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## **Innovative technologies for ancient cities: knowledge-based transition towards prosperity**

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**Abstract:** This paper discusses the way knowledge and innovation can support the performances' implementation in ancient cities. Assumption underlying the approach is that the construction sector, unlike others, is sensitive to evolutionary innovations rather than radical ones. The future of ancient cities, is inevitably linked with the ability to reinvent new behaviours for spaces and devices, with the design of transition technologies, able to fit within a built system, previously characterised by high degrees of rigidity. To support the theoretical analysis, the historic centre of Salerno has been assumed as a privileged case study. The paper shows how textures, monumental complexes and isolated buildings in the real estate market, can become new dynamos of development, enabling EU countries to maintain a strong position in the global economy.

**Keywords:** building technologies; innovation; ancient cities; collective spaces; knowledge-based transition; integration design; prosperity.

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**Biographical notes:** Serena Viola is a Researcher at the Università degli Studi di Napoli Federico II. Her recent scientific interests deal with technologies for preventing uncontrolled transformation processes, maintenance and recovery procedures for identity protection. The definition of recovery priorities supports the outlining of acceptability thresholds for design scenarios. Ascribing to buildings, squares, paths the role of mediators between different cultures and identities, she works to identify the contribution of architectural technology to support contemporary cities towards the creation of common grounds. In 2010, her research contribution has been selected to participate in the initiatives promoted by the Italian Ministry for Public Administration and Innovation in Shanghai World Expo 2010, Italy of Innovators, evidence of the technological excellence of our country, final design and prototyping of the 'vertical yard for building recovery'.

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## **1 Collective urban spaces' vulnerability**

Radical economic and social changes affect western cities, contributing, in recent decades, to implement the awareness of tangible and intangible risks. Different theoretical approaches and strategies have been provided, to analyse the vulnerability challenges referred to urban spaces, stressing on built qualities and environment evolutions, matching together development and preservation visions (Miller et al., 2010). The research carried out over the past years, concentrated upon the relationship between spaces, human agency and hazards. While the city, as a whole, tends to lose identity and suffers a slow washout of endogenous sedimented qualities, its spaces experience differential exposures to change processes. Being of stone, ancient cities express through architecture and urban places, the most enduring of the scriptures (Ferraris, 2012). However, they oppose a great strength to the seduction of homologation: in the era of globalisation, destructions, floods, earthquakes, violence, vandalism, theft, fire, deeply affect, metropolitan sites. Their vulnerability is thoroughly marked by factors as neglect, the ravages of time, standardisation, social change, intolerance, the disappearance of crafts, the disappearance of local traditions, and an inability to transmit the values and knowledge about the use of traditional materials.

In the disciplinary field of architectural technology, the vulnerability awareness derives from the recognition of the increasing transformations in cities and societies associated with the depletion of vital resources. In recent research experiences, collective sites have been taken as focal nodes for cross scalar scientific observations on the dynamics able to trigger and implement vulnerability, linked to the consequences of an ever-decreasing accessibility to basic resources: soil, water and air (Jébrak and Julien, 2008). Since ancient times, outdoor spaces formed the connective texture of a community, contributing through the distribution, morphology, materials, to return a trace of the local culture. Before the advent of globalisation, spaces of collective enjoyment formed the background of reference under which the creation and growth of a deep-rooted material culture, outlining societal values (Cunningham, 2011). According to recent studies, managing the transformation processes involving society and spaces, is assumed as a scientific commitment. Given the dynamic and variable nature of the stresses that make the city vulnerable, the architectural technology puts forward a cultural approach based on anticipation and active preservation (Caterina, 2012). A radical shift in built space management, supports the approach to elevate the concept of protection to a privileged means for innovation that overcomes the limits of physical areas, and involves creativity with new relations between social groups, cultural levels, triggering economic, technological and collective transformations (Landry, 2011). Condition for counteract the onset of vulnerability is the complementarity of knowledge, experience and expertise of various scientific domains, always implemented. Reconciling multi-scalar and multi-sector approaches, the paper brings into play an idea of the settlement as an interconnected system building-city-environment, where design scenarios arise from the complexity of the relationships between data, spaces and instances. With the help of a knowledge-oriented thinking, spaces and qualities can be protected and pass on to future generations. Combining the intrinsic and extrinsic limits that the ancient city opposes to dissipative processes, a knowledge approach can support the risk of loss reduction, coping, and adaptation. The paper refers about a pilot experience aimed to drive the change for spaces' structures and communities' relations. A knowledge-based approach supports the vulnerabilities' management experience, with a development and

preservation vision, enabled by a widespread collection and exchange of information, with the integration of applications, devices, and services.

