance – rhythm, frame partitioning

Figg. 20, 21 | Real Scale 3D Printing resolution by Winsun: 21 Winsun Office in Dubai (credits: Winsun).

and size- reflects the diverse functions housed in the building. The goal of the project was to explore the capacity of architecture to answer specific environmental requirements through the use of responsive algorithmic devices. In the case of Northwell Health, Katz Women's Hospital, the algorithmic attributes' manipulation was finalized to modulate the shade in relation to the organizational plan and room requirements: single-occupancy birthing suites, rooms for overnight stays for new fathers, large lounges for additional family members.

By applying the Combinatorial Architecture methodology, the researchers isolated a series of attributes with the goal to produce a digital model having the capacity to quickly adapt to the possible design variations. Projects were not conceived to be dynamic once built. Williams Tracy developed a system of diamond shape windows embedding solar panels in the centre (Fig. 17). Tracy's variable attributes were the level of extrusion of each window, that could create some kind of loggia, their size, and the size of the solar panels. This permitted to control how much shadow was required in each room and to augment the energy efficiency of the building. The proposal of one student Po Chen was based on vertical glass panels as shaders: the variable attributes were the spacing and rotation of the shader according to the rooms' functions. In the final solution realized by SOM in 2011, it was possible to identify some of the attributes of both proposals: Tracy's loggia type windowing system with variable size to fit different functions and Po's vertical glass shaders with variable partitioning (Figg. 18, 19).

The following paragraphs address how C.A. and Robustness can support research in innovative materials while managing economical and logistical the risk of full-scale prototypes applied to the relationship between architecture and Computer Numeric Control (CNC) full-scale production. Combinatorial Architecture and Robustness permitted to verify and identify similar and repeatable parts between small, fast prototyping machines and how 3D printing can affect the relationship between the material tectonics' and new forms of the liveability of the space. Printed Spaces was a master



Figg. 22, 23 | Printed-Spaces (credits: A. Zuccolo and B. Who).

studio lead by the author with a group of students of Printed Space in the second year of their Master's programme at Xian Jiaotong-Liverpool University.

The brief challenged how the potential full-scale Computer Numeric Control Techniques (CNC) could share some attributes of fast-prototyping, considering that full-scale prototyping had limited accessibility from a technical and economic standpoint. By adopting the method of Swan, Kotabe and Allred (2005), the students explored which attributes of a model realized with a fast-prototyping machine could reflect the state of the art of full-scale 3D printing (Figg. 20, 21). This research studio enabled students to research how full-scale 3D printing could develop new tectonics. At this time, full-scale 3D printing was mostly used to emulate traditional or high-tech buildings (Stott, 2015). This research, developed in 2016, explored new languages as a kind of 'brutalism' deriving from the properties of the material itself (Figg. 22, 23). For example, by slowing down the machinery speed and cooling process, and by simulating the type of CAD-CAM trajectories that the full-scale production would allow, rapid-prototyping started to acquire some of the 'melting' qualities of the real scale 3D printing extrusion process, somehow behaving like a gigantic toothpaste. Such a combinatorial approach permitted the creation of an exciting analysis: the structure developed with the small-scale 3D printed model enabled the production of new tectonic potential.

In the following paragraphs, the author will explore how the previously mentioned human factor Kitano, Holland, Swan can provide a positive variation of the idea of tectonic as esprit du lieu, consisting in the integration of the population into the construction and learning processes. An example is the project Za'atari Classroom launched by NGO Emergency Architecture and Human Rights[4] (Figg. 24-26). The technique the project chose was one familiar to many Syrians, selecting a combination of the Superadobe technique – a NASA and UN approved home building method which uses filled sandbags, barbed wire and traditional beehive vernacular techniques seen in Africa and the Middle East, similar to the techniques used to construct the

Figg. 24-26 | Classroom (Za'atari, Jordan) by Emergency Architecture & Human Rights, 2017 (credits: M. Rubino, 2017).

Great Mosque of Djenne in Mali. The design is conceived to ensure that structures retain up to 5 °C of heat in Winter and are 7 °C cooler than outside in Summer. The case study showed how the integration of human factors, rather than being a limitation for the execution of a building, enhancing its design robustness. It provided the possibility to access to local materials and the use of technics familiar to the local population, together with the intensification of the sense of belonging to the community. Ironically, all these factors, from an engineering standpoint, could be a cause of perplexity about the perfection of buildings' final execution. Therefore, robustness aims to maintain a certain level of control, deriving from the repetition of well-known tools or building blocks, while tolerating mistakes, innovation and human factors.

The case of the Fass School and Teachers designed by Toshiko Mori adds a new variable in the participatory architecture process. It combines some traditional attributes of space and local materials with innovative procedures and shapes. «[..] In the design, four classrooms and two flexible spaces are arranged around an interior courtyard. The oval shape fosters easy circulation between classrooms, allowing the schools' teachers to move quickly between classes. The variation of the perimeter walls in terms of height and proximity to one another creates a wide variety of sections and experiences through the building. Fass School's shape was inspired by vernacular precedents, while its construction utilized local, traditional skills and materi-

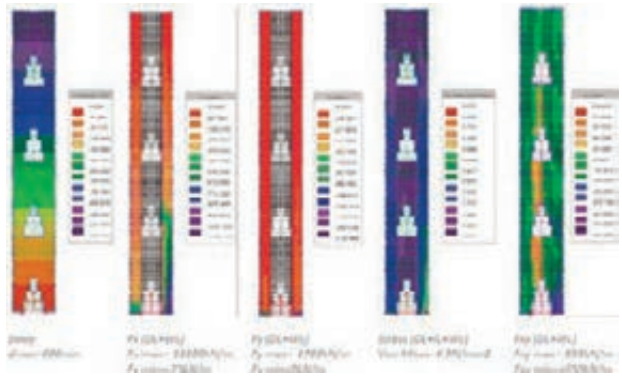
als. The local construction team was provided with instructional diagrams to assist with the sequencing of the structure's precise geometry – community involvement throughout every phase allows for easy maintenance over time. Small steel members and bamboo support mud-brick walls were used, which were painted white to deflect heat and perforated to allow for ventilation and airflow throughout the building. An inversion of the traditional pitched roof, the thick thatch roof, reinforces climatic comfort by providing effective insulation against extreme heat. A stack effect allows hot air to rise into the peak of the roof while inviting cool air into the spaces. With a roof pitch consistently 45 degrees or greater, the unique form also maximizes rainwater runoff, diverting water into a channel that encircles the building and empties toward an existing aquifer» (Mori, 2019; Figg. 27, 28).

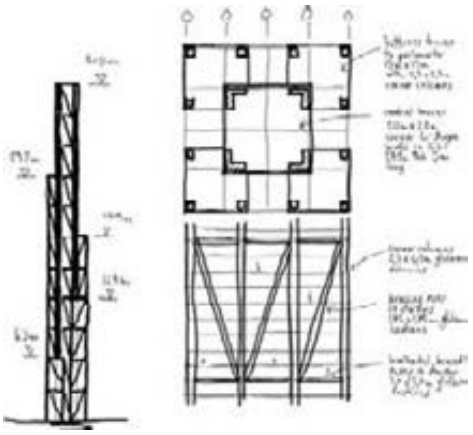
The case study of Za'atari Classroom shows how different factors were embedded into the relationship between technology, construction and expatriated community while privileging a traditional shape to recall their visual references and therefore the feeling of belonging. The example of Fass School and Teachers' demonstrates an interesting possibility to merge traditional and innovative shapes. By recalling Wang, Ke and Minett (2004) in Computational Studies of Language Evolution, Mori case study shows the opportunity to create an evolving language that enhances programmatic transformations – for example, the roof between the buildings creating a shaded public space. This prevents a stylistic crystallization or what Francesco Bandarin, would define as a folkloristic approach (Bandarin and van Oers, 2015; Ceccarelli, 2016).

Sustainable Energy Built Heritage and Human Atmosphere | Since early 2000, several countries' programs focused on the integration in the historical urban setting of sustainability, renewable energies and circular economy. In 2009, the Scottish and Irish Governments launched a campaign for the conservation and management of the

Fig. 27 | Fass School and Teachers' Residence (Fass, Senegal) by Toshiko Mori Architect (credit: I. Baan, 2019).

Fig. 28 | School and Teachers' Residence (Fass, Senegal) by Toshiko Mori Architect (credit: I. Baan, 2019).





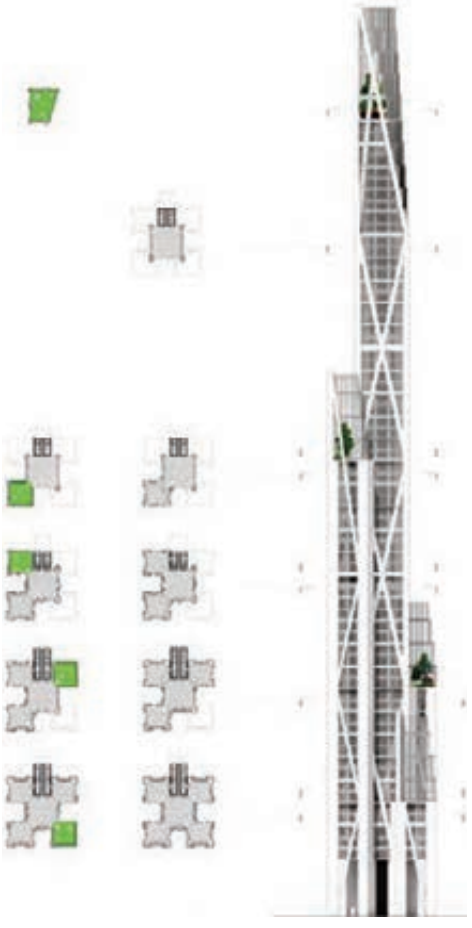


Fig. 29 | The Oakwood tower in London the notional site for the Oakwood tower, London's Barbican (credit: PLP Architecture); 3D finite element model for the crossed I-beam structural solution (credit: Smith and Wallwork); Buttressed mega-truss (credit: Smith and Wallwork); Floor plans at various levels highlighting sky gardens and core (credit: www.dezeen.com, 2019).

historic environment which contributed directly to sustainability in several ways (Changeworks, 2009). This included the energy and materials invested in a building, the scope for adaptation and reuse, and the unique quality of historic environments which provided a sense of identity and continuity in a period of rapid social and economic change. The report describes how the insertion of solar panels in the historical Dublin Downtown does not excessively affect the city landmark if done by studying a clear perspective. Oppositely, Cesare Sposito (2019) exposes an analysis on how a timber structure can become a landmark of the city, respecting bio-economy, circular economy, land use reduction, sustainable use of natural resources, reduction of CO_2 emissions in the atmosphere and recycling. Among the case studies cited by Sposito, the PLP Architecture (Fig. 29) unveils London's first timber tower showing the possibility to merge a building belonging to a sustainable cycle in London Cityscape. In a nutshell, Sposito explores the possibilities of timber as a sustainable building material throughout its whole life-cycle.

Natural Heritage, MAB and Human Atmosphere | The previous paragraphs analysed the possibility to integrate circular-economies and renewable suppliers' energy into the built heritage. The next paragraphs will question the relationship between massive renewable energy providers and the potential conflict they can create for the biosphere and human and wild environments. They spatially compete with agriculture and threaten wildlife. For example, desert tortoises were displaced by a solar plant in California's Mojave Desert and birds were burnt off by heat from the solar farm's mirrors which simulated a lake effect image from high up. Furthermore, these farms cause a landscape transformation, affecting the landscape perception for the whole population.

For this reason, UNESCO (2019) created the MAB Programme (Man and the Biosphere Programme), an intergovernmental scientific programme that aims to establish a scientific basis to enhance the relationship between people and their environments. MAB includes a series of biosphere reserves – 100% powered by renewables energies – to promote sustainable development based on local community efforts and government, science and knowledge: El Hierro, Jeju, the Galapagos Islands, Grosses Walsertal, Pellworm, Altaisky and the Lakshadweep Islands, as well as new initiatives at World Heritage sites such as Edinburgh and Aldabra Atoll. Also, MAB combines the natural and social sciences to improve human livelihoods and safeguard natural and managed ecosystems, thus promoting innovative approaches to economic development that are socially and culturally appropriate, and environmentally sustainable, usually disseminated in the occasion of the Renisla Forum. The Renisla Forums discuss key issues, including energy self-consumption and green building, sustainable electric mobility, renewable water strategies and collaborative opportunities with Africa.

In occasion of Renisla Forum 2014, the author was invited to present, as an example of good practice, the Whirlers project that she developed in collaboration with Duarte. Renisla 2014 took place the MAB site of El Hierro in the Canary Islands in

Figg. 30-32 | Wind Turbines and water reservoir, Gorona del Viento, Spain (credits: Renisla, 2014).

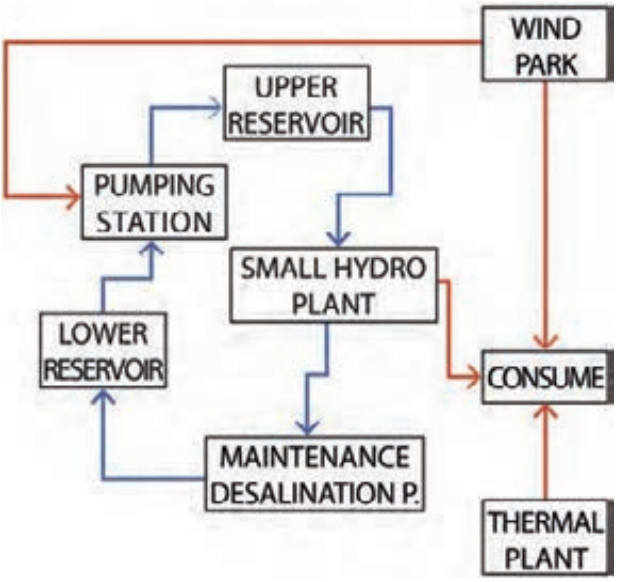


Fig. 33 | Scheme of the power exchange between Wind Turbines and Water reservoir, Gorona del Viento, Spain (credit: Renisla, 2014).

the occasion of the launch of the project Gorona del Viento: «[…] a wind-hydro system of a wind farm (11.5 MW), two water reservoirs, a pumping unit, hydropower plant, and seawater desalination plant. The wind farm supplies electricity directly to the network, and excess power feeds the pumping unit, raising water to a higher reservoir dam, which works as an energy storage system. The power plant uses the stored potential energy, ensuring power supply and network stability. The operation's philosophy is based on supplying the electrical demand of the island with renewable sources, thus guaranteeing the electrical network's stability. The diesel engine plant will only operate in exceptional or emergency cases when there is not enough wind or water to produce the required energy. This wind-hydro project will avoid the annual consumption of 6,000 tons of diesel, equivalent to 40,000 barrels of oil imported by sea to the island, saving over 1.8 million euros yearly if compared with conventional power generation costs»[5] (Figg. 30-33).

Whirlers is a visionary proposal which integrates sustainable energies with the public realm. For this reason, Whirlers was conceived to create a playful environment combining sustainable energy and public space. Its design consists of a micro-eolic plan that needs little wind for activation and therefore can fit different landscape types. The concept consists of a three-dimensional grid of Darrieus turbines (vertical-axis wind turbines with the main rotor shaft arranged vertically). Whirlers results from an implementation of the C.A. methodology in its 3-phases approach: Creative Reductionism, New Population of Solutions, Selection of the solutions better fitting with local factors (Fig. 34). It enables the adjustment and association of physical and measurable spatial attributes (scale, length, colour of wind turbines) to achieve a range of different public space typologies (with various thermal, chromatic, and density qualities) through the manipulation of rotational and relative distance values between specific building blocks (wind turbines; Fig. 35). Whirlers is still considered an excellent teaser to stimulate and propose a power plant that engages the public realm, integrating two factors that are usually incompatible: it can generate unprecedented types of public spaces applying the C.A. and to associate the physical and qualitative properties of public space with the quality of a renewable energies plant (Fig. 36).

Conclusions on long-term Robustness | Throughout this report, the author exposed how Robust Design and Combinatorial Architecture can mitigate and modulate the contrast between different visions and goals. The various case studies presented an increasing level of robustness deriving from integrating intangible qualities, human factors and the community feeling of belonging. The author has then exposed how the use of traditional techniques facilitates local populations to repair their buildings. Last but not least, the possibility to variate the forms with the same technology enables the adoption of new geometrical schemes and functions, preventing an over 'folkloristic' approach (Ceccarelli, 2016; Bandarin and van Oers, 2015), while maintaining the architectural flexibility of the 'type' described by Martì Aris.

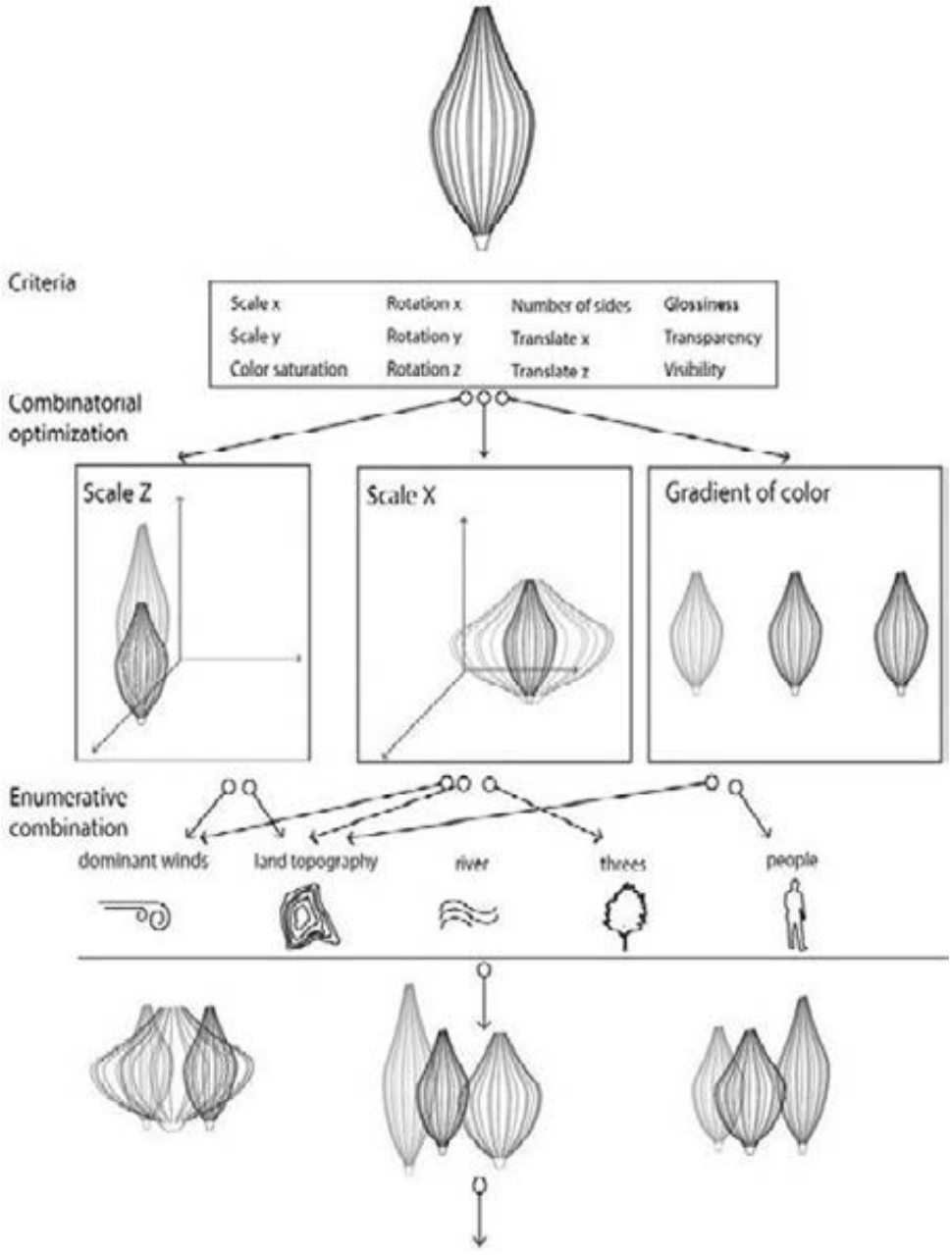


Fig. 34 | Different phases of the combinatorial method applied to the definition of a wind turbine population in the landscape: 1) creative reductionism; 2) creating a new population of the solution by adjusting the attributes and building blocks; 3) selecting the solution that better fits with the physical and sensible factors (credit: C. Tiazzoldi and E. Duarte, 2014).

Fig. 35 | Adaptation of the Scheme into Different Landscapes, Whirlers project by C. Tiazzoldi and E. Duarte (credit: C. Tiazzoldi, 2014).

Fig. 36 | Whirlers render by C. Tiazzoldi and E. Duarte (credit: C. Tiazzoldi, 2014).

The methodology cannot yet incorporate all the variables, as per the case of the designer Honchao Wang exposing the reticence of young generations to re-inhabit small settlements even if supported by smart technologies and infrastructure. For this reason, the idea of long-term Robustness was approached by a group of researchers at the Santa Fe Institute (Trancik et alii, 2005) and by Oilman (2008). This Robust long-term planning became relevant to mediate between the community's desires at a given time and long-term plans, permitting in this way history to sediment visions on the memories and lands. Robust or Combinatorial Approaches cannot manage and mediate all diversities in a short time frame. Nevertheless, the case of William Wang

demonstrates that it is possible to handle a consistent level of changes or noises having the flexibility to manage all the variables, thus leading to an optimal solution compatible with the uncertainty deriving from long-term visions.

