SMART RE-CYCLE RECYCLING STRATEGIES FOR ARCHITECTURES AND CITIES

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Abstract

The recycling of different forms of architectural buildings within the settlement areas and buildings that appear to be waste (Berger, 2006; Koolhaas, 2006) are produced unintentionally (Clement, 2008; Bauman, 2005) by the transformations of the city (Lynch, 1992; Price, 2003). The presence of numerous abandoned or being abandoned buildings and urban equipment structures - architecture and engineering products - is not occasional, but a structural factor of the form of urbanism that characterizes the contemporary city.

This research aims to take action on the effects of this dynamic, partly physiologically, for the internal migration of residences or other facilities and, for buildings and building materials, there is currently no programming life cycle, or recycling and design of these wastes (McDonough, Braungart, 2002). The aim of the research will be the recycling of these areas, and architectural objects, considering them as parts of new building structures, new architectures for new functions. There are significant instances of entire urban complexes that have completed their life cycle compared to the function for which they were constructed and compared to the environmental and energy sustainability. For this heritage building in the process of obsolescence, the research will study the strategies and tactics to turn new dynamics through integrated sustainable projects (Brundtland, 1987; Horizon, 2020). New functions in the urban context and the legislative overhaul of inefficient buildings will be an occasion to test, in a second phase, the complete recycling of buildings and their spaces belonging to the scene of daily life (De Certeau, 1990) that can be reinterpreted through their new configurations.

Keywords: Smart City, Re-cycling Strategies, Urban Design, Re-active Architecture, Re-load territory

1. Introduction

This paper aims to present some considerations, part of a research in progress[1], on architecture's role as a tool of investigation, knowledge and design of the city (Cf. to the urban design of Italian origin: Samonà, 1959; Rossi, 1966; Gregotti, 1966; Quaroni, 1967), as *outil* to interpret the dynamics of current and future transformation, or potential, in view of their intensification in time of economical, social and environmental crisis, and to prefigure sustainable futures for the territories of the contemporary world (Brundtland, 1987).

To act on the city is the most important element of the growth strategy EUROPE 2020 - smart, sustainable and inclusive (Horizon 2020) - where the urban environment (*Smart City*) is qualified as a system aimed to improving the life quality of citizens and communities (*Smart Communities*), a place for testing the convergence of economic, environmental and social sustainability through new "integrated urban projects" able to "re-activate the urban capitals under-used or expelled from other uses" (Horizon 2020) to re-enter them in new "life cycles" (O'Rand, Krecker, 1990; McDonough, Braungart, 2002).

The territories of the European city are an "artifact-city" (Abalos, 2010) that appears as a conglomeration of natural and artificial elements, physical and immaterial flows, a "porous and fibrous" (Secchi, Viganò, 2011) collection of heterogeneous elements. This artifact is characterized by smaller areas, dense and laden with memory, and vast diluted areas, with lacking qualities, that have broken the link with the precision of traditional boundaries between nature and artifice, city and countryside, urban and rural.

The object of this research is the city grown in the last fifty years, rapidly and disorderly, around the historic centers of small and/or medium sizes urban conglomerations (i.e. less than 50.000 inhabitants, VV.AA., 2006). These are urban areas of recent development, "widespread dust" characterized by the dispersion and low density building, the progressive reduction of agricultural areas and land consumption, the dependency on cars due to the increased territorial extension of the urban fabric (EEA, 2006). An "ordinary" built environment (De Certeau, 1984; Perec, 1994) identifies this type of city made of isolated houses on a lot, commercial and industrial warehouses, interspersed with open residual spaces and dense infrastructural textures, which include the places of history and identity. In Europe, about the 50% of population lives here[2].

In Italy, 20 million people live in the "widespread city" of the Po Valley, as many as are the inhabitants of Bombay, which cover 20 km on average per day (in 1980 these were 10) and 16.000 km per year (twice as many as in 1980) of urban and sub-urban area of 30.000 sq km (with a density of 650 inhabitants per km) equal to a quarter of Northern Italy (EEA, 2006).