## 2 Knowledge-based approach to manage new emergencies

During the last 20 years, the digital technology radically changed the operative context where companies and operators used to move. Computer science and electronics contributed to the definition of integrated services, including those relating to the built environment management. Progresses in the information and communication technology affected many areas of research related to the acquisition of knowledge for decision. Referring to heritage, technological innovations, until now, have been often relegated to activities connected to the lawsuits organisation, the costs' optimisation. Assuming as scientific basis Ruskin's idea of 'continuous care' for built heritage, a multidisciplinary research group, has been investigating the opportunities of applying knowledge-based approaches in collective spaces' preservation from new hazards. The cultural perspective moves from the idea that acquiring, processing and disseminating data can affect both the ordinary social and economic life, in cities, and emergency situations. A knowledge-based approach can drive cities' transition towards new prosperity, adopting knowledge to reinvent behaviours for spaces and devices, with the design of technologies, able to fit within material and immaterial vulnerabilities (Mason, 2006). From the Venice Charter (1964) that made reference to 'monuments and sites' and dealt with architectural heritage, the concept of heritage has expanded to include tangible and intangible entities in cultural landscape, highlighting the inter penetration of culture and nature. Referring to an anthropological approach, heritage has been identified with the social ensemble of many different, complexes and interdependent manifestations. For these reasons, a comprehensive approach was developed during the past decade, to give a better appreciation of landscape as a source of cultural identity, creativity and diversity. Under this perspective, knowledge is the driver of transformation. Extending the concept of settlement to any site, resulting from the combined effects of nature and human activities, the scientific community is committed for public spaces to take the role of harmonisation levers supporting the nurturing of shared values and attitudes. The future of ancient cities, is inevitably linked with a cross knowledge aimed to re-balance the environmental, economic, social and cultural dimensions. Three main ideas inform it:

- *The heritage of yesterday is the base to build the heritage of tomorrow.* Its survival calls into question, at the beginning of the third millennium, the foundational logic of interaction between anthroposphere, biosphere and technosphere (Matsumura, 2007).
- *History is the most powerful factor in shaping identities.* Urban collective spaces have never been evolving in a constant way, as the needs of the societies that inhabited them have been changing over time. Among many, one of the factors that has impacted more significantly on built environment, was the use of energy resources (Rifkin, 2002).
- *Time is at work gradually transforming spaces and societies.* Systems, age, structure, habits and traditions, activities have been the main aspects influencing changes in built environment. The ongoing challenge is today to find ways in which negative impacts can be managed.

Not the density, but the quality of architecture and construction, and the multiplicity of functions and proximity can produce the levers with which the process of technological change can be initiated. Anticipating processes can contribute with unconventional visions to urban landscape evolution towards more sustainable forms of development, lower consumption and waste of resources.

Achieving a new equilibrium between the dissipative processes has been assumed as one of the main focuses in a pilot technological experience aimed at saving resources, reducing environmental burdens, improving the quality of life, taking into account the evolution in energy production and use that marked public and private spaces. An experimentation on the residential settlement introduces a vision of transitional technology, informed to saving water resources, reducing environmental loads, and driving wastes' dispersal. Eliminating and saving are the imperatives that lead to the redesign of a set of adaptive solutions through trans-scalar approaches, linking the experience of technology transfer for a single device to an urban network. Citizens and technicians assume an active role in data collection, with the help of an information platform able to support the interaction among local and meta-local information, expert and common knowledge. The knowledge-based approach allows to build relationships between environmental parameters and the built system, through the establishment of procedures for data organisation in order to suggest the development of compatible scenarios.