Notes

1) More information at the webpage: archdaily.com [Accessed 23 December 2020].
2) More information at the webpage: fosterandpartners.com/projects/masdar-city/ [Accessed 23 December 2020].
3) More information at the webpage: ambiances.net/?fbclid=IwAR1IuUSTuLhnR3jMheq7JqW1MgW9OKZJupcQbbL8uz2GjAtZCvOGcL__EFw [Accessed 23 December 2020].
4) More information at the webpage: ea-hr.com [Accessed 23 December 2020].
5) More information at the webpage: goronadelviento.es/ [Accessed 23 December 2020].

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EXPERIMENTATION OF A NEW ADAPTIVE MODEL FOR ENVELOPE SYSTEMS

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ABSTRACT
In recent years, the construction sector is pushed to accelerate the development of technical solutions to increase building envelopes' performance compared to the various climatic changes that involve the built environment. The contribution illustrates ongoing experimental research whose intent is to address a design methodology through adaptive design techniques responding dynamically to contextual conditions of reference. The operating methods are based on the construction of dynamic simulation scenarios to create a highly adaptive model, which can be used as a component for advanced envelopes. With the support of the TCLab section of BFL, the model's development and testing intend to implement technical solutions with possible explanations of prototype lines.

KEYWORDS
climate change, environmental quality, adaptive components, building envelope, adaptive design

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For years, the effects of climate change[1], if on the one hand, negatively affect the general quality of the built environment and represent a fertile field of experimentation of innovative design processes and methods. In this sense, there is an increasing demand for methods and processes capable of calibrating the phenomenal interactions and the effects suffered and induced by the building system on the dynamics of climate change at the various scales of the built environment. By this, the building is assimilated to a living organism (Dal Buono and Scodeller, 2016), able to receive the environmental influences of the context and, on the other hand, is itself a relevant instrument of the modification of the physical environment, consisting of several coexisting and interacting elements and factors. In particular, the building envelope is not a static and passive system concerning the context. Still, it becomes a control surface of the performance offers according to the thermodynamic balance between inside and outside; therefore, 'influencing' turns the relationship's environmental context. In terms of the flow of matter and energy in the envelopes, the synergistic reading of the effects and relationships pushes innovation to define new performance criteria different and articulated corresponding to the performance of individual technical elements that contribute to the definition of internal and external environmental quality.

The contribution is part of this framework and is related to ongoing PhD research, in line with the European Directive on Energy Efficiency 2012/27/EU (Directive 2012/27/EU of the European Parliament, 2012) and the recent 2018/844/EU (Directive EU)2018/844 of the European Parliament, 2018), to achieve zero-emission buildings by 2050 and the integration of smart technologies to ensure that buildings operate and consume as efficiently as possible. The research scenario, financed with funds POR Calabria FESR/FSE 2014-2020 (Axis 12, Action 10.5.6), should also be read about the Strategy S3-Region Calabria[2]. It is placing itself within the Sustainable Building trajectory related to the development of specific technologies and materials with higher performance and the simulation and evaluation of buildings' environmental impacts. The research project wants to investigate the performance and control aspects of the components of the building envelope. The project results from the latest innovations, identifying and defining new technological solutions that express additional levels of response and environmental compliance, and the ultimate goal of verifying the possibility of arriving at prototype lines. The opportunity to have the TCLab Section of BFL[3] – Building Future Lab of the 'Mediterranea' University of Reggio Calabria – is strategic in examining the various scenarios of adaptability of the building envelopes, directing different design strategies concerning the environmental context of reference.

Starting assumptions | The research's reference scenario in progress highlights the building envelope's role in constant etymological and functional-performance evolution. An element able to control the interactions between the internal and external environment (and vice versa) as the different contextual conditions change and, above

all, respond to the multiple needs of users who 'live' the confined environment. The acclaimed attention to environmental issues, energy, and comfort conditions has oriented innovation towards developing technical elements, innovative multifunctional components (Milardi and Mandaglio, 2019), and high-performance materials that organize the envelope. The envelope transformed from a protective 'shield,' with insulating and sealing properties, to a surface of dynamic interaction between the external space and the confined interior. According to Wigginton and Harris (2002), the building envelope can be designed to operate as part of a holistic building metabolism and morphology and will often be connected to other parts of the building, including sensors, actuators control cables from the building management system. The complex management and regulation between parameters with high impacts on buildings (Bitan, 1988), such as air temperature, humidity, ventilation, and envelope elements, challenge declining new technical configurations that induce less variation in the context.

In line with these considerations, adaptive design[4] techniques, applied to the envelope, assume today a primary role in the function of programmable performance responses, useful to affect the quality of the built environment and, at the same time, modulate the effects generated by it. In general, adaptive behaviour combines sensors and movement mechanisms classified as pneumatic actuators, hydraulic actuators, and drives based on electric motors. Thus, these systems make the envelope responsive, interactive, dynamic, intelligent and increase its ability to change its structure to regulate the flows of thermal, light, and sound energy passing through it (Banham, 1969). The results of numerous research and initiatives concerning the panorama of programmatic policies in Europe[5] often reveal methodological gaps and applicative difficulties for the correct evaluation of the balance of technological and environmental parameters, thus pushing the designer to acquire different qualitative approaches to control the project. Against this, assessing the envelopes' adaptive behaviour is a challenge because of the building envelope's adaptive components' performance, which doesn't sufficiently characterize through static performance indicators such as U-value, g-value, T-vis, etc (Attia et alii, 2015). Moreover, these indicators' variability cannot be ignored, given the changing external and internal environmental conditions, leading to mismeasurement of building envelopes' adaptive characteristics.

In this sense, the innovative character of the current research aims to understand the envelopes' microclimatic functioning in the built environment, which is crucial in defining information that can increase the level of contextual relationship of new strategies of adaptive type. On the other hand, in constant development and experimentation, adaptive design technologies are linked to single architectural design cases, limiting the large-scale application of innovative envelope systems that contribute significantly to the control of microclimatic variations that trigger between building and context. From an initial analytical investigation, the following issues are identified: i) the demand for high degrees of environmental compatibility cannot disregard a valid but difficult analysis of technological processes, which continuously transform incom-

ing and outgoing matter flows and dependent on the microclimatic conditions of the context and environmental comfort; ii) the evaluation of the performance quality of adaptive envelopes is not ensured by a specific regulatory apparatus, underlining the need to classify the behaviour of adaptive technologies according to the environmental context of reference; iii) it emerges the need to investigate the building's energy operation in its technical components, considering that the quality control cannot take place ex-post, to address and simulate its dynamic process.

Adaptive building envelopes | The interest for an architectural project-related both to new languages and to themes of interaction (today, more and more 'intelligent') with the environment has led to conceive the envelope as a dynamic epidermal layer that changes, mutates, and adapts to different microclimatic conditions and the needs of users. In line with the literature, the research wants to position itself as a tool capable of supporting the panorama of building interventions, innovating the architectural language with elements endowed with new technological values aimed at improving the functioning of the system to the totality such as the world's first passive envelope powered by algae (Conato and Frighi, 2018), the Smart Material House BIQ in Hamburg (Figg. 1, 2) and the Media TIC in Barcelona (Figg. 3, 4). It combines high safety standards with a visual image of openness and transparency through ETFE panels, examples that contribute to the formulation of new approaches to adaptive governance, in its continuous feedbacks from the urban to the building scale and vice versa.

The envelope technologies' innovation involves transitioning from a single function of insulation/protection to adaptivity. These are capable of satisfying many interdependent requirements relating to specific environmental contexts. Therefore, according to this paradigm shift, adaptive building envelopes can interact with the environment and the user by reacting to the external output and adapting their behaviour and functionality accordingly: the building envelope insulates only when necessary, produces energy when possible, and shades or ventilates depending on the internal comfort requirements (Luible et alii, 2015). In particular, the focus is on the building envelope, which takes on a strategic role in achieving energy and living comfort goals. The new technological language of the envelope system enshrines a new relationship with the environment, dictated by the ecological burden of the materials used. Thus, the building envelope enters into symbiosis with the environmental context in which it places, thanks to intelligent control systems, overcoming the traditional passive bioclimatic architecture through integrated strategies.

Given the complexity of parameters and components that constitute an envelope, the development of an adaptive envelope requires the integrated contribution from other disciplines, such as to manage the factors on which its adaptive operation depends. In this direction, we add the decisive contribution of SMART systems for intelligent enclosures that, reading the user's reactions, monitor the environmental and technological performance with optimized information. This scenario opens the way

to dynamisms that, depending on the envelope's configuration, direct low-material choices, generating controlled systems during the life cycle. As expressed by Benyus, taking nature as a model, measure, and mentor (Benyus, 2002), the biomimetic approach investigates the adaptive requirements of building envelopes, which directs the research and development sector towards the realization of materials and components that respond to external stresses organically and passively.

Aims and objectives | The desire to research with a strong experimental character highlights how this must leverage more in the perspective of overcoming the frontiers related to the management of the processes of adaptation and transformation, necessary prerequisites in the development of responses in terms of maintenance and improvement of functionality and performance quality of the elements and systems. How can the building envelope system's technical elements generate systemic responses such as to capture the effects useful to maintain and improve its functioning, contributing to the definition of the internal and external environmental quality?

It seems clear that one of the theoretical-operational strategies is the definition of processes and technologies of performance control of the envelope to improve the quality of the built environment. The envelope means the totality of the parts that define an internal environment (characterized by relatively stable environmental conditions) to an external environment (variable by nature). The studies focus on the possibility of developing a controlled and reliable vision of building envelopes capable of adapting to different needs, exploiting changes as an opportunity to raise environmental and performance quality. Specifically, the research wants to address technological innovation's adaptive functional aspects of the envelope, offering the possibility to mediate the thermal and energetic loads induced by the building's same technical elements. The need for a measurable control leads to the realization of a model/adaptive element, with the ultimate goal of verifying the possibility of realizing prototype lines, implementing the technology transfer from science to production.

The difficulty in constructing a detailed performance-environmental profile of the envelopes poses a general objective of the research, the definition of technical tools to promote interventions on the built environment towards adaptive strategies related to the envelope system's performance control. This scenario of intent is aimed at the expectations of quality control, translating environmental requirements into technological performance, contributing to the mitigation of impacts. Thus, the research activities are directed to developing scenarios/simulation models and application testing through the proposal of an adaptive model that can become, through the implementation and application testing, a real example of the possibility of offering guarantees aimed at energy containment and mitigation of environmental impacts. The research project is, therefore, aimed at: i) classify the building's technical elements concerning their operating characteristics and performance requirements to be asseverated, providing a complete picture from the technical point of view; ii) identify the features of

Figg. 1, 2 | Smart Material House BIQ in Hamburg by Splitterwerk Architects and Arup, 2013. The most significant element is the integration, on the south-east and south-west building façades, of flat-screen bioreactors, made up of microalgae (source: syndebio.com/).

components, materials, and adaptive systems -in production or already built buildings- that allows the envelope to be understood as an environmental moderator (López et alii, 2017) to assume variable configurations; iii) identify design and performance criteria that facilitate the reading and the most suitable adaptive functions for envelope systems to specific environmental conditions.

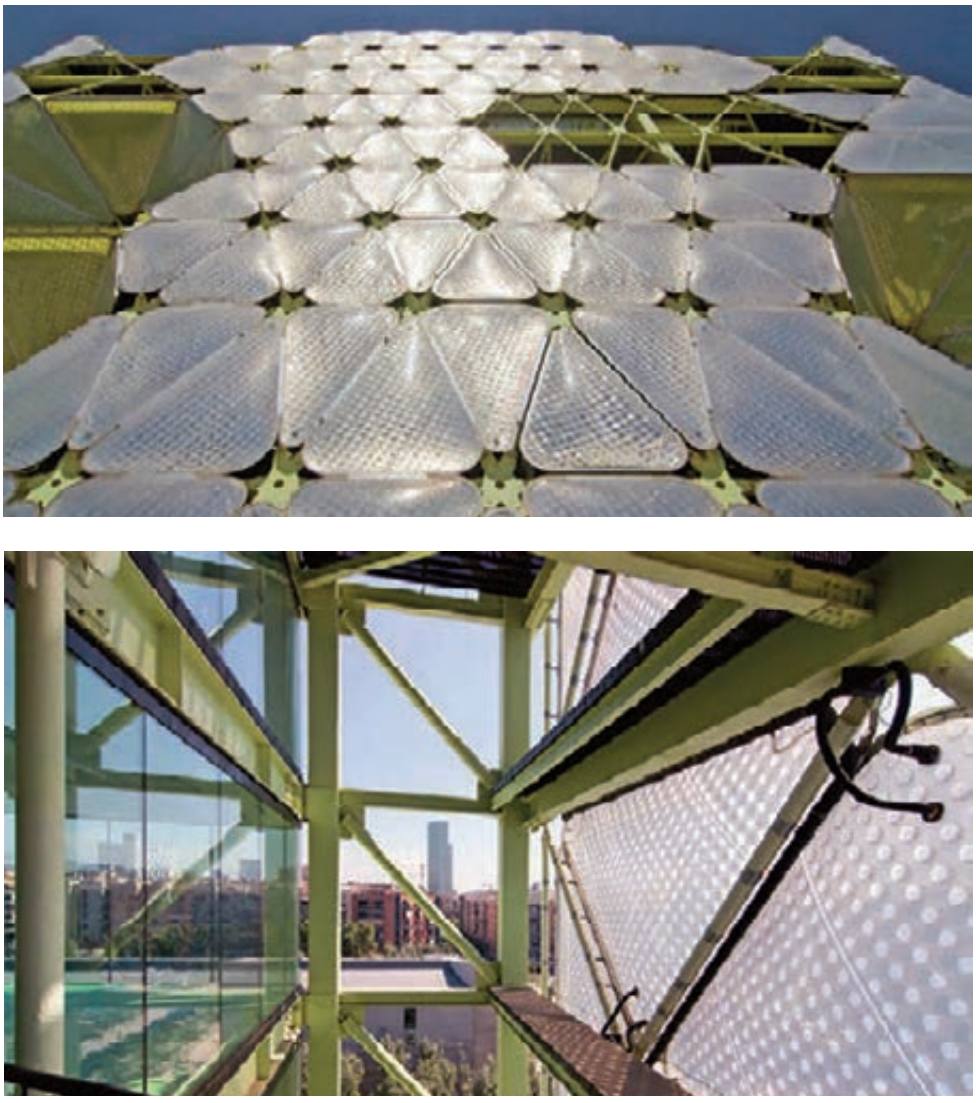
Methodology and actions aimed at experimentation | Starting from an analysis of the performance functions of the envelope, it emerges: i) the complexity of the technological elements constituting the envelope makes it difficult the correct reading of their behaviour, given by the summation of the different performances of the components of which they are made, influencing the climatic-environmental conditions of the area in which it places; ii) the difficulty in assigning adaptive characteristics determines a wrong measurement of adaptability, given the lack of specific indicators that combine environmental and adaptive parameters.

According to the above scenario and to study the modalities and the effects induced by the 'activities' of the building envelope on the microclimatic context, the research activities is articulated following a methodological procedure structured according to sequential phases, activating a process of validation/implementation of the partial results obtained. It is also expected a strong integration with different disciplines, thus implementing a qualified contribution and a sharing of resources in the field of architectural technology and other scientific areas involved. Specifically, we report below the sequential phases.

Analytical-knowledge phase: analysis of the technical-performance scenario related to the building system to identify which technical elements affect microclimatic variations; the building is broken down into its parts – opaque surfaces, transparencies, and roofing – focusing on the control of thermal, luminous, and visual fluxes to understand the technical systems' potential and criticality the functions to which they must necessarily respond to environmental requirements.

Analytical-critical phase: it intends to promote a straightforward reading of the incidence of the building's technical elements on the effects of microclimatic performance compared to effects-phenomena to control; the investigation of the state of the art will focus on the mechanisms of adaptive systems movement, made in recent years, defining a synthetic picture of the possible configurations that an envelope can assume automatically.

Critical-propositional phase: definition of an adaptive model-component, with the possibility of contributing in a verifiable way to improve the quality of the built environment and identifying those adaptive functions of movement, concerning microclimatic variations of context to which it subjected. In this phase, the role of TCLab is strategic for the execution of the model and to confirm that the requirements are satisfied; within the experimental activity, based on standardized protocols (UNI/EN, ASTM[6], AAMA[7]) will be carried out all the verifications that meet the requirements of industry standards.



Figg. 3, 4 | Media ICT in Barcelona by Enric Ruiz Geli Architect and Cloud 9, 2010. The envelope is characterized by a counter-facade in Etfe (Ethylene tetrafluoro-ethylene), which, being able to be blown with air and nitrogen, becomes inflatable or deflatable according to the environmental stresses external (credit: Cloud 9).

Expected results | The integrated reading of the effects and phenomena induced by the building, to varying degrees on the context, defines how adaptive solutions can contribute to reshaping physical-environmental requirements in terms of design flexibility, technological and experimental innovation. When considering methodological aspects, the field of future opportunities widens considerably because a basis has been

laid for approaching problems related to adaptive technologies and their functional completeness in building envelope systems.

In particular, with respect to the phases listed above, the following expected results are hypothesized: i) construction of performance repertoires on the elements of the building system to understand how they affect microclimatic parameters, through an investigation of technological and material characteristics; ii) elaboration of computerized sheets that relate phenomena, effects to be controlled with the identification of possible adaptive strategies, able to control the operation and behaviour of the envelope for the purpose of environmental comfort; iii) instruction and construction of feasibility checks useful to the development of prototype/s (of components or if possible of envelope elements) and possible simulation of the experimental adaptive solution – able to guarantee a positive response of environmental quality that becomes function of the level of technological complexity – with the support of the TCLab section of BFL with specific competencies for monitoring, testing and prototyping; the verification activity is necessary to allow to test the adaptability levels of the model, carrying out simulations of climatic conditions in urban environment and of the effects connected to them. The partial results of the investigation activities conducted so far (always in continuous validation and updating) are identified in the first elaboration of tabs on effects-phenomena to control the building system and adaptive systems that allow the envelope to assume variable configurations.

Conclusions | It is well established that adaptive design modes contribute significantly to the design process's dynamic organization, aimed at de-intensifying the urban system's performance in its components (complex urban elements, buildings, open spaces, infrastructure). About its effective functioning, the urban system can reduce climatic vulnerability also due to the dependence on in-stream processes that characterize conventional operating conditions. Therefore, planning and designing future interventions can instruct within them procedures of analysis/evaluation and verification design appropriate to the phenomena' complexity. In support of the design decision, these tools contribute in a verifiable way to the increase and improvement of the built environment's adaptive capacity, where the ability of dialogue and control of the envelope system respond efficiently and responsibly in the dynamic contexts in which they relate.

To respond to these demands, research efforts, though still ongoing, are directed toward designing the optimal combination of the adaptive model, focusing on the most appropriate adaptive efficiency, to specific environmental contexts. However, it is highlighted that the performance responses of building envelopes, linked to the environmental variables with which they relate, will need to intelligently and systemically regulate these variables' effects. Simultaneously, it is necessary to satisfy a wide range of needs (Del Grosso and Basso, 2010) by implementing their thermophysical and mechanical characteristics. According to this approach, it is possible to offer re-

liable efficiency levels because of the interventions on the envelopes calibrated to the contextual conditions that determine the technological choice but react to the same context through 'dynamisms' useful to increase the environmental quality.

The research's study and analysis activities cannot be considered exhaustive due to the complexity of the issue and innovation fields to investigate. Moreover, the experimental approach is functional to define the following potential applications: i) scientific impact – it determines an advancement in the definition of products, characterized by a robust, innovative content and methodological and operational tools for climate-change mitigation; ii) technological impact – the experimental content makes it possible to test levels of adaptability to climate change of technical solutions, carrying out simulations of climatic conditions in an urban environment and the effects related to them, assessable in terms of industrial spin-offs (these intentions are made possible through equipment and machinery that the TCLab section of BFL has); iii) social impact – activities such as workshops and symposiums are indispensable to involve the main stakeholders and overcome impediments in the adaptation process; the project highlights how qualified scientific information and adequate technical skills are essential so that it can rest on a solid knowledge base and be well-calibrated concerning the actual environmental needs; iv) economic impact – it is expected that the coherence of the objectives places the relationship between public and private investment-benefits in a short and medium-long term perspective, establishing a new mission focused on the improvement of business know-how, centered on the realization of innovative products aimed at market trends and efficient enclosures.

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Notes

1) The Intergovernmental Panel on Climate Change (IPCC), established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), provides a scientifically based view of the current state of climate change and its potential environmental and socio-economic impacts. For more details see the website: ipccitalia.cmcc.it/climate-change-and-land/ [Accessed 13 October 2020].

2) S3 Calabria – Smart Specialisation Strategy – Regional research and innovation strategy systematized at national and European level. For more details see the website: calabriaeuropa.regione.calabria.it/website/s3/areeinnovazione/ediliziasostenibile/ [Accessed 13 October 2020].

3) The BFL (Building Future Lab) is a laboratory infrastructure of advanced testing at the 'Mediterranea' University of Reggio Calabria, which supports creating new components with high performances through simulations with standardized protocols. In particular, the TCLab Section (scientific responsible Prof. M. Milardi) bases its activities on standardized and experimental tests, having as object the envelope in its technological and material structures. For more details see the website: unirc.it/ricerca/laboratori.php?lab=69 [Accessed 23 October 2020].

4) Current design paradigm is oriented to technological-sustainable performance with the implementation of materials with integrated reactive properties (Shahin, 2019).

