Urban spaces, new buildings and IC Technologies for health sustainability

Eugenio ARBIZZANI *eugenio.arbizzani@uniroma1.it*

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Introduction

In an ageing society the quality of health necessarily passes through the quality of life of progressively more fragile people, and the sustainability of the health system becomes a crucial aspect for the economic sustainability of the most civilized countries (AAL PROGRAMME). Citizens over 65 will be more than half of the population by 2050, but older people over 85 will be over 13% of citizens (Arbizzani, 2015). We are facing an epochal change in all aspects of civil and social life and this is mainly reflected on the issue of welfare sustainability. Already today, more than half of hospital stays are represented by people over the age of 65, and the trend is rapidly increasing with the age of the citizens who have to turn to hospital services. Older people need more long-term care than acute care and such care can be provided in de-hospitalized facilities, or better directly at home.

In this framework of progressive fragility, elderly people are today much more active and fit than even just a few decades ago. They have a higher level of education, and experience an active life until later in life. They retire later and remain active, both to maintain their own livelihood and their own free will. This compatibly with a physical framework that necessarily becomes progressively more fragile and requires assistance and personal care services.

Prevention in this group of citizens becomes crucial for maintaining the health and well-being of ever-growing population components (Arbizzani, Civiero, Mangiatordi, 2019).
Senior citizens live for the great majority in their own homes, in families of two or - more often - one person. Their houses are on average larger than their needs. The average size of residential spaces for older people is within 60 sm. per person, compared to 40 sm. per person in younger families.
Living lonely thus represents a phenomenon progressively characterizing the living conditions of the elderly generations. But at the same time even the younger generations face this condition of life and living: students, atypical workers, professionals in transition; ever greater population groups live, study and work in temporary places. Living as individuals but sharing social, productive and relational life becomes a central theme for the quality and sustainability of the social and economic system (Baratta et al., 2018).
Therefore, the design of urban and building systems changes its paradigms, in view of a greater quality of urban living. The places of living and social life are constantly changing their needs related to:

- the growing share of citizens living temporarily or permanently alone;
- the increasing need for equipped work and relationship spaces with features of multi-functionality and flexibility;
- finally the availability of building technologies and industrialized solutions that allow the creation of a new generation of "zero-energy buildings", interactive and interacting with the external environment and with technological infrastructures.

In the vision of a new social urbanity there is the opportunity to design city parts that are able to give new inclusive and integrated answers to the questions asked by the citizens. The theme of smart cities can be combined in terms of urban districts where establishing a social and economic deal between generations, with the aim of sharing and exchanging spaces, services, technologies, time.

Urban spaces for sharing.
The intergenerational residential district

The design experimentation that is undergoing in the municipality of San Giovanni in Persiceto (see fig01), concerns the development of a operative urban plan for a new peri-urban settlement. It has the objective of rethinking a piece of the city mainly oriented to offer citizens living spaces with high quality of relational and social exchange. At the same time present planning of the urban sector is aimed at adequately supporting the requests for social and health services, in order to improve life quality for the inhabitants of the district and the surrounding areas.
The urban frame that has taken shape is organized in "sub-centurial" urban blocks, derived from the ancient Roman centuriatio.

fig01 – S. Giovanni in Persiceto, new periurban quarter. Operative urban plan.

It specializes in functions and uses taking into account the peculiarities of territory, road connections and existing structures.
The mix of functions, building types and urban configuration contribute to the definition of a new properly urban structure.
The public utility anchors of this organization are mainly represented by the public equipment hubs (the school and sports districts); the commercial district; the urban squares system in the business district and the green system: the urban park, the park avenue, the cycle lanes system.
The housing is structured according to different medium-low density housing typologies that respond to different target families and different ways of living: medium-small court houses, single or semi-detached houses with private greenery, buildings with medium and small flats, freely scattered within the pattern of the urban frame, between the private gardens and the semi-public neighborhood green. In this urban landscape, the "intergenerational residence district" takes shape, distributed over three intervention blocks and including a plurality of typologies and uses: "temporary living houses", "intergenerational houses" and "elderly assisted houses".