Here, like in other European territories, the presence of abandoned, semi abandoned buildings and urban structures, or to which a next disposal is expected, it is a physiological element (Augé, 2004; Berger, 2006; Koolhaas, 2006). On the one hand, it is a dynamic process due to

internal migration to other sites and/or technological obsolescence of the production artifacts (Casali, Built Event, Gsaller, Lulaj, 2008). On the other hand, it depends on a surplus of buildings due to a decline in the demand for residential and commercial buildings (Lanzani, Zanfi, 2010) corresponding to a general state of underdevelopment and contraction - "shrinking cities" - rather than a real decline in the population (Aber, 2009).

A new cycle of "shrinkage" (Latouche, 2007) is taking place: in addition to the dynamics of urban growth - which is paving the way for new residues - is emerging the gradual underuse of urban space and its widespread emptying. It is a problem of space as "shrinking" (Oswalt, Cantz, 2005) in the uses of existing spaces, mostly related to the practices of production and commerce, and to their problematic management and re-use.

The urban spaces discarded, underused or useless because obsolete, empty or residual, the peripheral areas are, therefore, a design resource which can be used to revitalize parts of the city in order not to exhaust the potential of other lands (Clément, 2008).

The idea of recycling, understood as a strategy to re-use, re-generate, re-qualify the already built, is connected with the architectural concept of residue (Solà-Morales, 1995; Clement, 2008; Berger, 2006) - existing and potential - that each generation produces, and implicitly contains the positive value of evolution, as a repository of opportunities for change into a new entity that is of social and economic use (Latouche, 2007).

The re-cycling theories and practices refer to a recent interdisciplinary literature. The term re-cycling enters the language of technicians and researchers of different backgrounds only in the last decade, despite it had been sporadically used since the early seventies of the twentieth century (Smithson, 1967; Fuller, 1968).

The term "re-cycling/re-making" (McDonough, Braungart, 2002) indicates a repetition, a dynamic process, a movement in the opposite direction or a return to a previous state; re-cycling is the program able to re-use a material entity previously rejected or to design forever usable objects through continuous processes of transformation.

The act of "recycling" (Prigogine, Stengers, 1979; McHarg, 1992) concerns the regeneration and requalification, such as the action to put up with the times and/or to provide new or better skills/efficiency to an obsolete material entity.

Therefore, re-cycling does not involve the recovery of some objects in their original form, but it is to give new value and meaning to residual materials (Lynch, 1992) who lost their function, role and/or significance. The architecture and the city were always recycled: the palace of Spalato, the Theatre of Marcello in Rome or the Duomo of Syracuse are some of the historical examples. It is not a restoration, that tends to embalm an architectural or urban image, but a transformation, a process of construction and re-construction with/and on what is already there. (Abalos, Herreros, 2000). The contemporary innovative aspect is to consider strategic the policy of sustainable urban design: at the scale of the city, "part of city", urbanized territory.

2. Urban recycling strategies

The recycling strategies in urban design, are linked to the following themes:

1. The re-cycling in the construction of materials produced or derived from recycling processes or objects recovered from wastes and then adapted with minimal changes (Lynch, 1990; Price, 2003). The several sociological studies applied to the problem of urban waste in American cities (Davis, 1994; Chamoisea, 1998) and the ecological interpretations of the environmental system (Sachs, 2003) look at the re-cycling processes of nature such as a metabolic strategies that can be artificially recreated.

2. The re-cycle of the existing, opportunely transformed and adapted to the purpose, into a more complex and articulate spatial configuration, by fitting together heterogeneous pieces. The theme of the "wastescapes/drossscapes" production and dissemination (Berger, 2006) is investigated as a pervasive system of territory and urban fabric. The anthropological field considers waste materials used to recycle all those contemporary entities where there is the irrelevance of the interaction, "buffers places" (Bauman, 2005) perceived as inhospitable because they inspire submission and discourage the permanence, "technical spaces" and "junk spaces" (Koolhaas, 2006) not built for living but to produce or operate a territory, "empty places" inaccessible and invisible, to which is not given any meaning (Kostera, Kociatkiewicz, 1999).