5) EU Adaptation Strategy has among its primary objectives qualitative improvement of the environment through adaptive design processes. For more details see the website: ec.europa.eu/clima/policies/adaptation/what_en [Accessed 25 July 2020].

6) ASTM International, the acronym for American Society for Testing and Materials International, is a U.S. standards organization and leader in defining materials and test methods in almost every industry.

7) AAMA, the acronym for American Architectural Manufacturers Association, was established in the U.S. in 1936 and is one of the most prestigious associations operating in the industrial world of windows and components of windows.

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THE CONTRIBUTION OF ENERGY POVERTY ALLEVIATION TO A SUSTAINABLE FUTURE
Eastern European Urban Context

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ABSTRACT

Energy poverty as a phenomenon is linked to the combined effect of three main factors – low household incomes, high energy costs and low energy efficiency of housing. It is a proven fact that this phenomenon has a serious negative impact on the quality of life and citizen's health, but in the same time, energy poverty contributes to a huge waste of energy and thus affects sustainable development of the built environment. Altogether the energy poverty generates deficits and discrepancies for territorial economies and society. The paper investigates the issue of energy poverty and its appearance, also in the Eastern European context. The potential for alleviation and – in the long term – for the elimination of energy poverty by applying measures for energy-efficient retrofit of residential multistorey apartment housing is analysed. The emphasis is put on achieving the optimal ratio of saved energy versus used financial resource for renovated housing.

KEYWORDS

energy poverty, social exclusion, condominiums, affordable housing, energy efficiency

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Energy poverty is a relatively new and insufficiently explored issue. Apart from its social implication, it is a significant constraint for sustainable development of the built environment. In most EU countries, buildings are the largest energy consumers; about 85% of the consumed energy is used for heating and hot water preparation. In view of the increased global economic insecurity, accelerated by the coronavirus pandemic, it is expected that the problem will become ever more prominent and, therefore, needs adequate attention and research. Such a conclusion is even more valid for Eastern European countries where energy poverty is a well-documented problem according to statistical data. One of them, Bulgaria, is leading (together with Latvia) in the negative ranking of share of households unable to provide normal heating for their homes. Households in Eastern Europe would consume twice more energy than the average in Europe to achieve the same welfare level. The vulnerability of citizens in Eastern Europe (Bulgaria, Croatia, Estonia, Greece, Hungary, Latvia, etc.) could be related to the legacy of the centrally planned economy, such as the poor thermal insulation of housing stock, the historically low energy prices and the predominance of unsustainable energy sources.

Existing approaches to defining energy poverty are still not well coordinated (Bouzarovski, 2018). Usually, energy poverty tends to be associated with specific demographic groups and/or types of housing. Therefore, energy poverty could be described as the inability to secure an acceptable level of heat comfort in energy-inefficient homes. Most common national social policies are indirectly related to addressing energy poverty, such as subsidizing a 'social electricity tariff' etc. However, few aspects of existing energy, social and climate policies have been identified as having a positive economic impact on energy-poor households. It can be concluded that common policies to tackle energy poverty at the European level are not yet established (Bouzarovski, 2018). In general, the possible policies to alleviate energy poverty could be seen in three directions: raising the level of household income; subsidizing of heating costs and subsidizing of housing retrofit. While the income level and energy costs policies are depending on much more variables and could be considered as long-term interventions, reducing fuel poverty by the implementation of energy efficiency measures in high rise apartment buildings can bring fast and efficient results if proper action will be put in place.

Energy (un)efficiency of existing mass housing in Eastern Europe | Energy inefficiency of the housing in Eastern Europe and related fuel poverty is a problem of momentous importance but it could also be viewed as an opportunity for reshaping of the housing sector through innovative housing initiatives in energy retrofit of condominium housing. Such an approach uses financial and management tools based on energy saving-oriented housing retrofit (Georgiev, 2017). The region comprises of 11 EU member states that joined the EU from 2004 to 2013. Due to process of forced urbanization during the rule of communist governments in Eastern Europe, about half of the

existing housing stock in these countries was constructed between 1960 and 1990 of the twentieth century (Economidou et alii, 2011). During this time, new housing construction was consisting predominantly of pre-fabricated large-scale multifamily housing apartment blocks built in cities with little or no consideration of energy efficiency. For example, this type of housing represents about 70% of the existing housing stock in Bucharest and 45% in Sofia (United Nations, 2013).

During the time of the centrally planned economy until 1989, the planning, development and construction of new housing were almost fully implemented by the state within the frame of the five year 'socio-economic development plans'. A limited and distorted private sector activity existed in the so-called 'individual' and 'cooperative' housing construction. That share of housing supply, in addition to being a minor, was the subject of inequality in terms of access to financing, subsidies and building materials supply, compared to the state housing development. According to the prevailing in this period doctrine of the centrally planned economy, all the parameters of the dwellings to be built – quantitative, qualitative, financial, etc. – were also determined in a centralized way through housing planning in the framework of five-year development plans (Georgiev, 2017).

A key characteristic of housing stock in Eastern Europe currently is the prevailing of private homeownership. After 1989 the transition to market economy in Eastern European countries forced privatization of existing apartment housing which was prior publicly owned to a great extent. The level of homeownership thus increased up to 90% that is far beyond the average figure of 65% for Western Europe (United Nations, 2013). In most cases, housing privatization was implemented in several years by simply selling the apartments in high rise multi-storey buildings to sitting tenants converting their status from renters to apartment owners in condominiums. The quick mass privatization of high-rise apartment buildings left many Eastern European countries without an adequate regulatory framework for management and maintenance of these newly formed condominiums, as pointed out by various researchers (Lujanen, 2010; Tsenkova, 2005; Georgiev, 2017). In addition, new homeowners had few resources to manage and maintain their newly acquired apartments as well as the adjacent common areas of the buildings. As a result, after the transfer of ownership, the housing stock in many countries from the region is ageing prematurely and deteriorating following the low quality of construction works and used materials, lack of funds and proper maintenance. Due to the above-mentioned reasons, combined with the inherited from the socialist past low construction quality and lack of management, high rise apartment buildings in Eastern Europe are in general extremely energy inefficient (United Nations, 2013).

Condominium model «[...] means that the owners own their dwelling, but, more accurately, they own the space which is defined by the internal walls of the dwelling, which might not be connected to the ground on which the building stands. Their ownership is listed as property in official records. The common parts and the land are,

however, owned jointly by all owners» (Lujanen, 2010, pp. 179, 180). Condominium model exists in all European countries. Different is how this property occurred in both parts of Europe. In Western Europe, but also in Eastern Europe (until World War II) condominiums emerged through the united efforts of private investors that jointly developed and inhabited an apartment building. In post-war Eastern Europe, most of the new apartment buildings were built and owned by the state and their dwellings were used as rental ones. They were hugely privatized in the period 1990-2000, along with imposing by the state of certain conditions for collective management and collection of running costs for these buildings. It was made by introducing requirements for the establishment of collective representative bodies at the building level – homeowners' associations (HOA). This is the case in Romania, Czech Republic, Hungary and others (Georgiev, 2017).

During the communist government after 1944 the state in Bulgaria, as well as in other centrally planned totalitarian countries in Eastern Europe, seized the role of the main developer and to meet the policy of forced urbanization has started a massive construction of multi-storey residential buildings in so-called 'housing complexes'. However, unlike other Eastern European countries and the former Soviet Union, the ownership of newly built apartments in Bulgaria was transferred immediately after their completion to their residents without providing the necessary legal provisions for adequate maintenance of the condominiums. Such 'primary' privatization of newly build apartment housing was quite peculiar for an Eastern European country at that time and implied further heavy problems with maintenance and management of Bulgarian condominiums later on. Within the time of large-scale industrialised housing construction in Eastern Europe (the sixties, seventies, eighties of last century), there were some changes in building regulations following the energy efficiency. The legislation dealing with the thermal resistance requirements of buildings changed over the years, taking into account the existing conditions for the supply of energy sources. For example, for large-panel construction systems, the stipulation has been adopted that the buildings will be operated in conditions of provided district heating (which is subsidized everywhere at that time in the frame of a central planned economy). Within the socialist economic system, for ideological reasons, the energy prices were kept by the government far below the market levels through heavy subsidies.

As a result, artificial energy prices, that were subsidized for the final consumer, combined with the relatively low energy prices on the international markets until the end of the seventies of the last century, had their impact on the low-level thermal insulation of residential buildings in most Eastern European countries. The global increase of energy prices, that occurred later, was reflected to some extent in regulations and housing design layouts. This led to some improvement in the thermal resistance of large-panel residential buildings. But in other housing systems, and especially in monolithic housing, nothing significant has been done in terms of energy savings (Georgiev, 2017).

Changes in large-panel housing construction in terms of improving energy efficiency were reflected in: a) changes to the facade panels, increasing the thickness of the thermal insulation layer in three-layer panels, reducing or eliminating thermal bridges, improving the composition of concrete for single-layer panels; b) obligatory laying of a thermal insulation layer in the floor slab above the basement; c) improving the thermal insulation above the ceiling level – the roofs so far were made according to the so-called 'cold' type – the transition from low to high under-roof space.

In all of the Eastern European countries, as a rule, high rise residential apartment buildings from that period have extremely low energy efficiency. For example, the building envelope of residential buildings had real heat transfer coefficients, more than 3 times higher than the norms for new building construction introduced after political changes. In most of the existing residential buildings, the basements and attic levels were without thermal insulation. Extremely poor thermal insulation of building envelope has become the main reason for increased heat losses (BPIE, 2016).

Housing retrofit: an overlooked tool for alleviating fuel poverty | The proposed approach that was analysed in the pilot cases reviewed, is focused on the improvement of housing physical structure potential to eradicate energy poverty, as opposed to the primary focus of existing research on tenants' behaviour aspects. Due to the prevailing share of homeowners, reducing fuel poverty by the implementation of energy efficiency measures in high rise apartment buildings in Eastern Europe is largely depending on their decisions regulated by the legal framework defining their rights and obligations within the condominium. These are framework legal regulations which need to be in place in order to ensure that energy-efficient retrofit can be successfully applied to residential buildings. Depending on the level of development in the condominium legal framework, different level of achievements is observed in renovation activities in Eastern European countries.

Although in complicated legal and economic environment innovative pilot projects have been implemented in Eastern European countries revealing the potential of improving the energy efficiency of housing as a tool to alleviate fuel poverty. International organizations have often played an important role in funding and realising projects to improve the energy performance of apartment buildings. In recent years housing refurbishment projects have increased in scale. The creation of a legal, financial and organizational framework to improve the energy performance of housing stock in these countries was speeded up by EU energy efficiency legislation. All countries in Eastern Europe have already transposed EU directive on energy efficiency (Energy Performance of Buildings Directive – 2010/31/EU) in their national legislation (Economidou et alii, 2011). The sharp increase in prices of fossil fuels, primarily imported from Russia, and the related increase of the importance of fuel poverty issue is another incentive for national governments to increase their involvement in legal and financial support for improving housing energy efficiency. However, some countries

are more advanced in support of residential energy efficiency therefore practically diminishing fuel poverty.

The main obstacles for large scale energy efficient retrofit activities for condominium housing can be outlined as follows (Lujanen, 2010; Economidou et alii, 2011; Georgiev, 2017): a) lack of legislation for adequate management of condominium housing; b) lack of energy-saving incentives and financial tools for the renovation of condominium housing; c) non-existent legal enforcement rule in condominium residential sector; d) undeveloped social rental housing sector able to accommodate insolvent apartment owners from condominium buildings. Regardless the overall problematic status of the condominium housing management and energy-efficient retrofit in Eastern Europe as a whole, there are, however, examples of innovative approaches that are creating a breakthrough and could be outlined as best practice cases. Most of the successful condominium housing renovation schemes in Eastern European countries are loosely or strictly based on the ESCO model.

Quasi ESCO approach combined with a (small) subsidy | Being not directly fully associated with EPC and ESCO this scheme actually contributes from savings from reduced heating bills thus allowing repayment of subsidized homeowners loans used for renovation.

Condominium Housing Renovation Scheme in Latvia – The project Energy Efficient Modernization of Condominium Buildings was started in Latvia in 2004. During this project municipalities and homeowners' associations had an opportunity to obtain soft loans under favourable conditions for energy-efficient retrofit of their buildings. The project has been implemented in cooperation with German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, German Development Bank Kreditanstalt für Wiederaufbau (KfW), Ministry of Environment of the Republic of Latvia, Environmental Investment Fund and Mortgage Bank (Gerőházi and Szemzo, 2015). In total, 5 million euro has been targeted for the realization of the building renovation activities. In the beginning, 127 loan applications were received and Mortgage Bank specialists have selected 47 projects to participate in the 2nd stage of the competition. Some of the applicants left the project implementation during the preparation process.

Since this project was a first large scale attempt to tackle the energy efficiency problem in high rise apartment buildings in the post-Soviet era in Latvia numerous obstacles were identified during the implementation phase. It was difficult to obtain the necessary agreement of 75% of apartment owners to start the loan-based project. Due to the different socio-economic level of apartment owners, it was hard to organize common activities in loan obtaining. The project envisaged a comprehensive condominium building renovation, which was technically the best approach, but at the same time was expensive. Not all of the apartment owners were able to meet the loan requirements. As a result, until 2005 just five building renovation projects were com-

pleted. Evaluation of energy-saving results obtained during the heating season after the renovation was made. In 2005 renovation of two more condominium buildings has been finished.

Within the framework of the renovation project Latvian Environmental Investment fund provided following supportive activities: i) consultations to the representatives of municipalities about the possibilities of financing; ii) information for project popularization; iii) help for the municipalities during the project implementation, e.g. procurement process and renovation activities itself; iv) monitoring of the implemented project during the loan repayment period. Finally, out of allocated 5 million euro about 1.6 million euro were actually invested, with an average investment of approximately EUR 3,500 per renovated flat. The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) supported the project with interest subsidies and non-reimbursable subsidies for construction costs totalling approximately EUR 580,000. The BMU commissioned the KfW banking group to make the reduced-interest loan available via the Mortgage Bank of Latvia (LHZB). During the first heating period following the modernisation savings of approximately 40% of carbon dioxide emissions were recorded, along with reduced heat consumption and heating costs (Beuermann and Bunse, 2008).

Zaharna Fabrika Pilot Condominium Renovation Project – By the beginning of the project start (2003), the condominium buildings in Bulgaria (60% of owner-occupied housing) suffered severely from low energy efficiency and the lack of adequate management and maintenance, leading to high energy bills, progressive deterioration of the stock and great reduction of its' market value (Fig. 1). Most of the apartment owners were not only unable to secure the necessary funds to cover the building management and repair costs of operating and repairing the building, but some of them could not pay their heating bills. Homeowners' associations did not exist in legal terms, making extremely difficult the attempts to maintain and refurbish existing condominium buildings, because all of the apartment owners have to agree and to be able to afford the renovation. By 2003 no single action was taken in Bulgaria tackling the issue of deteriorating condominium housing even at the level of a pilot activity (Georgiev, 2017; Eco Building Club, 2015).

Fig. 1 | Zaharna Fabrika pilot building before renovation (credit: G. Georgiev).

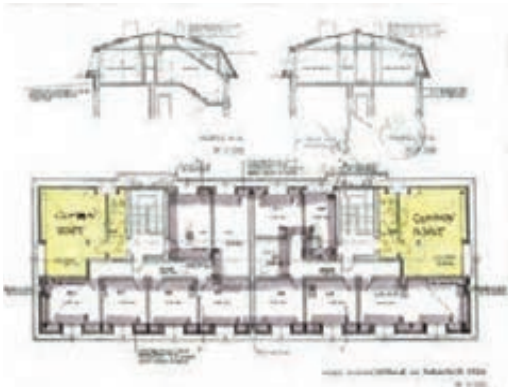

Fig. 2 | Roof reconstruction plan of the pilot building (credit: G. Georgiev).

The project initiator was the Bulgarian Housing Association (an NGO, developing housing-related projects in Bulgaria since 1995), supported by Dutch housing associations De Nieuwe Unie from Rotterdam and Woondrecht from Dordrecht. They found that the management and maintenance of residential condominium buildings in Bulgaria suffer from a chronic lack of adequate legal and organizational form. As well known, the problem of maintenance of common areas such as staircases, roofs, facades, engineering installations, is extremely acute and leads to the increasing degradation and decapitalization of buildings and surrounding areas. Defects in the amortised infrastructure also lead to compromising the construction of the buildings, the risk of fire, and so on. As a result of the preliminary study, the project partners concluded that the Dutch model of multi-storey apartment building management by owners' associations could be a good starting point for finding a solution in Bulgarian conditions (Vv.Aa., 2007). The project aimed to improve the living comfort, physical condition, energy efficiency, management and maintenance of existing condominium buildings in Bulgaria by testing a pilot activity, where an efficient organizational and financial model for reconstruction and subsequent management by newly established homeowners' union is applied. The renovation of the apartment building increases the standard of living, reduces energy costs and facilitates the future maintenance of the property. A logical outcome was also the increase in the market price of the renovated building (Georgiev, 2017).

The building's roof, basement, windows and external brick walls of block 10 were in poor condition. The construction, dating from 1947 had 13 flats, all of them privately owned. Based on the survey data and discussions with the owners of Block 10, the specific financing model was discussed. A project with financial and technical part for the implementation of the reconstruction was developed. It was assumed to perform complete thermal insulation of the external walls of the building and reconstruction of the attic space by an upgrade and thermal insulation of the roof structure. Two shared-owned ateliers were allocated in the upgraded under-roof area. They were targeted for

Fig. 3 | The pilot building under renovation (credit: G. Georgiev).

Fig. 4 | View at the reconstructed pilot building (credit: G. Georgiev).

Fig. 5 | Energy efficiency certificate of the reconstructed building (credit: G. Georgiev).

rentals, in order to cover a part of the loan repayment (Georgiev, 2017; Fig. 2). Zaharna Fabrika Pilot project consisted of energy-efficient housing renovation by use of a soft loan, offered by Dutch International Guarantees for Housing (DIGH), followed by energy auditing and building certification. This pilot project was the first in Bulgaria example of a purposefully conducted operation to test all the interconnected stages that address the problem of reconstruction of the existing condominium building by establishing a homeowners' association to carry out the renovation and subsequent management of the building (Figg. 3, 4). A key moment for the successful implementation of

the renovation project of the pilot building (bl.10) was the establishment of effective interaction between project consultants and homeowners. The willingness to cooperate and the involvement of the apartment owners was the decisive precondition for achieving the end result, namely better housing, cheaper maintenance of the building without additional financial burden for the homeowners (Beuermann and Bunse, 2008).

Among the key benefits from the realisation of the project were more than 50% reduction of heating costs, allowing the money saved on energy bills to be used for renovation loan repayment. Following the retrofit, the building was audited for measuring the achieved savings and was given Certificate 'A' for energy efficiency (Fig. 5) In line with Bulgarian legislation the renovated building was granted a property tax vacation for ten years. Zaharna Fabrika pilot project proved that it is possible to renovate a condominium building with almost no subsidy, covering the entire retrofitting costs by a soft loan with a 'bottom-up' driven project, supported by an experienced expert team, working closely on site with the apartment owners. According to Beuermann and Bunse (2008, p. 17) «[...] there is huge potential for this project to be replicated».

Replicability of Quasi ESCO type projects – Considering that high share of residential buildings in Eastern Europe is privately owned, there is huge potential for replication of quasi ESCO type projects. There are a lot of multi-storey condominium buildings that need urgent renovation and could be improved to provide greater comfort for residents, lower energy consumption and higher market value of the property. While the Pilot Latvian Example is involving loan plus subsidy, the Pilot Bulgarian Example is based entirely on a soft loan but has shown the potential for the renovation even in this situation. In the case of Pilot Bulgarian Example, additional reserves for internal self-financing are utilized through upgrade of the renovated building. In both cases, careful project engineering is needed and involvement of specialized on-site consultant is crucial.

ESCO based projects, combined with EU subsidies | ESCO approach considers the participation of so-called Energy Service Companies in energy-efficient housing renovation activities. As mentioned in the FRESH EU Project: Energy Performance Contracting (EPC) refers to an energy service model type and includes the outsourcing of different forms of energy services from building owners to specialised EPC companies – usually Energy Service Companies (Milin et alii, 2012). One of the main purposes of EPC agreements is the implementation of housing refurbishment projects to enable quantifiable and long-term guaranteed savings. In terms of the EPC duration, the EPC contractor (i.e. usually an ESCO) and the building owner enter into a long-term contractual relationship allowing repayment of funds used for renovation from future energy cost savings. The contract duration depends on the types of investment/types of energy savings realised and the extent of homeowners' financial involvement or subsidy element. Contract duration for building technology measures (replacement of source of heating, ventilation etc.) is up to 10-15 years. Based on East-

Fig. 6 | Financial scheme of RenEsco (credit: credit: www.renesco.lv).

Fig. 7 | Renovated building in Valmiera (credit: www.renesco.lv).

ern European energy prices, building construction measures (building envelope interventions), however, cannot be repaid by energy cost savings over such a timeframe. They require a longer project contracting period of 20-25 years or/and additional co-financing – subsidy or own input on behalf of the house owner (Milin et alii, 2012).

RenEsco[1] projects in Latvia – Until 2010 the urban housing stock in Latvia was renovated only by the homeowners' associations (HOA) or Housing cooperatives (HC). Therefore, the number of renovated houses was rather small, since the occupants of multi-apartment houses were people of very different income and professions, and there were few among them which could assume the task of organizing and managing the renovation process on a professional basis. Therefore, at that time the renovation rate was reaching 1-2% of buildings in total. A small increase in the speed of multi-family building renovation was achieved after 2009 thanks to resources of EU Structural funds.