The district is located in the immediate proximity of the railway station and the fast road system, in direct contact with the park avenue and the main public utility services.
The aim of the project is to equip the urban compound with spaces and technological infrastructures that can emphasize integration and inclusion among the different groups of people and families, aiming at a living innovation user-centered, capable to improve the quality of life and also contribute to the sustainability of the public health and social care system.
The entire district should be equipped with ICT systems at the level of public spaces, with the provision of mobility and shared transport services and the location of smart equipments and tools for the provision of public utility services. At the building level, meeting, study and work rooms and social laboratories will be provided. They will take place at the different floors inside the buildings and will be dedicated both to tenants and to external guests.
The “intergenerational houses” are located in a site facing to the green park avenue, they are distributed in three buildings connected to each other and equipped with shared services both at underground level, at ground level and on the upper floors. At these levels laboratories, laundries, co-working rooms, urban labs, spaces for physical well-being, outdoor spaces for shared greenery are provided. The dimensions of the flats are small (from 45 to 65 sm.), being able to take advantage of common areas for socialization and service.

The real estate complex is equipped with some “clusters”, a housing solution that allows people - individuals or families - to have a private space (around 28 to 55 sm.) and - if they wish - to carry out most of the shared activities with others: having space to cook, to eat convivially, to temporarily accommodate people, to practice leisure activities, even outdoors.
Potential users include couples and elderly people, students and singles, families; all aimed at making use of a portion of their own space and sharing a larger part of space, equipment and time with the resident community.
Sharing spaces offers obvious financial savings in access to property, but the attempt is to provide an environment that contrasts the sense of isolation of the single condition, recovers the sense of belonging to the group and pushes people to share their own social experiences.
In the district there is also a building more specifically intended for “temporary living”, with a possible destination as a student residence, designed in the shape of hotel (rooms from 12 to 18 sm.) and common internal as well as nearby services (library, playroom, living room, gym and sauna, dining and meeting rooms).
The pivot of public utility of the district is represented by the "assisted elderly house" (see fig02), a socio-sanitary structure, devoted to the life of elderly people, fragile or not self-sufficient.