3. The re-cycling of the interstitial or abandoned spaces of the contemporary city by the new architectural bodies, temporary or not, and recycling of geographical and environmental structures that persist such as the key elements in the urbanized territory (Bélanger, 2009). Research about the "third landscape" and "abandoned waste of an area previously used" (Clement, 2008), introduce precious "reserves" suspended between a previous use and a not yet re-functionalization, structural "frames" of Nature in the city (Secchi, Viganò, 2011).

4. The re-cycling of the discarded or underused spaces of mobility - infrastructures, service and railway stations, ports, airports, intermodal hubs, highways, subways and tramways, urban and suburban roads - into a complex structures, widespread and multi-functional, to re-organized the functional hierarchies (Lanzani, Zanfi, 2010) and to develop an integrated transport in relationships with the urban transformations (ISPRA-ATAP, 2010) the potential of crossing city-territories, to their re-newing as urban catalysts (IENE Infra Eco Network Europe, Dinetti, 2000)

In recent years, the consolidation of a reflection on architectural re-cycling (Ciorra, Marini, 2011) has led to the development of a vast repertory of ideas and projects.

The different approaches to singular objects and/or residual spaces of the city are related to the reconfiguration of existing volumes by actions of addition/subtraction (B. Tschumi, *Le Fresnoy*, Francia 1997; Z. Hadid, *Spittelau Housing*, Vienna 2005; Alsop Architects, *Sharp*

Centre, Toronto 2004; UNStudio, *Bunker Te House*, Olanda 2006), the modification of existing shells by actions of opening/closing/ technological optimization (Lacaton&Vassal, *PLUS Housing*, France 2004; F. Schluter, *Wohlfahrt-Laymann house*, Oberursel 2010; MVRDV, *Frosilo Gemini*, Copenhagen 2005), the introduction of new "parasite" bodies in existing buildings (Luderwaldt Verhoff, *Neo Leo Vertical Living*, Colonia 2005; Stefan Eberstadt, *Rucksack House*, Leipzig 2004; Korteknie&Stuhlmacher, Las Palmas Parasite, Rotterdam 2001; Lang&Baumann, *Hotel Everland*, Leipzig 2007), the temporary occupation of residual spaces (Atelier d'Architecture Autogerée, *Eco-Interstice*, Paris 2011; Assemble, *The Cineroleum*, London 2010; Collectif ETC, *Place au chanhement*, Saint-Etienne 2011), and the colonization by micro-architectures of residual spaces (Ecosistema Urbano, *Eco Boulevard*, Madrid 2006; Karo Architekten, *Open air Library*, Germany 2009; NOX-Architekten, *D- Tower*, Netherlands 2003).

The approaches that use re-cycling as an integrated urban strategy, able to produce a significant gap in the history of a city or territory, are attentive to the "ecological rationality" which makes of objects and spaces to recycle a "geographical subject" (Albrecht, 2012; Secchi, Viganò, 2011).

Pioneer of this approach is the project *Potteries Thinkbelt* by C. Price (1964) in Staffordshire, in which the new city-university is not only a building, but rather an architecture of relations, a moving network that reuses the dismantled structures of the ceramic industry of the declining valley and the existing railway system [3].

Similarly, the residual and obsolete spaces of abandoned infrastructures become the "backbone" of the urban transformation envisaged in the *High Line* project by J. Corner (2010) in New York. The recovery of the elevated rail line to a linear park activated the urban regeneration of a whole city-parts by restructuring the density, compensatory transfers of building surface and morphological rules of adjacent construction to the new linear park in environmental key, featuring some "poles" and hierarchising residential and tertiary interventions.

The prefiguration of the city's future is underlying the project *Agropolis* by J. Schröder (2008) for Munich 2030 in which the design strategy sets the rationale of metropolitan development beside the occupation in progress of spaces while awaiting new buildings, with agricultural areas for the production of food situated right inside the city. It is a social policy that focuses on the quality of food and the lives of the citizens, that takes into consideration rural nature as well as an aging population and the job crisis. But it is also a geographical-scale strategy that redefines image and overall urban quality through the redesign and governance of the city's open spaces.

