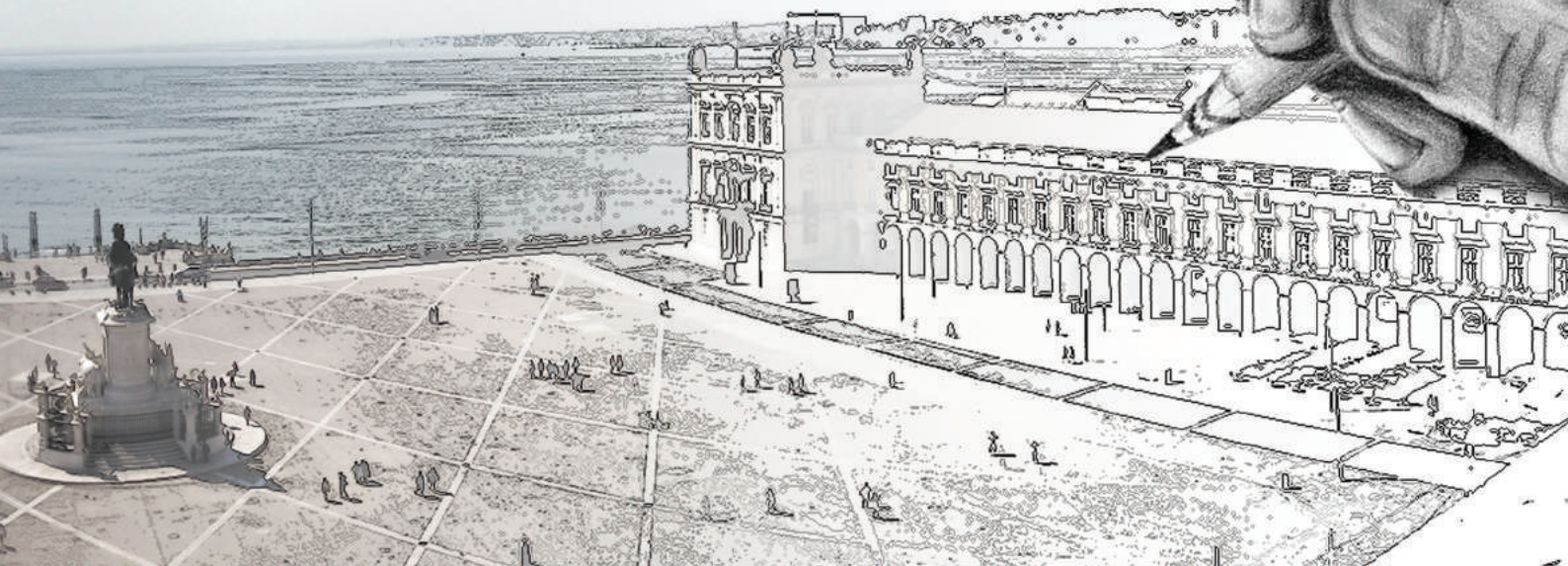


ESTUDOS SOBRE A CIDADE

ESPAÇOS

VIVIDOS • CONSTRUÍDOS



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CITIZENS PARTICIPATION

SUSTAINABLE DESIGN

SUSTAINABLE DEVELOPMENT

SOCIAL SUSTAINABILITY

TERRITORIAL EFFICIENCY

EXPERIMENTAL ARCHITECTURE

CLIMATE CHANGE

THERMAL CONFORT,...

Ficha Técnica

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Editorial

The number 4 - 2016 edition of the magazine Spaces lived and spaces constructed: studies on the city focuses on topics related to sustainable development, presenting a very diversified range of texts, which relate to and intersect different areas such as architecture, design, Urbanism, engineering and social sciences, some with a more reflexive tone, others with a strong empirical component. However, this set of texts that reveal very different research experiences and carried out by researchers from different countries, constitutes an important contribution to give solidity and density to this thematic area. For the edition of this issue, the coordination of José Luís Crespo and Elisabete Freire was fundamental.

The director of the journal Espaços vividos e espaços construídos: estudos sobre a cidade,

Maria Manuela Mendes

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Introductory note

The Sustainable Development Symposium (SDS) is an event geared mainly toward young researchers. It is an important annual conference organised in Europe, since 2011.

During these last four years, the Symposium has been building a unique platform for the discussion of such an important topic as this of the Sustainable Development. The Trinity College, of the University of Dublin (Ireland), was responsible for the first call; in the following years it was held at the Institute for Process and Particle Engineering, Graz University of Technology (Austria), at the Parthenope University of Naples (Italy) and in 2014 it was organised by the Faculty of Economics and Business of the Pan European University, in Bratislava (Slovakia).

The Faculty of Architecture and the Institute of Social and Political Sciences, both academic institutions of the University of Lisbon, was pleased to host the fifth edition of the Symposium, in Portugal, from the 15th to 17th of June 2015.

The aim of the SDS 2015 was to gather young researchers and academics from European Universities from a broad range of disciplinary backgrounds (e.g., Architecture, Urban Planning, Technologies, Social Sciences, Engineering, etc.) who are devoted to build a more sustainable development, and so, to create a better and a more friendly environment for the present and for the coming generations.

At the end, the authors present at this event have come not only from Europe. They were from Algeria, Austria, Belgium, Bosnia & Herzegovina, Brazil, Canada, Check Republic, China, Germany, Great Britain, Israel, Italy, Ireland, Mexico, Norway, Poland, Portugal, Serbia, Slovakia and Turkey.

Over three days stay, in Lisbon, it was an important opportunity to share and to discuss one's perception and achievements. Another goal of

this meeting was to create a research network for further synergies.

Among the proposed themes for the SDS2015 (<http://sdsymposium2015lisbon.weebly.com/aim--topics.html>), the presentations covered aspects mainly related to Architecture, Urbanism, Design, Natural Resources Management and Policies and Practices towards Sustainability were presented by architects, urbanists, designers, engineers (civil, chemical and materials), geographers, sociologists, economists, geologists, climatologists, environmentalists.

And thus, they were organized in twelve sessions: architecture & sustainability (2 sessions), architecture & sustainability, contribution of cultural & economic activities for sustainability, energy technologies & policies for a sustainable development, economic activities based on sustainable practices, methodologies for assessing sustainability, practices for a social sustainability, policies & practices on natural resources management (2 sessions), policies & practices on land planning & management, renewable energies, sustainable design (2 sessions), urban sustainable design & planning.

Apart from these theme sessions there was 3 conferences by invited keynote speakers: Eveline Durieux, from the LIFE Communication Team of the European Association for Information on Local Development (AEIDL), based in Brussels (Belgium), Alan Belward, the head of the Land Resource Management Unit, in the Institute for Environment and Sustainability of the European Commission's Joint Research Centre, based in Ispra (Italy) and Martin Dolinsky, an economist and professor at Pan-European University, Bratislava (Slovakia).

E. Freire (SDS 2015 Coord.) & J.L. Crespo

The restitution of spatial continuities as an urban project for improving territorial efficiency in the Metropolitan Region of Barcelona

Carles Llop^a, Marta Carrasco^a, Konstantinos Kourkoutas^b, Arturo Calderon^a

Abstract

The research project from which this article stems, pretends an approach to the concept of territorial efficiency from a projectual perspective, that each territorial actor gives to their problems and their needs in the relation to the resources uses and the respective social, economic and environmental costs. The Metropolitan Region of Barcelona (MRB) is the selected case study, studying the diverse metropolitan projects that have been planted and/or implemented from 1985 till now. With the objective to provide a transverse lecture of the city and the territory, it is suggested that the urban project should be utilized to intervene in order to achieve a greater mutual adaptation between different social and ecological systems, increasing the overall level of organization and thus territorial complexity, and thus setting the foundations for a more sustainable development. In this sense, we analyzed which project strategies permit contribute positively to the territorial efficiency, not only on a local level but on the totality of the region as well. Starting with this diagnostic of the MRB, looking for the concrete territorial

situations that characterize it, and taking into consideration the analyzed projects, a series of project logics are proposed, seen as strategies with a positive potential with regards to urban and territorial efficiency.

Finally, the different examples permit to affirm that this project logic, once applied it can contribute positively to the territorial efficiency of the whole region, especially when considering the multiplicity of scales that a project can entail it aims to achieve an effect greater than the mere establishment of a physical continuity, giving answer to different aspects such as mobility, accessibility, ecological functioning and urban integration, and so on.

Keywords

Spatial continuity, Urban project, Metropolitan Region of Barcelona, Territorial efficiency, Regional efficiency, Territorial situation, Project logic.

Introduction

The content of this article poses some of the objectives and questions of the National Research plan with the title “Efficient Cities, Metropolitan territories and urban regions: Strategies and project proposals for the regeneration of the territorial mosaic city, after the urban explosion”¹. The principal objective of the research is the

evaluation of the Metropolitan Region of Barcelona (MRB) in terms of territorial efficiency, viewed through the analysis of recent metropolitan urban projects, with their respective project logics and strategies. Based on the detected territorial situations encountered within the MRB, and from a multiscale viewpoint, the totality of the MRB was diagnosed in terms of problematics that have arisen in the last decades of intense

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¹ This is a research project funded with Spanish national funds from the Ministerio de Economía y Competitividad (Spanish Government) and the ERDF (European Regional Development Fund) program of the European Union, and that is being developed in the framework of the Proyectos de Investigación Fundamental No Orientada, Plan Nacional 2012 (project code BIA2012-35306) from 2012 to 2015. The research members of the project are Carles Llop Torné (PhD, professor of the Dept. of Urban and Regional Planning, UPC, and Main Researcher of the project); Antonio Font (PhD and professor of the Dept. of Urban and Regional Planning, UPC); Albert Cuchí (PhD, Sustainability Institute of the UPC, professor of the Dept. of Architectural Technology, UPC); Josep Maria Carrera (Architect and Economist, Àrea Metropolitana de Barcelona); Salvador Rueda (Biologist and Psychologist, director of Barcelona Ecology Agency); Marta Carrasco Bonet (architect, PhD candidate of the Dept. of Urban and Regional Planning, UPC); Konstantinos Kourkoutas (PhD, CORE, UAB); Arturo Calderon (architect, PhD candidate of the Dept. of Urban and Regional Planning, UPC); Silvia Mas (architect, PhD candidate of the Dept. of Urban and Regional Planning, UPC); Lorena Maristany (architect, PhD candidate of the Dept. of Urban and Regional Planning, UPC).

urban development, that has been coined with the term “the urban explosion” (Font, Portas, Indovina, 2004)², principally characterized by the different processes and phenomena that go beyond local particularities and are shared by most contemporary urban regions today (Llop, Bosc, 2012).

In this context, the project logics are proposed as project tools capable of inverting determined territorial situations to achieve an improvement both in environmental as well as social, setting the path for a more sustainable development for our territories. These are the logics that we propose as means for the regeneration of contemporary cities, metropolitan territories and urban regions, as demonstrated practical and applied experiences.

For the analysis of the selected projects a methodological guide was developed that in a transverse way, relates and links different concepts to perform a lecture of the reality of each territory and the qualities of each project. This guide was developed over a series of themes that we propose as key concepts for the analysis of the contemporary city and territory. That is, an interpretation of urban and territorial phenomena not solely utilizing morphological criteria, but also considering the contributions that come from other disciplines such as ecology, sociology, etc. The proposed themes are: morphology, metabolism, networks, landscape and time. And the content of each one of them has been developed through attributes compiled from dif-

MORPHOLOGY	STRUCTURE	METABOLISM	NETWORKS	LANDSCAPE	TIME
Types of fabrics	Habitability	Social Metabolism	Ecological, green and blue infrastructures	Character and identity	Velocities and rhythms of the territory
Compactness	- closeness to workplace	Energy management	Types of open spaces	Life quality	Risks and fate
Density	- closeness and accessibility to public transport and public facilities and services	Materials management	Ecological connectivity	Solidarity	Impacts, perturbations and associated cycles
Intensity	- green spaces perception	Biomass management	Topological networks	Landscape banalization	Innovation and creativity
Diversity	- vital space	Pollution	Landscape connectivity	Multiplicity and diversity of landscapes	Climate change
Complexity	- environmental qualities	- Gas emissions	Energetic networks	...	Energy transition
Road and infrastructure routes	- accessibility to natural and public spaces	- Light pollution	Production and exchange of goods and capital		
Barriers and obstacles	- social diversity	- Noise pollution	Mobility and transport infrastructures		
Green system	- housing politics (housing right)	- Soil pollution	Social and cultural		
Porosity	- housing quality	- Water pollution	Information and knowledge		
Permeability	Activity	- Electromagnetic pollution	Organisational		
Public space system	- scales of activity	Resilience	Informational networks		
Canopy and skyline	- diversity of activity		Smart grids		
Limits and borders	- intensity		Governance and organization		
...	- research and knowledge		...		
	Mobility				
	- interconnectivity				
	- accessibility to flows				
	- hierarchy and the scales of mobility				
	- pedestrian streets				
	- cycling paths and bike parking areas				
	- commuting and daily mobility				
	...				

Table 1 – Methodological guideline for the project analysis. Attributes considered for the analysis and diagnose of the selected projects

²The concept of “Explosion of the city” was developed during another research led by the Department of Urban and Territorial Planning of the Universitat Politècnica de Catalunya – BarcelonaTech (UPC). The results were published in the following publication: “L’explosió de la ciutat: Transformacions territorials recents en les regions urbanes de l’Europa Meridional”. Antonio Font (ed.). Barcelona: Colegio de Arquitectos de Cataluña. COAC & Forum Universal de la Culturas, 2004. ISBN 84-96185-18-4 (edition languages: catalan and english).

ferent systems of indicators³ for evaluating city performance from the point of view of different disciplines in terms of efficiency, and the contribution of other specialists.

Territorial efficiency

In general terms, we understand the concept of efficiency as the relation between the results reached/achieved (based on some pre-established objectives) and the resources utilized to achieve them. From a territorial perspective, various authors have approached the question in different ways. In ecology, the expression of the concept of efficiency is to maximize entropy in terms of information. Efficiency can be explained through the relation between the energy and urban complexity (in terms of organized information) (Rueda, 2012).

From a socio-ecologic point of view, the concept of efficiency is proposed as a means to improve the socioeconomic satisfaction of human needs, while maintaining the ecological quality of the landscapes and conserving the availability of natural resources and the environmental services offered by the biophysical matrix (Marull, Pino, Tello, 2008).

According to Rueda, efficiency is a concept directly related with urban metabolism, that is to say, the flows of material, energy, water that support it's functioning. But the metabolic requirements of a city are also dependent on the sum of material and energy resources necessary to sustain the different aspects of human activity (Wolman, 1965).

Therefore in order to achieve a higher territorial efficiency, from a sustainability perspective, it is necessary that the city and the territory can satisfy the needs of its inhabitants and users, utilizing its own infrastructure and within its given capacity (Rueda, 2012).

From other perspectives, it is evident that we can also talk of energy efficiency, efficiency in terms of mobility, or even in economic terms. But if the principal objective is to achieve a higher efficiency in order to improve the quality of life of the inhabitants of the territory, without risking its future functioning, then we need to consider the question of territorial efficiency with a more holistic/integral perspective. And thus achieving habitability models within a feasible framework of sustainability.

Even more, we assume that the concept of efficiency is specific to the time moment and changing depending on the urban problem (or

territorial situation) and in a position to propose a sustainable development, and a greater mutual adaptation between the different ecosystems, whether urban, rural or natural. As a consequence we propose the territorial efficiency from the project response given to the needs and problems of the different actors related to the used resources and the social, socioeconomic and environmental costs. That is, from a qualitative point of view, a project, whether urban or territorial, permits to increase the territorial efficiency from a multiscale perspective when promotes, with the minimum consume of resources, the integration of the environmental systems and the biophysical matrix; the urban compactness rather than the functional scattering; the social diversity rather than the segregation; the proximity and accessibility to flows (of mobility and public facilities); the permeability rather than the fragmentation, and the mixed uses rather than the specialization. All these issues permit the increase of the efficiency of the different systems, allowing the co-evolution between them as well, in order to lead to a more sustainable development of our territories.

Problem definition: the territorial situations

The territorial situations are consolidated realities, and are their specific processes that impulse the emergence of these realities. When we talk of territorial situation we refer to the identification of territorial spaces, characteristic in terms of morphology, understood through its phenomenology. That is observing how a space has transformed and why.

- The consolidation of certain urban areas as established centralities;
- The decentralization of the different types of economic activity towards the metropolitan periphery;
- The development of new polarities around new & existing infrastructures;
- A territorial dispersion that implies an extensive and growing consumption of peri-urban land;
- The fragmentation, gradual loss and isolation of natural areas;
- The population loss in metropolitan centres;
- Processes related to the internal restructuring of cities;

³ UN-Habitat agenda indicators, Urban Audit, Smart Cities - European ranking of medium sized cities, LEED for Neighborhood Development, BREEAM Communities, Banco Público de Indicadores Ambientales (BPIA), Landscape Indicators by Landscape Observatory of Catalonia, Barcelona Urban Ecology Agency, Observatori de Sostenibilitat de les Comarques Gironines, among others.

- The territorial infrastructures and the problems related with the accessibility to the diverse regional mobility flows (of different scales and types).

Project logics and strategies

When we refer to the project logics in terms of efficiency, we talk about those projects, actions or interventions that when they are applied through the project (urban and/or territorial) and in specific cases or areas, tackle the problematic of the different territorial situations and contribute positively to the efficiency of the whole region.

Principally, the project logics that we propose aim to tackle the problems related to the open spaces and its degradation and regression due to the urban development in extension and the construction of infrastructures that act as barriers; to the habitability of the spaces and the mobility in relation to the accessibility and proximity to the flows; and to issues linked to the regeneration and reprogramming of different fabrics or areas to promote their transformation and reintegration to the territorial matrix in terms of connectivity.

In the research project we propose the following logics or strategies:

- Consolidating the open spaces and the ecological infrastructure;
- Restoring the spatial continuities;
- Reprogramming the deteriorated natural and environmental spaces;
- Designing and planning the borders and promoting the interaction in the ecotones;
- Promoting the territorial waste spaces as opportunity spaces;
- Optimizing the metabolic cycles;
- Reprogramming the degraded specialised areas;
- Integrated the fragmented fabrics into the territorial and urban system;
- Promoting the territorial and urban regeneration;
- Reconsidering and planning new areas of centrality;
- Reconfiguring the metropolitan streets as structural axis;
- Integrating the infrastructures;
- Increasing the multimodality and intermodality in the mobility networks;
- Ensuring the accessibility to the mobility flows;
- Improving and ensuring the habitability of the different fabrics;

Spatial continuities

Two types of spatial continuities were considered: the ecological ones, that normally occur at various scales and correspond to the functioning of the system of territorial open spaces; and the urban ones, that from a social perspective, we tend to relate with a more local scale (although not necessarily) and questions such as accessibility and mobility of the inhabitants of the MRB.

In ecological studies and “in landscape systems, corridors create connectivity between different habitats. A system of corridors can lace together two distinct ecosystems. *Channelled movements of matter that are spatially differentiated from an adjacent static area may produce or maintain an observable corridor. Here, movement of objects is greater within a strip than in the surroundings.* Corridors in the landscape are “strips that differ from their surroundings; (and they) permeate the land. *They are movement paths for species, for water, for wind, for material of the landscape.* They exist as qualitatively different zones of conduit that connect two ecosystems, end to end. But in addition to connectivity, they also provide distribution as they open up their contiguous surroundings to the stuff that is moving within them, whether species, air, information, or creative practices (Forman, 1995).