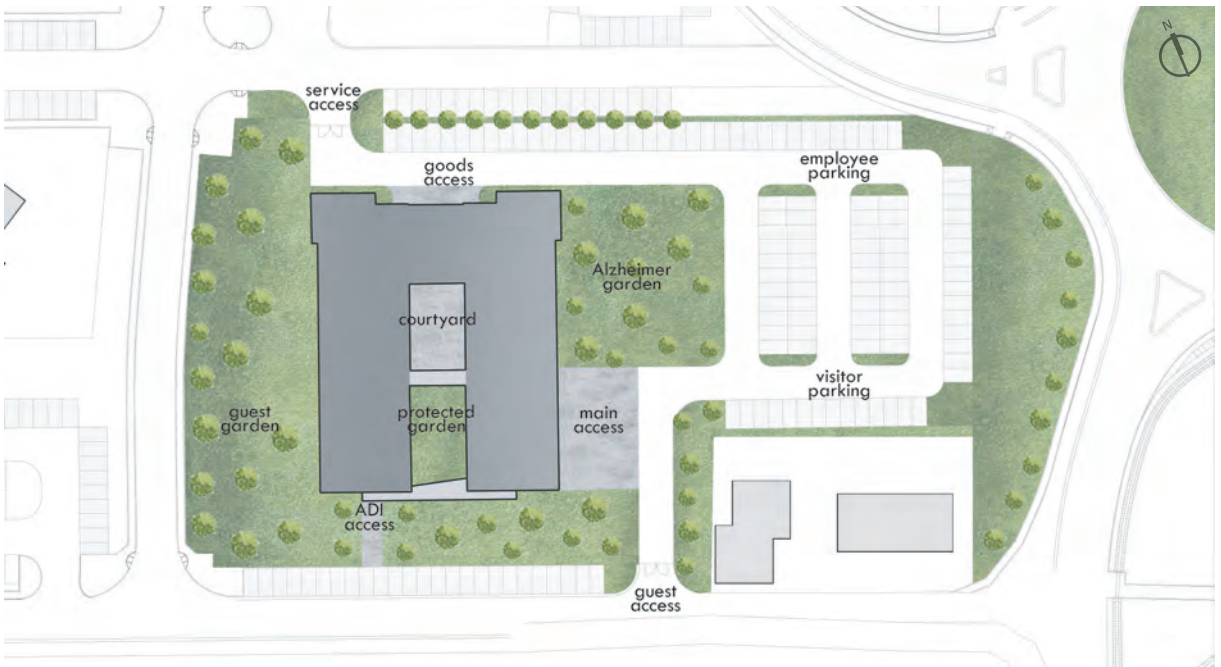

fig02 – Assisted elderly house. General plan.

The structure is conceived as a multifunctional pole, a supportive hub open to the external facilities and services. The assisted elderly house is composed of five different functional areas.

The most of the health structure is occupied by the real "protected residence", with a capacity of 60 guests. On the ground level take place the acceptance area, common spaces for living and doing occupancy therapy, services to the elderly guests (see fig03). The first floor of the building is divided into two different residential units, each for 30 guests, with six single rooms and twelve double rooms. Rooms are shaped in a minimum space (13 to 19 sm.) with a bow window for individual eating and living. Each residential nucleus is equipped with dining room, living room and occupational activities room, facility management and general services (see fig04).

Accessible from the hall and directly open to the outdoor garden and wood, the "daycare center" can accommodate 15 guests during the day. This nucleus is equipped with living and convivial dining spaces and has two rooms for daytime rest of the guests. The whole dimension of this area is quite small because it can use all the services of the entire building.

fig03 – Floor plan. Functional areas.

fig04 – First floor. Residential units.

The “support center for home care services” is also located on the ground floor. In these two rooms caregivers of public utility services to the territory are hosted. Call center, meeting room and services take place to offer health, living, facility and support services to the outside houses of the district. Also patients discharged from the hospital stays may obtain post-intensive health care from this service. A fourth more nucleus is conceived as health care space, where surgery, physical rehabilitation therapy and fitness can be provided. This space functions as a first nucleus of a wider health center in the future intention of the planners. Finally general services facilities, such as dressing rooms and staff bathrooms, warehouses and kitchens are directly connected with service driveway and entrance. They are structured to allow service to the entire structure and also to the surrounding district.