ESCO approach has been used throughout Europe for renovating of public buildings and also for industry and commercial sector buildings. Multiapartment residential buildings were actually not targeted by ESCOs. The same was the situation in Latvia until the first multi-family building EPC renovation project was commissioned in

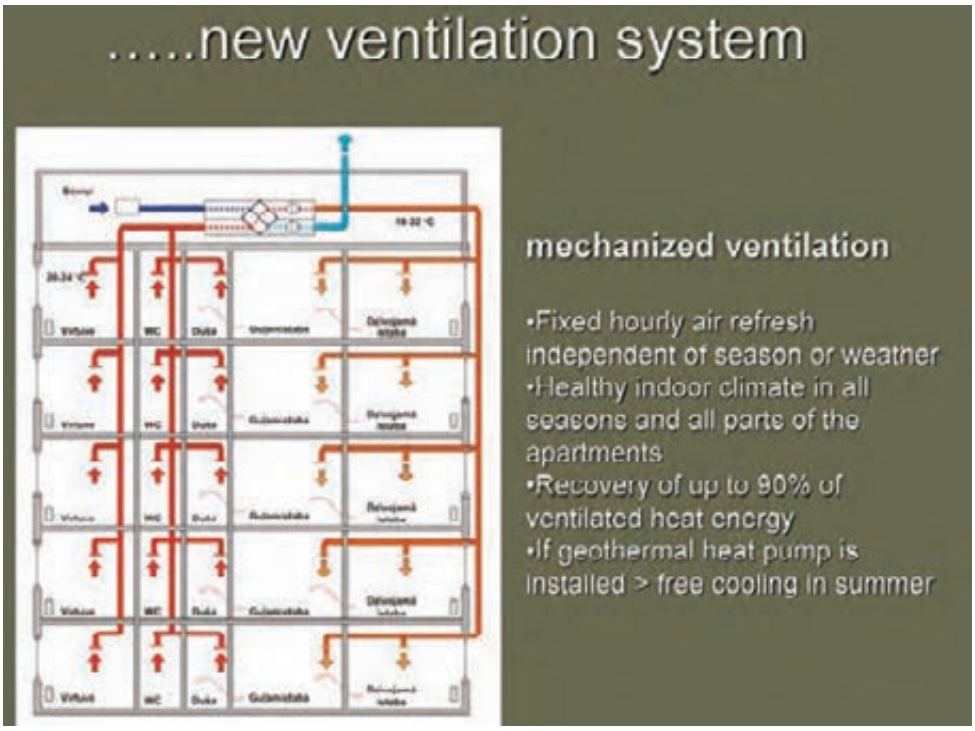

Fig. 8 | New ventilation system in renovated building (credit: www.renesco.lv).

2008 by the ESCO company named Sun Energy Baltic (Zvaigznitis et alii, 2015). It was a subsidiary company of the Netherlands company Zon Energie that was newly established with the support and participation of Dutch experts and capital to develop and implement energy efficiency projects for residential housing. For the new scheme, the available ERDF co-financing was also attracted. Subsequently, the new ESCO company changed its name to RenEsco Ltd. The RenEsco company business model was based on the combination of loan and a subsidy: a) energy performance contracts (EPC's) were signed with condominium buildings guaranteeing RenEsco to receive the energy savings during 20 years; the savings were typically 50% or more; b) a combination of 40% ERDF grants (National Renovation Program) and 60% loan was used to cover the renovation works; RenEsco Ltd collected on behalf of homeowners the renovation loan and the subsidy and paid for all renovation costs, increasing the comfort and value of the building and extending the building lifetime; c) after the renovation, apartment owners paid the same money for the heating costs as before the renovation and the funds from the saved energy are used for loan repayment; RenEsco gives a 20-year guarantee on everything it has improved and changed; d) RenEsco decides about the measures, technologies and quality of materials.

The energy-efficient renovation measures included: full building envelope, new hot water networks, new heating network, new ventilation recovery systems, repairs in common spaces of the building, switching (sometimes) to renewables (geothermal). Because of the business model used, RenEsco could invest much more than flat owners would do themselves (Figg. 6-8). Due to the innovative renovation scheme within 6 years (2008-2014), RenEsco Ltd financed and performed energy-efficient renovations of 15 typical Soviet-era apartment buildings in four Latvian towns using Energy Performance Contracts (EPC's). The total heating area of refurbished buildings is about 42,000 square metres with 660 apartments and totally invested EUR 5,360,000. The monitoring of the energy behaviour of the renovated buildings shows that on average space heating consumption is reduced down to 77 kWh/m^2 per annum and network circulation losses is down to 4.5 kWh/m^2 per annum, meaning a combined figure of 81.5 kWh/m^2 per annum. The energy savings of the renovated buildings are calculated at 55% (Zvaigznitis et alii, 2015).

The successful activities of RenEsco have been acknowledged in the EU, and it has won the European Energy Service Initiative at EUSEW 2012 in Brussels. Recently RenEsco Ltd was involved in EU funded Sunshine project that foresees a further step in the use of EPC for energy retrofit. Sunshine project supports public and private ESCO's and leads to an innovative investment scheme based on the long term guaranteed safety, health, comfort, and affordability for deep renovation of buildings. Sunshine project is about deep renovation – the idea of capturing the full economic energy efficiency potential of existing buildings with a focus on building envelopes that leads to remarkable energy savings. The RenEsco Ltd achievements have made a good start, but having in mind the enormous size of the issue of high energy consumption of privatised apartment housing in Eastern Europe needs urgent expansion in Latvia and in other countries with the same problems. As in the most European countries, the implementation of ESCO principles in Latvia is still being hindered because of regulatory, administrative and financial barriers. Therefore, only RenEsco is actively providing energy services for the Latvian housing sector. Actually, it is the first company in the world to offer ESCO based renovations for privatized former rental multiapartment buildings (Zvaigznitis et alii, 2015).

Several preconditions are crucial for the development of a larger-scale follow-up activities in ESCO based condominium housing retrofitting activities: 1) establishment of rule-of-law (contracts must be enforceable); 2) development of long-term governmental policies and programs in housing sector enabling organizing large-scale renovation activities; 3) establishment of transparent and market-based pricing of energy (at least €/MWh 50); 4) availability of affordable long-term financing vehicles.

Conclusion | Using capital subsidies for fighting energy poverty through the improvement of the built environment is the most efficient and socially acceptable approach. Such an approach is associated with a higher initial level of investments, as well as the

need for capacity to assess, design and implement energy-efficient housing reconstruction activities. However, in the long run, investing in energy-saving housing retrofit has no alternative in terms of the efficiency of the subsidies used (both socially and financially). Eliminating the problem of 'energy poverty' is impossible without the support of the affected households through subsidies. Subsidies invested in energy-efficient housing reconstruction result in efficient and immediate savings in housing heating costs, which in turn reduces or eliminates the 'energy poverty' phenomenon for residents of reconstructed housing. Energy-efficient housing reconstruction (retrofit) is the fastest and most efficient (in terms of public resources used) way to combat energy poverty. However, there is a limiting effect on the requirement for a larger one-off public financial resource. This resource could also be obtained or complemented through financial engineering schemes with third party involvement.

Assistance for preparing and implementing the renovation process is necessary for the successful renovation of the multistorey apartment buildings on a larger scale, as homeowners' associations and their umbrella bodies do not have the proper competence for undertaking efficient renovations (Georgiev, 2017). It is important to point out that technical assistance should enable market actors in the field of housing sector rather than strengthen the monopolies of publicly owned companies. It is worth to concentrate geographically the initial pilot condominium energy retrofit projects (i.e. concentrate loans and subsidies used) because this could provide substantial economy of scale which can serve as a layout for a larger neighbourhood.

The lack of well-functioning legislation is an obstacle for sustainable maintenance of existing condominium housing, that is well recognized among researchers. But we cannot undermine the probably bigger obstacle of fuel poverty that is universally valid for tackling large scale energy efficient renovation actions in big cities' housing estates in Eastern Europe. We cannot achieve a satisfactory rate of energy retrofit of condominium housing up to the desired standard in Eastern Europe, without substantial reduction of the fuel poverty among apartment owners. «[...] In situations where the owners are unable to pay for rising energy costs and the required major renovations, other parallel measures such as subsidies are needed» (Lujanen, 2010, p. 193). Although common in Eastern European condominiums, the fuel poverty problem is even more important because «[...] the challenges are geographically wider and affect the management of apartment blocks in most parts of the world, including large-scale developments in many fast-growing metropolitan regions» (Lujanen, 2010, p. 193).

Due to the universal nature of the problems of the renovation of owner-occupied apartment housing the above-mentioned pilot approaches (best practice cases) could be replicated in a wider European context. However, this can be made in limited scale developments with relatively identical income level tenants, avoiding 'fuel poverty enclaves'. Large scale energy retrofit projects for condominiums in Eastern Europe as well as in other countries can only happen after a partial restructuring of the tenure status of the residents – from poor owners to renters (Georgiev, 2017).

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Note

1) For more informations on Renesco Projects see the webpage: renesco.lv/projects/renovating/en [Accessed 18 October 2020].

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FUTUREDESIGN
Reflections at the limit of impossible

Dario Russo

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DESIGN

typology
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ABSTRACT
Can today design help to improve the world? During the 20th century, it did it. Actually, it has been establishing itself historically in this sense: to improve the everyday life of common people. In the last decades, however, design has become a sort of magic patina helpful to make goods attractive: a dimension of project linked to more the look of goods than to the challenges of our time. By the way, Maurizio Carta talks about 'futuredesign' and 'alternative present' – a reflection on present helpful to determinate a better (next) future. The present crisis, that is now rooted, calls for a rethink. We must grasp it in order to determinate the change that we need. The Paleo-Anthropocene in which we live, predatory and really unsustainable, has to become a Neo-Anthropocene, sustainable both socially and ecologically. Design, Urbanism and all the disciplines of Project should converge towards this change. The Future City, that it will be born from this mature and balanced cultural spur, will be an Augmented City – open, smart, sensitive, creative and fluid. And the key of the project will be the empathy: the capability to design for and with the people – for a better world.

KEYWORDS
design, crisis, sustainability, urbanism, city, empathy

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The history of design is often related to that of architecture and art. Compared to these two disciplines, obviously, design is a new entry. And yet, although it really didn't cross the history of Western culture, in the last century it has changed its statute many times, by assuming different forms and social roles. Born to create Beauty with industry at the beginning of the last century, it became, during the first half of the 20th century, a mean to improve everyday life through industrial products able to elevate the social conditions of people. On the contrary, many people think that design simply serves to renewal the look of objects in order to make them more saleable – a sort of polite version of programmed obsolescence. In April 2020, but, everything changes, because we have to face a worldwide pandemic. In this scenario, clearly emerges the idea that our current development system is at a breaking point; especially the resulting global pollution. We must change, we must evolve in order to maintain minimum standards of (life) quality. And perhaps our very survival is on the line. Therefore, those issues addressed by Carta become ever more significance, because they are not simply speculations around project but operative guide-lines towards the Future. Or better the 'alternative present', as he loves to remark; by reading the book we have to remember that there is present and alternative present: the first one is that we suffer, whilst the second is that we design by thinking of the future (Carta, 2019, p. 18).[1]

A very effective quotation of Gille Deleuze introduces the first chapter: great thinkers are a bit seismic, they do not seem to be subjected to evolution, but they proceed for crisis, for shocks (Deleuze, cit. in Carta, 2019, p. 9). In this perspective, the term 'crisis' does not mean final point of a dramatic destiny but start point in order to redesign everything, be better. In fact, the crisis we are living is a great opportunity – which is to redesign the world. As Einstein (2005) states in 1934, 'insanity is doing the same thing over and over again expecting different results'. That is why a crisis can be a blessing both for people and Nations – because it leads to progress. Creativity comes from distress, as the day from the dark night. Here is a simple as vital concept, formulated by Heraclitus before and better than Einstein – change, when times ask for it, will not be only licit but also necessary.

Be the change that you wish to see in the world | The change we are talking about, obviously, is both macro and micro. If it is true that great changes are created by a plurality of actions addressed towards a common goal, it is important that everybody acts in his small way, regardless of how big his small way can be and from the enormous effects the only one person can contribute to determinate. Gandhi encourages to be the change that we wish to see in the world. Therefore, like good university professor, with roles of academic and politic management, Carta aims to update his own academic discipline in relation to the times of the alternative present: as far as the academic field that he knows very well, he invites all to give more thought to goals, education, internship, by promoting in all the matters of the courses of degree in Architecture – but also in those in Design, Agricultural Sciences and I would add


Maurizio Carta
Futuro
Politiche per un diverso presente
RUBBETTINO

Communication and Social Sciences – the themes of liveability of the city, quality of landscape, of cohesion of the inland areas, of environmental sustainability and of energy efficiency (Carta, 2019, p. 347). According to Carta (2019, pp. 348, 349), we need to remodel of the paradigms we teach at the Universities, to move away from obsolete metaphors, to adopt new models and narratives. In brief, we need to rethink deeply the disciplinary contents of Urbanistic and of all the disciplines of project. Undoubtedly, Design is one of them and more of all, it is aimed at experiment and modify its line-guides, because it is closely linked to two fundamental things that are constantly evolving – technology and society. Therefore, we agree with Carta when he states the need for updating the academic programs. Also, why this is the only way to maintain contact with our disciplines, which evolve on the field, and to plan research on the real world.

In the first pages, Carta (2019, p. 12) relaunches the figure of the intellectual as an activist, aimed to contribute really to society: it is no longer the time of abstract and neutral intellectuals, inmates in their studies and intent on purely speculative researches. In the words of Gramsci in 1919, we are called to 'participate actively in practical life as constructor, organiser and permanent persuader'[2]. Moreover, at the vision of Gramsci of the intellectual as an activist, Carta intertwines the vision of Jean-Paul Sartre (1972), that is the intellectual as technical of practical knowledge that inserts himself in what that does not concern him, or better that it would not concern who is intent only on pure intellectual speculation. So, between Gramsci and Sartre, Carta reminds the illuminating definition that Tomás Maldonado gives to designer – 'technical intellectual', that knows and can do. For Maldonado, in fact, the theory has to be impregnated with practice and practice with theory (Riccini, 2009, p. 167). The designer, in short, as the urbanist to which Carta (2019, p. 203) refers, is a thinker able to move from thought to action in order to impact on territory and society.[3]

Thus, the design of the future will be more and more institutional design – a very wide and responsible project aimed to orchestrate many partial activities inside an overall logic. Carta remarks that the human city cannot be reduced to its urbanistic components, not even to those 'augmented' by emotions, or to the social ones, or much less the economic ones, but it requires a political synthesis of all these and especially a renewed politic humanism, a 'walk together' towards greater civil participation to the political responsibility (Carta, 2019, p. 169). This capability of orchestration, of coordination is – or it should be – also that of design, that assumes here a strategic, political and institutional dimension. In this elevated meaning, obviously, design is not about products look, as people commonly think, and not even it can be reduced to 'styling' of product, as Gillo Dorfles states (1972)[4]. It is this also the conviction of Maldonado in 1976 that, far from referring to the form (of the product) end

Fig. 1 | Cover of the book 'Futuro – Politiche per un diverso presente'; the image is 'Cosmogonia Barocca' by F. Ferla.

in itself, highlights on the wide range of implications of design. In brief, design is a 'fully-fledged social phenomenon' (Maldonado, 2008, p. 15).

Neo-Anthropocene | The institutional question is obviously linked to the ecological one, that is highly developed in the Carta's essay. The now all-pervasive turbo-consumerism, with its dissipate and predatory way, is primarily responsible for the ecological footprint on the Planet. It is also a serial heatsink of social and civil values – a process now degenerated into a global looting, a brutal neo-colonialism that has deformed cultures, flatted differences, anaesthetized democracies (Carta, 2019, p. 40). Moreover, we have to consider the devastating changes that, as we know, imply exponential damages – breaking of food chains, reducing of quality of life, increase of wars, rampant migration (IPCC, 2019). Whether we like or not, our era has been defined Anthropocene, because the history of man is connected to the natural one and the whole of human activities implies a decisive impact on the Planet. Thus, we should need a paradigmatic turn – from erosive, extractive, pervasive, unfair and conflictual Paleo-Anthropocene in which we live to Neo-Anthropocene, in which humanity, far from be the problem, design and implement the transition towards sustainable development (Carta, 2019, pp. 57, 59). That is an inspiration for urbanists, architects and designer – there is again time for designing future, a better world where the human nature and the not human one thrive together for millennia (Ellis, 2018).

In this perspective, in the future the cities will be more and more characterized by growing number of new makers (designers of the latest generation) that carry on reuse and recycling actions on the entrepreneurial model of a start-up inside the circular economy: the economic model on which the cities of the circular society of the 'alternative present' will arise will be able to generate local value instead of the extractive economy that creates dependence from the exogenous strategies of corporations (Carta, 2019, p. 67). For example, an interesting case is that of the urban gardens, thanks to the collective work of inhabitants-farmers that create a 'green, urban and human archipelago' similar to the Arabic luscious scenarios that made of Palermo Aziz, a wonderful city. As Carta preconizes, in the city of future, nature will not be anymore antagonist of architecture, but it will return to be vegetal material of the urban project before Anthropocene could casted out it (Carta, 2019, p. 313). Thus, nature will not be any more Broken Nature, as the title of the exhibition by Paola Antonelli and Ala Tannir (2019) at XII Milan Triennale, aimed at clarifying the connections between we (humans) and the environment – connections that have been now compromised, if not completely broken, in the last centuries. On the contrary, design will have to be in charge of the human salvation (Design Takes on Human Survival is the subtitle of the exhibition) – it will have to offer critical means in order to look to the future with a different awareness.

Augmented Cities | The model of the city in the circular society of the 'alternative present', however, will not be limited to separate collection. It will point rather to the

recycling of wastes inside an industrial system that is ecologically sustainable through the reduction of land consumption and the promotion of principles and practices of urban regeneration, reuse and recycling (Carta, 2019, p. 220). Waste will have to assume a positive value thanks to a net of infrastructures helpful to recycle everything in an almost total way. This is the real goal to reach through the tool of separate collection on various layers and treatments. This is the circular economy – pure Beauty! (Carta, 2019, p. 109). According to the principles of circular economy nothing is a waste and everything comes out from a production process is raw material helpful to another production process. The same product design is based on the possibility to disassemble the parts for reusing them in the production cycles founded on the production chain and on new production nets. That is a more creative designed recycle – a planned generative post-obsolescence instead of the rapid programmed obsolescence (Carta, 2019, pp. 68, 69). What appears is thus a new systemic project, because is about the relations between people, enterprises and resources of a territory, in order to promote the local culture and identity as well as a collective well-being (systemicdesign.org). In short, today more than ever 'there is a need of system actions' (Carta, 2019, p. 244).

This net of people, activities and resources naturally adds something: it creates Augmented Cities (Carta, 2017). The city of future is certainly innovative, dynamic and transformable, able to evolve according to external and internal inputs – a city that innovates its hardware by putting in the field a sustainable, open and participated model, but also and first of all its software, which is the way of living, producing, moving. Without doubt, the augments cities are more sensitive towards people and environmental as well as able to evolve in a resilient and flexible way, by assuming incremental and adaptive processes such as to generate community from our increasing 'augmented humanity' (Carta, 2019, p. 125). Therefore, the Augmented Cities imply A Paradigm Shift, that can be considered as a constant as necessary shift, because our cities have to change from time to time, both outside and inside, in order to adapt themselves to new lifestyles. That is a 'visceral revolution', in the words of Andrea Branzi (2006) – a process of re-functionalization of the building (or whole urban areas) of which the designed use is changed in part or completely. One thinks for example of the former industry warehouses that once were peripheral but are now central and so functional to all a part of city that has grown with time and participate now inside and organic system. Thus, the design adapts itself like a chameleon in order to elaborate temporary, not definitive and subject to change solutions. Of course, we are not talking about operations of lifting, cosmetic surgery, we are not talking about nose makeover or correction of lips or breast, but about the actual replacement of internal organs of improving functionality (Zardini, 2004, p. 574).

The heart of the augmented cities is obviously the communities that too are open, smart, sensitive, creative and fluid (Carta, 2019, p. 183). And of course, the term 'community' can only remind, an urbanist as well as a designer, of the great Adriano

Olivetti, enlightened businessman, that is always mentioned in the histories of design (and not only), to which Carta refers, often and however, by talking about Future. The sharing economy implies a co-policy, that is an augmented, dynamic and innovative policy, because it is founded on cooperation. That is a return to 'economy of communion' that in Italy was successful and set a model of cooperative system (Carta, 2019, pp. 154, 155). The augmented city, thus, is also a city on a human scale or better the 'city of man', as Olivetti states (1960), thanks to a very elevated idea of industry, that is the heart of a process of modernization in an economical sense but also from a social and cultural point of view.[5]

Empathy | Besides, the concept of community is the basis of so-called emerging design – Design. When Everybody Designs – thanks to collaborative nets, made for and with people. One alludes here to a methodology based on an interdisciplinary approach and driven by a heterogeneous team in which the designer works as a facilitator-coordinator of different skills in order to solve problems of a social type with the greatest possible participation (Manzini, 2015). In the same way, the urbanist which Cart talks about is a sort of cultural coordinator, an urban designer aimed to create harmony, balance, sonority: an orchestra director of city where there are many and different orchestra musicians, each with his instrument with peculiar timbre, all able to read music but not just as eager to perform according to one rhythm, one time, one scan that are designed by the careful baton of the urbanist-orchestra director. And one does not always have the lucky of conducting a close-knit and well-composed orchestra, but often one has to find harmony where there is dissonance, balance where there is unbalance, sonority where someone else would hear noise (Carta, 2019, pp. 545, 546).