Functional corridors may not necessarily be discrete structures. Past research has simulated dispersal and patch colonization on heterogeneous landscapes and identified the regions of the landscape in which flows were funnelled and that, therefore, functioned effectively as corridors. They found that in some cases actual “corridors were diffuse and difficult to identify” (Turner, Gardner, O’Neill, 2001). Reduced contrast between habitat patches and the intervening matrix may enhance connectivity more than would a discrete typical corridor. Evaluating the actual effectiveness of a linear habitat patch as a corridor requires a three-step evaluation of whether organisms can find, select, and successfully move through the patch. Enhancing our understanding of how organisms move through heterogeneous landscapes (along corridors or through the matrix) is a key component of understanding the responses of organisms to spatial pattern (Turner, Gardner, O’Neill, 2001). According again to Dramstadt et al. (1996), the corridors have two basic controls/indicators: width and connectivity. Accordingly, they are attributed five major functions:

- i) habitat,
- ii) conduit,
- iii) filter,
- iv) source and,
- v) sink,

and respectively based on the degree that they fulfil the above functions they can be categorized in two broad categories (Rodá, 2003), in terms of their ecological functioning:

biological corridors - a lineal element of the landscape with limited width with the function of canalizing flows (of energy, material, information) adapted to the presence and conditions of the corridor. These corridors are more vulnerable to perturbations that can alter their structure or continuity.

ecological corridors - the second concept of the corridor, amplifies that of the earlier category in two important aspects: i) its larger dimensions and ii) its general objective of permitting diverse flows both biotic and abiotic. Thus these corridors provide habitat, and more specifically multi-habitat for diverse species. They constitute landscape elements much more strongly pronounced territorially speaking.

social corridors - In the urban environment, one can also observe situations where the different urban fabrics and their functioning (social indicators, social services, habitability, mobility etc.) are seen interrupted by the presence of such types of infrastructural barriers. Related to this, there can also be other types of consequences such as social segregation and isolation, if the barrier effects becomes intensively pronounced. Urban continuity, in this sense, refers to the continuity of the urban fabric in terms of social connectivity and accessibility. While social connectivity refers more to the relational and interchange potential/possibilities between the different fabrics and urban spaces. This connectivity is possible if the space holds the particular qualities and conditions for it to be produced, but at the same time it is also necessary that an adequate access to mobility flows exists or can be established.

Landscape connectivity is generally accepted as a highly significant landscape attribute for conservation biology, thus setting up habitat corridors has been a classic approach to landscape connectivity management that has been advocated as a key conservation strategy in human-modified landscapes where urbanization, infrastructure development and other activities frequently sever natural connections (Rodá, 2003). Indeed, connectivity stands out as being one of the most widely used metrics of landscape function. Some authors consider it a single attribute while others tend to distinguish two aspects: *connectance* and *connectivity* (Marull, Pino, Tello, 2008) where the former refers to connection from a structural point of view (based on physical attributes), while the latter describes functional aspects of the connection between landscape elements, such as patterns of organism movement and migration, or the response of organisms to the presence of barriers. For many species, connectance and connectivity are indeed quite distinct (ibidem).

In the case of the Metropolitan Region of Barcelona, chosen as the case study, the open spaces within this area are found in a fragmented state. Observing in detail areas such as the Llobregat river or the Vallès area (figure 1), we can appreciate how the infrastructures act in many cases as barriers, disconnecting the different spaces and invalidating ecological and social functioning of the territory.

The big infrastructures are structured conditioned, to an extent, by the local geomorphology and geology of the territory, taking advantage of

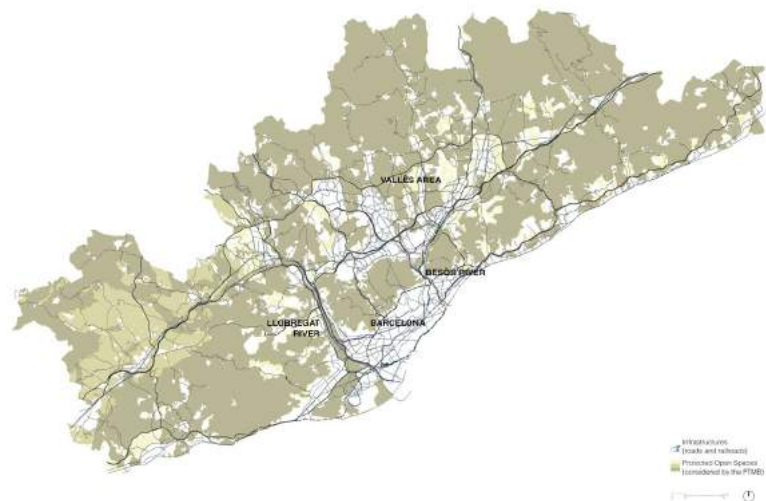


Figure 1- The current fragmentation of the protected territorial open spaces in the Metropolitan Region of Barcelona caused by the infrastructures

Source: Sílvia Mas and Lorena Maristany

the valleys and plains to avoid obstacles. This efficiency in infrastructural terms can have a great impact on other territorial infrastructures and systems, what lately has been coined as green infrastructures of the territory, as a way to interrelate the structure and function of territorial open spaces.

Methods

Data collection and analysis

The applied methodology is principally based in the identification and study of different metropolitan projects that are analysed posteriorly in more detail. A GIS (Geographic Information System) database of all the detected projects (figura 2) in the metropolitan area was created, projects that impulsed significant operations of urban transformation. Most of these were promoted by public administrations and, for this reason, an extensive analysis of the public databases and information was performed. At this moment, and taking into consideration that this can be considered as an ongoing effort, after the completion of the project, we have identified 800 projects that were developed in the metropolitan area of Barcelona, between the years of 1985 and 2015.

The use of GIS technology has also permitted the development of spatial and network analysis in the metropolitan scale. In this article, a series of the produced cartographies are presented, in relation with the question at hand that is territorial fragmentation and spatial discontinuities.

It is also important to highlight the fact that a great part of the analysed data was complemented with the work and collaboration of architecture students that have performed an extensive survey of the territory, through the course workshop and laboratory.

With respect to the detection of the territorial situations, their identification as exemplary cases was done based on the Atlas of Transformations 1977 - 2014 (*Atlas de las Transformaciones 1977 - 2014*)⁴ developed by the team of Prof. Antonio Font (Font, Llop, Vilanova, 1999) and at the same time on the analysis performed with GIS. The superposition of the two types of data, have permitted us to detect those territo-

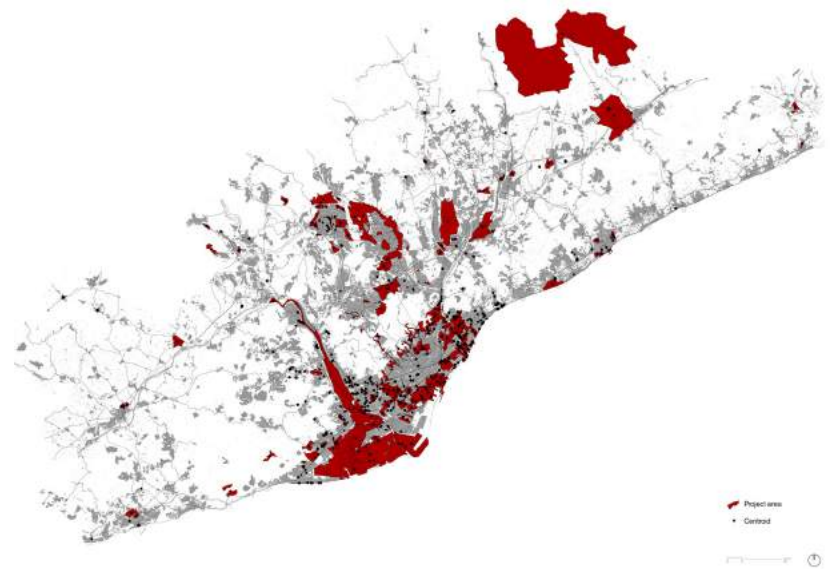


Figure 2- Visualization of the database of the metropolitan projects that we have registered and that have been developed or planned from 1985 to 2014

Source: ICGC (Cartographic and Geological Institute of Catalonia)

rial hotspots where characteristic territorial situations appear. With the further help of aerial photos and other thematic maps, its evolution and transformation can be explained both in physical as well as phenomenological terms.

Context and territorial situation

The territorial disconnection and fragmentation

The moment of the greater urban expansion in the MRB was produced during the 70s and 80s as a consequence of the growing internal immigration. During this period the important cities of the MRB like l'Hospitalet de Llobregat, Terrassa o Sabadell grew in a rapid way and in an extension that permitted to cover the increasing demands for housing. With the proliferation of the private vehicle and economic industrial development, it was made necessary the construction of a road network that could connect these important cities, on a local and international level. The improvement of the telecommunication technologies during the following decades, also permitted urban development in areas solely accessible by private vehicle, like low density resi-

⁴ The Atlas of the Transformations 2004-2012 continues the previous works developed by the Urban Planning Chair of the Dept. of Urban and Territorial Planning (UPC). From the maps of "Uses and forms of building 1977-2000" of the MRB, the research team proposes its updating to the last period 2004 - 2012. The series of maps of "Uses and forms of building" and "Variations of uses and forms of building" show the transformations that the MRB has suffered in each period, and permit concluding the reason why these changes have been. The maps concerning the first period have been published in the book "The construction of the metropolitan territory" (original title: La construcció del territori metropolità, Font, A. (ed.), 1999).

dential areas, industrial and logistics areas along key infrastructures etc. In this historic moment, the priority in terms of efficiency was to facilitate all this incoming population and the construction of new infrastructures that would satisfy these needs.

The key question to consider is how this de-

velopment took place. The big infrastructures were constructed following principally a regional logic, of efficiency in terms of reduction of distances and time, as well as savings in economic resources for their construction. A logic that at the moment did not take into high consideration the biophysical matrix present, as a result having

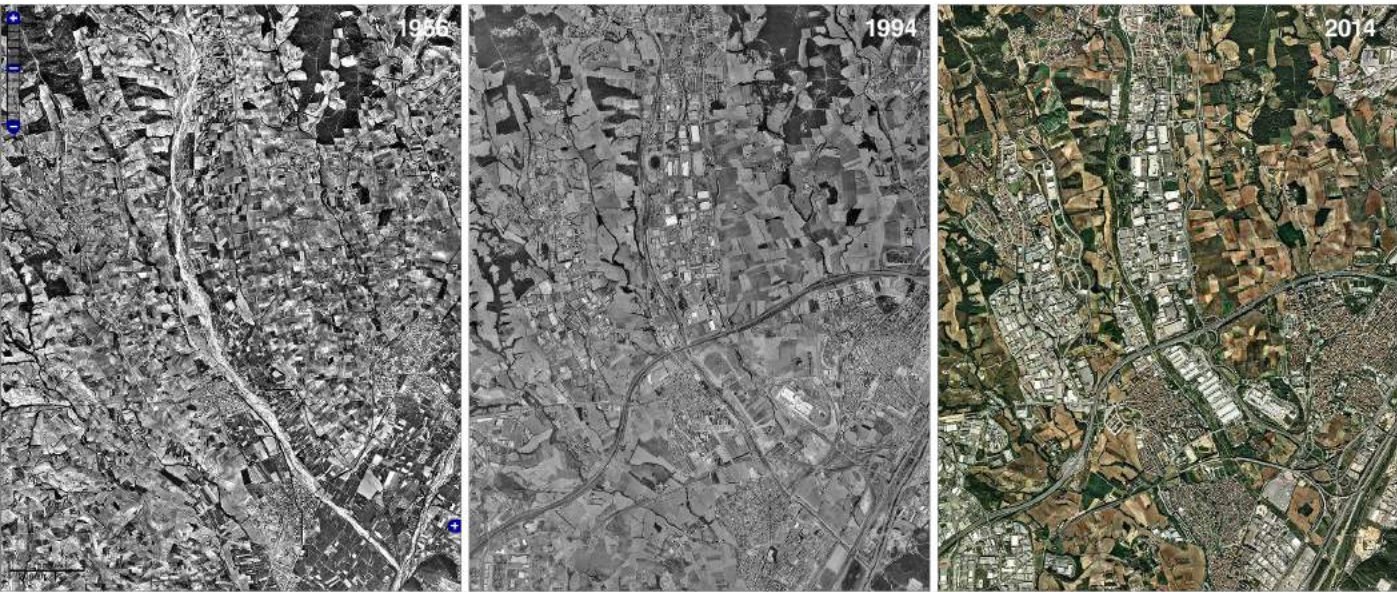


Figure 3- An example of the disconnection between territorial open spaces in the Vallès area

Source: ICGC

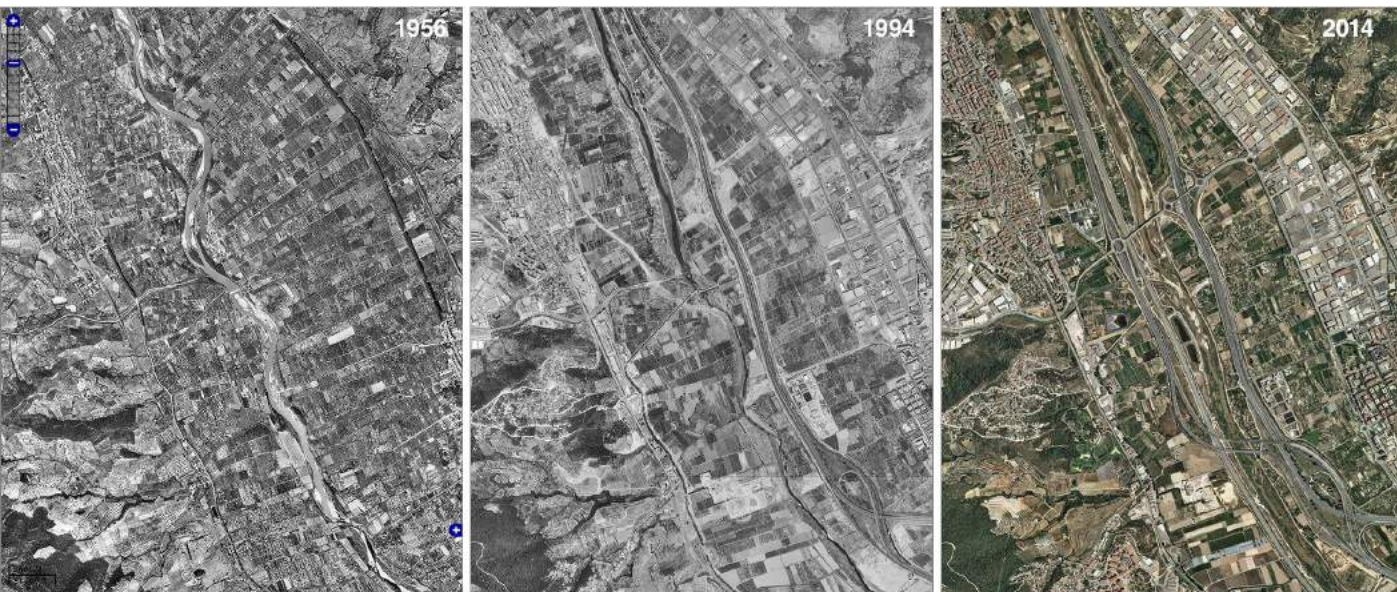


Figure 4- Due to the infrastructural reiteration, the Llobregat river remains disconnected from the other surrounding natural open spaces as well as the surrounding city

Source: ICGC



Figure 5 - The case of Montcada i Reixac. The concentration of infrastructures in the same area cause an impact even bigger since they directly contribute to the isolation and segregation of the different neighbourhoods

Source: Bing Maps

the lack of integration of these infrastructure in the landscape, in functional and aesthetic terms. Rather the contrary, with the majority creating barriers for the continuity of open territorial spaces and contributing to the further spatial fragmentation (figure 3). It is also interesting to highlight how we are often encountered with situations of infrastructural reiteration that further worsen the existing problematic (figure 4).

In the case of urban spaces, the consequences can also be traduced on a social level.

During the 90s, and as a result of the urban expansion, many cities reach a point that they exceeded the existing infrastructural limits that on many occasions also formed the formal city limits. As a result, a disconnection between determined areas and neighbourhoods can occur, by the fragmentation of the spaces and corridors that guaranteed the interaction and flows between these areas (figure 5).

In the case of rail infrastructure similar situations can be encountered. In this case, the biggest problems were found inside the consolidat-

ed urban nuclei, where the rail lines constituted a major barrier in functional and structural terms but also on a less tangible level, producing social segregations (figure 6a). Same effect can happen with major highways crossing urban centres, forming corresponding barriers for the inhabitants of the city (figure 6b).



Figure 6.a, 6.b - Examples of road and railroad infrastructures as urban barriers that cross the city

Source: Miguel A. Hernández and Sandra Murcia

The infrastructural barriers in the MRB

In order to explain the issue of the barriers present in the MRB we elaborated a specific map that crosses the two types of information. On one side the GIS network analysis has provided us with those section along principal infrastructures

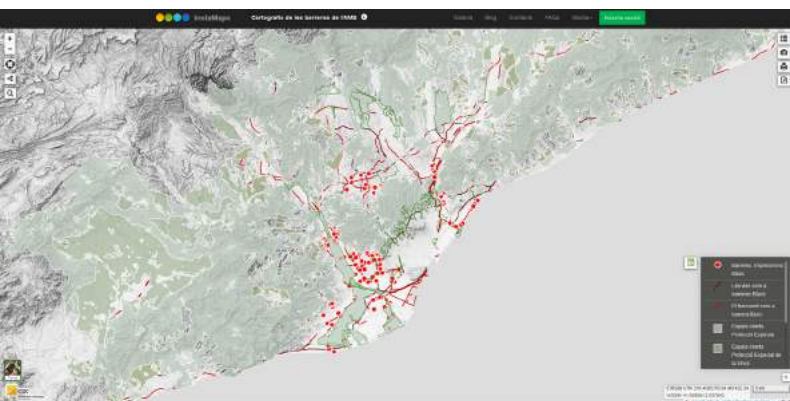


Figure 7 - Interactive map of barriers in the MRB
Source: <http://www.ciutatmosaicterritorial.com/mapabarreres.html>

(highways and railway) that form barriers to the continuities and connectivity of natural and anthropogenic systems (figure 7). And complementing with the onsite field work with the detection and localization of these situations among the various municipalities of the MRB.

In this way, combining both types of information, it can be observed that the most exemplary cases of barriers are concentrated along and near infrastructures, although not limited to these cases (urban peripheries are also characterized by such phenomena).

Results and discussion

In this research project more than 800 metropolitan projects and plans were registered for the period between 1985-2014, within the MRB. Based on a qualitative analysis of these projects that apply the project logic in question in this article, the restitution of territorial continuities, is demonstrated the value of the proposed strategies.

The selected projects are presented in continuation, as a *good practice* guide. They do not respond solely to one logic, but the exemplary value lies in the combination of strategies that each one implies. In this sense, we present the specific points of each one in relation with the logic in question.

The restitution of the territorial continuities as project logic

The principal objective of this logic is the reconnection of territorial and urban spaces, overcoming the infrastructural barriers to achieve

the reintegration of the fragmented spaces to the biophysical matrix. On one side, it implies recovering the ecological functioning, and on the other, the social functioning, such as the accessibility between spaces, the access to different territorial flows, overcome isolation and segregation and in this way recover the latent relation between the city and its natural spaces.