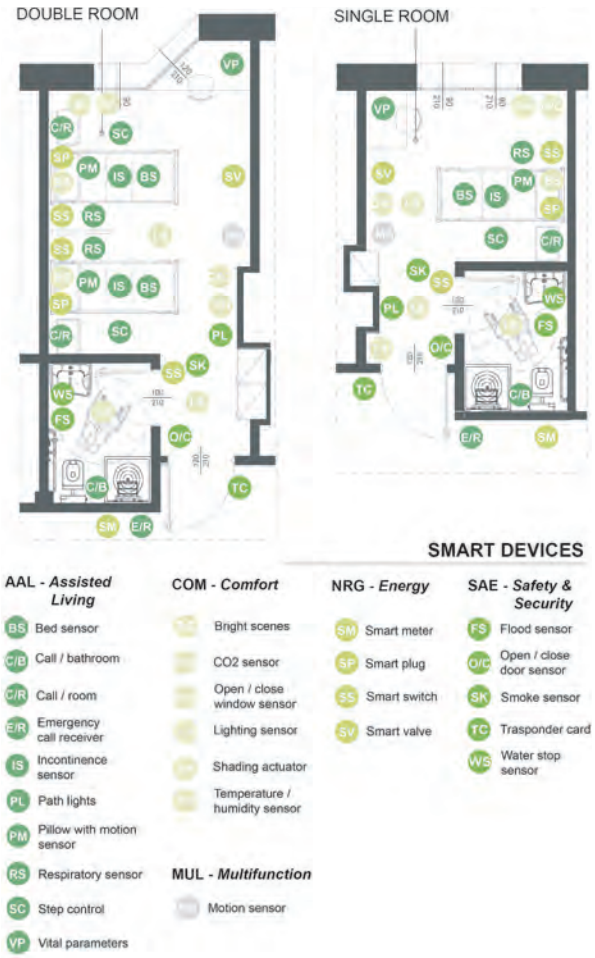

fig05 – Bedroom types. Smart devices location.

The complex building is designed to rationalize and optimize the use of space and equipment, is equipped with all the services required by the regional health care regulations, and is organized to ensure a synergy in the different use of all spaces over 24 hours a day.

The energy sustainability of the intergenerational district is guaranteed by its inclusion in the dimension of the new periurban area, which can be equipped with a geothermal power plant and a district heating network, which will position solar and photovoltaic systems. Each building will adopt latest building technologies maximum energy and environmental efficiency, in fact it is now commonly clear that new construction technologies offer an important positive cost-benefit ratio.

IC Technologies for the elderly. AAL platforms supporting personalized services in the smart district

Ageing society is one of the key topics of EU's framework programmes for research, in line with the Horizon 2020 objectives, that address the side effects of this demographic trend and support older people to remain "active" and "healthy". "Active and Ambient Assisted Living Joint Programme – ICT for Ageing Well" is integral part of this research context. Starting in 2008, it aims to improve conditions of life for older adults, enhancing the industrial opportunities in the area of ICT and IOT technologies. In this international scenario, the issue of Ageing Society offers new market opportunities and new trade's growth, indeed: according to the AAL joint programme, there is an increasing interest in products, services and systems that enhance autonomy and independence of elderly people at home and

in the community, reducing costs of health and social care and improving their social participation (European Commission, 2014).
The European Commission strongly encourages digital innovation in care and assistance and fosters the promotion of innovative services for the elderly. International research relies on the enormous potential of savings obtainable through the use of communication and automation technologies, so creating new forms of residence and urban sociability for the elderly according to new paradigms. The development of advanced devices and systems in domestic and urban environment aims to improve their quality of life: based on an interoperable and wireless system, integrated with an open cloud-based architecture network, smart technologies are enabling factors to smart personal services.
According to this framework a study is ongoing dealing with the development of an Ambient Assisted Living platform, starting from the functional and technological upgrade of a range of existing residential buildings for the elderly. In this innovative housing model, the integration of a series of smart technologies in the home environment will be useful to guarantee: an adequate level of comfort indoor (COM - Comfort), safety at home (SAE – Safety and Security), detection of emergencies and personal assistance (AAL – Ambient Assisted Living), the management of energy flows (NRG – Energy) for a optimal use of available resources (Hergott, Oswald, Bosch, Tobolla, 2019).

In the context of smart cities, ICT and IOT platforms are considered as new interactive tools through which citizens share and use information promptly and safely, activating innovative and digital services, more effective for their quality of life. Within this innovative scenario, the AAL platform is conceived as an interactive tool based on the integration of intelligent components at different scales of the city (from urban space, to the building and the home environment) and on the management of a series of smart technologies, able to respond to various aspects and needs posed by old end-users and their caregivers.
A digital architecture system integrated into the home environment and at city scale will be able to collect and reuse of information by different devices, boosting the interaction between end-users, while a communication interface will enable innovative functionalities and services for the elderly and their caretakers.
Thanks to the interoperability between technologies and systems it will be possible to enable new services and allow the automatic interaction between applications and their reuse. The acquisition of data and information is the key factor for the provision of a range of personalized services dedicated to the Ageing Society.
The digital architecture is conceived as a system composed by: a gateway that allows data to be acquired from a series of sensors located in the home and a central aggregator,