In order to design the 'alternative present', thus, more space and importance should be given to the emotional aspects as well as functional ones. Most of all we need to put people in the foreground, through a constant process of listening, of dialogue and of interaction in which who is involved express a fruitful alternation of reason and emotion, of facts and sensations, of rationality and instinct, in order to recompose the specificity of places (Carta, 2019, p. 177). This vision, people-centred, reminds Design Thinking, an innovative method based on the new (digital) technologies, the interdisciplinary confrontation and most of all on the experience of the user (person even before than consumer). Pragmatically, passing thought some iterative phases, the design thinker aims to leverage on the experience of many people (prospective users) that participate in this process thanks to an interaction which serves to create empathy[6]. The communities involved in this process have everything to gain. They are augmented communities, as has been said – a precious formula of collective intelligence that finds favourable conditions in augmented cites.

To understand the dynamic of the collective activity of those who participate to this process of developing with and for the people, it is possible to refer to the concept of Opera Aperta (openwork), formulated by Umberto Eco in 1962. Based on

happenings, the openwork of Eco opens up to different integrations, parts that add concretely something, and it channels them into the process of a structural vitality that the work owns even if it is not concluded, and that it works also in the way of several and different outcomes[7]. In the same way, Carta observes that the contemporary culture consists often in the participation of its users, by accumulation and stratification of points of view, becoming in real open-source culture, where one cannot recognize anymore a principal author but a collectivity of authors/readers, where audience and work merge into an incremental product, that evolves through next writings (Carta, 2019, p. 289). We add – next writings that give 'openness' and 'dynamicity' not only to urbanism but also design.

An interesting example of it is the work of Droog Design, a group of artistes-designers founded by Renny Ramakers (design historian and critic) and Gijs Bakker (designer), international point of reference since the first years of Third Millennium. The multiple Droog objects, midway between industrial production and artistic installation, «[…] are as basic and as minimal as can be: that they consist only of what is needed to materialize the concept. But usually, the concept dictates 'more': less and more literally coming together in one product» (Lupton, 2006, p. 79). In this sense, thus, Droog Design is a concept design, or better 'open design', where «[…] open = undefined» (van't Spijker, 2006, p. 52)[8], that is 'opera aperta' (work in progress), as the work of Eco – virtually endless and open to interpretation-completion by the viewer-user, that becomes part of the work itself. In the second half of the book, Carta presents new challenges – Between metropolis and archipelagos; Heterotopies of median Italy; Antifragile communities; Heritage and creativity; Sicily, land of innovation; Cities of culture; Palermo, Aziz; Polipheries; Vision and courage; Epilogue, but not too much. These are concrete challenges for measuring our courage, because Future-design calls us to action and not only to diagnosis; now we know how to be protagonists of change, what to do day after day to lift ourselves from the torpor that clouds our action e to defeat the individualism that mutilates action.

Notes

1) As the author explains at the end of the book, the 'alternative present' can generate an alternative future, coherent with mine/our vision of the world more interesting, happier, that hovers on the edge of the present state of things. That's why the future comes from the interaction between reality and what that is possible, but it feeds on the courage and the capacity of putting them together (Carta, 2019, p. 369).

2) L'Ordine Nuovo was a publication with variable periodicity founded in Turin on May 1, 1919 by Antonio Gramsci and other socialist intellectuals from Turin (Palmiro Togliatti, Angelo Tasca and Umberto Terracini). The Ordine Nuovo declared its program of social and proletarian renewal in the Battute di Deludio written by Tasca himself.

3) As Carta (2019, pp. 203, 207) states, we cannot escape from repair the fracture between research and project experimentation, recomposing the alliance between research and project, between

theory and practice; because those that fallow in love with practice without science are like helmsmen that enter in ship without rudder or compass, that have never certainty where they go. The practice must always be based on a good theory, Leonard da Vinci wrote in Trattato della Pittura. However, there is no solid theory that is not based on solid fundaments of practice, if one does not want to be virginal helmsmen that have never heard the howling of the stormy sea.

4) According to Dorfles (1972, p. 124) Styling is the mere formal change of product, without any technical or scientific reason, in order to increase its 'appeal' and make him more saleable; it is a sort of 'cosmetics' and employed in USA as well as in the nations in which consumerism is more pronounced.

5) In the Second post-War period, Adriano Olivetti founded Edizioni di Comunità (Editions of Community), then the magazine Comunità (Community), cultural point of reference of the homonymous politic movement, started in 1947. In 1959 Editions of Community published a collection of essays significantly titled Città dell'Uomo (City on Man).

6) For more information on Design Thinking, see: Lewrick, Link and Leifer, 2018, 2020.

7) According to Eco (1962, pp. 56, 61): 1) because the 'open' works are in motion, they are characterized by the invite to make the work with the author; 2) there are those works that are materially concluded but open to continuous germination of internal relations that user has to discover and choose while he perceives the totality of stimulations; 3) every work of art is substantially open to a virtually endless series of possible readings, of which each leads the work to relive in according to a personal perspective, a personal taste and a personal implementation.

8) An emblematic project is Do + Create (2000), in which the user is invited to do something in according to an operative indication. For example, the chair Do Add Short Leg, by Jurgen Bey, has a leg shorter than the others that makes it impracticable; but the solution is enclosed in its name – Add a Short Leg, in order to complete the chair making possible its use. Another example is the tape Do Frame, by Martí Guixé, characterized by a décor that alludes to a setting of days gone by (5 cm x 50 m). In the same way, Do Scratch, another project by Guixé, is a lamp that is hidden in a black box waiting for seeing light. In fact, it is can be 'turned on' by scratching part of its surface – Fiat Lux! Or even, Do Break, by Frank Tjepkema and Peter van der Jagt, seems a very common porcelain vase; but it is panelled from inside with a layer of silicone. Thus, if one breaks it, ever part stays in place, and who took the satisfaction of breaking something has again a perfectly working object. But the most sensational object is the 'virtual' armchair Do Hit, by Marijn van der Poll, that appears like a metallic cube. It works like it – one buys the steel cube, that is empty, and hits it with a hammer until one obtains the desired shape. It is not the best of comfort perhaps, but who will use this armchair? Or better: who will use it as an armchair?

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DESIGNING THE FUTURE
Open discussion on design ethics

Tiziano Manna

section
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ABSTRACT
The contribution aims to focus attention to the system of responsibilities that revolve around man's ability to alter and significantly modify the landscape that surrounds him. Confronting the field of design in the broadest possible sense by bringing out the relationships between ethics and design. Offer food for thought for a change of vision that allows to identify new approaches to the design process having the attention and ethical responsibility of those called upon to plan the future in which they will live. An open debate, free from the rigid logic of the academic world in the perspective of a scientific thought that does not evolve linearly but proceeds by rhizomes of thought. The aim of the discussion is therefore not to validate a theory in demonstrating assumptions but to outline a generative matrix of thought that can provide useful elements for an interpretative exploration of transversalities related to the taxonomy of design. The purpose of the discourse is the discourse itself.

KEYWORDS
design process, ethics, meta-design, aesthetic, ontology

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Design changes the shape of time by altering human cultures, consciousnesses, habits and customs. It is as if nature reappropriates itself within the artificial dimension, making it natural in its final appearance, in its temporal and spatial mutations. Mutations that man is unable to predict or avoid, by virtue of the fact that recursion is not controllable. Man cannot interact on the natural events of changing the existing, but he can use the knowledge to act in the best way, in harmony with nature. It can therefore distinguish between a right and a wrong action, a project with acceptable consequences from one with disastrous consequences. Attention because right and wrong, good and bad are judgement values easily misunderstood by feelings of approval and disapproval which are part of an emotional, i.e. subjective, plane. It is, therefore, necessary to dwell on the concept of ethics as an 'aesthetic-design code', deepening the Greek idea of 'right' and 'good' as synonyms of 'beauty', not only in terms of formal proportions but especially in terms of action-cause and effect.

The aim here is not to open a debate on ethical design or on the ethics of the project, but to discuss ethics as a function of a possible choice in the process of transforming reality, remaining within a specific framework that investigates in terms of 'soft ontology' (Borgo and Vieu, 2006). Dealing with ethics in its modern and contemporary sense, in its being a 'system of laws in which the legislator is absent', a system of obligations in which the insistence on the imperative character is rooted in divine commands (Fonnesu, 2004, p. 40).

Design: a systemic vision | The designer, first of all, is the 'manufacturer' of an artificial world characterised by events and phenomena that define social, cultural, anthropological and psychological components. Designer of a reality first of all phenomenal, man carries within himself the responsibility of having succeeded in modifying the environment in which he lives adapting it to his own needs. The objective, if it can be defined as such, is to identify the possible links between the act of designing and the ethical approach as a design parameter by imagining a systemic constraint (Norman, 1988) configuring – aesthetic code – capable of lowering the level of human-productive entropy to the detriment of a global activity with destructive consequences towards nature understood as existence (Fig. 1).

In modern times a moment in culture in which the very idea of nature presents itself as entirely invested by the human can be identified (Levinas and Peperzak, 1989). In this sense, it is difficult to separate man's responsibility from the contemporary configuration of the existing, so it is necessary to look at design as a 'configuring action' of nature in which man – the designer – intervenes and operates, becoming an instrument of transformation. This problem of human interventions on nature, not previously considered of ethical importance, has shown, in extreme concentration, what primary and secondary consequences – possibly irreversible – are connected with the collective activities, produced by the development, mainly self-regulating, of the social systems of economics, science and technology, and with the intensification of their reciprocal relationships (Apel, 1992).

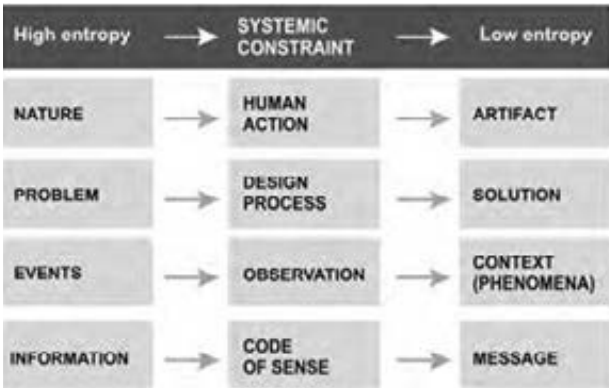


Fig. 1 | A comparative example of systemic constraints on entropy reduction in nature; different processes identify different interpretative planes of configuration of reality.

What is considered important is to analyse the design process – and therefore the system – in its components and to consider the designer as the author of an artificial world whose events and phenomena he can modify. The same ones that define and outline the 'spirit of the times'. Project activity is currently divided according to the outcome of the design process. This means that the final product defines the boundaries of the designers' competence. It is important to consider, on a theoretical level, the design as a multidisciplinary set of the 'visual', where it is true that there is a categorization and diversification of the disciplinary fields but it is equally true the fact that essentially the final result of this process is always something that – cognitively – it has its own visual identity.

Here it is the visual itself, what is seen, articulated with the help of the same tools of narration, becoming the project's subject (Chia and Piscitelli, 2009). The 'space of the problem' cannot be reduced to the mere design of artefacts, but it is necessary to go beyond the cognitive artefact and consider 'as artefacts' also the events and phenomena deriving from the inclusion in nature of a new project (Lamendola and Krysik, 2011). Artefacts without materiality but conceptually tangible as real events within a given reference system. For example, it can be considered an event that from 2009 to 2015 the percentage of American adolescents aged 12-13 years who use social media on a daily basis increased from 58% to 87%.

A San Diego University research relates this event to the growing phenomenon of youth suicide, which seems to involve mainly girls aged 13-18 (Twenge, 2017). It should be made clear that events and phenomena are interchangeable variables, meaning that an event belonging to a given system may be a phenomenon within different systems. This means that events and phenomena can be cause and effect simultaneously in the same system and in systems that are totally unrelated to each other; what determines belonging to one or the other category is the external observer, the one who makes a measurement and decides on the reference parameters, in a defined time. Dealing with events and phenomena in nature means entering the field of the phenomenolo-

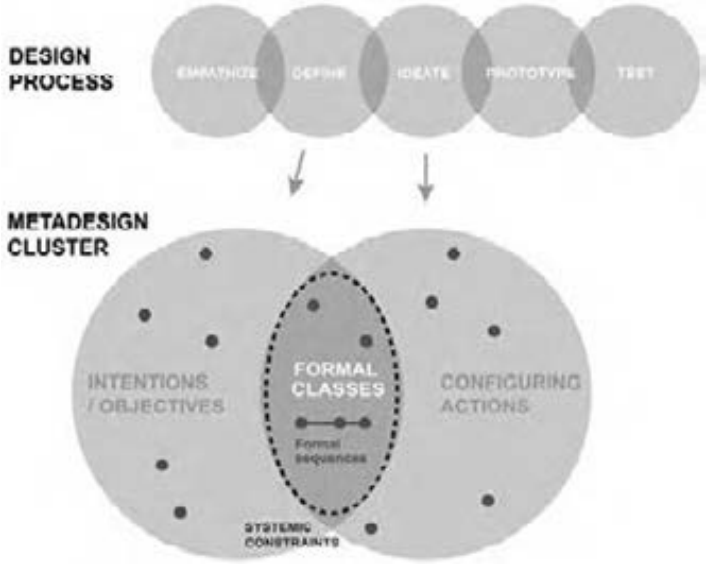


Fig. 2 | Representation of the system that identifies the formal class generated by the design phase defined as 'meta-design cluster'; design intentions and configuring actions, organised in sequence, define the formal class of configuring agents.

gy of perception and it is appropriate to clarify that dealing with design on a theoretical and phenomenal level means considering design a configuring act of nature itself.

Most configurations possess specific properties, which cannot be traced in the constituent elements but can only be grasped and investigated by considering the object as a whole, as it appears (Parovel, 2004, p. 34), thus investigating it within a phenomenal system closely connected to perceptual interactions, where organisation, configuration and perception constitute a set of relations. Sensation and perception allow and generate awareness of an event, of a presence, of a thing; awareness that is built through a reaction of the senses to stimuli when they appear, returning a meaningful thought a construct that forms the experience (Calabi, 2010, p. 16). Circumscribing the 'space of the problem' to the design process as a system of relationships allows to identify in the designer's action the pivotal element on which to address a discussion of ethical responsibility applied to design since man with his actions designs nature making it artificial.

Formal classes and configuring actions | According to Donald Norman's model, with reference to the 'seven stages of action', between the execution sequences of an action and the evaluative-perceptual sequences of the world there is an intermediate stage which follows the 'evaluation of interpretations' and precedes the 'intention to act': the 'purposes' (understood as what we want to happen). The purpose – the aim – is something that precedes the intention because this is its translation in terms of functional sequences. In other words, intention identifies the 'formal sequence' useful for achieving the aim (Kubler, 1989). Even if, as Norman states, the stages are not separate and distinct entities, we can say, in relation to the discourse, to be within the metadesign (Fig. 2). The purposes, the aims of a specific action define the visual form of the action itself, configuring its intentions where design is understood as a solution – an answer – to a problem. In this sense, the design process consists of a specific sequence of actions aimed at configuring a result – in the case of industrial design, the result is the 'product'.

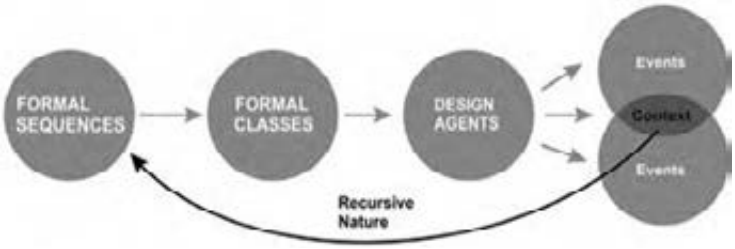


Fig. 3 | Interpretative representation of a 'field of form' as a system of interactions influenced by the recursiveness of nature as a generating force capable of (re)organising information through derived events and phenomena.

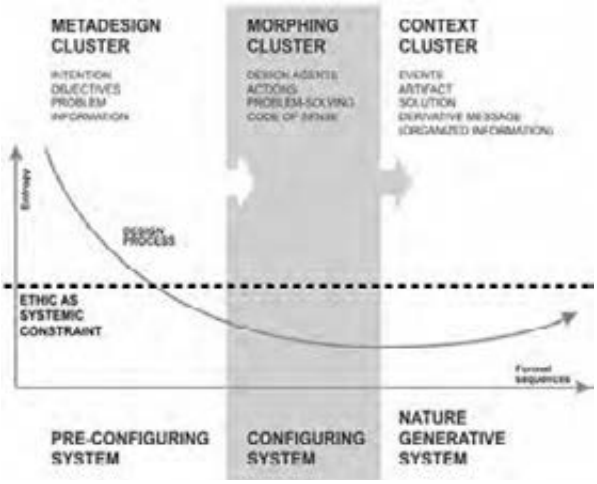


Fig. 4 | Relationship curve between 'entropy' and 'formal sequences' with reference to the design process and the use of the 'ethics' component as a design parameter (systemic constraint).

The problem and its solutions constitute an entity called a formal class. From a historical point of view, only those solutions that are connected by links of tradition and influence form a chained sequence. They open up a limited yet unknown domain of mental forms, most of which are still susceptible to further elaboration by means of new solutions. A sequence suggests a succession that is open and susceptible to extension (Kubler, 1989, p. 44). Intervening on the meta-design, on the purposes – and therefore on the sequence of intentions – means acting on the configuration of formal classes which, in a concatenated way, will influence the whole system of context related to them (Fig. 3). The definition of this system is useful to understand the fact that the context – the 'space of the problem' – besides being a force field (Patella, 2005), is also a morphic entity identifiable with the concept of 'form field' in which configuring agents define events and phenomena. A physical but also conceptual place where matter is organised and configures reality on a phenomenal level. According to astrophysicist Massimo Teodorani (2015), this field has a purely informative value and is defined as a field of form because only the form – or the meaning – acts as a link between the various entities. Formal classes, in this sense, reflect the formal sequences deriving from design intentions by determining one or more systems of configuring agents.

Consequently, the ethical component, understood as a reflection of meaning and design constraint, should concern the aspects of the meta-design inherent in the purposes and intentions innate in the artefact because it is these that will determine the information emitted by the generated morphic entity (Fig. 4). Such information is indispensable for defining the formal classes constituting the derived systems in terms of events and phenomena. It is important to emphasise the importance of the meta-design as a pre-configuring phase that determines the passage from a state of power to the effective transformation of the existing (Mondello, 2004), since the project, before becoming such, is a mental prefiguration, an idea, a set of neuronal synapses that produce an immaterial image. To intervene, therefore, on that image, on that still unfinished transformation of information, means acting on the component that will determine the entire resulting system, that of the visual, of the perceptible.

This involves making assessments and considerations in order to place ethical constraints on the configuration of information derived from the reality design process. Intervening, then, on the language code, where the designer is the issuer, reality is the receiver and the artefact is the message, container of meaning and informative signals. Working on the consequences deriving from bad design, with a view to restructuring the result of natural self-organisation that it has generated, requires much more energy than working at the root of the design process. Moreover, the correspondence between design intentionality and the finished object depends on the coherence of perceptible parts, also from the point of view of expressive and communicative ability (Calabi, 2010, p. 14). When an artefact is configured it will start to output information closely related to its design. All procedural actions that are implemented during the design process generate a genetic map of the artefact, which can be traced back to its properties (implicit and explicit), allowing us to know its essence (Bloom, 2004). The genetic characteristics of an artefact allow us to read its design sense, its history, the reason for its existence, as well as making visible the aims and intentions of the person who designed it (Figg. 5, 6).

A new paradigm | Designing the future through an ethical filter means making ethics a lens through which to observe reality and consequently the entire design process. Ethics must be perceptible on all contextual levels of a project, phenomenally spreading in the formal classes that are self-configuring in a natural way. To be ethically correct, a project must be genetically correct at the root. An artefact can be defined as ethical when the ethical values on the basis of which it was designed are perceptible in its structure, its use, its history and the intentions of the designer. If this occurs, if the designer has transferred that information into the artefact, making the ethical values of the design constraints, then the artefact will most likely communicate those values, will emit information-ethical signals. Artefacts built with industrial waste, assembling reuse elements, materials obtained alternatively with the use of oil, machines with sustainable environmental impact, possess an aesthetic appeal dictated by their ethical na-

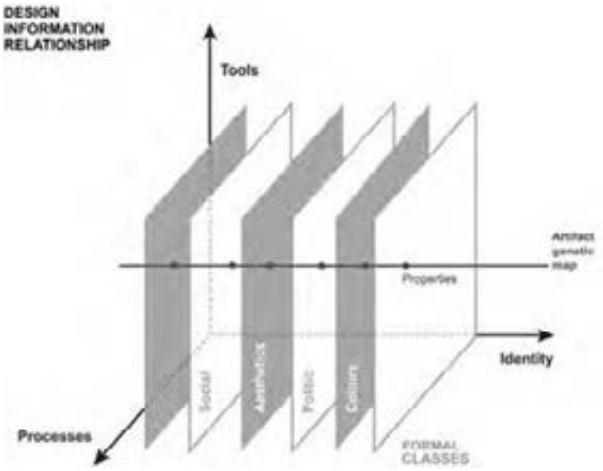


Fig. 5 | Experimental visual elaboration of coordinates useful to carry out a 'genetic mapping' of artefacts: the graph shows a hypothetical system of relationships between specific properties, contextual planes, formal classes and derived sequences.