In this case, the question of scale is very important, making a multiscale analysis perspective imperative. This will permit to identify and locate the *passages* (Forman, 1995) that will facilitate and enable communication between the different spaces and permit a reconnection both in physical and practical terms.

In relation to the question of efficiency, this logic promoted the integration and restructuring of the territorial matrix, encouraging the continuity between different spaces, and integration of fragmented patches. At the same time it contributes in the recuperation of the accessibility to the flows, whether ecological, mobility or socio cultural, searching to reinforce these permeabilities that, in a small scale, can have an impact on a larger scale. Small interventions, surgical interventions, can have a much more significant effect and change the relational logic between city and territory. The analysis of the projects was done with these considerations in mind.

So, the logic of the restitution of the spatial continuities can be developed and resolved following different strategies. In continuation we present these strategies in relation to the various selected projects that incorporate them and put in test these types of operations in relation to the idea of the territorial efficiency. It is necessary to have in mind that these projects proposed highlight certain aspects and can respond to more than one project logic. Above all, in the case of the open spaces and the question of territorial fragmentation, it is necessary to think in the question of consolidation as a strategy to reconstruct the ecological corridors and the landscape connectors of the biophysical matrix.

Reconstruct the ecological corridors and landscape connectors of the biophysical matrix

Returning to the question of scale, in the case of ecological corridors, it is imperative to consider not only the structure on a local level, but also the potential that it holds for a restructuring on a regional level. For this purpose it is necessary to identify which spaces hold the potential for connectivity in the open spaces system. The Ter-

ritorial Metropolitan Plan of Barcelona (PTMB) (figure 8) was a recent plan that considered these questions. The plan was approved in 2010 and considered three principal axes one of them being the open spaces, and the other two the urban settlements and the infrastructures. In the case of open spaces in was based on the structuring and consolidation of the existing patches/units in order to give them more coherence, robustness and capacity to fulfil with the function they undertake (Generalitat de Catalunya, 2011). As explained in the plan, the resulting structure permits to comply with three objectives: favour the diversity of the territory and maintain its reference and relation to the biophysical matrix; protect the natural spaces; and conserve the landscape as a social value and a territorial asset. The continuity of this structure, formed by a series of patches and ecological corridors also contribute to the braking of the urban expansion, put a limit to the city while permitting at the same time, the conservation of the existing biodiversity of the territory.

This territorial structure and the search for connectivity on a regional level are based on respective consideration on an intermediate and/or local scale. Such examples of recuperation and transformation of ecological corridors are the cases of the fluvial parks of the river Besos and river Llobregat, located respectively on the east and west of the city of Barcelona. In both cases, during many decades the rivers suffered considerable degradation losing great part of the ecological capacity, serving solely as sewage canals for the urban areas. Thus respectively as part of their gradual infrastructuration they both suffered a transformation and a conversion from rivers to canals. During the last decade and due to a change of vision of the MAB (Metropolitan Area of Barcelona) as well of the planning practice in general, a new role has been envisioned for these spaces, with their restoration and update of their function. That is to convert them to lineal parks, facilitating them with increased accessibility has permitted the revalorization of these spaces. On the other hand, and thanks to the distinct interventions aiming at the ecological restoration it has been rendered possible to recuperate to a great extend the natural capacity of the rivers in terms of flows, biodiversity and water quality. To reinstitute the river as a social space, a key element was the construction of new passages/connectors between the fluvial space and the city. Through this initial experience with its successes and mistakes, great lessons were learned on the part of the administration (figure 9).

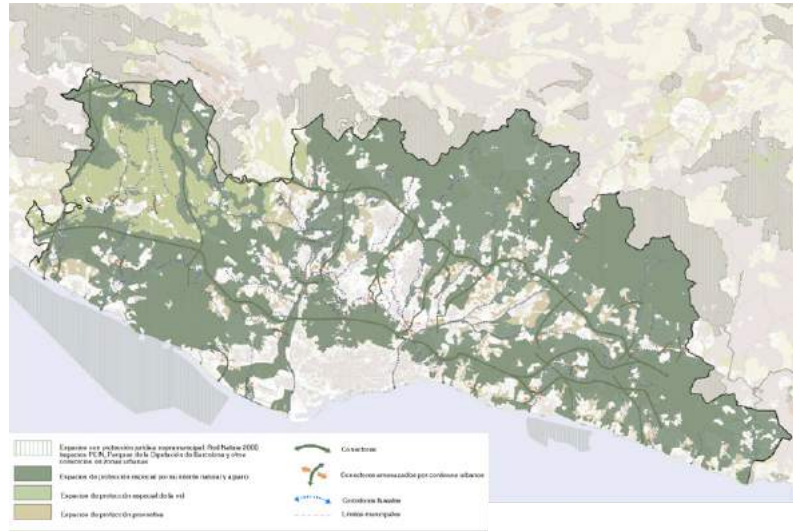


Figure 8 - Proposal of the PTMB concerning the open spaces and the different kinds of protections applied

Source: PTMB, 2010



Figure 9 - The Llobregat River Park and two of the underpasses that connect the river with the urban areas

Source: Bing Maps

Identify and project new permeabilities that reconnect different fabrics.

When we talk of permeability we refer, on one hand, to the possibility of crossing or overcoming transversally a barrier, of any type. In the MRB there are many different projects that have realized this type of operation, going after this objective of increasing accessibility and identification of the elements of the territorial matrix.

If we look at the area of the Vallès Occidental, and in particular, the municipalities of Terrassa and Sabadell, two intermediate size cities, located in a territorial space characterized by the fragmentation of the existing open spaces (natural or rural). Both cities during the last decade have developed proposals to tackle the ordinance of their

peri-urban space and take advantage of the landscape possibilities of their immediate surroundings. Examples of such projects are the two green rings projects of the two cities, where in both cases, it is interesting to highlight the focus that these projects put on the question of permeability



Figure 10 - The area of the green corridor while the project of the Directional Center was under construction
Source: Bing Maps

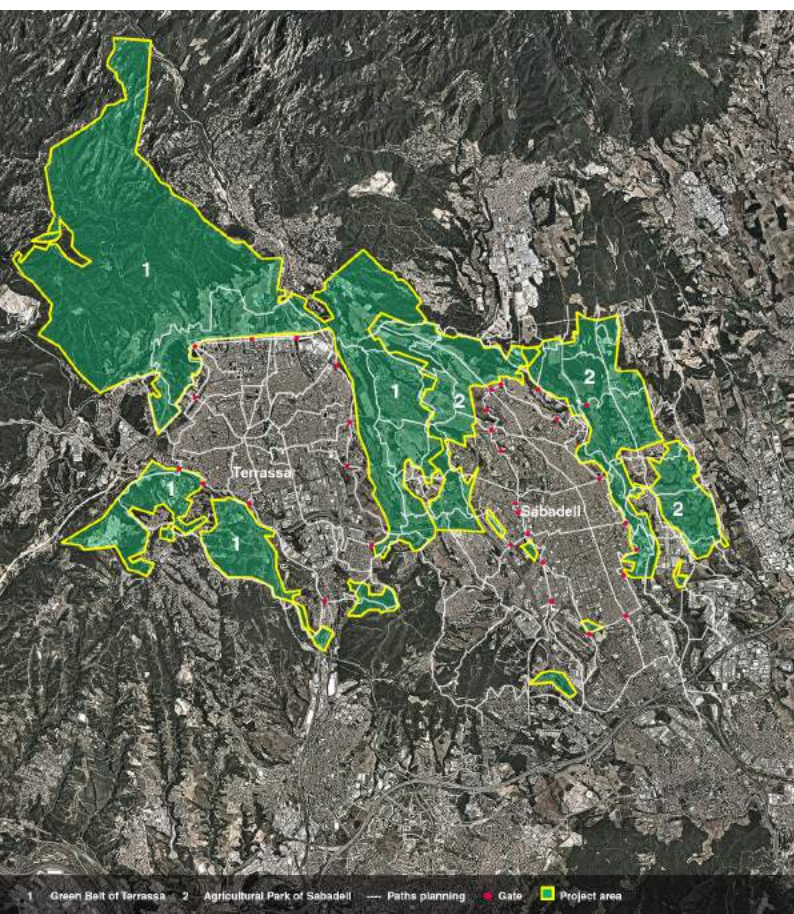


Figure 11 - Project area of the mentioned projects concerning the cities of Terrassa and Sabadell
Source: Bing Maps

and accessibility as well as the continuity between the urban and rural fabrics, in terms of interaction between the two. In this context both cities developed specific proposals focusing on the rural paths as key components and elements of the territorial matrix. Other key elements are the *doors of/to the city*, referring to specific points where this rural-urban interaction takes place. The establishment of these continuities not only caters for the respective social connectivity but also for the recovery of the historic identity of the territory in landscape terms, permitting the integration of the peri-urban space as an asset; landscape, historic and environmental.

Anyway, returning to the regional level, one can observe how these projects adhere to their administrative limits. On one hand, the two proposal confluence along the space of the metropolitan corridor, between the two cities, but each one differentiated from the other (although with similar objectives). And on the other hand, this differentiated treatment (depending on the administrative area/limit) can result in a conflicting situation in terms of continuity of the city rings in their totality. In Figure 11 we can clearly see how both projects pretend to consolidate their respective peri-urban space, but do not bother to integrate within, these spaces that are left out of their municipal reach.

In the case of Barcelona, there is another project that can serve as a good example; the case of the *Doors of Collserola*, that it proposed to work the interaction between the natural space (Park of Collserola) and the urban space of the city of Barcelona. The proposals needed not only contemplate the open spaces but also include an architectural proposal that will contribute towards the reinforcement of the interaction and interchange of flows (social and ecological). Thus, the project proposed eleven Doors, as specific interventions to work towards the general question of permeability and reconnection between the two heterogeneous spaces. And it pretends to change the perspective that the city of Barcelona has had historically with the Park, and at the same time consolidate the park as a metropolitan park, for the whole MRB.

Construct new complex urban spaces - connectors with the necessary attributes and qualities to overcome the infrastructural barriers with an added value

In the case of the city, the disconnected spaces and fabrics should be approached starting from the inherent complexity of the city. It is not

sufficient to merely connect two points, or guarantee accessibility, overcoming existing infrastructures. In order for the effect to reach a wider extent, it is necessary to endow the intervention with an added value. A clear example that managed not only to reconnect two neighbourhoods but also generate a new quality public space, is the project of the Parc de la Solidaritat (Park of the Solidarity) (figure 12) in Esplugues de Llobregat. In this case, the B20 highway that divided the city was overcome with the help of a *gran plaza* that hosts a diverse programme of different uses. This square generated a new pedestrian circulation and flows that were impossible before the intervention. This new public space, with areas for relaxation but also of circulation, is able to reconnect the two neighbourhoods and at the same time, improve their specific qualities (habitability, accessibility, and pedestrian/light mobility).

Another example is the project of the plaza of the Sec River and the passage/footbridge of the Farigola in the city of the Cerdanyola del Vallès. Again, the overcoming of the river is not accomplished solely through the construction of passage, but also is complemented with a new public space, a *plaza*, that handles the circulation of flows and at the same time becomes a motivation for a new connectivity between neighbourhoods. This intend to come up with a functional programme that attracts the social flows, provides and additional value to the project, making sure that the effect if the intervention is extended to an area and scale greater than that of the project area.

Conclusions

From a spatial point of view, it is clear that the restitution of the continuities as project strategy, contributes to the efficiency of the whole metropolitan region, as it was demonstrated that the development of local interventions, can be linked to strategies on a larger scale, looking to maximize the effect in terms of efficiency and spatial coverage. Therefore, the consideration of the multiplicity of scales present in a project is a decisive aspect when contemplating a greater efficiency for the project. In the following plan (figure 13) we can observe the identified project of our database that has tackled the question of the restitution of spatial continuities of metropolitan spaces.

It has been observed that when the projects are considered or constructed in an articulated/coordinated manner, their effect increases exponentially. In this sense, we can talk not only of



Figure 12 - Solidaritat Park in Esplugues de Llobregat.

A park located over an infrastructure to promote the reconnection between two neighbourhoods

Source: Bing Maps

projects, better yet of project or transformation areas. In this context, it is key to consider ways that each project can be integrated in the existing matrix, even improving it in terms of efficiency, resolving those nodes or points where conflict or misconfigurations exist.

In the case of open spaces, and given the constant state of tension that they are found in, it is imperative to have a plan or a regional project that can secure the conservation and functioning of the open spaces system structure at this wider scale. These are in reality really complex spaces, where a tight superposition of flows takes and place, respectively giving birth to a multiplicity of dynamics. For this reason, the restitution of the potential continuities is necessary to be considered in conjunction with the question of territorial fragmentation. So, on one hand it is necessary to apply measures that contribute to the consolidation of these open spaces (providing protective elements against the urban pressure). At the same time, on the other hand, when projecting new infrastructures, they should be projected in an integrated and respectful manner with respect to the territorial structure and function.

Therefore, in order to achieve a more sustainable territorial development, as we mentioned in the beginning, is necessary to promote a mutual adaptation between the different systems present in the territory, whether urban, natural, or rural. In this way contribute in re-establishing relations and scales of proximity, connect neighbourhoods through green spaces, facilitate pedestrian flows as well as the accessibility to urban services, and thus on a long run change the social metabolism of the territory. In consequence, the possibility to increase efficiency arises, by reducing energy dissipation, cutting down on pollution and coming

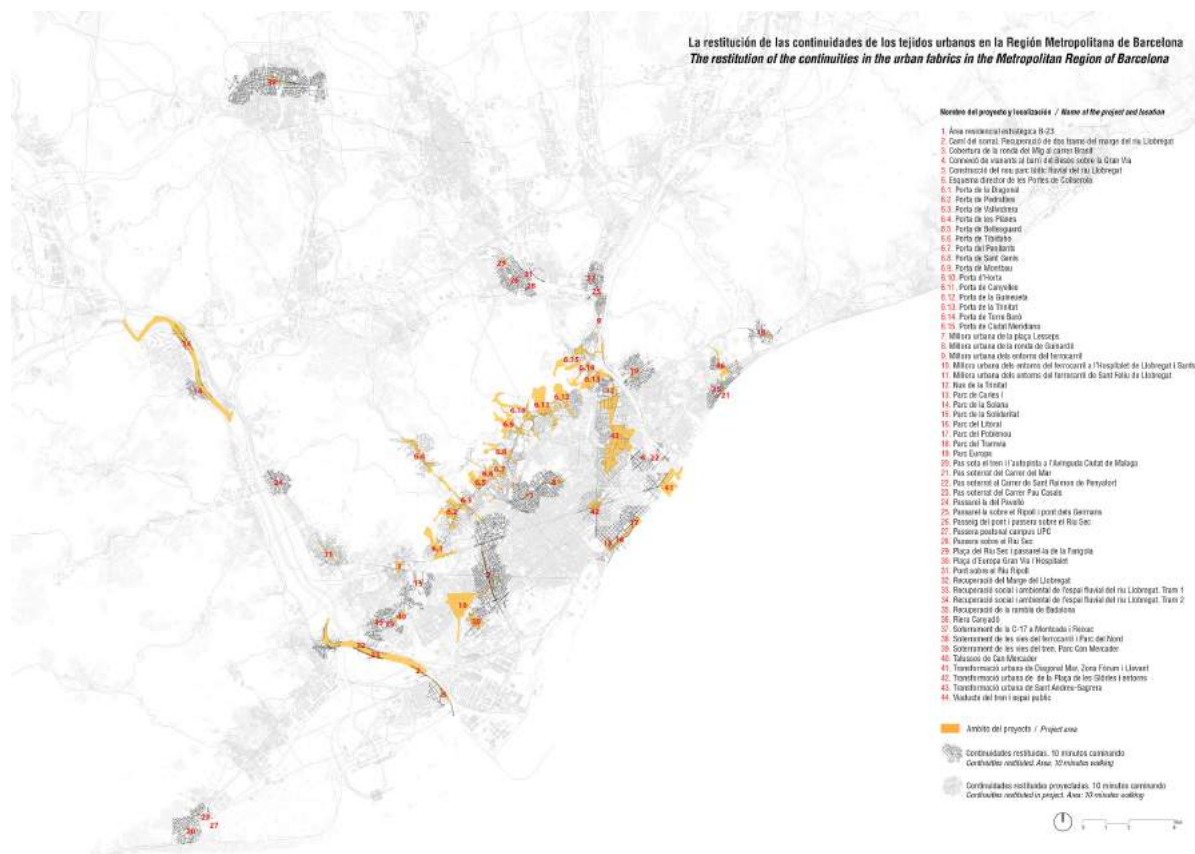


Figure 13 - Map of the projects that contribute to the restitution of spatial continuities in urban areas

up with new systems and approaches that make a more efficient use of energy altogether, while considering a wide range of questions related to the territory (mobility, natural patches size, habitability, natural capacity of the territory). The respective project logics could be thought out as platforms for resolving and improving all the aforementioned questions.

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Municipal decision-making steering tools and citizens' awareness and participation within Lisbon Metropolitan Area

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Abstract

At present, as a consequence of the urban sprawl, the exponential increase of population living in cities and its impact upon the natural environment and, as well as, on the human quality of life, municipalities have been adopting and incorporating sustainable tools in their planning and management policies and procedures. In Portugal, the municipalities within the Lisbon Metropolitan Area (LMA) have been revealing some awareness for the need of an urban sustainable development approach and thus defining strategies to improve the urban environment quality for a better and healthier life of their inhabitants. As evidence of this, is the Lisbon Municipality (LM) itself that has made available a group of formal but also

informal planning and management tools; it is important to emphasize that Lisbon it is an appropriated case study, since it is the first capital of an European country with participatory tools, such as the Participative Budget or BIP/ZIP programme. Despite most of the procedures empowers the social layer, the success of such urban policies is the result of a bilateral will, so, it is relevant to assess the significance of this social component on urban decision-making.

Keywords

Sustainable Development, Urban Planning tools, Participation, Healthier lifestyle

Introduction

There are four significant milestones on the environmental awareness. The first, in 1962, when it was published the book *Silent Spring*, written by the marine biologist and conservationist Rachel Carson which brought the environmental concerns to an unprecedented public debate and, on following years, it has generated the global environmental movements (Griswold, 2012). A decade later, in 1972, it was an international conference convened under United Nations auspices, the *Conference on the Human Environment*, held in Stockholm; it has focused on the discussion about the growing environmental degradation as the result of unbridled exploitation and use of natural resources; the *Stockholm Declaration*, the first document in international environmental law to recognize the right to a healthy environment, contains 26 principles to guide the nations through their responsibilities', an action plan, split into three categories including an environmental assessment, environmental management, and 109 recommendations; in overall, there was

an agreement on the need for common vision and principles to guide the peoples of the world in the preservation and enhancement of the human environment and thus, geared the search for a balance between economic development and reduction of environmental degradation (UNEP, 1973).

A third moment on this crusade, has happened in 1987, with the released of the Report of the United Nations World Commission on Environment and Development (UNWCED, 1987), *Our Common Future*, coordinated by Gro Harlem Brundtland, and thus, well known as the *Brundtland Report*. It aimed to set recommendations for a sustainable course of development; it raises the perception and commitment to action on the part of individuals, non-governmental organizations, businesses, institutes, and governments. This report and the commitment of the UNWCED laid the groundwork for the convening of the 1992 *United Nations Conference on Environment and Development*, held in Rio de Janeiro, informally known as the *Rio Earth Summit* or simply *Rio92*; resulting from this meeting two important documents with

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the regard to sustainable development, the *Rio Declaration on Environment and Development* and the *Agenda 21* (UNEP 1992). The first document consisted of 27 principles intended to guide countries and the second, a voluntarily implemented action agenda for the UN, other multilateral organizations and individual governments around the world that can be executed at local, national, and global levels.