In the *Multiramblas* project by Barcelona Gausa-Raveau (2010) the dense city of Barcelona gets re-cycled at the urban scale with synergic actions of re-cycling for the urban fabric of the Plan Cerdà. The intervention concept regards the adoption of an analogue scheme to that of GATPAC-Le Corbusier which allows the traffic flow to function on a 3x3 bloc matrix, instead

of a 1x1 bloc one. Inside this super-quadra the roads are recycled as public space, green areas, urban farming.

The approach is geographical and multidisciplinary also in the project *Grand Paris* by Secchi-Viganò (2011). Primarily, design is a tool for acquiring knowledge about the metropolitan area's contemporary problems linking the rise of social inequality and spatial forms of injustice, to the environmental crisis and the mobility. The design strategy is the architecture of a new "porous city, isotropic and permeable", dense with important places, whose design born by current and potential residual spaces that each generation bequeaths. The "porous city" re-lives the perimeters, re-builds the *mixité* on the open space's limits to activated its reuse, and it gives space to ecological networks and green space next to water traced by highly structuring paths in the existing tissues. The strategic areas to re-cycle are the industrial/commercial ones identified such as "potential dross".

In Italy the national initiative RI.U.SO. presented at FESTARCH[4] aims to promote the cultural, social and economic transformation and enhancement of cities by re-cycling the obsolete housing stock, proposing itself to contribute to the "City Plan, for the sustainable urban renewal 2012", program for the Italian cities and urban areas.

3. A case-study in the Italian province of Udine

Starting from this review of the most significant international project experiences, similar in scale and methodologies, this research has been experimentally applied to a real area-study.

3.1 The commercial street

The survey area is the territory of Tavagnacco, in the Friuli-Venezia-Giulia Region in Northern Italy, a territory of 15.000 pop. located near the city of Udine (100.000 pop.) to which it forms a single and continuous urban area (Marcialis, Grandinetti, 1979). This territory plays an important role due to the presence of an high infrastructural level, logistics nodes of connection with the big national and international networks, an high accessibility accentuated by the near highway-gate, widespread urban services where the quality of life is perceived as better than in other areas.

The widespread urban agglomeration is the most evident aspect of this territory. In the last sixty years urbanization has intensified producing the typical city-territory that characterizes urban sprawl in Northern Italy. Around small to very small size historical centres , occupying vast portions of farmland and agricultural areas, it produced a continuous "weld" between urban (52%) and landlocked open space (48%).

In this context, at the moment the space occupied by the commercial and production activities is 11% of territory (1.707.968 square meters). The key aspect is the location of these activities

along the commercial street, connecting Udine to the north of the regional territories and the national border, for about 10 km. This led to the development of a commercial artery called Tresemane, both infrastructural and productive, that constitutes the most recognizable element of the area, both at regional and international levels[5].

At present the Tresemane artery, apparently close to saturation and in which the commercial expansion phase is completed, is composed by:

1. the commercial front, continuous but inhomogeneous in the character of settlements;

2. the rear with mixed residential areas and/or big production building;

3. the cross connections between the two main areas, with mixed commercial and production uses.

The commercial street has always been an impassable barrier, a road infrastructure in which successive volumes constructed (warehouses) fallow areas and unused agricultural fields, forecourts, parking lots, etc., "vagues terrains" (Solà-Morales, 1995) that create distance and generate situations of spatial injustice. Today, for their partial abandonment, underutilization or obsolescence, there are critical elements of residual (Berger, 2006), current and potential of this area.

The economic crisis and the changes in relationships between dynamics of production and spaces of work, which has accelerated and made more manifest the process of the domestic manufacturing reorganization, even here will produce a deeply altered settlement situation.