### **3 Pilot laboratory for the ancient city centre of Salerno**

Situated at the north-western end of the plane of the Sele river, at the exact beginning of the Amalfi coast, the old town of Salerno developed within the range between Bonadei mountains and the sea, since the time of the Roman foundation, satisfying the constraints imposed by the presence and location near the port. Like many Italian city centres, Salerno grew up on itself over the centuries, stretched to the maximum exploitation of public and private areas, which reached the highest levels with the dense system of *streetule*, rich in historical memory and iconography. The small size of the road sections and the lack of parking spaces, is at the same time, one of the main causes of buildings and spaces' deteriorations, and the most significant limitation on the design of recovery solutions.

Adopting the centre of Salerno as the case study, the research prefigures the development of a 'network approach' to the circularisation of technological processes. The search introduces a critical re-proposition for city centres, in terms of logistics, procedures of control, tools, based upon the idea that built environment can be assumed as a permanent yard. A pilot laboratory for vulnerability detection, reduction of consumption and waste has been designed with the aim of combining technicians from the superintendency, the municipality, the construction companies, with university researchers. The pilot laboratory is conceived like a cross-sectional structure between the agencies for heritage protection (university, regions, supervising, municipalities...), strategic occasion for centralisation of material and immaterial knowledge, human resources, financial institutions. A coordination service integrates structured information, technical know-how, strategic and management abilities between all the involved partners. The determination of dialogue and concentration modalities between heritage management and protection agencies is assumed as the priority request that informs the

lab. It is involved in the acquisition of the out coming data, and in the elaboration of design scenarios for each singular courtyard based on the monitored data. The laboratory is designed with the following aims:

- to put to point a process of control for the dissipative processes realised in each building, recording all the sensitive data necessary in order to acquire a degree of meaningful acquaintance of the state of processes
- to manage through data banks, a cross sectorial knowledge about gains and losses
- to identify the vulnerabilities' evolution
- to characterise the technological priorities and the modalities of intervention to a short and medium period
- to activate protocols of communication between protection agencies.

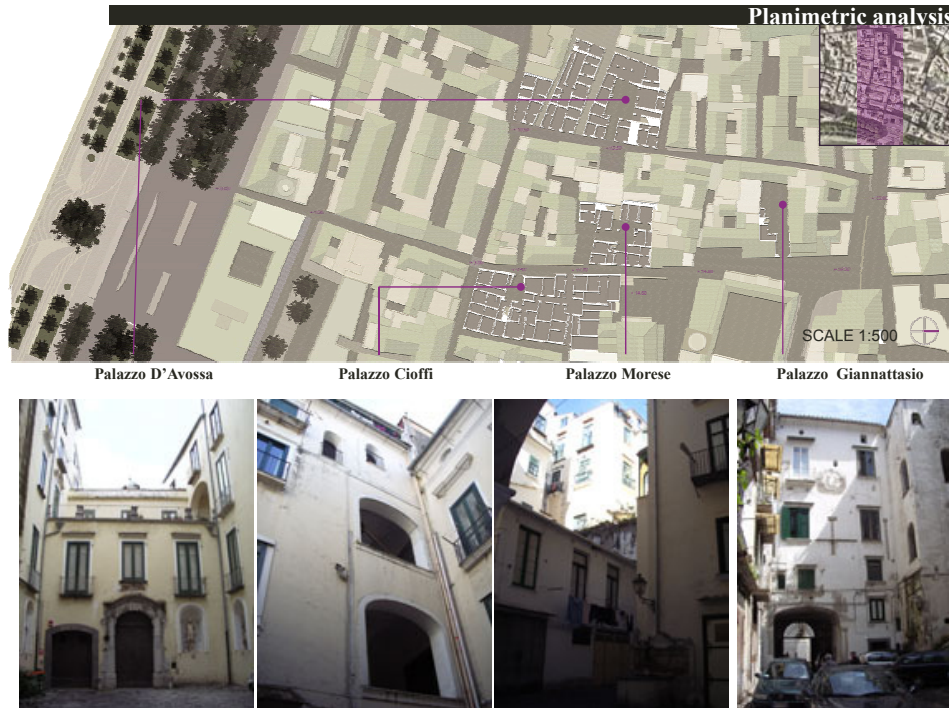
The laboratory is conceived as a fundamental opportunity for facing the challenges related to the pre-figuration of innovative strategies at architectonic and environmental scales. The predisposition of a net of monitoring for the control over the state conditions, transforms the built environment into a connected system, equipped of sensibility, intelligent, reactive, guaranteeing very low costs to control. After years of partial matches, through the pre-figuration of an information system for built heritage maintenance, knowledge is called into play thanks to the potential offered by visual communication, interactivity, connection. The ancient city centre becomes an engine of innovation and diffusion of culture, a place where the advancement of knowledge and human skill materialises and incorporates database technologies, supports decisions, networking technologies, space's identification, tracking technologies, and office and multimedia systems. An ever-growing array of tools and devices can support the organisation of the knowledge-based system: information referred to waste and consumed resources, and to technologies to be integrated for a new urban metabolism. The physical, social and economic context, completes the description and the representation of relationships. Figure 1 offers some descriptive of the network approach adopted to collect data. Assembling, analysing, storing and distributing information with the support of devices and sensors for spaces' analysis, control, surveillance, communication, is supposed to revolution the internal workings and the external relationships, in built heritage management, enabling new ways of access to past evidence.