Therefore, Rio-92 conference was a turning point as it has placed environmental issues firmly on the political agenda and to the need to embark on a different form and development process than the one it had followed so far in order to save the planet and the survival of its own human being; and though both documents, the Rio Declaration on Environment and Development and the Agenda 21, are non-binding some national and state governments have legislated or advised that local authorities take steps to implement the plan locally, as recommended in Chapter 28 of the document. These programs are often known as *Local Agenda 21* or simply by the acronym *LA21*.

Europe turned out to be the continent where LA21 was best accepted and most implemented. Several initiatives, some implemented and defined by the European Union, have been developed at European level and have been important in the planning and the management at regional level, but especially, at local scale. At this scale, the problem is focused on the urban sprawl and its consequences on the natural environment and as well on the human quality of life. In fact, with the exponential increase of the population living in cities and the current urbanization trend, it is crucial that sustainable development principles apply to cities, as Ban Ki-Moon (2012) has emphasized *sustainable cities are crucial to our future well-being ... our struggle for global sustainability will be won or lost in cities*.

Among the European initiatives it is important to highlight the first *European Conference on Sustainable Cities and Towns* (EC SCT), in Aalborg, Denmark, in 1994, whereby the *Charter of European Cities & Towns Towards Sustainability* or *Aalborg Charter* was adopted; this document, considered as the European equivalent of the Earth Summit's Agenda 21, it states that municipalities and their citizens have a great responsibility in creating environmental, social and economically sustainable communities; so, it has provided a framework for the delivery of local sustainable development and calls on local authorities to engage in Local Agenda 21 processes (SCP, 1994). This Aalborg Charter was signed by the participants, more than 3,000 local authori-

ties, NGOs, national and international organisations, and scientific bodies, from more than 40 countries, it has resulted in the largest European movement of its type contributing to the *European Union's Environmental Action Programme: Local Action Plans Towards Sustainability* and, as well, started the *European Sustainable Cities and Towns Campaign*. Meanwhile, this campaign was responsible for the organization of three further European Sustainable Cities and Towns Conferences: Lisbon (1996), Hanover (2000) and Aalborg (2004). So, ten years after, this 4th Conference, the so-called *Aalborg +10*, which purpose was to develop a common understanding of sustainability, as well as, to develop a framework, the *Aalborg +10 Commitments*, a set of ten shared voluntary oaths on sustainable measures, to be used at the local level that would better articulate how to embed sustainability across municipality sectors. Thus, sustainability has turn into a priority among central, regional and local authorities but also in several professional areas and one of these is the urban planning and management. In fact it may play a central role on the road to a more sustainable and healthy life, because through it becomes possible to put into practice the goals set for a sustainable development: avoid urban sprawl, contribute to the revitalization of urban centres, promotes their imperative redesign, making it more inclusive, reassesses the problems of production and reduces waste, creates the conditions for a more active population, in particular, the elderly, promotes the intergenerational relationships, and so the quality of life and health as well.

In this context, the present research focuses on the evaluation of the Portuguese urban planning and management mandatory tools, in particular, the municipalities within the Lisbon Metropolitan Area; furthermore, it was evaluated some informal tools. The main purpose is to assess whether they are on the path towards a sustainable urban environment. In addition, it is also important to perceive whether citizens' respond to this challenge? Are they aware of its importance? And is sustainable development a concern for citizens? And what is the preponderance of participation in decisions?

Land and urban planning and management in Portugal

In Portugal, there is a large set of formal land planning and management tools covering the different scales of approach: national, region-

al, inter-municipal and municipal. This network operates on a hierarchical basis established by the Basic Law on Land Use Planning and Urban Planning (LBPOTU), where some plans may have a more global vision and establish guidelines for the others. However, it is a complex, bureaucratic, static, time consuming and elitist system, as it does not promote the participation, in the different phases of the process, of the population, NGOs, sometimes creating inter-municipal conflicts due to lack of relationship and interconnection (Freire and Crespo, 2011); and, at an urban level, these tools are also insufficient for the structuring of the cities.

The aim of this research is to assess the set of instruments of the AML municipalities, in particular, the one for which they are responsible for: the municipal master plan (PDM). It is a medium/long term tool that is both formal and mandatory. It sets the strategy and the rules on the land occupation, use and transformation and also defines the general norms of urban management. Usually, it should have a ten-year term, but due to situations such as the long and complex process between the beginning of the review and finally its publication, this timeline is usually too long.

Recently, the PDM is more feasible and has earned more autonomy to act upon the territory because of the revision of the urban policies structure that looks for a more complementary system instead of a hierarchical one (Oliveira, 2010). However, as mention before, there are some functional problems that can be summarized into three aspects: a poor articulation and cooperation between municipalities and their PDMs; the existence of several superimposed institutions in the performance of the territory; and instability in the several agencies and authorities that are responsible for the administration of the municipal land.

As informal tools there is, for example, the strategic plan, the participatory budget or the local agenda 21. The first sets up the guidelines and action plans, defining more precisely the following paths in order to achieve the territorial goals, which are generally focused on a theme (transport, tourism, environment, etc.). They should help the PDMs to create stronger guidance on the development of municipalities and have an important social element as they should include the key players in the urban process. In the case of the participatory budget, citizens are invited to participate and decide on projects for the city and where part of the municipal budget available should be spent. At last, the Local Agenda 21 is a tool that promotes several levels of participation

of the population: establishment and decision making. Thus, it contributes to people empowerment, in order, to improve sustainable development in the city and its neighborhoods. Individuals and public or private bodies are invited to discuss urban problems and to find sustainable solutions to improve the quality of space.

In addition, to these informal tools, it can be also weighed other municipal actions that are focused on improving social, urban and environmental sustainability, such as those covering education, awareness and dissemination about the importance of a balanced development.

For a more thorough and substantiated research, in the evaluation process that follows, in addition to the PDM all other tools mentioned above are included in the assessment.

Ranking AML municipalities' sustainability based on their planning and management tools: a methodological approach

The Lisbon Metropolitan Area (AML) has the higher population density and economic concentration, in Portugal. AML comprises 18 municipalities, divided into two half by the Tagus river, 9 municipalities in each margin, covering a total area of about 3 000km², and although it represents only 3.3% of the Portuguese land, here lives almost 3 million inhabitants, about a quarter of the population (Figure 1). At the economic level, it concentrates around 25% of the active population, 30% of the national companies, 33% of the employment and contributes with more than 36% of the national GDP. With an Atlantic coast of about 150km and a riverfront of around 200km, the AML has a great variety of morphology and an important natural wealth, which give it an environmental, landscape, economic and leisure potential that it is important to preserve and value. It has two large estuaries: the Tagus, which is the largest wetland in the country and in Western Europe, and the Sado; in addition, it has five protected areas, integrated in the Natura 2000.

As it was expressed earlier, one of the goals of the present study is to assess whether AML municipalities are pursuing a path for an urban sustainable development. This evaluation is based on the methodology set by Levent *et al.* (2004) where the authors, through a multi-criteria analysis, establish a comparison between some European cities, considering a set of criteria related to their green spaces (Lampert, 2014). But, for the present case study, the aspects used were

defined and adapted to fit the specific benchmark of this research. Therefore, the target was the set of municipal planning and urban management tools available and, namely those considered to be relevant for their sustainable development.

As source for building the database, it was used the official website of the municipalities; the criteria were grouped into three main groups: formal tools, informal tools and other actions. They were all examined according to the adoption or not of such resources. The PDM aspect is the only exception, since it is mandatory, thus it was decided to calculate its efficiency through the time scale of its review, available at the Coordination Commission for Regional Development of Lisbon and Tagus Valley (CCDR-LVT).

Therefore, in the first group, as *formal tools*, was only contemplated the PDM. The second group, *the informal tools*, is divided into three main indicators: the strategic plan, the participatory budget and the local agenda 21; and the last group, *the other actions*, which screens those projects that include social and urban sustainability. In this case, three projects were taken into account: *A Square in Every Quarter*, *Healthy Cities and Aalborg Charter Commitments*. As environmental sustainability projects, were considered those covering relevant aspects such as: hygiene, air quality, noise, water and sanitation, waste management. Finally, the management of green spaces where some initiatives with an educational, awareness and dissemination purpose have prevailed, and which have contributed to the awareness of sustainability. Thus, it was possible to add a total of 9 main criteria to make the comparison among the urban tools of the 18 AML municipalities (Table 1).

The results from the municipal tools assessment

The analysis of Figure 2 shows that in general the results are positive (greater than 0), which means that almost all municipalities have implemented a set of instruments with a sustainable target. In fact, 8 municipalities have a score higher than 0.5 suggesting that almost half of the municipalities have a more sustainable path based on the tools adopted. The northern part of the AML, represented in blue, has the municipalities with the best results. On the south bank of the Tagus River, Almada is the only exception, and ranking third in the test.

In a closer perspective, Lisbon stands out, being the best placed municipality. The reason may



Figure 1 - The municipalities within the Lisbon Metropolitan Area

Source: authors

be related to the municipality relevance to the country, since it is the capital. Also, the impact of some conferences that were held in Lisbon, such as, the second European Sustainable Cities and Towns Conference, on central, regional and local authorities growing interest in following a sustainable path. This has brought to the spotlight issues such as the need to implement the natural heritage protection, the urban pollution reduction, developing more and better green spaces for a healthy lifestyle and inter-generational relationships and inner cities social-economic problems, etc. In addition, tourism has become a central part of the city's economic growth and therefore it is crucial to have a positive image and so, the city public space has gained relevancy. Obviously, to work and take these sustainable measures and strategies, municipalities are dependent on policies that have underlying concern for sustainability.

Cascais is a similar case to that of Lisbon, showing values above average (0,88) and so it is well positioned compared to other municipal boroughs. Geographically close to Lisbon, Cascais municipality has been attracting Portuguese and foreigner visitors. Since the Second World War, many important European aristocratic and rich families have found refuge and set residence there. At present, as the result of the vast natu-

		FORMAL tools	INFORMAL Tools				OTHER actions			
		PDM	Strategic Plan	Participatory Budget	Local Agenda 21		Urban & Social Sustainability projects	Environmental Sustainability projects (health, air quality, waste & green spaces management, etc)	Educational & Awareness initiatives for Sustainability	Dissemination initiatives for Sustainability
		Revision Time	With vs. Without	With vs. Without	With vs. Without	in force	With vs. Without	With vs. Without	With vs. Without	With vs. Without
Municipalities on the North Tagus River bank (the Great Lisbon)	Amadora	-	+	+	-	-	+	++	+	
	Cascais	+	+	+	+	+	+	++	+	+
	Lisboa	++	+	+	+	+	++	++	+	+
	Loures	+	+	-	-	-	+	++	+	+
	Mafra	-	+	+	+	-	-	++	+	+
	Odivelas	+	-	+	-	-	+	+	-	-
	Oeiras	+	+	-	+	+	+	++	+	+
	Sintra	++	+	+	-	-	-	++	-	+
	VFXira	-	+	+	+	+	+	++	+	+
Municipalities on the South Tagus River bank (the Great Lisbon)	Alcochete	-	+	-	+	-	-	++	+	+
	Almada	++	+	-	+	+	+	++	+	+
	Barreiro	+	+	-	+	+	+	++	+	+
	Moita	-	+	-	-	-	-	++	+	+
	Montijo	+	+	-	+	+	+	++	+	+
	Palmela	+	+	+	-	+	+	++	+	+
	Seixal	+	+	-	+	+	+	++	+	+
	Sesimbra	++	+	-	+	-	-	++	+	+
	Setúbal	+	+	-	-	-	-	++	+	+

Table 1 - Assessment of AML Urban Planning and Management Tools

source: authors

ral and cultural heritage, tourism is a significant part of the city's dynamics.

Sintra, despite its potential because it has a World Heritage Cultural Landscape, and also, close to Lisbon, did not achieve a satisfactory result (0.17) according to our criteria chosen for analysis. A possible explanation for this might be that policies are not being effective from a sustainable development standpoint and changes must be made in order to increase and/or improve it.

Almada is ranked third, and its result is close to that of Cascais (0.82). As in this municipality, Almada has a strong brand on the natural resources, with a long coastline that houses a long sandy beach fringe, and so, the results also suggest that measures are being taken to protect the territory and there is a strong commitment towards a sustainable development.

Amadora, with a score of 0.29, and Odivelas with the lowest score are both an interesting case

since despite their results they are included, from the beginning, in the small group of AML municipal districts that has signed both the Healthy Cities and Aalborg Charters. Nonetheless, the explanation for these scores are not similar; in the first case, it is the result of the time taken to prepare and review the PDM, it has taken over 16 years (Freire and Crespo, 2011) and the lack of a Local Agenda 21; therefore, its outcome on the present evaluation was undermined; and, in fact, Amadora has been showing an awareness for the importance of improving the quality of public spaces and, in particular, green spaces and pedestrian mobility. In the case of Odivelas, there is a poor outcome because it has been feeble in the application of tools and strategies for a more sustainable development. Meanwhile it was perceived that is being lacking a more acute approach, such as improving the cleaning and the maintenance of the urban space, people empowering in decision-making processes or

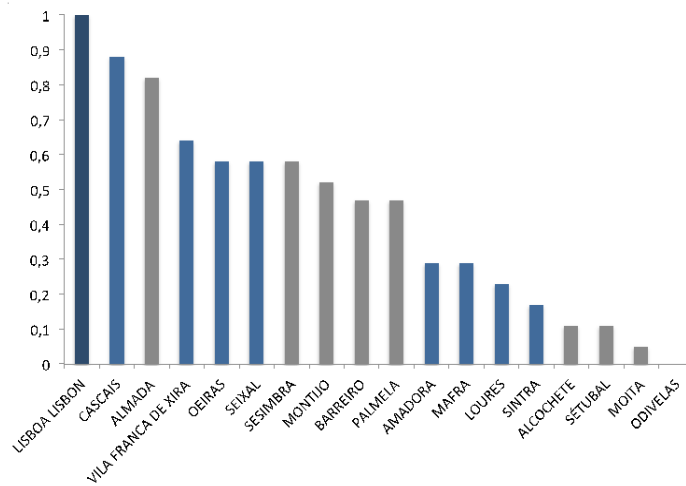


Figure 2 - Results from the assessment of the sustainability level of AML Urban Planning and Management Tools in use

Source: authors

becoming more concerned with increasing education, awareness and dissemination on sustainability issues. However, we are aware that the lack of data online on the official website may be a cause for such results. In any case, it is a issue to be acknowledged because the disclosure of information is an important aspect in today's society, which contributes to citizens' awareness and commitment to their city.

As it can be seen on the table 2, one of the tools that it has been adopted by municipalities, and, in recent years, even by parishes, it is the participatory budget, which by its peculiarities and increasing importance, it will be evaluated and outlined separately, on the following topic.

The participatory budget

In addition to formal tools, there are other informal and more participatory ones with implications on planning decision-making. This is the case of the so-called participatory budget (PB) taken and applied as a project of a public participatory management model. The PB can be defined as an informal example of urban management, with the direct participation of the population on establishment of the priorities regarding the use of part of the municipal budget. For Cabannes (2008) the PB is a process through which the population decides, or contributes to the decision making, on the destination of a part, or of all the public financial resources available for a given territory. In addition to formal

tools, there are other informal and more participatory ones with implications on planning decision-making. This is the case of the so-called participatory budget (PB) taken and applied as a project of a public participatory management model. The PB can be defined as an informal example of urban management, with the direct participation of the population on establishment of the priorities regarding the use of part of the municipal budget. For Cabannes (2008) the PB is a process through which the population decides, or contributes to the decision making, on the destination of a part, or of all the public financial resources available for a given territory.

This initiative has its roots in Porto Alegre, Brazil, in 1989. According to Hoskyns (2005) after a few years, the participatory process has made Porto Alegre the city with the highest quality of life in the country. PB is a new form of governance based on the direct participation of citizens. Since the beginning of the first experiences, the PB has been raising the empathy and recognition from different sectors of society. It is a worldwide phenomenon, current in all continents, with a particular emphasis on Latin America, Europe and, more recently, in Africa. Although there is no overall statistics on the number of existent PB, it is estimated that they currently exceed 2,000 worldwide.

In Portugal, the first stage (up to 2004) has comprised consultative and in-person processes; the second (post-2005), has included deliberative processes with the possibility of *multichannel* participation; also, in this last phase, the

Town Councils developed autonomous processes of the municipalities. The empirical analysis undertaken, it has revealed the low incorporation of participatory mechanisms within the participatory budget. This tool, throughout the country, has its most effective expression in the Lisbon region (Crespo, 2013).

Lisbon municipality was the first European capital to implement the PB, aiming to strengthen the link between the municipality and its citizens. The Lisbon PB had its first edition in 2008, and dissociate from other similar experiences because it is a truly deliberative process, which confers effective decision-making power on citizens to present proposals for their city and to vote on the projects they consider being the priorities. The most voted projects, up to an amount equivalent to 5% of the investment budget, which correspond to five million Euros, are accommodated into the proposed municipality budget and activity plan on the following year. In this context, in July 2008, the Participatory Budget Principles Charter of the Municipality of Lisbon was endorsed; annually, there is an evaluation of its results and, in order to improve it, adjustments may be added reflecting an evolutionary nature. It can be identified a set of the PBs potential as a participatory and territorial management tool: the institutionalization of participation, allowing commitments to citizens in the definition of investment priorities; the powers equity and the creation of a space for direct communication and cooperation between elected representatives and voters; to boost the citizens identification with the destiny of its municipality (Dias, 2008).

In addition, in 2010, the BIP/ZIP program (Priority Intervention Neighborhoods/Priority Intervention Areas) was implemented by the Lisbon City Council. It is an initiative by the authorities to create opportunities for the participation of the inhabitants. The BIP/ZIP program is part of the Local Housing Program (LHP) and aims to stimulate partnerships and small local interventions to enforce social-territorial cohesion. The need and relevance of this program is the result of the existence of degraded neighborhoods, where there is poor living conditions, consequences of the urban decline and the lack of social partners. Thus, it contributes to improve the quality of life of residents and the municipality as well. To achieve this, the municipal authorities got involved with residents, parish councils, architects, lawyers, start-ups and other professionals to boost local development and bottom-up urban planning.

Finally, it is important to emphasize that Lisbon is the only European capital with participatory tools: both the PB and the BIP/ZIP program.

Conclusions

Obviously, all PDM problematic conditions have created difficulties in achieving and consolidating sustainable urban development (Rego, 2014). This is probably the reason why there is the need to support a more sustainable urban planning based on other informal tools that can help improving the efficiency of the urban policies. At the end, decision making tends to be essentially based on these other planning tools rather than on the PDM.

In general, within AML municipalities and, in particular, that of Lisbon, have been promoting and implementing some actions and applied urban planning and management tools in order to set a strategic and sustainable development. However, there a clear difference between the municipalities of the north margin (with higher values) and the southern margin (with lower values) of the Tagus Estuary in the adoption of such procedures.