To the contraction in demand for prefabricated warehouses with medium surface (700-1000 square meters) - in favor of smaller or larger types of spaces, functional and less expensive for artisans with fewer employees, or with upper quality and environmental standards for advanced tertiary activities (Digital Technology District) - is added the critical nature of this area related to the commercial cars monofunctionality.

The future need for reduction of energy consumption will have effects on mobility, accelerating social segregation by reducing trips - virtual mobility, de-materialization, e-commerce, shared workspaces, etc. - towards the most active walking, cycling or efficient public transport, etc.: the commercial street, conceived for cars and shopping centers, will require to be completely rethought. The residual spaces, existing and potential, will have to be recycled.

3.2 Re-load the [on]production territory

The experimental research in progress is concerned with the formulation of integrated design strategies aimed, at the urban scale, to upgrade the survey area for its sustainable future and

improve the lives of the people, by considering environmental aspects, the decrease in energy consumption, contrast of social inequality and mobility. The identified strategies are:

1. the re-cycling of the commercial/artisan artifacts, of small and medium size, in order to optimize energy consumption, integration of new functions, functional *mixité* and reduction of ecological and environmental footprints, by grafting new activities and new connections, new green and habitable roofs, new home-work units, recomposition of technological casing, use of renewable-sources energy;

2. the re-cycling of the productive tissues, in-between areas and obsolete services, to densify some parts by inserting new architectural bodies in welding of the discontinuous fronts, increasing the volumes above, beside, behind, or to thin out some other parts by process of re-naturalization or reuse for urban agricultural production;

3. the re-cycling of the infrastructure, roads, service squares and parking lots, congested river networks, so as to become green reinforcements, linear parks, water infrastructures, porous soils with diffuse facilities, such as stops in public spaces, doors of new multifunctional system transports.

The architectonic actions of addition/subtraction are oriented to experiment volumetric hybrid formulas of residence, work, leisure, through techniques of "adaptive reuse"[5] (Latham 2000). Adaptive re-use that refers to the formula "Small Office, Home Office" or the historical residence-workshop-retail space, and to the re-functionalization processes to share in a synergistic way activities and answers to their needs, such as co-housing and co-working defined "Creative Communities" (Florida, 2002). The artisan-commercial spaces are inside rearranged by assuming scenarios where two or more companies choose to live together under one roof or small business incubation and high-tech clusters share common services and facilities designed by densification in adherence between two or more existing buildings (MVRDV, 2005; Gruentuch, Almut, 2006). These adaptive reuses provide functional *mixité*, housing and social housing projects (Fernández Per, Arpa, 2007) based on innovative environmentally friendly techniques (IaaC, 2006) and new forms of social integration in order to contrast the housing discomfort of the "grey population stripe" - singles, young families, seniors, immigrants - whose buying power continues to decrease (VV.AA., 2007).

The modification of existing casings through actions of opening/closing/ technological optimization (Lacaton&Vassal, 2004) aims to reconfigure the image of construction faces and to improve the performance and energy efficiency by working on/with: thermal isolation, passive systems, solar greenhouses, harvesting rainwater, etc.; retrofitting operations (Dunham-Jones E., Williamson J., 2008) aim to the integration of architectural organisms and plants at different scales, from the re-vegetation of walls facades and building systems through "vertical green" (Blanc, 2008) to the urban re-naturalization (Despommier, 2010; Boeri, 2011).

To the densification, of the volumes in the most compromised places by formal and functional re-composition of territorial recognizable figures in the urban continuum, corresponds the re-naturalization of some in-between and residual spaces such as effective ecological infrastructure at the urban and geographical scale by remediation and deconstruction (Lim, Liu, 2010) and insertions of new forms of urban agriculture (White, Przybylski, 2010) and organic gardens for food independence and direct sales of products in excess (Andraos, Wood, Maas, Haeg, 2010).