As showed in Figure 2 recording, modelling, visualising, interpreting are the main axis along which knowledge-based systems can serve as an aid to management processes.

The laboratory efforts related to the European communitarian politics for the next decade, promote scientific innovation through "... new methods of production, supplying and distribution; the introduction of changes to the management, the organization and the conditions of job, in the qualifications of the workers". According to the European guidelines of the knowledge-based society, rethinking technologies' integration for built heritage calls in a cause the reorganisation of the activities of control, inspection, participation, through the redesign of tools and procedures. Taking into account the characters of identity, the search faces integrability procedural difficulties, tied to elements' complexity and the absence of information in terms of reliability and durability. The concept of integration is grounded in the awareness that technological innovation can have a profound effect upon the existence of each of us every day, on our way to 'live', to relate to others, and thus the shape of physical and social places. The link

between building settlement, environment and technological innovation are undeniable, but it is highly unbalanced due to the differences in times of transformation.

**Figure 1** Planimetric analysis: sizes, morphologies (see online version for colours)



As showed in Figure 3, the idea of technologies' integrability is declined in relation to the potential transition of the settlement system towards innovation. The concept of integration, referred to the use of new technologies into existing systems allows to redirect the current operational practice, fragmented and undifferentiated, to actions based upon the respect and promotion of local diversity. In the context of Salerno, the courtyards are the connective texture of the community. In the succession of decades, the courts, like other collective spaces have taken over the role as drivers unaware of social harmonisation, strengthening the initial ability to create synergies between the natural and the man-made environment. Designed to accommodate people and activities, courtyards become common grounds, suitable to recovery actions. The aim of the lab is to create spaces that optimise the use of environmental resources, comfortable, with a level of quality of life appropriate to the contemporary standards. To this end, the research group assumes the introduction of additional plant facilities located within the individual accommodation and communal areas of the court (Bongers, 2006). The attitude to promote a new vision for urban prosperity informs the definition of active preservation scenarios, putting forward technical procedures of renewal, substitution and integration, with the aim of captivate users, strengthening interests, attracting investments. To this purpose, a great effort has been made by the pilot experience with the aim to abandon the shy recall of an ancient image, to focus contributes on the environmental qualities of spaces, emphasising green areas, materials and technologies. An advanced search of