In order to be successful, there must be a respond and reciprocity of the citizens with their involvement in the municipal instruments and actions, the most desired participatory governance, endorsed strongly at the LA21 and, in particular, as the first rule of the Aalborg Commitments set on: *we are committed to energising our decision-making processes through increased participatory democracy* (ESCP, 2004, p.2). Taking into account the results from the participatory budget and the BIP/ZIP study, they could be ways to get citizens engaged actively in sustainability targets. In both, the involvement of the population and the territorial actors is a binding matrix. And following the positive experience from the case of Lisbon municipality it is clear that people are willing to get involve on solving the problems in their surrounding environment. Hence, the empirical analysis undertaken has revealed that the participatory practices implemented arise as a response to the urban problems, the administration and the social needs of the inhabitants.

The debate and practices on participation and involvement of the population in sustainable urban management have a new angle. It emerges as a positive measure to face the economic crisis, to cover the present user's needs and an attempt to connect the population with the au-

thorities and legitimize their decisions. This new circumstances promotes more contextualized responses, a sense of belonging and adequacy of resources. Participation is seen as a fundamental tool for sustainable urban planning because it fits and facilitates implementation in diverse territorial contexts; it also adapts to diversified social, political, economic and ideological transformations.

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Voids in the Cities: Obstacles or Opportunities? The Practice of Urban Agriculture in Lisbon¹

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Abstract

Urban voids can be defined as temporary vacant spaces in contemporary cities generated by various processes which are connected to urbanization. With this research we look at the process of legalization and recognition of informal uses of voids in the contemporary city. We focus on a case study in Lisbon, where we aim to understand how the municipality (CML) perceives and deals specifically with the informal urban agriculture; how the municipal regulation of those uses is implemented and how are the resulting changes perceived and accepted by the users.

We registered different perspectives from farmers and the CML regarding the appropriation of space. CML's idea of how space appropriation

in the gardens should be made is oriented towards the creation of an ordered and aesthetic environment, which collides with the functional and affective way farmers relate to the land. In general we find that the municipality is changing methods, getting closer to an inclusive approach by integrating the former users in the projects. However there is a pre-selection of which farmers' needs are amenable to be integrated in the projects and thus the top-down way of implementation persists.

Keywords

Voids, Urban agriculture, Urban planning, public participation

Introduction

For a long time agriculture has been an important part of urban settlements (Mougeot, 2000; Henriques, 2009; Matos and Baptista, 2013). With the rapid concentration of people in urban areas since the industrial revolution, cities tended to spread, assimilating great part of farming areas (Martins, 2012; Matos and Baptista, 2013). Rural land was thus reduced to "pockets" in the city, today in the form of gardens or tracts of recreational land that were eventually integrated into the city in the form of public gardens (Martins, 2012). However much of these fertile areas remained without formal use, providing "a certain continuity that allows the flow of air, of water and matter, simultaneously with the flow of residents or casual users" (Matos and Baptista, 2013, p. 457). According to Gandy (2012, p. 4) since the last quarter of the 20th century there was an increase of unplanned void spaces which do not appear as a result but as a side effect of the planning process (*idem*). This is visible in Lisbon as a consequence of multiple processes including a so-called urban shrinkage which

derives, among other phenomenon, from deindustrialization and depopulation (Lima, 2011). In European regions where these processes are most visible comes the question of how to handle these spaces (see e.g. Haase, 2008; Rink, 2009; Rösler, 2008; Lima, 2011). Agriculture or urban gardening can be one of the solutions.

Urban planning is just one side of the city development. It is the regulated, intentional and conventional process which depends on formal agreements and development of documented plans, centrally decided by city authorities, with more or less participation of citizens. In such discourse the space is seen as "abstract" (Lefebvre, 1991, p. 49-50), as a void which should be filled by meaning. However, at the same time there is the informal everyday use of the void space, which sometimes stays unrecognized by the official discourse. The inclusion (or exclusion) in the city plans of this kind of informal appropriation of space lays on power relations among city dwellers and among city dwellers and local authorities, relying mostly on daily negotiations (Purcell, 2013). According to Dias *et al.* (2014) top-down approaches tend to over-

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look already existing local initiatives, something that may jeopardize the actual implementation of the pre-conceived plans. According to Salet and Thornley (2014) informal projects may go ahead and be included in the planning of the city and such informal activity becomes more important if the formal mechanisms are lacking or leading to dysfunctional results” (Salet and Thornley, 2014, p. 196). In Lisbon, formal and regulated urban agriculture is a recent initiative that stemmed from informal practices initiated decades ago in city voids (CML, oral communication, 2015). Nowadays we witness the regulation and integration of much of these practices in the city’s master plan.

With this research we aim to understand how the municipality of Lisbon perceives and deals with the informal use of voids in the city, specifically with the informal urban agriculture; how the municipal regulation of those uses is implemented and how are the resulting changes perceived and accepted by the users. There are several studies regarding city planning in Lisbon (Alden and Pires, 1996; Silva v Syrett, 2006; Pereira and Silva, 2008; Raposo and Valente, 2010; Lima, 2012; Matos and Batista, 2013) and specifically urban gardens in Lisbon, including the informal ones (Martins, 2003; Madaleno, 2003; Henriques, 2009; Matos, 2010; Martins, 2012; Bernardo, 2013; Cabannes and Raposo, 2013; Silva and Monte, 2014). However, to our acquaintance, there is no study that follows a specific ongoing project of legalization of the informal gardens in order to analyze the methods used by the municipality, the results of these methods and the assumptions that underlie them. In this paper, by approaching stakeholders in the course of the implementation (the case of Vale de Chelas) or shortly after it (the case of Quinta da Granja), we were able to describe a specific legalization process in real time. The reported change of approach regarding the role of citizens in the process of city planning, by adopting a more inclusive position, added to the recently implemented strategy regarding the planning of green spaces in the city, allowed us to question whether this endeavor is being fulfilled.

Lisbon’s Strategy for Urban Agriculture, specifically the legalization and regulation of informal agricultural practices provided the framework for the research. We conducted semi-structured interviews with city space planners and with former informal users of the city space in two recently constructed farming parks, both located in places with previous informal farming activity. With this research, we gathered

the views of the stakeholders towards the farming parks and towards the performance of the other stakeholders. Furthermore we sought to understand which assumptions and ideas underlie the municipal projects of farming parks and what reasons influence the farmers’ practice.

We start by discussing the position of void urban spaces in the current urban planning discourse. We stress the contrast between the roles of urban planning and informal uses, where the former is a tool for a formal definition of the functions of void urban spaces and the latter is a process of its everyday appropriation. Other important characteristics of the urban planning discourse are mentioned, especially the connection with ideas of utopian thinkers, still significantly present in the contemporary planning discourse. Next, after a brief introduction to the emergence and practice of urban planning in Portugal over time, and after presenting the research’s goals and methodology, we present the research results. There, we focus on the perspective of the municipality and of users, both during and after the implementation process. We try to reach the assumptions which underlie their perspectives. In the last chapter we discuss the results within the framework of the current urban planning discourse. We conclude the paper with some general remarks regarding the present and future of the urban voids in Lisbon.

Theoretical framework

Void urban spaces in the current urban planning discourse

Urban voids can be defined as temporary vacant spaces in contemporary cities (Rahmann and Marieluise, 2011), generated by various processes which are connected to urbanization. According to Santos (2011), they are the result of both city expansion and decline. They can be part of the city periphery as residual spaces around infrastructure or produced by unregulated suburban development. We can also find them in city centers as abandoned sites, brownfields or interstitial voids between buildings (Santos, 2011).

Voids can be produced by urban shrinkage, a phenomenon that is affecting many European cities nowadays. The term urban shrinking is used to describe a situation when “loss of population and economic downturn have brought about a fall in the demand for housing, commercial property and social infrastructure buildings”, which caused an “increasing number of

² In Europe we can find good examples of this process in some cities in eastern Germany, for example in Leipzig or Dresden (Haase, 2008; Lima, 2011, p.8).

vacancies calls for the demolition of buildings, producing more empty spaces and transforming the urban fabric” (Rösler, 2008, p. 147). Urban shrinking is very often derived from the process of deindustrialization of formerly prosperous industrial regions (Haase, 2008, p. 1-2)³.

Voids can also be residual spaces (Wikstrom, 2005) or spaces left over after planning, i.e. SLOAPs (Doron, 2007, p. 20). Wikstrom (2005) describes them as “unplanned or left-over land” which is often an “indirect result of planned building”. They occupy a “periphery of architects’ and planners’ intentions” (Wikstrom 2005, p. 50), but they are intrinsic to urban planning (Nielsen, 2002, p.54).

As summarized by Doron (2007) we can also find other concepts describing these phenomena in architecture and urban planning discourse. What they often share is the subjective judgment and aesthetic appreciation, which do not recognize many of the functions that the voids can actually have (Doron, 2007, p. 14-15). This is also stressed by other authors. McDonogh (1993) shows how the “speculative emptiness” connected to vacant lots is usually seen as a “natural, short-term phase within our models of growth and change in a ‘healthy’ city”, but as “wasteful, uneconomic, or threatening” when it lasts too long (McDonogh, 1993, p. 7, similarly Edensor, 2005, p. 8). As Haase argues, European urban policy makers still concentrate on the idea of growth, therefore urban decline or stagnation is seen as something undesirable (Haase, 2008, p. 1).

However, Haase (2008) shows, that recently there is an emergence of approaches that search for new ways of raising life quality, even in low-density or shrinking cities, and which do not rely on the idea of an optimistic economic and demographic future (Haase, 2008). Also Gandy (2012) argues that spaces once “regarded as marginal or aesthetically problematic have gradually gained an increasingly significant role in urban discourse”. According to the author, it is a consequence of “changing aesthetic characteristics of cities themselves and the proliferation of anomalous or ‘empty’ spaces” (Gandy, 2012, p. 4).

In the Portuguese context, voids are often called expectant spaces in the planning and architectural discourse (Santos 2011, p. 35). As concluded by Veiga et al. (2010), these spaces “are the result of the functioning of the land market,” being “inside the game of interests between public and private actors” (Veiga et al., 2010). Lisbon’s voids could also be connected to the process of urban shrinking³. Lima (2011) draws attention to the fact that during the economic

crisis Lisbon’s shrinking process can be accelerated. Therefore the author argues that we need a new no-growth paradigm of urban development consisting for example of creation of more public and green spaces (Lima, 2011, p. 15).

Formal and Informal Uses of Space

The prevalent approach to marginal urban landscapes in the contemporary urban design is rather utilitarian seeing them mainly as a waste space rather than discovering their “intrinsic qualities” (Gandy, 2012, p. 5). Unofficial or marginal activities often stay unrecognized, ignored, or are even excluded (Edensor, 2005). Edensor (2005) argues that since the contemporary city becomes increasingly subjected to regimes of regulation and demarcation, [...] certain spaces are deemed suitable for nothing. “However these spaces can play roles that cannot be fulfilled by the highly regulated contemporary city: they can be for example spaces for leisure, adventure, cultivation, acquisition⁴, shelter and creativity” (Edensor, 2005, p. 21).

Similarly, McDonogh (1993) argues that some uses that answer to specific needs of particular social groups are seen as inappropriate and thus are not included in the urban design. To describe the spatiality of this exclusion processes McDonogh uses a concept of empty space. He defines it as a space void of certain specific contents, while “the process of definition of correct and incorrect contents can derive from territorial struggles between groups of users” or from the “imposition of cultural values” of one social group “upon the space” (McDonogh, 1993, p. 9). We can see the process of exclusion as a part of a broader tendency of the contemporary Western city to produce ordered and regulated space which is characterized by “surveillance, aesthetic monitoring and the prevalence of regimes which determine where and how things, activities and people should be placed” (Edensor, 2000, p. 54, similarly Gandy, 2006b, p. 507).

But despite this tendency, the contemporary city and its society is not controlled by one center of sovereign power. According to Gandy there is always an “interplay between formal and informal networks of power, and between the visible and invisible manifestations of authority.” Thus “society is increasingly controlling itself through innumerable surveillance networks” (Gandy, 2006b, p. 507-508). Amin and Thrift (2002) also argue that there will always be blind spots, overlooked spaces, which exist out of the networks of production and power, out of the systems of

³ According to Lima (2011) Lisbon has been shrinking since the 1960s, mostly between 1981 and 1991 when the population was reduced by 40% (Lima, 2011, p. 13), which created a significant amount of abandoned buildings and areas around the city.

⁴ E.g. plundering and collecting of materials or food etc.

regulation (Amin and Thrift, 2002, p. 92). We can see void spaces, appropriated and reclaimed by their everyday users, as a good example of such blind spots. The inclusion (or exclusion) of informal appropriation of space into the formal planning depends on power relations among city dwellers and among city dwellers and local authorities, relying mostly on daily negotiations (Purcell, 2013). As Salet and Thornley (2014) state informal activity becomes more important if the formal mechanisms are lacking or leading to dysfunctional results.

In Lisbon it is frequent to find spaces of different dimensions apparently with no formal use. Some belong to the municipality; others are privately owned by individuals or institutions⁵. According to the municipality⁶, informal uses may be more or less tolerated by the owners of the space. In some cases there is a tacit agreement between the owner and the user, in others the uses are maintained until the owner is aware of the situation or until there is another use defined for the area. This also applies to expectant spaces owned by the municipality where many unregulated urban gardens are located. Nowadays we witness the regulation and integration of much of urban gardening practices into the city's master plan, i.e. integration of informal practices into the conventional planning. However, it is difficult to predict which uses or practices will be considered by the authorities to be part of the formal plans. As pointed by Salet and Thornley (2014), "institutional conditions can never fully explain what strategies are brought forward in social and political practices; they only offer conditions (particular opportunities and constraints) that vary between different institutional contexts. Urban policy practitioners respond to these conditions in the most intelligent way they can" (Salet and Thornley, 2014, p. 197).

Utopian visions of an ideal city in urban design

In order to explain deeper reasons underlying the tendency to regulate space of contemporary city and exclude some uses, we look at utopian ideas hidden in the urban planning discourse. Many of the ideas which we find in the history of urban planning were inspired by thoughts of utopians, especially the idea that if we give a new

order to space, we will also positively influence society (Harvey, 2000, p. 154, similarly Gottdiener and Hutchison, 2011, p. 332). Designed nature, which includes parks and gardens, played a significant role in the process of utopian change of the city as well (Gandy, 2006a; Clark, 2010). In its controlled and regulated form, nature was expected to have a role in the construction of the healthy and beautiful city (Gandy, 2006a, p. 66-67; Clark, 2010, p. 144), and also of the ideal society (Burrell and Dale, 2002)⁷.

According to Gandy, the "earlier attempts to create an Utopian synthesis of nature and culture were gradually supplanted in the 20th century by a more radical and technologically inspired vision" which Gandy calls "hygienic city" (2006a, p. 66). This idea combined the earlier conceptions of healthy city with the use of green spaces and the scientific management of space, bringing a vast diversity of innovations such as "land use zoning and regional planning" (Gandy, 2006a, p. 66). But the implementation of this new utopia did not bring expected results, and during the 1950s and 1960s "planners themselves increasingly recognized that the ideal of 'master planning' was illusory and began to explore ways of bolstering their legitimacy through wider public consultation" (Gandy, 2006a, p. 67).

Public participation as a tool of urban design

Probably the most influential reaction to the conflict of the modernist fantasies of ideal city with the lived reality was the famous work of Jane Jacobs *The Death and Life of Great American Cities* (Jacobs, 1961). The author opposes the prevailing way of urban planning of the first half of the 20th century and stresses the importance of public space and street life. She claims that planning should be reoriented back to human scale and recognize users as co-creators of public space. The organization of public spaces should contribute to the creation of intimate relationship among neighbors and thus create a sense of community (Jacobs, 1961).

Jacobs's vision was criticized by some authors. For example Harvey (2000) objected that Jacobs was in her own way every bit as utopian as the utopianism she attacked. Harvey argues that in her conception there is also an "author-

⁵ For example, we find many spaces in road encroachments around Lisbon's Metropolitan Area (LMA) left without any use that are now informally used for farming. Also in the recent past, there were cases of informal organizations starting cultural and leisure activities in abandoned buildings. (E.g. Casa de São Lázaro in Lisbon, (2010) an occupied building used for cultural expression, exhibitions, communitarian meals, concerts, etc., evicted by the CML; Laranjinha, an occupied primary school used for cultural and educational activities, located in the Sintra municipality, Damaia, very near to the borders of the LMA, also evicted by the municipality of Sintra).

⁶ Information collected through an informal interview with two people of the staff responsible for the planning of city's green spaces.

⁷ The authors show this on the example of the reconstruction of Paris during the regime of Napoleon III, when gardens were supposed to help with the prevention of social tensions, or in the concept of the "Garden city", which was meant to merge the advantages of living in the city and in the country (Burrell, Dale, 2002).

itarianism hidden within the organic notion of neighborhood and community as a basis for life". Community offers not only security, but also social control which can be oppressive. Thus the social diversity which Jacobs wants to create can work only as a "certain kind of controlled diversity", as Harvey calls it, which is maintained by self-surveillance of the members of a community (Harvey, 2000, p. 164). According to Gandy her approach has its roots in romantic anti-urban sentiments which follow an idealistic picture of rural or small-town society (Gandy 2006a, p. 65). Gottdiener and Hutchison (2011) argue that "Jacobs's ideas about community may also be passé", because people are not fixed in locality to the same extent as in the past (Gottdiener and Hutchison, 2011, p. 337).

But despite some criticism, the idea of community as a base for a viable city advocated by Jacobs endured and influenced urban planning (Gottdiener and Hutchison, 2011, p. 338). We can find it in the concept of participatory or bottom-up planning. Dias et al. (2014) argue, that to create sustainable projects we need to develop a proper bottom-up approach which "identifies the community needs and aspirations" (Dias et al., 2014, p. 501). The authors map the current approaches to urban planning and conclude that despite this need the top-down approaches still prevail. Even when the community is included the professional actors still maintain their dominant lead over the other stakeholders. "In some top-down approaches which include the public in the later stages of planning there is a risk of "manipulation of local opinion rather than a genuine participation, because the agenda has already been framed and developed by the professional actors" (Dias et al., 2014, p. 500).

Urban planning in Portugal

As Alden and Pires (1996, p. 27) argue a "planning system is very much a product of its special political and constitutional history". In Portugal, there was a monarchic system until 1910 and in 1922 a right wing coup gave rise to a dictatorship that only ended in 1974 with the 25 April military coup. The lack of political and financial autonomy of local authorities under the dictatorship led to the absence of autonomous initiatives in development planning (Alden and Pires, 1996). Therefore, the centralized process of decision-making was perpetuated until the 1980's, when the Municipal Master Plans (Plano Director Municipal, PDM) were introduced in

order to decentralize planning; to introduce the concept of social and economic development in city planning, until that time disregarded; and to integrate the public in the decisions concerning urban territory (Alden and Pires, 1996). However, only in the 1990's, motivated by a change in the law that simplified the process of plan preparation, the objectives of the PDM started to be reached (Idem).

The process was enhanced by Portugal's integration in the European Union (Alden and Pires 1996; Silva and Syrett, 2006; Moreira, 2013). Thee access to the European funds redirected the public policies at the local, regional and national level (Silva and Syrett, 2006). At the organizational level the use of European funds led also to changes in the state administration, leading to the strengthening of the regional tier of territorial administration (Silva and Syrett, 2006).