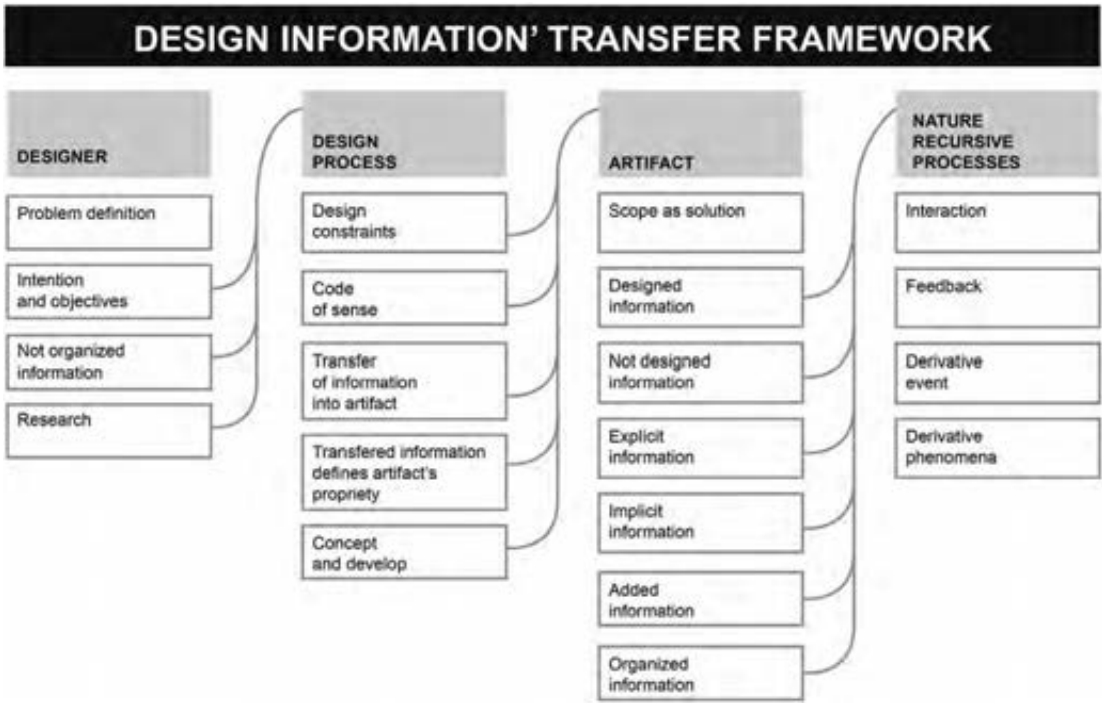


Fig. 6 | Representation of design as 'information transfer' elaborated on the basis of the founding theories of 'brand design'.

ture, by the designer's thought transferred to the product that reflects his attention for existence. Enjoying the aesthetics of an ethical artefact means sharing its 'nature', means entering into an empathetic relationship with the artefact that somehow manifested and communicated its ethical intentions (Figg. 7-9).

In the idea of a project that is beautiful because it's right, is not an aesthetic of ethics conceivable? If the project were rethought according to a new paradigm, aimed

at an ethical configuration of what exists, would it be possible to give shape to a new formal – and cultural – class that promotes a new attitude towards human activity? Is a new taste for 'ethical doing' conceivable?

The inclusion of systemic constraints as an 'ethical filter' in design processes is conceivable regardless of the design approach used (Figg. 10, 11), but it is essential to create a new language that offers an alternative and develops a new design culture on the part of the designer and those who benefit from it (Kercher, 2003). This seems possible only by virtue of the fact that conceiving a new position – social, cultural, operational – implies the non-acceptance of previous positions (Kubler, 1989, p. 79). But a change can depend, by recursiveness, also on multiple minor configuring actions, without losing its radicality matrix. The paradox we face when discussing the ethical value of human activity such as design derives from the fact that the consumer society, with its current logic of business and profit, seems incompatible with ethical action.

Ethics is not a trend: every moral consideration is neglected, forgotten. In the rare cases where it is mentioned, it is regarded with contempt as 'moralism' – or it results in an empty ceremonial of appearances. One of the phenomena of involution and decadence of the society in which we live is the loss of ethical values. Profit – and in particular short-term profit – is thought to be the only measure of value. If profit is at the expense of the general good, and in violation of the fundamental principles of ethics and fairness, the 'success' thus achieved is admired and revered, becomes 'sanctifying' and makes any other considerations irrelevant (Livraghi, 2003). A gap that increasingly seems to be rooted in the collective imagination and is found mainly in advertising, where a project is defined as ethical when it is associated with visual communication for non-commercial purposes or with the aim of educating and/or raising awareness among the general public on issues of general interest. This limits the scope of interest to social communication only of which are protagonists non-profit entities and associations, which by statute set themselves noble objectives and base their work on an ethical code. But does this overlap that often occurs between the idea of an ethical project and socially useful communication always reflect an ontological coherence?

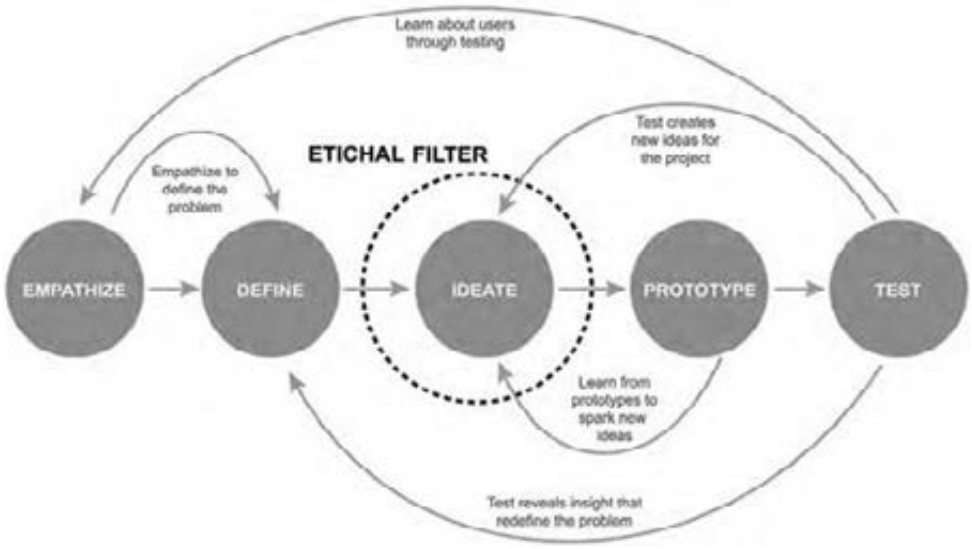
The idea that a social project is always ethical has developed culturally and autonomously through free cognitive associations according to which an action is ethical when it benefits a given system. It is no longer sufficient to act in favour of an isolated system, but it is necessary to benefit the global system – that of nature – in its entirety, in harmony with existence. Reducing the idea of ethical design by superimposing it on social design – or social communication – is highly limiting and seems to be a way of escaping more challenging discussions on ethical design, for which, even among professionals, there seems to be a kind of 'glossophobia'. To confuse communication of social utility with the idea of ethical project circumscribes the problem to a purely ethical meaning. Having an ethical approach to design by establishing systemic constraints means creating a new design code that allows the transfer of ethical values from the designer to the artefact in such a way that the latter can emit information sig-

Fig. 7 | Stuart Hydegarth, Tide 200, 2018. Commissioned by the Museum für Kunst und Gewerbe Hamburg, permanently installed and suspended in the main entrance hall, it consists entirely of plastic found on the beach (source: www.stuarthaygarth-200-2018).

Next page

Fig. 8 | Tord Boontje and Emma Woffenden, Transglass Glassware, 1997: furniture objects developed with the use of recycled bottles (source: tordbontje.com/transglass).

Fig. 9 | Example of design with high ethical impact: during the 2020 pandemic emergency, a well-known snorkelling mask was modified to be used to support intensive care units. The conversion fitting was designed to be 3D printed and the production file freely shared via the internet (credit: www.isinnova.it/easy-covid19/).



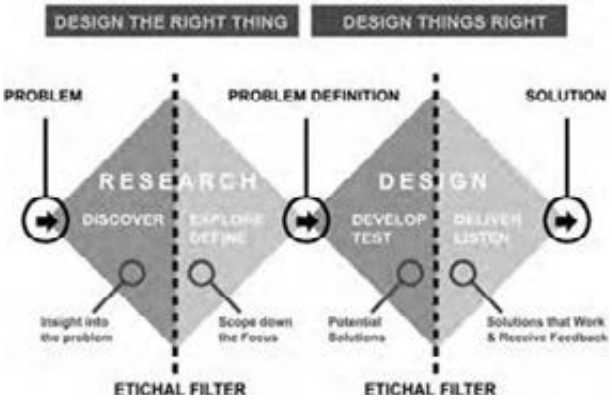


Fig. 10 | Visual re-elaboration of the Design Thinking process assuming the inclusion of an 'ethical filter' as a design parameter.

Fig. 11 | Hypothesis of visual application of the 'ethical filter' on the 'double diamond' design process.

nals consistent with its ethical nature without the need to build a communicative superstructure – brand design – to make them perceptible, visible or tangible.

Responsibility and information transfer | Brand design is a project discipline that has the ability to transfer values into an artefact and manages to transmit the most disparate information through its communicative potential, even managing to force the perception of a product (Bassani and Sbalchiero, 2002). But transparency, correctness and coherence on the part of those who configure reality are necessary components so that an added information signal – as in the brand identity – is consistent with the essence of the project, that explicit communication is consistent with implicit communication (Kubler, 1989). For example, it would be inconsistent to communicate the in-

tention to save animals from oil spilled into the sea using a petrol engine boat, the information signals connected to the explicit communication are not consistent with those emitted implicitly.

The designer's responsibility lies precisely in the ability to bind the meta-design to the ethical values that it intends to transfer in the artefact, with the awareness of the risk that involves a position also – and above all – professional (Erdönmez and Gunes, 2016; Devon and Poel, 2004). The challenge that designers are called to face is, therefore, inexorably invested in the need for research, within this polycentric and centrifugal system, a balance between emotion and artificiality of the human environment, so as to guarantee and increase its quality. There are three ethical cornerstones around which this responsibility takes shape: the environment, the relationship that man establishes with it and, a highly topical issue today, the culture of peace, based on the principles of respect and tolerance. The designer must represent, then, the point of balance between humanistic values and technical conscience to be used both in a careful and conscious process of criticism aimed at improving social and environmental living conditions (Bollini, 2003, p. 54).

Giovanni Lussu focuses his attention precisely on the subject of the profession: 'Doing your job well', as it was in the spirit of medieval guilds, is no longer enough. The tragedies of the twentieth century – tragedies that the advent of the third millennium does not seem to have put an end to – seem to have brought a more widespread awareness of moral responsibilities that go beyond this definition. The zealous railwayman who with efficient competence routed the death convoys to the death camps, for example, was certainly doing his job well, but was he not in some way an accomplice of the exterminators? There are many other forces shaping the world and if you want to improve it, you have to do it from a perspective that is definitely not only professional (Lussu, 2003, p. 96).

Conclusions | Adopting an ethical attitude towards life, work and human activities can be a challenge (Kercher, 2003) but also an opportunity, to create a common territory – cultural 'handshaking' (Norman, 2007) – capable of providing the conditions for developing a reality configuration based on ethical principles. The thought of an ethical-behavioural code in relation to the configuration of the existing, not only involves planners, designers or managers of a company. The issue affects institutions and politics on a large scale. We need to return to a reality in which we can choose the ethical alternative, but in order to do so, it must be there, it must be offered as a possibility, and more, we must be educated to perceive it. To participate, the public must be technologically and aesthetically literate, and also care about the moral implications of their role as human beings as creators (Hughes, 2006, p. 173).

Ethical responsibility is an aspect of civil, social and political interest (Sassaro, 2003) and should be a key issue in any field of human activity. Teaching ethics in schools, universities and professional training courses would mean directing humanity

towards a culture of ethics. Not utopian intentions, but concretely achievable in the exercise of the profession, with privileging the needs and interests of society: an affirmation of values that must return to having the highest place in the hierarchy of professional and cultural priorities (Bollini, 2003, p. 53).

Communicating ethics does not mean – as is often the case – to mystify in a rhetorical way an informative message but, on the contrary, to make visible the invisible by transmitting information through a 'state of facts'. Information should not be manipulated, but designed according to high values. New ways of approaching the design of the existing imply a revision of all human decisions. Instead of continuing to consider the past as a microscopic dependency of a future of astronomical dimensions, we should think of a future in which the few changes still possible will be of a kind that the past already holds the key. It is the task of our generation to construct a history of things that does justice to the meaning and being of things, to the plane of existence and its fullness (Kubler, 1989, p. 148).

In the contemporary landscape, pervaded by awareness of sustainability impact, an informed consumer pays more attention to the product: whether it is harmful to the environment, to health, whether it contains hazardous substances, whether and how ecologically sustainable it is. Communicating this information with ontological consistency builds user loyalty and invests the product with an ethical aura of responsibility. To place at the center of existence an ethical relationship than 'everything' means to do it in an omnidirectional way on the level of reality, involving all the formal sequences and the configuring agents. It is necessary to have ethical teachers as well as managers, executives, workers, in the idea of giving space to a community in which every man becomes an ethical designer of the future.

Acknowledgements

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TERRITORIAL DESIGN AND NETWORKING
Blended strategies to redesign future connections

Irene Fiesoli

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DESIGN

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ESSAYS & VIEWPOINT

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ABSTRACT
Today, sustainable innovation is meant to evolve from the linear model to the circular one. Attempts are made to offer – starting from a knowledge and training upgrade – a new innovative society (Society 5.0) where companies are part of complex relational systems leading to the creation of new sustainable and interconnected supply chains (territorial networking). In this context, the design develops new project visions based on relational paradigms and represents the bridge between technological innovation and social contexts, since it is able to shape technology by harmonising it with cultural, social, economic and political elements.

KEYWORDS
strategic design, territorial networking, innovation technologies, circular economy, knowledge

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Today, sustainable innovation is meant to regenerate in a circular way, providing companies which follow this approach based on mechanisms that drive value creation and are consistent with the principles of not only environmental, social and cultural, but also economic sustainability (Sobrero, 2018). According to this new paradigm, the value of production factors (material and energy resources) and finished products is maintained in the economic process for as long as possible in order to minimise waste production. Indeed, the linear model typical of our current economy – make, use and dispose – has reached its limits since the depletion of a portion of natural and energy resources starts to emerge (Sobrero, 2018). Therefore, the transition from this linear model to a circular model (circular economy) becomes necessary: considering all the stages – from design to production and use, until end-of-life destination – it has to be able to take every opportunity to limit material and energy input and minimise rejects and waste by paying attention to the prevention of negative environmental externalities and the creation of new social and territorial value (European Commission, 2015).

The objective of this article is to show how it is possible to imagine – through cases still isolated and yet to be experienced in their potential – an innovation offering a new model of society which efficiently uses production factors, and optimises material, energy and waste stocks, according to the logic of making, using and recycling. This innovation connects environmental and economic aspects in a context of raw material shortage and price fluctuations, contributing to the supply security and to the promotion of resources and natural capital (European Commission, 2010) by designing products with the aim of turning them into resources for another production process and linking the different actors in the current supply chains in order to create new, more integrated, circular, innovative and, hence, sustainable ones.

From an operational point of view, the new production model can be implemented, starting from the planning phase, through the use of good practices which can be integrated into a single strategic project to form a veritable paradigm change, producing dramatic changes especially in the relationship between producers and consumers. Companies, from this perspective, will be part of a complex, more and more interdependent, relational systems where will develop new project visions and innovation no longer linear, but namely circular and coherent, based on this new relational paradigm which will allow the creation of new, innovative, sustainable and interconnected supply chains. This model of circular economy in which, in addition to the development of products and services, many methods of production and use, and alternative ways of social interaction with consumers will be added, makes it possible to find new unmet needs which will be a source of inspiration for innovation (Fig. 1).

On the basis of these reflections, there are many best practices that, especially in the last few years, are standing out not only at a national level: a particular example is definitely the production system used by both the Volkswagen Group and Audi in the process towards carbon neutrality. The Aluminium Closed Loop project[1], which con-

sists in giving the aluminium industry waste back to the manufacturers in order to recycle it, has allowed achieving both the aim of contributing to company decarbonisation, and the one of revitalising resources that, otherwise, would have been impossible to use and, therefore, easy to eliminate. Depending on exactly this objective, there is also another interesting circular economy project by the Audi Group called Exchange 2.0[2]. In this project, the components used are brought back to the original quality level so that they can be sold as new replacement parts with a double benefit, in both environmental and economic terms.

The same theme of durability for everyday objects and of their reuse or recycling reaches the game world. Indeed, when they stop arousing interest in children, toys end up in the trash even if they work perfectly. This is a material waste and a massive environmental problem since 80% of toys (mainly in plastic) end up in landfills or incinerators, while the recycling percentage is very low. Rethinking toys from a circular perspective, avoiding pollution and emissions, recovering materials and extending the product lifecycle, is a subject which many start-ups, encouraging the reuse and the sharing of old toys, mobilise on. Some of these start-ups need to be mentioned: Rejoué[3], a French company that has recovered, repaired and resold toys since 2012; in the same direction heads Toy Cycle[4], a Californian company that has realised a platform where it is possible to buy second-hand, recovered and repaired toys; even Lego, in recent years, encourages the sharing of bricks that, today, almost always hand down from father to son, but the objective – characteristic of the Lego Replay Initiative[5] – is to encourage to donate bricks no longer used to children's charities. This concept is more and more supported by the idea of using a toy without possessing it effectively as if it were a fully-fledged service.

An idea that Happy Baton[6] is trying to put into practice by sending every month, to the families signing up for a sort of subscription, a box with appropriate toys for the different ages and needs. At the end of the month, the toys inside the box are returned in expectation of new ones. The same principle is also used by Whirli[7], a British company that has introduced the use of tokens as bargaining chips for toys. A key step on the path to a real circularity of toys concerns a different structure in the way they are produced. Green toys[8], a Californian company, uses only recycled plastic – like yoghurt pots – to make toys. The same path is undertaken by MGA Entertainment, the toy industry giant – which has a turnover of 9.1 billion dollars and offers, among its leading products, the Bratz dolls – by activating a collaboration with Terracycle (the most famous recycling company in the USA) to reassure the recycling of both toys and packaging. These are some examples of how to develop systems centred on circularity, with highly sustainable purposes and enabling the activation of strategic synergies and collaborative services.

It is possible to talk about the circular economy even starting from a particular material. For example, the viscose produced from cotton waste, rather than from wood pulp, not only avoids to cut down trees but especially allows to enhance waste. In-

Fig. 1 | Circular Economy in the Danube Region (credit: MOVECO Design, J. Lindl, Ideen die Fruchten, 2018).

deed, this is the path many companies have decided to undertake. One of the first companies to choose a 'circular' viscose is Lenzing[9], which has introduced some technologies in the production process to decrease the wood pulp previously used, by replacing it with cotton waste. In Italy, Monvania[10], one of the main companies in the textile district, has been focusing on the recycling of cotton linter – cotton scraps, in other words, useless fibres with a length of fewer than 16 millimetres – to obtain viscose. According to some estimates, about 40% of the cotton fibres – merging production waste, pre-consumer and post-consumer waste, up to the unsold stock – get lost. In most cases, waste ends up in landfills and incinerators. According to Monvania, in terms of performance, the linter additionally makes a whiter, slightly thicker string, obtaining a brighter viscose particularly pleasant to touch, not to mention the lower environmental impact, even in the production phase: the process requires less water consumption and use of chemical products compared to the traditional production. In this way, the material is enhanced by respecting the environment and trying not to misuse what this offers.

Finally, the project CAmbieReSti?[11] (acronym of Consumption, Environment, Energy Saving, Lifestyle in Italian) represents one of the few examples of critical consumption encouraged by a public institution, since it is sponsored by the Environmental Department of the Municipality of Venice and funded by the Ministry for the Environment and the Protection of the Territory. In this project, the testing phase had, as absolute protagonists, some families that, with local support groups specially trained, allowed to create a social network which, at the end of the testing phase, was able to organise itself again in order to continue the path undertaken in a self-managed and independent way. CAmbieReSti? has also managed to support, in parallel, the creation of a social economy Network between producers and consumers, considered essential in order to turn the conscious need of another consumption into real practices. The territory is therefore conceived as a context extended to social issues and even to the behaviour of human settlements with regard, for example, to civic education, respect of the laws, hospitality: all these qualitative elements are the essence of the so-called territorial identity (Figg. 2-4).

In the Sustainable City, designed by Magatti, major personalities are the ones who facilitate the development of human, social and environmental resources combined and are responsible for their society also in the future; while minor personalities are the ones who consume the resources without regenerating them (Magatti and Gherardi, 2014). At the centre of the city, there is a balanced ecosystem, based on human and planet health. The common good is conceived in terms of human development, intended first of all as an opportunity to cultivate transcendence and embody a value

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Fig. 2 | One year of the Audi CO_2 program, Audi saved around 90,000 tonnes of CO_2 on balance by the aluminum closed loop at the Neckarsulm site (copyright: Audi AG Rights, 2018).

Fig. 3 | Lego Replay Initiative (credit: LEGO, 2020).