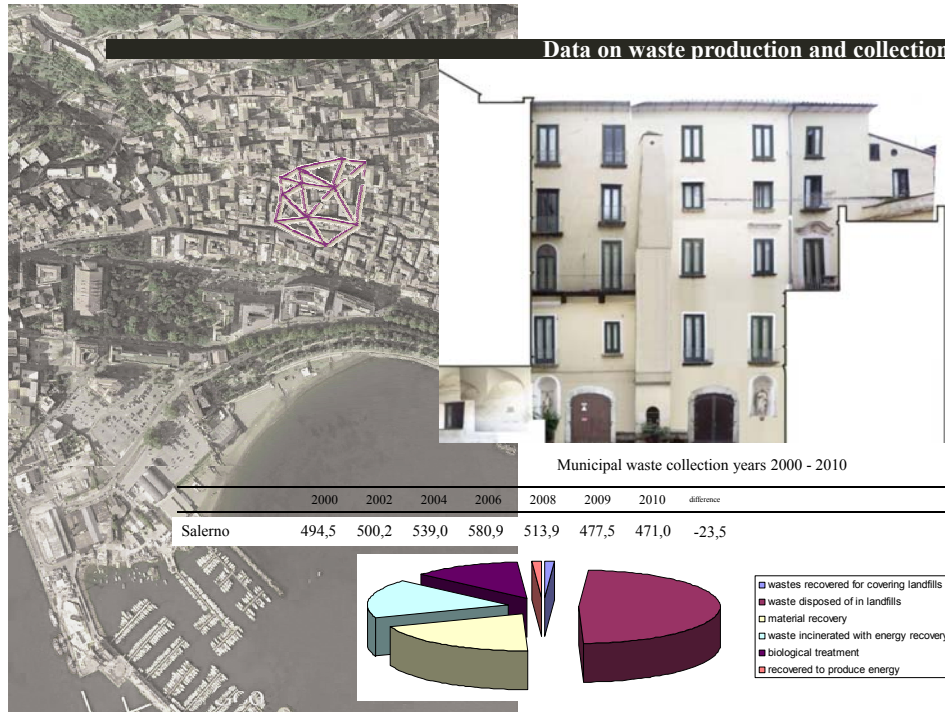
coherence between past and present arrangements, has been informing the solutions at the urban and environmental scales, focusing on pollutants' emissions adaptation, working on pedestrianism, bicycle uses, bio-compatibility of materials.

**Figure 2** The historical reconstruction of the urban plant and its impacts (see online version for colours)



As for organic waste and waste waters, the draft outlines alternative solutions, by comparing the efficiency of new technologies with the spatial characterisation and material of existing buildings. For example, for the collective treatment of waste products, the design takes into account both the question of the location and dimensioning of spaces' onsite storage, whereas the control of emissions and the reduction of energy waste (Sakamura, 2006). Taking into account a technological scenario, elaborated according to the Philips Design Probes programme presented in Eindhoven in 2011, the lab works on the hypothesis of a conceptual self-sufficient home that converts sewage and rubbish into power. The investigated solutions envisage the use of a special compartment located below the floor of the kitchen of each apartment for organic waste, to be transferred to a tank located in the courtyard of the building. The waste water in each bath, properly treated, is reused as water recycling for a variety of purposes, including irrigation of the green. This process of waste treatment generates various benefits such as a complete collection and disposal, sewage effluent reduction, less consumption of water and heat recovery.

**Figure 3** Data on waste production and collection (see online version for colours)



Under these technological approaches, each environmental unit of the ancient city of Salerno becomes an autopoietic and propulsive cell of metabolic conversion for the whole urban tissue, though devoted tasks that support the creation of new connections between spatial units. In this way, each courtyard opens to the circularisation of the urban metabolism. An unusual vision connotes, building after building, the ancient city centre, from a block to neighbourhood scale with the prospect of energetic and social interaction. The penetration of a unused way of technological thinking is related to the flexibility of the components with which the city is equipped for the transition to brand new types of logic, that continually redefines itself and within itself sustains and reproduces. The issue of flexibility is one of the greatest areas of innovation in response to changing needs, and it contrasts strongly with the design concept that informs the rethinking of technical devices for use in buildings and ancient spaces. Flexibility provides the ability to anticipate these changes and metabolises in the design process, thereby providing a reasonable rate of transformation over time while preserving the city's values.

Gradually, transforming these spaces, the design provides answers to the imperative of flexibility of uses, the selected courtyards share the attention from clients and designers, towards the promotion of multipurpose environments, viable under different microclimatic safely, easily. Offering more than one solution to help balance everyone's needs and recognising that one solution may not work for all, the laboratory commitment has been orienting the requirements' definition to the implementation of transit and pause spaces, adopting devoted separation, service, furnish elements, greenery. These experiences capitalise on building design, scale, architecture, and proportionality to host



multiple activities, to promote community involvement, to protect, and enhance the environment and natural features.