Regardless of the institutional changes achieved, the difficulties to translate planning principles into specific practices have prevailed over the declared policy intention of disseminating and applying such principles (Pires, 2005). Despite several initiatives to strengthen other strands of government besides the state, and almost 40 years after the 1976's constitution, centralized power is still an issue. In the city of Lisbon a central state control still prevails together with a weak "metropolitan government" (Silva and Syrett, 2006, p. 114). Nevertheless, there have been some attempts in Lisbon to include the citizens' views and needs in the process of planning (e.g. participatory budget⁸). According to Pires (2005), despite the ups and downs of official planning policy, ideas to accommodate environmental concerns, to foster public participation and to develop a strategic and integrated dimension to spatial planning, "are gradually finding their way into practical experiments and, consequently, into the agenda of discussion among [Portuguese] planners" (Pires, 2005, p. 241).

Objectives and methodology

With this research we aim to understand how the municipality of Lisbon perceives and deals with the informal uses of voids in the city; how municipal interventions in the city space are implemented and how are the changes perceived and accepted by the users. We focused on the cases of the informal use of municipal land for urban gardens and on the process of their legalization through the construction of official farming parks owned and henceforth managed by

⁸ This initiative is organized at the municipal level and means to involve the public in allocation of part of the municipal budget to projects that deal with the use of city spaces, infrastructures, etc.

the municipality. Since we aimed to study informal uses and methods used by the municipality to manage city space, we searched for farming parks that were constructed in the areas previously used in an informal way as this would enable us to pursue our goal⁹.

Thus the research was developed in two farming parks located in different parts of the city of Lisbon: Quinta da Granja and Vale de Chelas. Quinta da Granja was the first park being built (2011) and Vale de Chelas (2013) is the largest within the area. The first is located in the city center and the latter is situated on the northern outskirts of the city¹⁰. We conducted semi-structured interviews with farmers in both farming parks. We tried to contact people with various relationships with the particular place. Thus interviews were made both to “old” farmers that have been working in these areas for decades, and also to “new farmers”, people that were selected through the public tender¹¹. Along the interviews several issues related to the municipal strategy were raised by the interviewer. Participants were given freedom to develop the subjects as they wished, using their own frames of reference. Semi-structured interviews were also conducted with two people from the municipality who were directly involved in the conception and implementation of the city’s strategy for urban agriculture. We consulted also other sources of information (e.g. the websites of organizations of urban agriculture, national and international; the CML’s website and documents; online newspapers etc.) dealing with the planning of the city and the strategy for urban agriculture initiated by the CML in 2007.

We performed qualitative analysis of the collected data. The number of interviews followed the principle of saturation regarding the results of continuous analysis. The approach of each stakeholder was analyzed according to the aims of the research. We sought to identify similarities and dissimilarities among the various statements of farmers and among the information collected along the interviews with the CML staff and drawing upon other sources of information on the urban agriculture strategy and on the CML’s position on the informal use of municipal land. The results section is further divided into three sections: first we use the data obtained along the interviews with the CML staff and we focus on the informal uses in the city of Lisbon and on the strategy of the municipality

towards these uses; secondly, referring also to the CML’ interviews, we focus on the Lisbon strategy for urban agriculture; finally we present farmers and CML’s perceptions and motivations towards the farming parks’ projects using the information collected with farmers and the CML.

Results

Informal uses and urban voids as expectant places - a municipal perspective

According to the municipality, control over the informal appropriation of municipal expectant spaces by citizens was, until recently, random and aimed to deal with the situation in an effective and fast way and with the least logistics possible. Allegedly this was the result of the lack of staff to perform the monitoring and regulation of the uses and therefore the process consisted mainly on the expulsion of the users (CML¹², personal communication, 2015).

Recently the CML initiated an inventory of the existing municipal expectant places and their uses. Before the inventory was finished the responsibility had been passed on to the parish council (*Junta de Freguesia*) as a result of the reform of local authorities’ institutions in 2013 (Reforma da Administração Local - CCDRN, 2016; CML, personal communication, 2015). Taking into account the diversity of uses found along the inventory, the CML perceived farming activities as “the best examples of uses found” and started a process of legalization of the occupation of space in which some of the uses were perceived as being unacceptable (e.g. prostitution bars, car workshops and storage houses or leisure places for family and friends). Before such findings the municipality felt the need to terminate these initiatives in order to regain control over the city space (CML, personal communication, 2015).

Gardening as an acceptable informal use

As we were told by the CML, their strategy towards the “acceptable” informal uses of the municipal space is based on the principle “if you

⁹ In these parks the gardens were classified as “social gardens”, i.e. regulations and objectives were different from other urban gardens. In social gardens the promotion of social and economic wellbeing was intended, thereby allowing farmers to sell their production. Gardening was also considered as an occupational therapy for unemployed or retired people. Creating the possibility for people already farming there to stay was also a pre-determinant.

¹⁰ Further details on the parks can be found in the results namely in the section II regarding Lisbon’s strategy for urban agriculture.

¹¹ Along the interviews the difference between the views of the new and the old farmers became evident. This was related to the fact that the new farmers were not acquainted with the previous form of informal use of the place. Once the aim of the study was to analyze the strategy of the CML towards informal uses we concentrated on the “old farmers” discourse. Therefore, most of the results presented in this paper are based on the perceptions of the old farmers, despite we took into account also the “new farmers” perception when it was relevant.

¹² Department of Green Structure and Energy [Pelouro da Estrutura Verde / Energia] of the municipality of Lisbon

can't beat them, join them". Thus, when confronted with informal uses susceptible of being included in the city planning, the CML proceeded with their regulation. Among the several uses found in these areas during the inventory, farming was the most common (CML, personal communication, 2015).

Informal urban gardens are legalized by establishing a contract between the farmer and the CML. This contract does not include any investment by the municipality (e.g. water system, fences, storage houses, etc.), only imposes some simple rules considered essential for public health and aesthetic issues that consist mainly of prescribing the materials which can be used (e.g. wood as a degradable material is preferred to other materials such as plastic or metal), and prohibiting the storage of stuff and garbage and to construct any structures. Farmers can continue farming until the CML has another formal use for the land. In the meantime they pay a symbolic annual fee. The legalization of these uses was a strategy that helped the CML to regain control over some parts of the city space. Furthermore, by keeping the space actively occupied the CML prevents the appearance of other potential but less acceptable uses (e.g. emergence of landfills etc.) and also the degradation of the soil.

Municipal Strategy for Urban Agriculture

In Lisbon the inclusion of formal agriculture initiatives in the city planning started recently, except for some rare initiatives in the end of the 1990's¹³ (Henriques, 2009).

According to the CML in 2007 there was a change in the management and conception of the city's green spaces by adopting a more functional perspective of these areas through the inclusion of sports and leisure activities in the parks and gardens (e.g. kiosks, gymnastic devices, cycling roads). Also, agriculture was considered to be an important part of the green planning of Lisbon, which was first put to practice through the adoption of Lisbon's Green Plan, henceforth integrated in the City's Master Plan, thereby establishing Lisbon's ecological structure¹⁴.

Within this framework the strategy for urban agriculture was initiated and a committee was created for its implementation. As we were

told, after some research and visits to other European cities to gather experiences, the committee conceived the "farming parks" which would include both farming plots and green spaces for recreation. This choice was based on the idea that agricultural activities should not be isolated from the rest of the city, on the contrary they should be accessible to everyone in order to raise awareness on subjects such as "food quality", "environment" and "organic farming". The choice was also economical since it was more cost-effective to construct a farming park than a conventional garden; furthermore the maintenance of the space, which generally represents a significant part of the budget, would be guaranteed by the farmers (CML¹⁵, personal communication, 2015). Thus farming parks were defined by the CML as "urban structures to be used by the farmers that are also open to the public for diverse leisure activities, with pathways for people to walk and cycle" (Henriques, 2009; CML, 2016).

According to the CML's website these spaces were created "to contribute for the development of an environmental conscience by learning and applying good farming practices and to incentive the interaction between neighbors and strengthen social bonding among the users". On the environmental perspective, the "farms should promote the ecological balance of the territory through the use of good farming practices that would protect biodiversity and the ecosystems and enhance soil fertility and drainage capacity" (CML, 2016).

Among regulated farms the CML established different types according to the main objectives underlying their creation: leisure farms, pedagogical farms and social farms (CML, personal communication, 2015). Social farms consisted of institutional farms created as a project of social support aiming to decrease social injustice and urban poverty. Therefore the annual fee requested for the use of these farms is lower when compared to the leisure gardens; whenever possible the plots in the social gardens are larger (minimum of 100 m²) than in the leisure gardens (minimum of 50 m²) and the selling of the products is allowed (CML, personal communication, 2015). Social gardens are associated with the farming parks built where farming activity was already a reality, assuming that those farmers are the ones that mostly take advantage of those benefits.

In 2011 the first two parks were finished and

¹³ An example is a Pedagogical Farm in Olivais in 1996, aiming to promote environmental education through a non-formal education concept, integrating the pedagogical and recreational components. It is a public facility managed by the municipality of Lisbon through the Education Department (CML, 2016; Henriques, 2009).

¹⁴ With the plan, its author, the landscape architect Ribeiro Telles, meant to create green corridors through the city that would connect different types of land uses, such as gardens, urban spaces and some of the already existing farming plots (references). It also intended to increase the number of farming plots.

¹⁵ Former Department of Urban Environment, Division of Studies and Projects [Departamento de Ambiente Urbano, Divisão de Estudos e Projectos]. Current Department of Planning / Urbanism / Urban Rehabilitation / Public Space / Patrimony / Municipal works [Planeamento / Urbanismo / Reabilitação Urbana / Espaço Público / Património / Obras Municipais]

opened to the public: one of them in *Quinta da Granja*, Benfica, which is one of our case-studies, and the other in another area of the city, Campolide. As a part of the project, the CML provides fences, storage houses, and installation of the water system; technical support and workshops on organic farming techniques. In 2013 other 4 parks were completed, one of them in Vale de Chelas (our other case study). In 2014 the city had already 10 farming parks and more of them were completed in 2015 (CML, 2016).

After the farming parks' regulations had been created, the municipality started the search for the most proper locations. The criteria were based on the fertility of the soil, on the functional category of the area on the PDM, localization and other circumstantial factors related to the specifics of each place. At first the CML looked mainly for places classified as "green spaces for leisure" and "productive green spaces"¹⁶. Among those, spaces with high agricultural potential were selected. In a second phase the Green Structure Department¹⁷ wanted to go further and also started to look for places that were under other categories on the PDM, but which had suitable characteristics for agriculture. Their use was then negotiated between the different departments of the municipality (CML, personal communication, 2015). Although this is not assumed to be a selective criterion by the CML, most of the places where the parks are implemented¹⁸ had been already used for informal farming. Nevertheless, not all expectant spaces with previous agricultural use are considered equally interesting to be integrated in parks: either the soil is not fertile and/or the localization is not suitable for the purposes of the CML's project, or there are simply no financial conditions to construct the park. These legalized farms not integrated in parks are called "disperse farms". According to one of the interviewees from the CML, the existence of prior farming activities is mostly related to the priority given to social gardens by the municipal strategy for urban agriculture. By consolidating these farms into the farming parks the CML guarantees to a certain extent that the former gardeners will remain in the regulated areas. These people are not expected to join the public tender to be integrated in the project once they have priority access to the plots, which also helps to assure their permanence on the site (CML, personal communication, 2015). Even though farmers in disperse farms are also allowed to remain working in the place, these however stay in a precarious situation since the contract ends at the moment the CML has another

purpose for the area. When included in farming parks one can expect a more secure situation.

Contextualization of the case studies on CML's strategy for urban agriculture

Quinta da Granja was constructed in 2011 and it was the first park built. It is placed in the former territory of a large private farm. Some decades ago a part of the farm was sold to the municipality by the owners' descendants. In the subsequent years there was no definition of a formal use for the area. According to the municipality, in 1999 the CML conceived a project for the renewal of the area. However, mostly for economic reasons, its implementation was finished only in 2011, already as a part of the municipal strategy for urban agriculture. The planned intervention included the construction of a garden for recreation, and also the implementation of more plots for urban gardening. Today, 56 plots are being used for farming (CML, personal communication 2015; CML, 2016).

As we were told by farmers and the CML, in *Quinta da Granja* farming activity started when the area was still owned by the private proprietor with his permission. This primary group of farmers used water from a water mine and from a well through the acquisition of hoses and engines to enable the collection of water, therefore the CML did not install any water system on that part of the urban park. Other parts of the gardens, newly created with construction of a park, got the water system installed (by the municipality)." (CML, personal communication, 2015).

The farming park in *Vale de Chelas* is more recent (finished in 2013) and with more than 200 plots it is the largest park constructed in the city at the moment (Câmara Municipal de Lisboa - Parques Hortícolas Municipais, 2016). As we were told by the CML, this area is a space left over after the construction of buildings and roads all around that area. It is located in a valley and has been informally used for agriculture since decades ago. The soil is very fertile due to its geographical conditions. The first CML project was conceived for 15 hectares of land, from which 6.5 hectares were for agricultural use (CML, personal communication, 2015). However, due to changes in the project budget, the area had to be reduced and the number of plots decreased from 400 to slightly more than 200 (CML, personal communication, 2015). When the CML started the project more than 100 peo-

¹⁶ Translated from the portuguese, F.T. [*espaços verdes de recreio e de produção*].

¹⁷ Short for Department of Green Structure and Energy of the municipality of Lisbon.

¹⁸ True at least until this research and the fieldwork were finished, summer of 2015.

ple were already farming in the valley (CML, personal communication, 2015). The selection of *Vale de Chelas* was justified by the soil fertility, the dimensions of the space, and also by the imminent real estate projects, that would occupy all of the area, something the CML's Green Structure Department wanted to prevent (CML, personal communication, 2015).

CML's and farmers' perspectives on the project of farming parks

Different perspectives regarding space functions and forms of occupation of the newly built farming parks arose in the discourses of both the CML and the farmers integrated in the projects. In the next section we present both perspectives and we discuss the issues that stood out. We especially concentrate on their views regarding the forms of appropriation of the space within urban gardens which illustrate the way farmers and the CML perceive each other's interventions in the public space.

Implementation process

When we asked farmers if the CML included their perspectives on the project, in general people did not seem to understand the question. The possibility of integration of their opinion was not even considered by the farmers. So, when the municipality arrived to *Quinta da Granja* and especially to *Vale de Chelas* to present the project to the population of farmers and to inform them that they could stay after the reconstruction, the general reaction was disbelief. People were not used to this approach. The former municipal control of informal uses was done by literally tearing down the farms and expelling the farmers (especially in *Vale de Chelas* where, according to the CML, this happened recurrently). Nevertheless, once farmers understood what was going to happen and what were their rights and duties, some of the rules seemed difficult to accept. The obligation of sharing the plots and the other resources (water, storage house) with people they did not have any close relation with was one of the changes that caused most friction¹⁹. Also, there were farmers who used to have large unregulated areas that had some difficulties in accepting a situation where everybody was supposed to have the same area, whether they were able to cultivate it and needed the amount of production or not. This rule led some farmers to leave the area.

Prohibition of some social uses of the garden was another critical issue. People were used to enjoy the space in the company of family and friends, in gatherings and barbecues, for resting, etc.

So, when the authorities initiated the contact with informal users they already had a finished project in hand, created exclusively by the municipality without previous consulting with the former and future farmers. Nevertheless, by allowing and prioritizing the access of the former farmers to the plots the CML intended to favor these people, notwithstanding, that this approach was mainly based on their own perspective. So although the CML seems to focus also in fulfilling the farmers' needs, it does not ask them directly what their priorities are. This might explain farmers' noncompliance with some of the settled rules which is leading to conflicts among the users, and between the users and the CML.

For example, while farmers were required to share resources some freedom of choice was also granted (e.g. they could choose the neighbors in the plots; choose the plot location; choose to sell the products or not; respect for the old pathways in the construction of the parks by the authorities). Thus we could say that to a certain extent some of the needs of the farmers were integrated in the projects. However, the selection of needs and priorities (on the projects) was decided by the municipality. As a result we see that farmers circumvent some of the rules. As one farmer says: "Oh yes I can [use herbicides]... I look to the one side, I look to the other... if they [the CML representatives] are not in the surroundings I will use it". Another farmer, one of the oldest in one of the parks, complains when talking about the use of biological products to protect the crops: "Who sets the rules in my land? Them? I am the boss in my land; I am paying to be here" (farmer in QG²⁰, personal communication, 2015).

In turn the CML shows an undeclared tolerance regarding the transgression of some rules: "In the beginning they were very skeptical about organic farming techniques, but now the majority uses it and sees the benefits and that it is not more expensive. There is only one, one of the old farmers that continues to use the products" (CML, personal communication, 2015). Concerning the maintenance of dogs the CML representative adds: "I arrive to the farms and there is this peaceful dog on the pathway next to the owner's plot... Of course I am not going to tell her that she can have the dog there, that is against the rules, but I am also not going to run to put the dog out" (CML, personal communication, 2015).

¹⁹ Although the CML gave farmers the chance to choose the neighbors, not everybody had friends or family interested in renting a plot.

²⁰ Henceforth we will use QG for farmers of Quinta da Granja, and VC for farmers of Vale de Chelas.

CML's view of (formal and informal) farmers' practices

As mentioned, informal uses are seen by the authorities as inevitable and so their strategy to control the uses in municipal expectant spaces is to accept them and regulate them. However, this acceptance is previously weighed and some uses that farmers associate with farming activity are not allowed by the municipality at all, which is not easily accepted by farmers. For instance, from the perspective of the CML, gatherings, having dogs or planting trees, are attempts of the farmers to appropriate space for themselves, and therefore should not be allowed. Other practices that according to the municipality put at stake public health or aesthetics are also discouraged - e.g. use of fertilizers and chemicals to protect the crops.

The expected recreational and aesthetic role set by the CML for the farming parks does not allow the simultaneous presence of seemingly incompatible activities. Thus, accumulation of stuff, plastics or other materials is not compatible with the existence of a beautiful, ordered and attractive garden; keeping dogs and organizing gatherings collide with the possibility of contemplative silence, etc. Therefore the CML prohibits activities that would primarily fulfill the needs and aspirations of farmers in regards to the functions of the garden. In the preferences of the CML we see a tendency to create ordered space, i.e. space that facilitates control of the uses by exhibiting a form of symmetric organization. Aesthetic is intrinsically related to the idea of order and illustrates the need to exclude everything (e.g. materials, behavior, practices) that collides with the CML's notion of beauty and an attractive landscape. Both ideas are related to CML's conception of farming parks which are supposed to have the conventional garden role and be quiet and contemplative spaces.

Farmers' perspective on the implementation and management of farming parks

In general, farmers do not have any complaints regarding the construction of the farming parks. As one farmer said "well, it is a good project, they could have just thrown us out, and it is more beautiful now, more organized" (farmer in QG, personal communication, 2015). CML's previous ways of dealing with informal uses might have an important role here, explaining farmers' positive reaction to the change of the method.

However, in regards to the maintenance of the project, most of the farmers mentioned that the CML is not fulfilling its responsibilities. Farmers enumerate a number of problems: the muddy pathways, the lamps that do not turn on, the lack of a bathroom in *Vale de Chelas*, the quality of the soil in the areas the CML intervened (in both parks), on the top of which CML's response to the complaints is late or absent. Also, as most farmers pointed out, some projects features were not very realistic, something that became clear when applied in the field; for instance the height of the fences and the high number of robberies, or the destroyed door locks in *Quinta da Granja*. Water plays a major role in the farming parks. For most of the old farmers from Vale de Chelas, which had no access to water whatsoever (except for residual water sources or sewers), the existence of water for farming is the reason that led them to accept CML's conditions in the first place and to continue farming there; in Vale de Chelas the existence of water is the central issue influencing old farmers' perception on the farming parks. In *Quinta da Granja*, where the water system was not implemented by the CML and the informal ways for collecting water were maintained the old farmers complain, especially since the new plots constructed with the farming park have a water supply installed.