Fig. 4 | Monvania homepage website, cotton linter detail (credit: Monvania).

in an action, even an economic one. There are man-sized territories and cities where is promoted a lifestyle in which individual needs can match with the necessities of the community. Everything is framed within a vision, not only passive but also active for the citizens (Magatti and Gherardi, 2014). There are territories where active in-

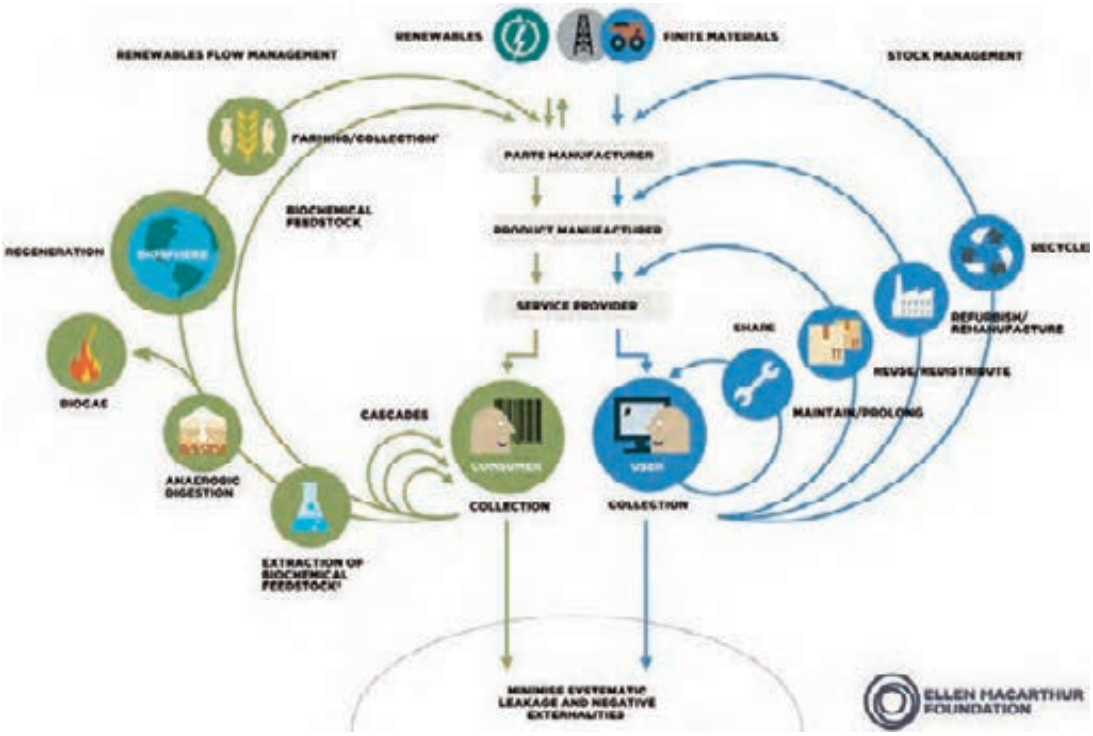

Fig. 5 | Circular economy systems diagram (credit: Ellen McArthur Foundation, drawing based on Braungart and McDonough, C2C, 2019).

dustries and companies evolve towards more and more competitive levels by using all the tools necessary to make this change happen, such as technological innovation and the synergy among private companies, public authorities and research institutes. Human capital is enhanced by stimulating creativity, professional growth, flexibility, cosmopolitanism and open-mindedness. Interaction and constant dialogue are encouraged to highlight the concrete needs of the citizens and make the resulting response efficient and effective.

The territories with a strategic vision of their own development are therefore able to define their lines of action, involve the citizens in some issues of public relevance, support awareness-raising socio-cultural actions, improve environmental quality and use technologies to digitise and innovate, promoting transparency within government procedures and the openness and sharing of data streams (open data). Smart territories where citizens live a good life and life quality is consequently guaranteed; the implementation of a territorial model which ensures citizens access to culture, creativity, information, probably using the innovations offered by the new technologies. As a consequence, there is a new economic model which tries to combine the needs coming from

the bottom-up society, driven by strong ethical reasons and by the awareness that some procedures need to be changed. To do this, the territories should become an incentive for the activation of local synergies and a link for the various actors of the supply chain; inside the territories, there should be physical spaces where new companies can contribute to the important start-up phase and their sustainable development (Fig. 5).

Territorial networking beyond Industry 4.0 | Starting from these initial considerations and also including the complex scenario of Industry 4.0, which is shaping the new wave of Society 5.0, it is clear the importance of relationships among the active subjects of the current productive panorama and the birth of new forms of interrelation among them. Simultaneously with this technological growth, there is an increasing product dematerialisation which is more and more oriented toward a system and an experience planning with an eye to connection and network. Consequently, the context where planners – designers – act has now changed since it designs not only products but also complex systems, services, interactive products, integrated communication models, relationships. This does not mean that products will be gradually removed, but on the contrary, they will be so enriched and adapted for specific contexts that they will be able to relate with a single element as well as with the whole, including the users engaging with the system. Designers, always with greater attention, have to plan these relationships since the modality described above not only will take place within the business management of the production cycles – related to processes, marketing, sale and after-sale – but also will develop especially outside the companies, in order to facilitate smart production, linked with all the actors in the territorial manufacturing system that will be part of new supply chains in the future.

This is combined with the spread of new ways of thinking, creative approaches and innovative business systems, such as Social Innovation and Open Innovation, sharing economy and commons, crowdfunding, peer-to-peer theory, lifelong learning and much more, which have led to the birth of new actors – including makers, co-working spaces, start-ups and spin-offs – with innovative skills from a cultural, social and even technological point of view, thanks to which they meet more than just particular market needs. These considerations show a scenario which allows analysing in-depth the current sources of innovation capable of generating new knowledge and understanding the role of designers in this context, whether it is always the one of the knowledge catalysts or a different one, and the methods and tools which can and have to be used (Germak, 2008).

Particular attention should be paid at the role of design as a discipline traditionally capable of managing – and planning – complexity, developing nowadays, as expressed by Manzini (2015) in his book Design, When Everybody Designs, in a project scenario filled with new ways of creative realisation which uses different approaches such as Open Design and Co-Design and for which, as explained by Verganti (2009), innovation is not only the one driven by technological development or market impulse

but the result of a third synergy, that is to say a radical change in perspective introducing a new way of competing: Design-Driven innovation, headed by design, creates new meanings. Precisely these new meanings deserve an insight and a collective claim on behalf of the entire Design scientific community, to understand what will happen in the future of the discipline, to try to make disruptive and strategic products and services more and more oriented toward the 'interpreters' of the market – from researchers to technology suppliers, from artists to designers – since they are able to grasp, mould and reverse the meaning of things in a sector; it is important to wonder why in Italy there is not a structured – regional or national – system yet, aiming at promoting design research in order to develop useful connections among the different actors in the overall panorama and to reconnect them with the business frame of reference (Verganti, 2009).

Considering that technologies and scientific research, at the basis of the same social and economic development, evolve anyway and independently following more or less radical, but quick, implementations in a flow constantly in progress (Santachiara, 2016), only through the realisation and the corresponding application of these innovative technologies, there are implications for society leading to – positive and negative – mutations, which can make a change in many cases. This particular turn of events shows the reason why the social system and its institutions very often appear to be delayed compared to the technological progress. This progress not only represents a combination of mutations and technological innovations, but also reveals a connection among technological innovation, and particular social contexts and the interaction that users have in these contexts and with these technological artefacts.

The origin and the spread of technology involve, therefore, complex harmonising processes among cultural, traditional, social, economic, and political elements, despite the differences that are created by combining them and that make this kind of action so difficult. The role of training will be essential since it allows to reduce the new digital divide which is emerging between who, despite having digital objects and getting in touch with technological systems, is crushed by them and who, on the contrary, is able to manage technological innovations strategically, by using a new and integrated type of knowledge.

There are many types of knowledge. Traditionally, knowledge is divided into tacit and explicit. Tacit knowledge is considered the hardest to deal with since it lies in one's mind (Polanyi, 1962), this means that the focus needs to be put right on the management of the latter form of knowledge. In this respect, by projecting the reasoning related to knowledge in the territorial networking field, it can be said that the individual represents the smallest organisational unit and, at the same time, is the holder of tacit knowledge, which is fundamental to understand how organisations manage their knowledge and how they gain it. Nonaka e Takeuchi (1997) underline the fact that tacit knowledge and explicit knowledge are not totally separate but mutually complementary entities. Tacit knowledge and explicit knowledge, actually, interact with each oth-

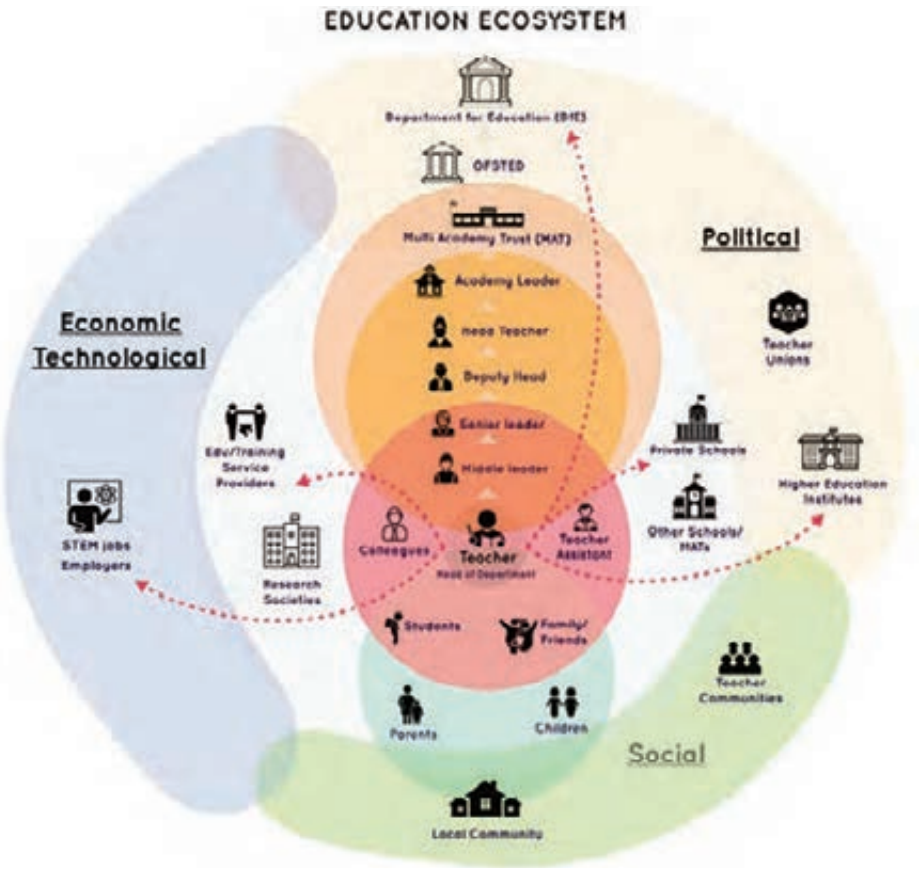

Fig. 6 | Education Ecosystem (credit: Royal College of Art, London, V. Koo, 2017).

er through the creative activities of human beings. A conversion that enriches, in terms of quantity and quality, the individual knowledge and, consequently, the knowledge of the organisation to which he/she belongs.

Following Spender's (1996) and Grant's (1996) studies relating to business knowledge, the most important resources within an organisation are its tacit knowledge and its explicit knowledge. Grant highlights the fact that companies can be considered as social communities specialised in both knowledge creation and knowledge transfer among the members of an organisation. These processes are realised through the transformation of organisational inputs into outputs, by using the knowledge of the organisations. As a result, all the processes concerning knowledge creation, acquisition, preservation, and use take place within these social communities. If Grant thinks that the role of society is to coordinate these processes within an organisation, in order to generate a competitive advantage, then knowledge exploration and sharing in society

are the most relevant aspects to manage this intellectual resource. The organisations have to recognise the need to create an environment where knowledge can be shared with the workforce, thanks to a constant update and a continuous renewal of tacit knowledge, in order to get the necessary resources to maintain their strategic flexibility and the management of their own knowledge capital (Fig. 6).

What can be done to encourage and design a long-lasting industrial rebirth based on both a cultural and technical-scientific basis? First of all, it will be essential a strong and pervasive spread of private and public investments led by the innovation of productive activities and territories, which will be difficult to realise without adequate industrial and territorial development policies, apart from traditional incentives to individual companies or territories. University will play a key role in this requalification and rebirth, by strengthening relationships intended to promote the introduction of scientific, technological, creative and organisational input within production processes; by integrating these inputs into projects including a close collaboration between universities and Made in Italy industrial districts, high-tech centres and creative urban industries; by contributing to the renewal of the role the major urban systems can play in bringing out multicentre (metropolitan, regional and national) innovative platforms thanks to their social composition and to the merging of network infrastructures (Cappellin et alii, 2017). Moreover, to strengthen the dissemination and the efficiency of these devices, some initiatives such as the ones with national technological clusters and others at a metropolitan and regional level, should be consciously used as innovation and culture platforms for local development. It would be necessary to maintain action persistence, commitment towards the reduction of bureaucratic burdens for universities and companies, a vision on how important the reinforcement of the third mission is, together with a university refinancing.

All this could make the difference and promote a rearrangement of the available resources in trajectories of industrial leadership with virtuous relationships among universities, industries and territories. In conclusion, the image of the territory that emerges is that of 'relational landscape', characterised by production and training activities, where the exchange of ideas within the production process is essential. As a consequence, an environment made of cultural integration and economic collaboration will emerge, where innovative process and transformation practices will be established, relying on a kind of multi-sector and integrated offers (Morelli and Sbordone, 2018).

The future paradigm | In the last decades, the concept that history does not lead toward the assured progress, but an extraordinary uncertainty, has been clarified. The change in human condition requires a paradigm change, a change in our vision of the world. This need to change paradigm becomes more and more urgent since the dogma of infinite growth is drastically questioned by the ongoing European and global crisis, by the dangers caused by a short-sighted technical and scientific development, and by the excessive consumerism which makes individuals and communities unhappy. It is

necessary to rethink of, explains Ceruti (2018, p. 79), progress, growing, globalisation ideas within a complex perspective, in order to conceive irreducible multiplicity of dimensions intertwined in the new human condition. It is essential to measure growth in different terms from the purely quantitative ones of the GDP, by putting in place the indicators of human development. The current development model, which does not consider human development, is completely inside the coalitions which repeat the zero-sum games: the individual success is fuelled at the expense of common good.

In the book La Nostra Europa, Ceruti and Morin (2013) argue that it is necessary to develop techno-economic policies within a logic of civilisation and planetary politics, which has as its macro objective the common good, and as a key task the 'globalising solidarity'. It is important to look for culture and anthropology able to rethink of the idea of progress since the politics of the last century has been stuck in the logic of zero-sum games: a part wins at the expenses of the others. Unfortunately, this has happened not only at an international level but also at the level of individual national companies. Today, in the era of planetary interdependence, continuing these 'games' is devastating and inconsiderate if one cares about the sake and future of humanity, because the actors of zero-sum games – actually – all loose, by bringing out the risk that there will be no winners and losers, but just losers. Humanity, therefore, is called today for the first time in history to step out of the war and unconditional environmental exploitation age, typical of the paradigm of zero-sum games, to finally generate a collaborative paradigm of positive-sum games.

Obviously, it is not enough to regenerate a culture of tolerance, it is necessary to do more: it is essential to reaffirm that the others, the gaze and the ear of the others, are the driving force and the precondition of our own development (Ceruti, 2018, p. 81); as suggested by Pope Francis, today the challenge is to conceive and live the planetary community in a positive way. A 'culture of encounter' has to arise, characterised by comprehension, connection, hybridisation and also a constructive conflict on diversity. Without these characteristics, there is no culture, there is no social life, there is no spirituality. Humanity would cease to exist. The sense of belonging, shared by all people and territories, needs to be developed as an ethical and political task fundamental to build, following Edgar Morin's expression, an 'Earth civilisation' aiming at the promotion of an anthropological evolution, made of cohabitation and peace.

Design, as a discipline traditionally able to manage and plan complexity, is developing within this – even conceptual – scenario filled with new forms of creative implementation which use new – for the most part still unstructured – approaches deserving an insight by the Scientific Community to understand what will happen in the future of the discipline and which methods and tools will be the best to create strategic products and services oriented to the new ways of living everyday life. Design – especially the strategic one – represents the bridge between technological innovation and society, capable of planning users' interaction in specific contexts characterised by special technological solutions (IoT). From this perspective, technology is designed as a social fact

and, in order to spread the application of new technological discoveries in different social contexts, it is necessary to expand their use within training contexts where these are a strategic tool for the creation of an emerging class, with a greater cultural capability and able to avoid potential negative effects in the future (Ceruti, 2018).

To sum up, it is possible to affirm that the social distancing from the assured progress and the continuous orientation towards uncertainty clearly show how problems and crisis have to be experienced as opportunities for growth and development, as well as new spaces for experimentation and creative design. Even in the face of the period of social distancing caused by the Covid-19 pandemic, the risk of a value collapse and the current social structure is visible. It is necessary to go beyond distance, trying to reinterpret and redesign it, to experience new forms of social distancing which come closer, mentally speaking, to recollection situations and meditation retreats; by using new methods and tools as a result of cross-fertilisation and an interdisciplinary – or transdisciplinary – approach attempting to join different scientific sectors, sometimes even distant one from the other. For this reason, today, we have to try to perceive progress as a challenge and a potential achievement, as a result of our choices and our will, to develop renewal capacities, typical of humanity.

Notes

1) For more information see: modo.volkswagengroup.it/en/vision/aluminum-closed-loop-a-virtuous-cycle-to-reduce-waste-and-emissions#:~:text=Aluminum%20Closed%20Loop%2C%20a%20virtuous%20cycle%20to%20reduce%20waste%20and%20emissions,-Volkswagen%20Group%20Italia&text=Audi%20manages%20the%20aluminum%20it,tons%20saved%20in%202019%20alone [Accessed 16 December 2020].

2) For more information see: audi.com/en/company/sustainability/core-topics/value-creation-and-production/exchange-2-0.html [Accessed 16 December 2020].

3) For more information see: rejoue.asso.fr/ [Accessed 16 December 2020].

4) For more information see: circulareconomynetwork.it/2020/09/allunghiamo-la-vita-a-teddy-bear/#:~:text=Tra%20queste%20la%20francese%20Rejou%C3%A9,giocattoli%20usati%2C%20recuperati%20e%20riparati [Accessed 16 December 2020].

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8) For more information see: walmart.com/browse/toys/green-toys/4171_1111647_132910_6365011?&adid=22222222254430577908&wmlspartner=wmtlabs&wl0=b&wl1=g&wl2=c&wl3=420276840403&wl4=dsa-872056265706&wl5=1008311&wl6=&wl7=2840&wl8=&veh=sem&gclid=CjwKCAiAi_D_BRApEiwASslbJy94rad-PtQN0mkcGdEdZrXHbJ5FPiAQrVpm8vD-vKq8lOgG3nDsnXhoChlcQAvD_BwE [Accessed 16 December 2020].

9) For more information see: circulareconomynetwork.it/2020/08/tessile-la-viscosa-diventa-circolare/#:~:text=Una%20delle%20prime%20aziende%20a,sostituendola%20con%20scarti%20di%20cotone [Accessed 16 December 2020].

10) For more information see: monvania.com/ [Accessed 16 December 2020].

11) For more information see: sinanet.isprambiente.it/gelso/banca-dati/comune/comune-di-venezia/cambieresti-consumi-ambiente-risparmio-energetico-e-stili-di-vita [Accessed 16 December 2020].

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URBAN POINTS OF REST
An emerging digitally fabricated modular system

Lina Ahmad, Marco Sosa

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ABSTRACT
The paper presents a case study of a developed production system designed to produce customized social settings and spatial enclosures, responding to specific social needs of a particular group within an identified social unit. The paper describes the relation between digital fabrication and the rules for design and assembly; how varied interlinked parameters are generated towards the realization of the final design. The presented case study narrates and reflects upon the system deployment within a selected context; an academic regional setting with a monocultural learners' population. Going back and forth between practical and digital evaluation, the paper describes the sequential stages of applied design and several prototypes realization. The case study; Urban points of rest, argues for a design variation within formulated digital fabrication systems in par with user participation.

KEYWORDS
lean-production, discrete architecture, digital fabrication, community involvement, prototype

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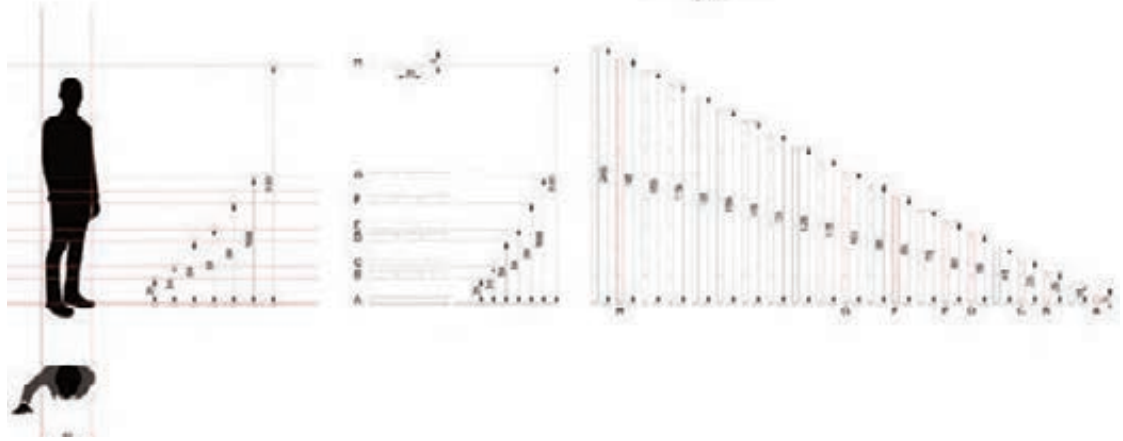
The paper presents a case study of a deployed modular system designed to produce and instigate a variety of urban spatial 'patterns' that promote customized social settings and spatial enclosures. The followed methodology emphasizes the value of doing, through an active explorative process of design and build, devising solutions to problems that would otherwise go unnoticed (Koskinen et alii, 2011) It describes a rigorous relationship between fabrication, making and community involvement through the application of coded prescribed process derived from specific rules of assembly. Drawing from the notion of 'discrete design' (Retsin, 2019a, 2019b, 2016) within perceptions from digital fabrication and making theorem, the case study narrates a system implementation within a selected context and locality. It argues for a design variation derived from the assembly of similar components in par with user participation.