Respect of the instances of reciprocity, connotes any choice managing distribution, morphologies, finishes, textures, constructive qualities, in order to control and limit interpersonal interactions, by reducing the visual impact, noise, smell. Courtyards are solved ensuring the need for privacy of members from different communities that form the context, supporting body contact, posture, visibility, silence. The design choices contrast the concepts of physical intrusion, auditory and olfactory, defined differently in every culture. Not altering the urban landscape essential features according to usability requirements, spaces are conceived with the aim of remarking built environment texture, with their typological and morphologic characters, preserving and promoting historical traces, respecting paths and boundaries. Their original genesis and consequent transformation have been therefore respected, showing shapes and distributions coherent with initial features and formative rules. Irregularities and discontinuities are submitted to distributive, dimensional and material choices. Interactivity is at the basis for the decision process aimed at the definition of a system of external and internal constraints able to orientate the final design choices. Constraints proposed by the design team, are shared with the qualified administration. Constraints are conceived as sort of forces opposing to transformation efforts, in order to balance the relationship conservation/transformation. The stronger the bond, minor are the chances of transformation.

The lab team takes into account all the impacts in terms of involved stakeholders, analysing the social physical environmental consequences, in order to outline propitious and adverse involvements. A critical map of the actors involved at any level, in the renewal project, supports the design with the continuous, open and structured dialogue. Modelling alternative solutions and relapses is the privileged method of working with stakeholders; an integrative negotiation approach drives the conflicts' solution. Communication, commitment and cooperation are the steps that enable shared choices, linking together requirement's definition. A critical map of the actors' attitudes is traced at the end of the decisional phase. It helps in outlining the customer's expectations and needs, comparing it with the design team consciousness on urban areas' performances and compatibilities. Design arrangements are oriented to grant compatibility between traditional performances and new vocations with the help of solutions that take into account the courtyards' morphology and geometry. Finally, design attributes priority to the circularisation of the technological processes, focusing on places' pleasantness and welcoming.

#### **4 Conclusions**

Collective spaces are the underlying armatures of societies, a physical, economic, social framework that supports the creation and growth of local shared identities. On the threshold of the third millennium, spaces are complex, dynamic and adaptive systems, generators of knowledge essential in the global competition.

The penetration of a brand new technological thought to unused ways of acquiring, managing and exchanging information, constitutes the scene of reference in which delineating the new concept for prosperity. Innovations are at the core of all economic processes, they help transforming the urban space implementing connectivity or proximity and distance, linking levels of tolerable emergency with recovery strategies.

Thanks to a knowledge-based approach, ancient city centres can be regenerated to overcome beyond the causes at the origin of the irrepressible weakening of public sites, returning to the foundational concept of the polis in the ancient age. In a scenario where squares and streets lose their functions, prosperity becomes the final aim of an innovative process based on re-thinking areas' hierarchies, relations and performances. Technological innovation brings to the city different types of benefits: reviving and sustaining the social economy, changing social relation, reinforcing existing, or creating new institutions for improved urban management and governance. In a prosperity perspective, ancient cities through innovations facilitate equitable access to the commons', water, air, biodiversity, knowledge, encourage social diversity and mixed spaces' uses. Active protection as combination of ancient qualities and new requirements has been adopted in the observed courtyards as the holistic approach to redefine prosperity perspectives. Expressing of obligation bylaws, regulations, and persuasion, it aimed at giving back assets to communities, mending the time/space tears throughout the creation of vibrant and healthy spaces. In this design vision, active protection has been therefore the foundation for enhancing a new and strong identity. Over passing any idea of external imposed boundaries, heritage protection has been directly related to the values recognised in built and inbuilt spaces. A place is not part of heritage of its self, but it becomes so, via the meanings that the community ascribes to it. In the laboratory for the ancient city centre of Salerno, the society has been therefore asked to take part in the recognition of the essential aspects of its heritage through debates. Assuming landscape identity as the sharing texture, a new design approach has been put into concrete form with the combination of development, valorisation, awareness, ownership, saving, managing. Transparency and accountability have been the main requirements in the awareness raising initiatives. Ensuring the physical and economic accessibility to sites was the condition that enabled equilibrium between private and public interests: At the same time, active protection meant not 'freezing sites in time' applying predefined and consolidated technologies. Architectural design is assumed to be one of the major catalysts for contemporary cities' physical, social and economic transition towards new scenarios, providing that communities are involved in this guided changeover. The definition of concentration disciplined steps can support final solutions and customers built environment acceptance. Outdoor courtyards promotion becomes the privileged occasion for giving dignity to marginal assets in the urban structure.

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