For farmers, especially the ones that were used to the freedom of the informal way of using the space, there is no separation between the gardens' productive and social function, something that collides with the aesthetic and ordered urban garden concept of the municipality. The subjective appropriation of the space in order to create a warm and familiar environment is part of their perception of a farming plot. As one of the "old" farmers says: "Before I had a huge table, more than 10 people could sit there, we made barbecues, gathered friends and family... now, I tried to create some shadow by hanging one canvas near the storage house, but they said we can't".

Assumptions underlying the CML project

Farming parks as "community sense raising" projects

With the purpose of strengthening community ties the CML created rules from the outside to be applied inside the community without consulting people first; for instance the rule that four people have to use the same tap to water the plants, or that the storage house is always

shared by four farmers. One representative of the CML says: “If the house was used individually these places would turn into the ghetto that existed here before, where some of them ruled and there were a lot of complaints and conflicts among them. We could see it on the meetings” (CML, personal communication, 2015). According to the CML and the farmers, at the time the project started to be implemented, power relations were already established among the farmers. There were farmers that appropriated large areas making considerable business by renting it to people wanting to farm. In fact to be able to farm in places like Vale de Chelas a previous demanding process of preparation of the land was needed since the place was filled with canes and bushes. Thus, land that allowed for immediate farming was much valued by farmers.

Creation of a sense of community by enhancing cooperation and sharing of space and resources is one of the topics of these projects. However this initiative has ultimately fostered the existence of conflicts between the CML and the farmers during the implementation phase - farmers would not accept the compulsory sharing - and later also among the farmers. By pushing farmers to create random relationships and by neglecting the already existing ties and conflicts the CML is inadvertently causing opposite outcomes in respect to those intended.

Rules as tools for the prevention of conflicts and for attending health and environmental concerns

While the municipality inadvertently creates potential conflicting situations, it also creates rules that mean to decrease the probability of conflicts. For instances, the maintenance of animals, the plantation of trees and the individual appropriation of the space are forbidden also because these activities are seen by the CML as potential sources of conflict among the neighboring farmers: the shadow created by the trees; the fruits desired by the neighbors or that fall on the neighbor's plot, the individual and eventually nonconsensual appropriation of a part of the shared plots, all create possible sources of conflict, at least as the authorities perceive it. So we see that while the CML inadvertently raises conflicts with its rules, it creates rules to avoid conflicts that do not exist yet.

Health and environmental protection also seems to underlie most of the guidelines of the farming parks. We see that users are encouraged

to adopt healthy lifestyles (e.g. sports, quality food, or outdoor physical activity) with reduced impact on the environment (e.g. the use of organic farming techniques or preference for wood as a material instead of iron, or other materials not ecologically degradable). Aesthetics also arises as a central issue. Some materials are prohibited because of their impact on the image of the farms; farmers are encouraged to plant flowers near the fences. Most of the rules created to regulate the uses in the *disperse farms* and also in the farming parks focus on the risks they pose to public health²¹ and address aesthetic concerns at the same time.

Discussion

CML's versus farmers' way of appropriation of space

As argued by Edensor (2005), voids are generally regarded as empty or unused spaces due to the fact that the informal uses are not recognized as existing or adequate (Edensor, 2005). In both case-studies we see that there is a change in CML's approach regarding informal uses: those which were in the past seen as inadequate and excluded are now accepted and legalized. Despite this change there is a prevailing tendency to prioritize aesthetics and the image of the place (e.g. spaces appropriated informally are seen by the CML as being disordered and not attractive to other users) motivated also by the need to clarify the legal status of the property, by not allowing farmers to fully appropriate the plot. Also the disorder found in the expectant places is seen as a threat and thus there is a need to create a specific order to facilitate the control of the space. We can compare it to the tendency of the modern and contemporary city to produce regulated and ordered space with a defined single use (e.g. Edensor, 2000, p. 54, similarly Gandy, 2006b, p. 507).

Indeed the project of farming parks suggests a very organized and structured appropriation of space which is also meant to support equality among users. Activities in the farms are supposed to respect a certain aesthetic conception (e.g. incentives to plant flowers on the fences, etc.) and follow cooperative use, which does not always have the expected results because it depends on the correspondence of values between both stakeholders, and on the compliance of farmers. The rules were introduced by the municipality, they did not come up from an internal need of the users to organize, create their own rules and cooperate.

²¹ For example CML's intervention in Vale de Chelas was triggered (among other factors) by the fact, that the farmers allegedly used contaminated sewers water to water the plants which were sold afterwards) (CML's oral communication).

At the same time the order and aesthetics within the appropriation of space seem to be differently valued by the CML and the farmers. For the municipality the regulation of the existing uses is a tool for controlling the space and the users - by eventually excluding non-compliers - and for supporting the creation of a community. In turn, for farmers the appropriation of space intends to create a place to farm but also a comfortable place they can share with friends and family. The functional dimension is clearly more valued than the aesthetic. Thus, to avoid conflicts they are forced to circumvent the rules and CML must disregard many practices which are actually not allowed. We can see the space as a complex structure of power relations where there are “blind spots” left, despite the rules and regulations prescribed by the authorities (Amin and Thrift, 2002).

Public health issues underlying the planning of urban space

Public health is underneath most of the objectives of these parks. We can connect this issue to Gandy’s notion of “hygienic cities” and to the general target of the modern planning to create cities that do not threaten public health, both physical and mental. It has its roots in the utopian projects of the *ideal city* and during the 20th century it also strengthened the assigned role of urban nature as designed parks and gardens in the modern city (Gandy 2006a, p. 67). We see these roots in the will to maintain the recreational function of the farming parks; in the way the CML prohibits the use in the farming plots of certain materials that might represent some danger to public health; in the fact that the CML excludes animals from these spaces and also in the background of the promotion of physical and outdoor activities and consumption of a good quality food.

The will to foster community sense

There is an almost paternalistic approach of the authorities towards the users of the farming parks: people should get along, cooperate, share resources and be friendly. If this proximity does not fit the farmers’ perspective, he/she can always give up farming and leave the place open for another more compliant or cooperative farmer.

CML’s will to create an ideal community through the adequate design of space is much in line with the utopian tendencies found along

the urban planning history to the present urban planning discourse (Harvey, 2000, p.156). But as Gottdiener and Hutchison (2011) argue, people’s behavior is influenced by the physical environment but not so significantly. Social relations are very complex and depend also on other factors such as education, race, class or gender. The idea that human behaviour can be foreseen and regulated so easily is thus simplistic (Gottdiener and Hutchison, 2011, p.205 e 303). Furthermore the communities created in these case studies reflect the kind of controlled diversity criticized by Harvey (2000, p. 164) the users accept the rules which are prescribed or they can leave.

Top-down interventions versus integrating the users’ needs in the projects

The interventions of the CML in the public space, namely in what concerns the farming parks and their implementation on places occupied informally, have followed a *top-down* approach. The project was conceived by the CML departments – in this case the Green Structure Department – with no previous consultation of the informal users and local populations. It can be argued that any project that intends to adopt the former uses developed in the area should incorporate their perspective (Silva & Monte, 2012; Matos, Batista, 2013; Dias *et al.* 2014). This is highlighted by Dias *et al.* (2014, p. 502): “when the local significant factors and the problem roots are not clearly identified in the urban design solutions developed by the professional actors working primarily alone there is every chance they will not fulfil the needs and the aspirations of the local communities” and therefore contribute to non-compliance due to their rejection of certain choices and rules.

In our case we see that the CML tries to a certain degree to include the needs of the farmers but doesn’t integrate the farmers in the process of mapping these needs. In the end farmers are granted with priority access to a project built on the CML’s perceptions and concepts. As a result some of the farmers’ needs are not attended (e.g. social function of the plots) and some local significant factors were not integrated in the project (e.g. robberies, problems regarding the sharing of resources, previously created social networks, the will to use organic farming techniques, etc.), thereby becoming a source of conflict and also a reason not to fully comply.

Nevertheless we can recognize a tendency for a more “bottom-up” approach. Although the con-

ception of the project was developed solely by the municipality, it also intended to respond to a need manifested by the local communities, namely the need or will to farm. From this point of view the initiative began from the bottom but was developed from the top, following the priorities and principles of the municipality, allied to a previous definition of the “problem” by the planner, and not by all stakeholders (Dias *et al.*, 2014).

Conclusions

Projects as the farming parks studied in our research are undoubtedly important for the city. Also, these projects had positive reactions from the population and led to an involvement of new members into urban farming projects. As we have shown, this was achieved together with the inclusion of the people who formerly used the space in an informal way. But despite a current change of the approaches in nowadays urban planning in Lisbon, the top-down approach prevails, even if it strives for social equity, sustainable agriculture and self-sufficiency. While some users' needs are fulfilled, others are not even considered. We have argued that this can be a source of ongoing conflict, leading to the users' circumvention of the rules or even to the exclusion of some members of the community.

Furthermore, the results of this research evoke ideas that repeatedly appear in the history and theoretical reflection of urban planning. Specifically, the utopian idea of building a community that integrates heterogeneous members of the society and their needs seems to be rehabilitated on the restructuring of Lisbon's urban gardens. However the results highlight the limitations of such vision when put into practice.

The results also point to the tendency of the modern and current urban planning to create regulated spaces as a tool to facilitate the control over the space. But as we have seen, the implementation of the CML's visions can be threatened by many procedural complications which cannot be fully included in the planning (e.g. changes in the budget or the problematic communication with the users). These changes then produce side-effects that highly influence the outcomes of the projects, namely through the consequences they have on the relationship between users and planners that may lead to non-compliance and ultimately to the modification of the rules. Thus the case of Lisbon urban gardens shows well the interplay of power, where even in well planned, structured and controlled spaces,

some “blind spots” are left that escape the local authorities' control. As future scenarios we may expect that either the ongoing everyday negotiation of the rules and uses will lead to a change of CML's vision with a gradual fulfilment of the needs of the users; or, on the contrary, the ongoing exclusion of non-compliers may lead to a more homogeneous community of farmers that is more in line with the project's guidelines.

In a context of economic crisis an increase of interest in urban farming can be expected. Alongside, we can also expect as a crisis' outcome the advance of expectant areas in the city. In this scenario urban agriculture finds good conditions and context to expand and be part of the solution, by contributing to the mitigation of the social and economic effects of the crisis.

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Impact of the Urban Fabric on the External Comfort.

A case of study City of Tolga, Algeria

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Abstract

Thermal comfort constitutes a bilateral factor between urban and architectural forms and expresses a great problem for the growth of modern cities. In the past, old settlements in arid regions reflected a fascinating harmony in which the relationship between human being and environment was very strong, especially in summer. The aspects of that urban fabric are numerous in particular we quote: the introversion (mansions) the density of the built mass housing and the symbioses between the habitat and the palm grove, as the judicious use of materials of constructions are extracted from immediate nature; these values give it a good quality of exterior comfort which was an imperative point. The present work evokes a study which covers the city of Tolga, one of the famous oasis in the Algerian Sahara in which we search to redefine the level of traditional urban and recent morphology, putting our experience

in accordance with the urban reality facing the aggressive microclimatic for a clear understanding of the behavior of the individuals within their surroundings.

Once existed a harmony, a good ventilation, a sufficient moisture, mild temperatures and a good control of shading areas (especially in summer) are the factors to look for during our research, in which it is always assumed: what are the real impacts of the urban fabric forms in the arid environments on the value of the external thermal comfort, and what kind of remedy seek the oasis cities to get out of this calamity?

Palavras-chave

Urban tissue; Urban morphology; Urban density; Outdoor thermal comfort

Background

Human thermal comfort (HTC) is widely acknowledged to be a pertinent issue from architectural and urban perspectives in present-day world, because of the difficulty to establish a balance between what is sensory and what is built. The responsiveness of human institutions in arid and fragile zones of the Sahara have an impressively interacted with extreme climatic conditions. We can boldly claim that the urban spaces within these areas have achieved an optimal integration of architecture with its Saharian environment. This has been attained thanks to rudimentary if efficient expertise urban-wise, introversion-wise, co-habitation with local scenery-wise (i.e., palm-trees), and local raw materials-wise. However, the constant deterioration of temperature and the exponential over-reliance on air-conditioning appear to have engendered an impression that the impact of architecture, or to put it more precisely the morphology of the urban tissue/fabric, on the

value of outdoor thermal comfort (OTC) is indelible, which it should be noted in the same vein, has completely vanished. The corollary of that can be summed up in the following outcomes: the individual's preference for indoors, and the shade attests to be presently missing from the essence of Saharian structures. The current research undertakes to study Tolga, as a case in point, as it is usually inflicted by extreme summer heatwaves. We aim primarily to assess HTC in the aforementioned town through a host of fields (i.e., urban tissues/fabric) with a view of coming to grips with the interaction between built spaces and Tolga's micro-climate. Also, we aim to investigate the local individuals' day-to-day behaviors vis-à-vis their urban structures. It should be noted that factors such as extreme-weather seasons (viz., winter and summer), indoor ventilation, average humidity, shady spaces, and moderate temperatures have been assessed and hopefully sought to attain. In so doing, we have attempted to address the following questions: To what extent are mod-

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ern Sahara-specific tissues/fabric influential on OTC? And what is the optimal way to deal with it?

Introduction

The value of thermal comfort at the level of external spaces claims a new tight atmosphere that surrounds our cities nowadays. Actually, Southern Algeria includes a sample of this microclimate fluctuation. The goal of this research is to show the resulting interaction between the built frame and the sensory quality within the urban fabric which differ according to time, spatial configuration and constructive aspect.

In a city-type position, we had the opportunity to diagnose the city of “Tolga”, a famous oasis spread out along the arid region of Zibans one of the foothills of the Aures. The first objective, our research is based on an analytical approach on the ground, attributing the city through a selection of districts then moving carefully to a measurement campaigns conducted by special tools. The second objective is presented under a numerical simulation acquired on the base of three dimensional software Envi-met 3.1¹. To evaluate the thermal comfort within districts evoked by two primary indices such as the PMV (Predicted Mean Vote) and PET (Equivalent physiological temperature) (Ali Toudert, 2005), those allowed with excellence an accurate reading of the external thermal aspect. The subject must answer its questions to build a strong strategy in arid areas; returning to reevaluation of old fabrics while trying to achieve adaptation to the environment is a factor of disability facing the sub-Saharan urbanization.

Issue

As clearly announces the preamble, the Algerian arid delivers aggressive symbiosis there or once existed is no longer found today. Faced with countless infrastructure needs, housing, and public facilities, the Saharan city is experiencing urban explosion badly affects the environmental quality in these fragile and hostile places.

A new identity to the southern cities is giving, one that serious its name by standardizing buildings, the use of hard material, both the divorce with the property of the desert nature All this violence so to say has necessarily changed the scale of these climate zones, testifying by rising temperatures, deadly heat waves and hot and long summers. Obviously we are aware of global climate change! But well, cities also take place

virtually discomfort registered outside space. The problem of our research is posed in two perspectives:

- Can we consider that the morphology of the urban fabric is the leading factor external thermal upheavals?
- What is the relationship between urban morphology and discomfort that contracts the oasis city?

Representation of case studies

Our study is a study of the arid region of the Algerian lower Sahara (Cote *et al.*, 2005), specifically the city of Tolga, which is considered as the second important and ancient oasis in Zibanes region after that of Biskra (chief place of the Wilaya N 7).

The process takes a strict distribution of our case study in entities (districts) by determining through morphological factors such as urban density (CES) (Hamel, 2005) and the geometry of streets (H/W) (Boukhabla, 2010) as far as their morphogenesis (urban growth) over the years.

Tolga represents perfectly the high correlation of primitive human settlements at the Sahara and the immediate environment in particular including the image of old core (old Tolga) that preserves modestly today the traces of Ksar. Second, has seen the great period of colonization, French imprint was carefully manifested in the district (West-Rassouta) that was designed to limit the railway.

The life cycle continued for the oasis giving new fruits of post-independence strategy, it was self-built in its two planned and unplanned terms, also the collective which is explored in the programs identified by Algeria (Five years). In the following we will illustrate the urban form of the city according to the data highlighted previously (table below).

Methods

The study is aimed at evaluating the external thermal comfort during the overheating that is to say, in the summer, it lasts almost five months (from late May to late September). Why takes all this time? The answer is clear it is related to the difficulty of everyday conduct of life in the city during the summer. Actually the work required

¹ Bruse M & team. Software & guide posted on: www.envi-met.com

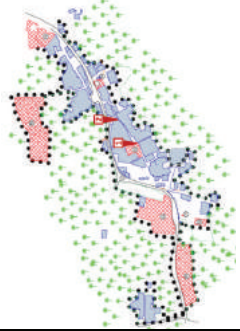

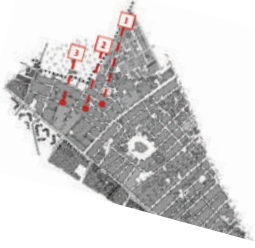


districts	Urban density	Street's Spatial configuration	Description	Plans
<i>old Tolga</i>	0.60	<p>point 1 : L= 3m Est-Ouest H/W= 1.3</p> <p>point 2 : L= 2.5m Sud-Est H/W= 2.4</p>	Ancient fabric surrounded by the palm grove, with a large built compact, narrow and winding streets, and prefigures the image of the ancient Ksours	
<i>West Rassouta</i>	0.68	<p>point 1 : L = 8 m East-West H / W = 1</p> <p>point 2 : L = 10m East-West H / W = 0.5</p> <p>point 3: L = 8m Southeast H / W = 0.4</p>	Colonial fabric, brings together series of regular islands including its geometry, its streets are wider than those of the old core	
<i>Sidi Rouag</i>	0.58	<p>point 1: L = 11 m East-West H / W = 0.3</p> <p>point 2: L = 10m Southeast H / W = 0.2</p> <p>point 3: L = 8m Southeast H / W = 0.7</p>	Owes its name to the mausoleum, which is based on a mound in the center of the district. Its main aspect is characterized by uncontrolled morphology	
<i>City El-Moudjahidine</i>	0.41	<p>point 1: L = 8 m Southeast H / W = 0.6</p> <p>point 2: L = 6m Southeast H / W = 1.2</p> <p>point 3: L = 6m North-South H / W = 1.3</p>	Founded on the basis of a state distribution of plots. The area is well known for its narrow streets passable	
<i>150 housing CNEP</i>	0.18	<p>point 1: North- South</p> <p>point 2: East-West H / W = 0.1</p> <p>point 3: East-West</p>	A collective set where in the logic of the vertical blocks is the typical form. Isolation is an inseparability of such places	

Table 1 – Summary data of urban forms in Tolga

Source: Author, 2014.

a decision Climate Action districts cited during three days of July (14, 15 and 17) it is considered the hottest month of the year for the data referential obtained from the weather station at the airport in Biskra.

The factors involved in the operation are respectively the temperature of the air (**T**), the temperature in the globe (**T_g**) it allows through the first to calculate the TMR (means radiant temperature) (Givoni, 1978) which refers to solar radiation, as far as the relative humidity (**RH**), and the speed of air (*V air*). The tooling is well distinguished which a thermo-hygrometer (HD 100) for measuring the air temperature and humidity and a thermo-anemometer (LV 100) for making the speed of the air; However globe temperature is acquired through a blackened walls added to the thermo-hygrometer. This approach calls for a comparison between urban space and the other is for the suburban measured data of the airport weather station.