consisting of a software application capable of performing functions of gathering, aggregation and analyzing data provided by the network of monitored homes, in order to provide educational feedback to end-users.
The system will be able to monitor consumptions, the presence of users, the level of comfort and at the same time to send commands for the efficient home management even remotely. While the gateway will be able to transmit various information outside the home to an interactive platform, this last will be able to provide data available to external applications for further processing, including Assisted Living services. The requirements of the achieved system are: interoperability, reliability, strength, ease of use and interaction with the user, while the end-users interface of the platform is being defined according to user-friendly characteristics, such as: accessibility, adaptability, customization of services and solutions.
Users integration represents a central aspect of the research project, whose final goal is also that of verifying how it is possible to increase or improve the independence and make the elderly more active and productive, whereas their functional and cognitive skills make it possible. According to this user-centered design approach, based on the analysis about specific needs of older people, the research proposes a conceptual map, as a model for the construction of the IT platform based on the integration of ICT and IOT interoperable solutions in residential environments for the elderly. In this phase, different functionalities of the platform have been defined, in relation to six strategic areas (Active aging, Health, Social inclusion, Independence, Productivity and Safety), identified as potentially effective for achieving a high level of quality of life for the elderly, in the residential building, as in the urban space.

Ambient Assisted Living.
The experimentation of protected space
In the health and care facility of the "protected residence" smart solutions will be integrated and tested to support elderly guests and caregivers who will work alongside the facility management operators. Both those directly operating within the building complex and those from the outside that will be requested to provide facility management, social and health services.
In particular, the project will pay particular attention to the functional and technological upgrade of the residential complex for the elderly and will include the integration of a series of devices in the domestic environment useful to guarantee: an adequate level of indoor comfort (COM - Comfort); home security (SAE - Safety & Security); emergency detection and personal assistance (AAL - Assisted Living); energy management (NRG - Energy) for optimal use of available resources.
The research will also focus on the development of the residential nucleus, in

which the composition of indoor environments interacts with external spaces, through the integration of products and the inclusion of smart devices capable of enabling a range of innovative services for the elderly.
The building will be equipped with a BAS-Building Automation System and an ICS-Information Communication System, and it will be integrated with the AAL platform under development. The ICT system can be connected to the various operators and caregivers who will be involved in managing the service to guests. The secondary users that interact with the housing module are: nurses; doctor; facility manager.
Inside the housing module the bedroom and bathroom will be equipped with sensors and actuators, for example pertaining to the "sleeping" which allows the evaluation of sleep quality during the night, in order to detect abnormal conditions in the breath, heartbeat, movement in bed. To promote a better quality of sleep, the environmental quality conditions (eg temperature, relative humidity) and the level of light intensity present in the environment during the day and night will be monitored (see fig05).
The following devices will therefore be introduced for energy efficiency and quality of life:

- (COM - Comfort): brightly scenes; CO2 sensor; o/c window sensor; lighting sensor; shading actuator; temperature/humidity sensor;
- (SAE - Safety & Security): flood sensor; o/c door sensor; smoke sensor; transport card; water stop sensor;
- (AAL - Assisted Living): bed sensor; call bathroom; call room; emergency call receiver; incontinence sensor; path lights; pillow motion sensor; respiratory sensor; step control; vital parameters;
- (NRG - Energy): smart meter; smart plug; smart switch; smart valve (it allows adjustment of the internal environmental parameters such as temperature, humidity).

Conclusion

In a society that ages and progressively fragments its social, cultural and productive structure, each person points out fragile conditions, any time different according to their physical, social or working status.
The experimental project has the aim to represent a case study in the field for the pre-figuration of urban portions.
Through the definition of public spaces and semi-private spaces and the integration of ICT technologies, smart urban districts allow to improve living, working and relationship conditions to the people who live in those spaces, in a stable or episodic manner. Smart urban districts can mitigate the risks associated with the fragility of each, acting synergistically on the abilities that each person is able to put in place in an inclusive and shared environment.

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