Artificial soils become new playgrounds for the storage and drainage of water or wetlands, in line with the recent experimentations of "playground" (Topotek, 2006) and "new topographies" (Aymonino, Mosco, 2006). The asphalt road, oversized on the private transport, becomes the frame of a sustainable mobility (car sharing, eco cars, public transports, bicycle paths, pedestrian zones, Cf. Forman, Sperling, 2003) which cross the new system of open space returned to the community, the architecture of a large linear park, structure of the entire urban strategy (VV.AA., 2010; Dinetti, 2000).

4. Conclusion

This paper has analyzed the role of re-cycling in the urban design practice as a tool for understanding and operating the sustainable transformation of contemporary cities and territories. For the city-territory characterized by "ordinary" built environment, without particular architectonic quality and whit different current and future problems, the architectural project is considered a necessary element to address in an integrated way the sustainable regeneration of the built environment at a time of economical, social and environmental crisis.

This article has suggested how the theme of architectural and urbanism re-cycle is extremely topical, based on international research and projectual experience. In particular, it has highlighted how the most recent and innovative theories and design practices for the city, architecture, territory are those which what view the policy of "smart" recycling as a strategic asset. This is the thesis that has been formulated and that is subject to verification in this research in progress.

The first results of the applied experimentation to the case study Tavagnacco have investigated the phenomenon of the abandonment, disposal, under-utilization of objects and spaces of production and commerce. Hypotheses of the future abandonments related to e-commerce and changes of the mobility dynamics are formulated. Possible scenarios of re-programmed cycle time, where the potential residual elements still in use become the opportunity to design sustainable transformations in the long time, have been outlined.

Due to the complexity of the case study (territorial extension, critical economical and environmental factors, strong monofunctionality linked to car commerce, etc.) the design thinking has pointed to the possibility, and necessary coexistence, of multiple re-cycle

strategies: of the singular commercial/artisan artifacts, productive tissues to densify or thin out; artificial and ecological infrastructures.

The result is a program of re-cycling/transformation of the city of/in production in progress. The conceptual horizon of this process is the return to duration as a goal of the sustainable urban recycling design: the choice of resources dislocation, the wisdom of using long-term tools, the need of ethics and aesthetics sustainability, have to do with what made attractive the cities and territories, with what adapting itself persists, with the Architecture, the City, the Urban Project.

Notes

1. Research Project of National Interest PRIN 2011, Research Local Unity od Trento: *Smart Re-Cycle. Recycling strategies for architectures and outspread city*. In progress
2. Historical trends, since the mid-1950s, show that European cities have expanded on average by 78%, whereas the population has grown by only 33%. A major consequence of this trend is that European cities have become much less compact. In half of the European urban areas, more than 90% of all residential areas built after the mid-1950s were low density areas, with less than 80% of the land surface covered by buildings, roads and other structures. Source EEA, 2006.
3. The yards of the railway stations in disuse accommodate some rooms for conferences and seminars, while the student accommodation are inhabitable capsules continuously moving on the old rehabilitated tracks, in the middle of the network of collective spaces scattered in the valley, in the residual marginal spaces of the past manufacturing activity. It is the idea of a flexible and open universality, just like its accessible and scattered architecture (rather than a gathered and contained one), through a system of newly functioning connections.
4. Promoted by National Builders Association (ANCE), National Council Architects, Planners, Landscape Architects and Conservators (CNAPPC), the RE.U.SO. manifest was presented at the FESTARCH, Perugia, 7-10 June 2012.
5. Along this artery the urban texture has grown in several phases - from the “Manufacturing Plan” in 1958, the “Industry Consortium Udine-Tavagnacco” in 1962, the “Tavagnacco miracle” in 70s/80s (Angeli, 1988) -, by singular replacement, the commercial functions replaced the artisan industrial activities along the road-front without replacing them entirely.
6. The concept of “adaptive reuse” stems from the debate on the historical heritage protection, but interests buildings that have value as a simple real estate resources. “Adaptive reuse is the process that adapts buildings for new uses while retaining their historic features” (Latham, 2000). This determines an extension of the building’s life-cycle, “cradle to cradle” (Mcdonough, Braungart, 2002) also responding to sustainability goals: minimizing the spread and preservation of materials, energy conservation, etc.

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