In 1929, Fuller reflected on the concept of houses mass production and contemplated on the idea of how it could totally redefine the architects' role (Arieff and Burkhart, 2003). The twentieth century, however, witnessed a surge of mass-production backed by the industrial revolution and the introduction of new materiality which brought with it assembly-line practices; standardization where identical products were mass-produced (James-Chakraborty, 2014). Around the 1980s, a new paradigm that looked into devising strategies that provide customized products at production rates emerged. Its manifestation directly linked to product quality and produced quantity (Pine, 1992). Today's emerging computing power backed by the introduction of numerically-controlled machines and the spread use of computer-aided design – CAD and computer-aided manufacturing – CAM technologies have revived architects and designers' interest in mass-customization. (Willis and Woodward, 2010) This has allowed for design complexity and variation within the same parameters of the defined process and reintroduced the direct link between design and production.

'Making' has always been a central part in architectural design. It is the way architects and designers are taught to think, synthesize a problem and visualize a 3D space. Yet for centuries, design has been separated from production, with architects making 'building representations' rather than buildings (Carpo, 2011). Development in prototyping technologies and design methodologies (parametric and computational procedures) has altered the followed traditional design measures and created a direct link to manufacturing and fabrication processes. The rise of digital design changed the traditional designer role, shuffled the order of design processes and opened new frontiers through an interdisciplinary approach (Tedeschi, 2014).

On site-construction processes typically follows a comprehensive set of prepared shop drawings and specification documents done by specialized contracting companies. The presented case study explores the possibility of introducing on-site digital fabrication modular system and linking the design process directly to production. It also suggests the end-user direct involvement by altering or creating his own environment based on need and preference. Modulation and layering become the bonding element for a construction language that does not follow a predetermined pattern for a



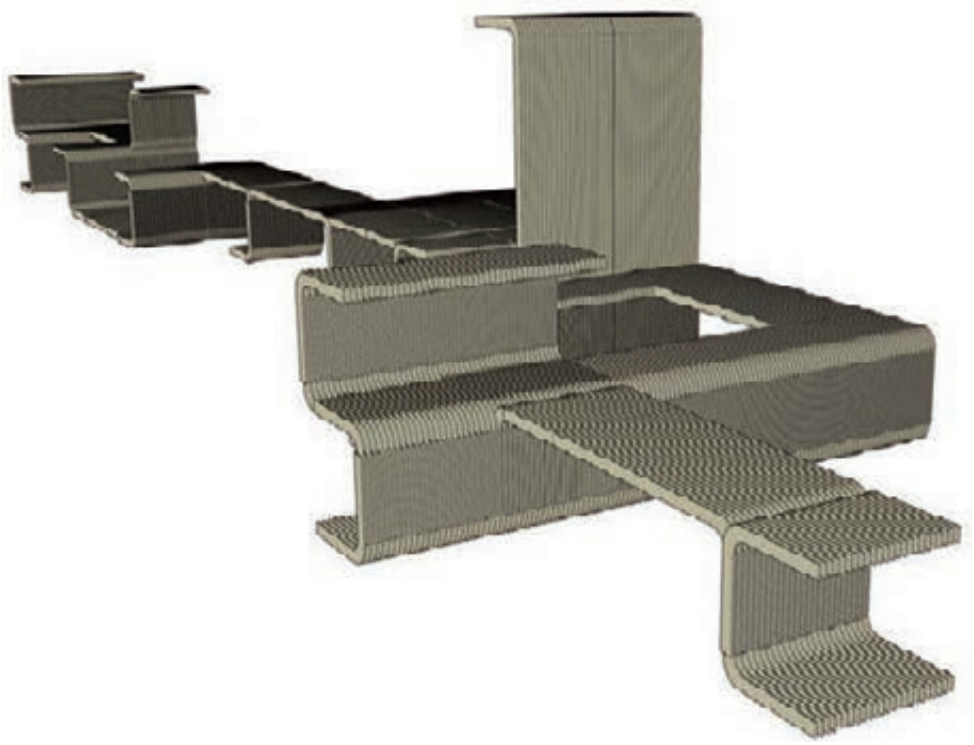


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Fig. 1 | Image of sketch of the prototype in site (credit: Authors, 2017).

Fig. 2 | Diagram for rules of Assembly (credit: Authors, 2017).

Fig. 3 | Image of digital model of the prototype simulating modulation possibilities (credit: Authors, 2017).

purpose but it is defined by the suggestive activity to occur. The modulation of the pieces is not guided by a predetermined aesthetic but have a certain freedom to flow, expand, encapsulate and generate.

Today's CAD/CAM technologies provide the designers with tools to prototype their designs and manufacture building components; thus, altering and changing the design processes as well as reviving the past notion of designer's interdisciplinary knowledge and approach (Schodek et alii, 2005). The presented case study is in par with worldwide conducted explorations by students and professional architects into finding methods and techniques to bridge between representation and production; whereby digital fabrication is seen as a way to avoid the drawbacks of traditional manufacturing and allow the production of diverse alternate forms and components. The uniqueness of the conducted case study stems from the context, where fabrication knowledge is in its infancy, and from the end-user, with minimal or no previous design knowledge, active involvement.

Prefabricated architecture, brief overview | The link between architectural design and fabrication can be traced back to 1906 to Aladdin Ready-Cut House; whereby pre-

cut numbered pieces were delivered to site for direct assembly (Aladdin Company, 1995). Other companies, such as Gordon Van Tine, Montgomery Ward, the Hodgson Company, Roebuck and Co. and Sears whose products existed until 1940, continued with the notion of prefabricated homes presenting them to their client or future homeowners through catalogue pages (Harris, 2010). Prefabricated architecture differs in its build-up approach and assembling process, they all depart from the known concept of in-situ site construction, thus challenging its methodology and procedures. Backed by the economical drive and technological advancement specific to their time, they explored the concept of ready-made, off-the-shelf and kit-built houses. This notion shuffled the hierarchy of design and build-up process, brought it to the controlled environment of the manufacturing factory, and at times gave its occupant an element of choice in the selection of the assembled parts.

The relation between design, fabrication and technology has gone through several rapid iterations within the past decade. Gershenfeld's notion of digital mass-customization, programming the physical world (Gershenfeld, 2012) and the concept of Digital materials (Popescu, Mahale and Gershenfeld, 2006). Leach's dispute that acknowledges the use of digital tools in a design practice but negates digital description and title. (Leach, 2014) And the followed post-digital discourse that questions the use of digital tools and techniques in relation to their application and affiliation as well as the meaning of digital design and digital material organization. Capro's description of the Second Digital Turn (Carpo, 2017) as tools for thinking enforced by today computation power and advancements in areas of form-finding simulation and optimization, and experiments with new forms of machine learning and artificial intelligence. As well as the argument for bespoke design through the file-to-factory process.

Modular versus Discrete Assembly, brief overview | Modular design is linked to the notion of prefabrication, where identical pre-cut pieces are delivered to site for direct and relatively quick assembly. The serial production of identical unit-solutions correlates to the industrial era, the permutation of technology and standard operations of lean production (Smith, 2010). The recent emerging Discrete movement adopts a similar social and economic value but negates the same unit mass-customization. It is described as «[…] a new paradigm that attempts to reconsider serial repetition as an economy of scale» (Sanchez, 2014, p. 1). that conveys principles of fabrication, customization and adaptability through the combinations of purposely designed parts across scales (Sanchez, 2016). Autonomous parts through their cumulative relation to one another define a system that is formulated, and yet is independent of the whole; one that grows or retreats in relation to the surrounded contextual settings and as such results in a number of possible derived solutions and equilibrium states (Sanchez, 2019).

Pedagogical Perspective | Experiential education within the Bauhaus school setting is one of the earliest examples of design and build pedagogy connected to its time

Figg. 4, 5 | Images of fabrication and assembling of the prototype (credits: Authors, 2018).

emerging technology and social context (Hayes, 2012). Kolb (1984, p. 38) defined it to «[…] the process whereby knowledge is created through the transformation of experience». Knowledge results from the combination of grasping and transforming experience. More recently, Blikstein described through three main attributes: 1) Enhancing existing practices and expertise, 2) Accelerating invention and design cycles, and 3) Long term projects and deep collaboration. (Ockman, 2012) It is seen to offer «[…] a pedagogical alternative to the theoretical, desk-based and media-driven (drawings, digital models) design process» (Canizaro, 2012, p. 20). It has been known to 'sup-

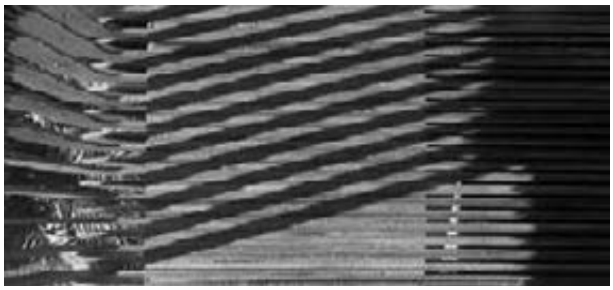

Fig. 6 | Image of the digital model of the prototype simulating modulation possibilities (credit: Authors, 2018).

Fig. 7 | Variation and adaptation to site conditions (credit: Authors, 2018).

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Fig. 8 | Interaction with and prototype usage (credit: Authors, 2019).

plants drawings, models, and all forms of representations' for the direct interaction with material and manufacturing processes (Brown et alii, 2013). The described methodology was further applied and extensively explored in many architectural schools across the globe (Erdman et alii, 2002).

Preamble | Design methodologies and trends correlate and adapt through time, responding to the latest technological advancement in tools, techniques and methodologies. The literature review presents a very brief overview of fabrication discourse. The presented case study situates itself within a government institution where the notion of fabrication is at its infancy, with a limited access to manual and digital fabrication tools and machinery. It also instigates the notion of making as a response to the current prevailing social consumerism trends. The study was conducted over two years, with all the data gathered prior to the international pandemic in 2020 enforced shift to online education. Phase I was the authors' initiative of instigating change in the local academic community, and Phase II is the transcended pedagogy implementation.

The contribution and originality stem from presented exploration of introducing digital fabrication and linking the design process directly to production. The process draws from the notion of discrete assembly using serial repetition. Parts and connections are repetitive. The uniqueness emerges from the design of larger formations that

correspond and are driven by parameters extracted from site, context and inhabitants/users' needs. The originality of this project is in its intake to democratise design through the use of technology. Next steps will look deeper into the possibility of deriving regional materials, thus adding the notion of sustainability to structural optimization. The approach combines design with rigorous research. It follows an empirical methodology that «[…] seeks to create knowledge that serves the design profession and others [an approach to] produce useful methods for practice or generalized methods that provide models for further development of domain-specific methods» (Poggenpohl and Sato, 2003, p. 5). Presented work fits within these two approaches; empirically through creating knowledge that is targeted to serve the local community identified within the selected academic setting, and methodologically through researching design systems, testing their implementations thus charting the next steps. The practice-research methodology leads to the creation of new discipline-related knowledge and suggests the inclusion of design as an assessment criterion (Pedgley and Wormald, 2007; van de Weijer, Van Cleempoel and Heynen, 2014).

The research shows a regional intake on the current debate of democratizing design, architecture and technology (Hyysalo, Hyysalo, and Hakkarainen, 2019; Ford, 2020). Through the devised process, the work assesses the devised system implementation and charts future possible scenarios. It draws from the usage of informal spaces

in residential neighbourhoods and deciphers a typological language used by the participants and proposes an alternative system. To the authors' knowledge, there are not any similar studies in the other government-based institutions in the country.

Contextualisation, Targeted Audience and Participant Backgrounds | Both parts of the presented conducted case studies take place in the Gulf region where prototyping and fabrication approaches are at its infancy. The region itself has witnessed a rapid socio-economic change (WHO, 2006) driven by the oil and gas commercial utilization. Since the oil discovery early 1950s, the nation has transformed economically and demographically. Its major cities today are examples of modern metropolises with signature buildings and high-rise towers following the global and international style (Guéraiche, 2017). Because of the influx of the working force, the local population constitutes the minority of the demographics. Despite that, they have one of the world's highest per capita GPDs in addition to several social benefits (Fox, Mourtada-Sabbah Al-Mutawa, 2006).

The University where the study was initiated, is a federal gender-segregated institution for higher education that follows the American liberal arts college system. It has two main campuses in two of the major cities and is accredited by the Middle States Commission on Higher Education. The Interior Design program, along with the other four offered programs in the College holds a substantial equivalence accreditation from the National Association of Schools of Art and Design based in the US. As opposed to the multicultural demographic of the nation, the academic institution is characterized by a monocultural student body composed of mainly young national citizens. Furthermore, the Bachelor of Fine Arts in Interior Design is offered only to female students.

Methodology and Phases | Phase I (Figg. 1-9) followed a practice research method implemented by the authors. The project consists of three interdependent prototypes. Their succession was used as means to further develop the design, refine the structural and material system, evaluate the manufacturing procedures and assess audience receipt and response, points there were also used as criteria for evaluation and assessment. The used 'prototype' terminology refers to 1:1 scale, functional, build structures; a reference to the devised system of design and assembly. Further, all realised prototypes are ephemeral and transient in their nature; existing for a period of time. Following the same rules of design and growth, they successively increase in size within the same level of system complexity. The prototypes responded to identified site parameters, initiating users' and passers interactions and response to the spatial change of familiar environments.

Rules of Design and Assembly – Using 6 mm timber sheets, a language for the components was devised from serial vertical and horizontal elements. Limited to a 2400 x 1200 mm cutting bed, 21 different lengths are derived to 50mm wide by 6mm

Fig. 9 | The final modular prototype on-site (credit: Authors, 2019).

linear elements with centred holes that are 200 mm spaced. From the 441 possible L-shaped configurations, 8 linear dimensions were selected based on distances extracted from the dimensions of the body at various resting points. The intersection corner is rounded off offsetting the hole by the half of the spacing distance in both x-axis and y-axis direction. This creates 64 possible L-shape configurations. For a more efficient material use and in order to minimize material wastage, any desired distance longer than 650 mm was divided into a linear element of the desired length and two 650 mm

Fig. 10 | Prototype example, Hexagon by Rawdha AlKetbi (credit: Authors, 2018).

Fig. 11 | Prototype example, Urban π by Zainab Alblooki (credit: Authors, 2018).

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Fig. 12 | Prototype example, Quarters by Natnael Gezae (credit: Authors, 2018).

L-shape elements. An aggregation system is derived from a well-documented language of layered sectional elements (Iwamoto, 2009), aggregated along steel rods and secured with end nuts at each end without any adhesive to accommodate possible slight material deformation. The compositions are realized as dual, triad and quad organizations attaining the prototype's aesthetic quality and structural stability. The system allows the prototype to grow in width, length and height. The interplay between solid and void, thus the achieved surface density responds to the applied force and the foreseen weight load from the predicted use and occupation. This results in a varied aesthetic appearance for the different surfaces and in an interesting light and shadow interplay.

Prototype I was used to gauge the structural stability of the devised building systems. The outcome was three pieces with two varied resting planes. Each unit took 30 minutes to assemble. Prototype II was larger in scale and assembled by volunteered male students through a 7-hour workshop. The main objective was to evaluate a non-designer community response to the initiated assemblage and built-up process. Unlike the common industry practice whereby drawings are used to outline the construction process, a 1:4 model was used as a construction guide and assisted the participants to visualize the expected outcome. Throughout the assembly process, the model was used as a reference point upon which the steps were charted, and the achieved out-

comes were evaluated. Prototype III is a linear micro-urban setting; it is realised as a more permanent piece as opposed to the ephemerality characterising the other two. Utilizing the devised system language and vocabulary, it demonstrates an example of an intervention at a micro-urban scale. The design of the prototype responds to two specific site parameters; linear spread and the successive change in light and shadow pattern. The tectonics forms an interesting interplay and an interactive language inviting passers to pause, inhabit and interact.

Phase II (Figg. 10-12) is practice-led pedagogy based on the experiential learning approach via making. The methodology is derived from the experimentation conducted in phase I and is used to diversify the learning process to embody four two main characteristics differentiating it from the standard classroom learning; interdisciplinary and based on need learning. In opposition to the stand classroom, the design via making process brought together students from all five majors from the junior, intermediate and senior level. Rather than following the learning standard of a defined curriculum, students learnt techniques and methods in response to an immediate presented need. They became experts in the tools and techniques they chose to utilize and had an overview of the ones used by their colleagues. Further, the followed methodology negated the drawing medium and resorted to scaled mock-ups made through manual and digital fabrication machinery as tools for design and construction. From the early project stages, it became evident how the practice method positively altered the students' learning approach. This was further strengthened through the personal and communal alliance and the systematic personal growth that accompanied the learning process manifesting itself through collegial involvement, participatory learning activities, critical dialogue, and innovative thinking.

The process was comprised of three main steps: 1) Problem or condition identification within the immediate local environment; respond with rapid sketches; communicate a design proposal through a scaled 1:10 model; understand the geometry, design the material joinery and figure the build-up process through a scaled 1:5 model; 2) Construct the 1:1 prototype working with the material tectonics, testing condition and mechanisms, curate the intended functionality and use, and examine the overall structure and prototype stability; 3) Position the prototype in the intended site and document its appropriation to the community, demonstrate the adaptation and use.

Reflection on deployed framework and conclusion | The presented case study is in par with worldwide conducted explorations by students and professional architects into finding methods and techniques to bridge between representation and production; whereby digital fabrication is seen as a way to avoid the drawbacks of traditional manufacturing and allow the production of diverse alternate forms and components. The uniqueness of the conducted case study stems from the context, where fabrication knowledge is in its infancy, and from the end-user, with minimal or no previous design knowledge, active involvement. Through the adaptable proposed

system, it also responds to the unique social local context of present varied occupation form to in-between residential space.

Next research phase aims to continue the investigation of autonomous parts that come together to form the whole design; a hands-on practice-led research into modular and/or discrete systems and assembling methods. In addition to possible system adaptation to pre-identified conditions and parameters, and future injected functions and occupation scenarios. The intention is for the system to be able to grow and/or shrink in adaptation to the context, thus having a number of possible 'equilibrium' states. The aim is for the parts to embrace fabrication and structural logic and for the assembly patterns and languages to be driven by locality and functionality, including prototyping across scales. In addition to notions of sustainable measures to be taken into account at the deployment and deconstruction phases. The making of the part (the unit) and the testing of the assembly and the various possible scenarios either through physical or digital simulation, with the intention to demonstrate several inhabitation scenarios based on inputted parameters and identified inhabitation conditions; a system that will have the capability to reconfigure based on varying inputted data. The variation comes from changing the site or from altering the inputted parameters, including the observed – collated ones from the community and immediate surrounding environment and desired – designed conditions such as injected programs and functions.

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Investigating the Future is an established practice for the academy and the world of crafts and industry. From the Chicago Columbian Exhibition of 1893 to the two Worlds Fairs of New York City (1939 and 1965) and so on, the future has been foreseen as filled with technology and amazing architecture but not every vision of the future has described promising scenarios. The four visions of the future proposed by Norman Henchey (1978) conceptualized in classes – 'possible' (any future), 'plausible' (future that makes sense), 'probable' (highly likely to happen), 'preferable' (the best that could happen) – have been brilliantly described in the 'Futures Cone' reinterpreted by Joseph Voros (2003). As we move away from the present, the 'possible' tends to 'preferable' due to the lack of elements and data on which to base the programming and the planning: in fact, the certainty on the type of technologies and production methods that will be available, on the social structure and user uses, and so on decreases. By 2030, the world will already be different: Thomas L. Friedman (2016) highlights that the three main forces of our Planet – Moore's Law (technology), the Market (globalization) and Mother Nature (climate change and biodiversity loss) – are all pressing at the same time, with inevitable consequences for the territory, cities, architecture, products and services that will be designed, developed and used in the future.

The 17 2030 Sustainable Development Goals presented by the United Nations provide an answer for this time horizon, tracing the path towards a model to achieve a better and more sustainable future for everyone. But will these Goals be able to accelerate sustainable innovation? Paraphrasing Luciano Floridi, philosopher of Information and Technology at the University of Oxford, we ask ourselves if 'green' (of natural and artificial environments) and 'blue' (of science, technology and therefore the digital world) will succeed to guide a vision of the future capable of replacing 'things' (objects) with 'relationships', 'individual planning' with 'common planning', the 'experience economy' (and not consumption) with a 'policy of care and relationships' (and not production). A vision of the sustainable future of living, by looking at the two time horizons of 2030 and 2050, will be played on an increasingly synergistic work aimed at providing answers to many questions. In this regard, the book 'Possible and Preferable Scenarios of a Sustainable Future – Towards 2030 and Beyond' collects essays and critical thoughts, researches and experimentations on the subject providing some starting points for debate for the international scientific Community.

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