Description of instruments:

Electronic Thermo-hygrometer HD 100:

It is a tool (Figure 1) designed by the company 'Kimo' is used to measure three climate parameters thereof to the air temperature (°C, °F, K), relative humidity (%), and the dew point (°C, °F, K) of the measurement ranges vary between -20° C to + 80° C for the air temperature and the dew point, and 5 95% for the RH. The resolution is (0.1% RH, 0.1° C). The apparatus is served by

a tube of 5 mm diameter contains a very sensitive cell which is obtained by the taken our using probes occurred. Since it can take measures in different units the thermo-hygrometer HD100 offers us the opportunity to have the maximum and minimum values within the place visited.

Of course, for the globe temperature (**T_g**), we tried to use the same means (thermo-hygrometer HD100) completed a blackened ball (Figure 2) 5 cm in diameter. This method was already used during the campaigns of previous measurements (Boutabba, 2007).

Thermo-Anemometer LV100:

The instrument (Figure 2) has to face the flow of the circulated air in favor of owning a hanging helix. As our instrument measures the air temperature identically to thermo-hygrometer. The air velocities are identified by (m/s and fpm feet per minute) while measuring ranges are limited between: 0.2m/s to 3.1m/s - 3.1m/s 35m/s. Thanks to the fine blades of the propeller, the slightest breeze of the air stream must operate the unit that also assumes the maximum and minimum values. As the resolution notes a gap of LV100 0.01m/s to 0.1 m/s.

Results and discussion

To assess the level of thermal comfort inside the districts we have tried to develop two indices defined by the PMV which is obtained based on the

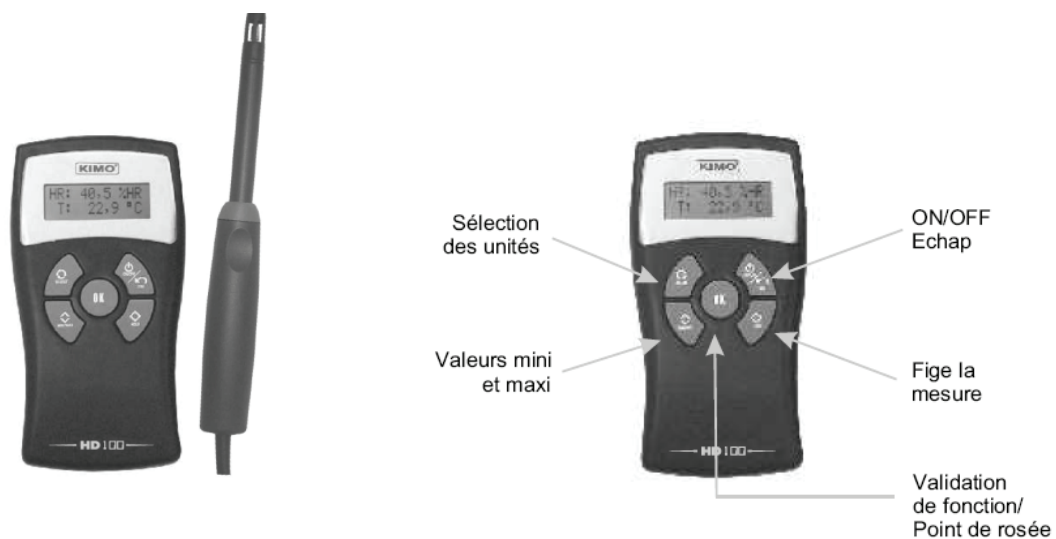


Figure 1 – The thermo-hygrometer HD100 model

Fonte: www.Kimo.fr.



Figura 2 – Left: thermo-hygrometer HD100 Kimo model with a darkened enclosure. Right: thermo-anemometer LV100 Kimo model. Fonte: Author, 2014

law of Fanger, and also taken on the PET method Gagge .Envi-met 3.1, which is our simulation tool and subsequently the extension Biomet we considered the thermal quality hour by hour through the climate data required for our measurement campaigns. Biomet is complementary three-dimensional software Envi-met model in which it aims to calculate a series of thermal comfort indices such as **PMV/PPD**, **PET**, and **UTCI**. It should be noted that Biomet is accompanied by the old calculation base (Leonardo) established a list of five variants: air temperature, means radiant temperature, relative humidity, air velocity, and the urban environment targeted. The new base of Biomet includes a column for various parameters related to the person exposed to climatic and urban conditions mentioned above.

In this scope, the work required a modeling of the five districts, adding a specific parameter to the places visited, and a digital readout at the base of our software.

Position (Tolga):

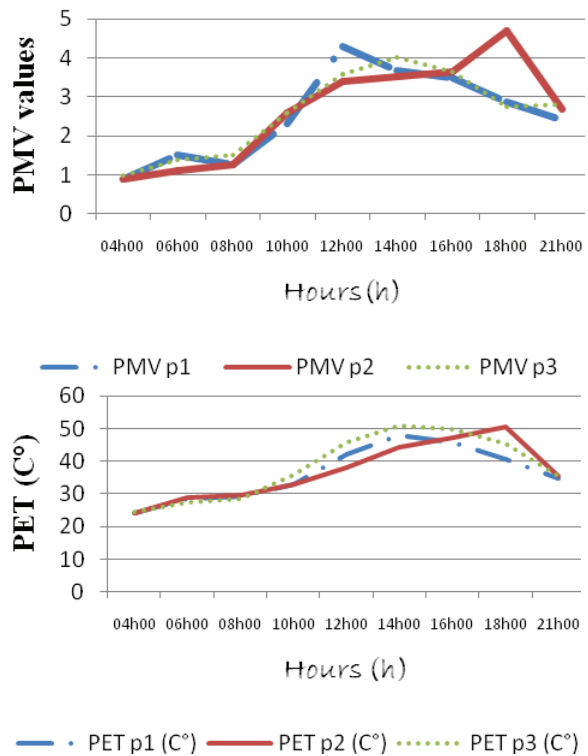
Longitude: 4.56 Est
 Latitude: 34.38 North
 altitude: 147 m

Buildings parameters:

Inside temperature (K): 297.1
 Heat transmission walls (W / m²K): 0379
 Heat transmission roofs (W / m²K): 1.94
 Albedo walls: 0.35
 Albedo roofs: 0.5

Input data Envi-met 3.1
 Fonte: Author, 2014.

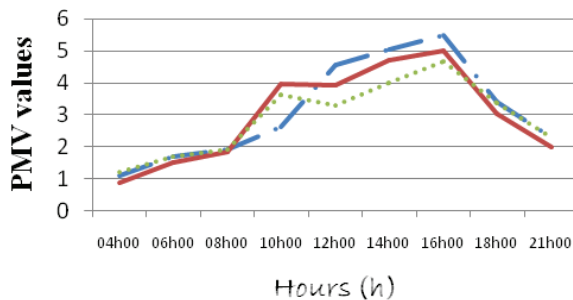
First sample (City ElMoudjehidine) [07/14/2014]:



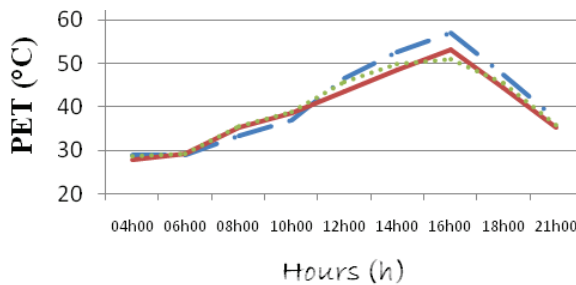
Graph 1 – Evaluation of the two indexes PMV and PET Hai El Mujahedin Fonte: Author, 2014

• The activity is hardly practiced in the period before noon, and well on that of the afternoon. It should be noted that the area was almost empty from 11:00 until 18:00 (maximum period of overheating).

Second sample (Sidi Rouag) [07/14/2014]:



— • PMV p1 — PMV p2 — • PMV p3



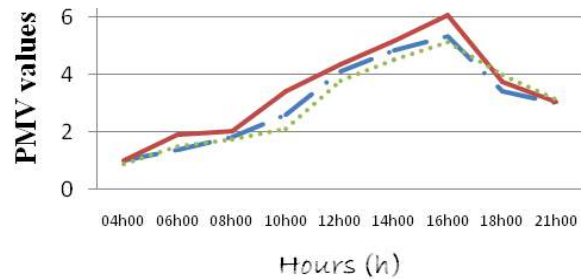
— • PET p1 (C°) — PET p2 (C°) — • PET p3 (C°)

Graph 2 – Evaluation of two PMV indexes and PET in Sidi Rouag
Fonte: Author, 2014

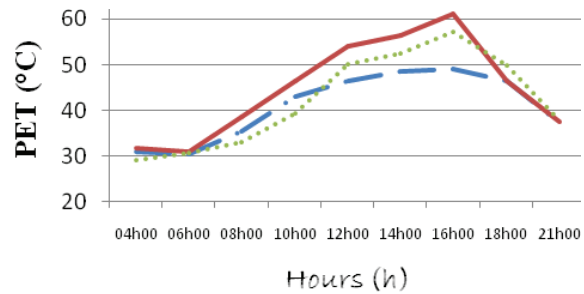
- Measured points show a thermal balance well defined: such as maximum values were taken at point 1 with $\Delta PMV_1 \max = 5.49$ and $\Delta PET_1 \max = 57.1^\circ \text{C}$, which dissects the extent of trapping energy on that street. The third point that concerns a ration of ($H/W = 0.7$) do not benefit from this advantage because of the physical setting of the street (absorbent building materials).

- For the liveliness of the district, the early hours of the morning (6:00 ET 8:00) made the good times of the extra-house activity. However, the rest of the day is a real handicap to human activity (without referring the period of overheating). This presents a huge challenge to go out or work elsewhere, or even walk to the edge of the streets for hours of extreme heat.

Third sample (150 units CNEP) [07/15/2014]:



— • PMV p1 — PMV p2 — • PMV p3



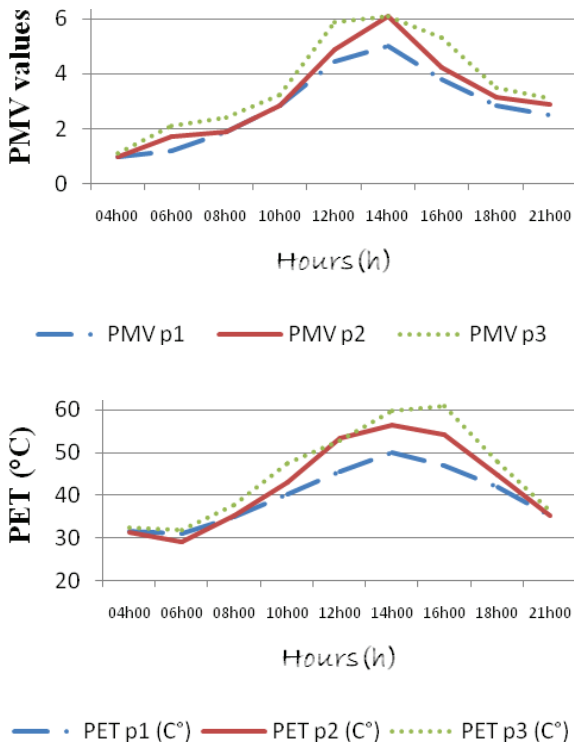
— • PET p1 (C°) — PET p2 (C°) — • PET p3 (C°)

Graph 3 – Evaluation of two PMV indexes and PET to 150 accommodations CNEP
Fonte: Author, 2014

- A large fraction (prospect) between height and width of the street which is framed between $H/W = 0.2$ and $H/W = 0.8$ which allowed a great sun exposure, on the other hand a very minimal shading surfaces.

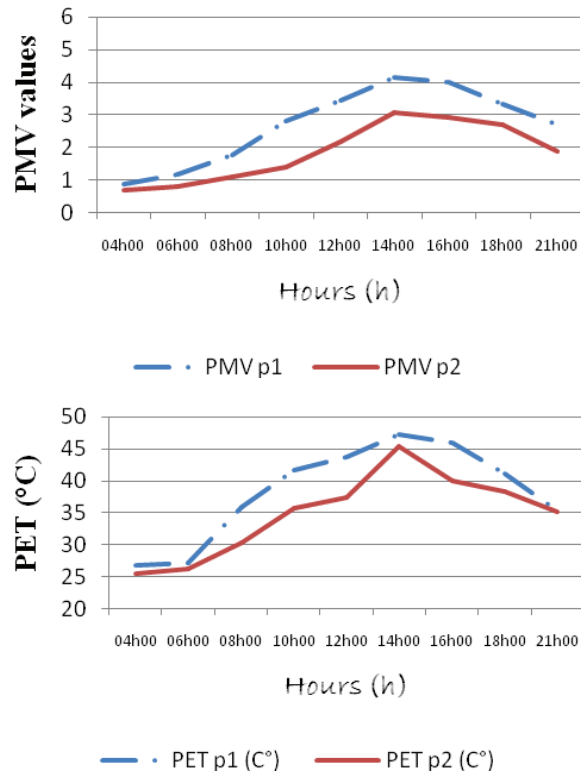
- Human activity in the 150 housing was one of the few things to see during most of the day (no men's land), asserting that night time was a bit lively in which we met with groups; despite all the tenants insist they are very dissatisfied outside their homes in addition they live most of their time in the air conditioning.

**Fourth sample (West Rassouta)
[07/15/2014]:**



Graph 4 – Evaluation of two PMV indexes and PET Rassouta West
Fonte: Author, 2014

**Fifth sample (Old Tolga)
[07/17/2014]:**



Graph 5 – Evaluation of two PMV indices and PET Old Tolga
Fonte: Author, 2014

- Even the high density of the area (CES = 0.68) West Rassouta is affected by this thermal imbalance of inside space; the hot zone is the most common in the majority of the day (a term balanced between 12 to 14 hours).

- A lot of constraint for normal human activity, most of that is practiced in the early hours of the morning or at the end of the day, if unable to do during the interval from 10:00 to 18:00.

- A great relationship between prospect (H/W) and thermal comfort the one that was evaluated through the TMR and PET (especially on the second station).

- The participation of building materials is very significant although the old quarter does not constitute the paved surfaces and reflective materials.

Street	Prospect (H/W)	Orientation	T _{a max} (°C)	V _{air} (m/s)	TMR _{max} (°C)	PET _{max} (°C)	PMV _{max}
City El Moudjahidine (CES= 0.41)	0.6	S-E	40.6	0.32-0.73	54.3	47.9	4.3
	1.2	E-O	40.8	0.47-1.30	58.9	50.4	4.7
	1.3	N-S	40.8	0.38-1.5	63.1	51	4
Sidi Rouag (CES=0.58)	0.3	E-O	41.5	0.37-1.75	64,3	57.1	5.49
	0.2	S-E	41.4	0.35-1.86	64,2	53.1	5
	0.7	S-E	41.4	0.53-1.45	60	51	4.68
150 housing CNEP (CES=0.18)	0.3	E-O	40	0.49-0.68	62.3	49	5.34
	0.8	N-S	41	0.40-0.72	67	61	6.07
	/	N-S	40.4	0.60-1.2	67	57.1	5.13
West Rassouta (CES=0.68)	1	N-S	39.9	0.53-1.00	59.6	49.9	5
	0.5	N-S	40.3	0.29-0.77	64.2	56.3	6.1
	0.4	E-O	41.1	0.49-0.74	64.2	60.8	6.1
Old Tolga (CES=0.60)	1.3	N-O	39.5	0.50-1.00	56.7	47.3	4.16
	2.4	N-O	39.6	0.60-1.60	46	45.3	3.07

Table 2 – Summary of results from measurement campaigns and simulation

Fonte: Author, 2014

Conclusion

During the summer period which corresponds to the zone of overheating, the study has not resulted in a comfort zone (or thermal sufficiency) of the five mentioned sites. Animated by the values of PMV and PET the summer thermal comfort is classified as non-materialized: PMV through districts is $3.07 < PMV_{max} < 6.1$ making it a state of extreme heat. It is said that the old Tolga is favorable despite its hot state (Previously comfortable). While PET is also predicted extremely warm periods in strong correlation with the prospect H/W and TMR ($45.3^{\circ}C < PET_{max} < 61^{\circ}C$) in which the minimum is taken to the old Tolga and the maximum is retained for 150 housing, in approving our hypothesis that dictates the positive intervention of the high density, aspect ratio H/W high. The primary objective of the simulation is to affirm our hypothesis announced that the spatial configuration of the external area vehicle thermal quality in a changeable way from one place to another, referring to thermal values and thus the morphological dependence of one another (Matallah, 2015).

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The importance of knowledge of social perception on climate change for sustainable development

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Abstract

Knowledge of the social perception regarding the potential risks arising from climate change can be a valuable tool for planning strategies, land-use planning and policies on environmental education, at a time when the future climate projections point out to the need to implement sustainable conditions to improve the quality of life of the population.

This research was based on the results obtained by applying a questionnaire survey to a Portuguese population sample, questionnaire whose objectives were to assess knowledge and level of perception of the population surveyed about climate change and the climate and weather elements that recorded the largest changes in recent years. The sampling was based on data from the population census of 2012, provided by the National Institute of Statistics, on the resident population in 2011, according education level. Six hundred people were surveyed. The sample included people from different Portuguese geographical areas to represent accurately the Portuguese Continental population, people from Bragança, Porto, Coimbra, Lisbon, Beja and Faro was inquired.

Fieldwork took place between March and December 2012. The questionnaire addressed the social perception of climate change from the point of view of the signals that show the possible changes, the causes, consequences, possible mitigation measures of its effects.

The statistical analysis included a univariate analysis based on the absolute and relative frequencies, and a bivariate analysis that involved

the analysis of the variables gender, region, age groups and educational level.

We conclude that the phenomenon of climate change is recognized by most of the respondents that showed an extreme sensitivity to the subject, being interpreted by them as something related to the climate and/or pollution due to the human influence, namely with regard to the increase in average temperature and in annual mean sea rise. They consider themselves informed about the causes and consequences of climate change and also documented in how to combat them.

However, we found that there are many gaps to be bridged as regards the clarification of concepts, behavioral attitudes to adopt towards sustainability and the need for clarity in the transmission of information from the sources. Responses also attest that there is little perception of the role of certain institutions with social responsibility, which could act more effectively in the protection of the people if they were well known.

We intend through the involvement of the community gain a better understanding of the opinions, knowledge and risk perceptions of the Portuguese population concerning climate change, which could serve as the basis of effective structural, political and cultural measures in order to promote greater human well-being.

Palavras-chave

Social Perception, Climate Change, Sustainable Development, Environmental Education, Quality of Life

Introduction

The evaluation of the perception and the knowledge of the population against the risks arising from conditions of bioclimatic discomfort associated with extremes of temperature and humidity, and its aggravation by the influence of climate

change, could contribute towards the adoption of strategies at local level. One of the objectives of this study is to ascertain the knowledge and perception of the survey population concerning climate change, and the climatic elements that have undergone major changes in recent years in Portugal. A questionnaire was administered

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to a sample of residents. Based on the results of the analysis of the questionnaire, we discuss the importance of knowing the perception of population in relation to climate change, aimed at an effective implementation of measures and regulations which could minimize the occurrence of risk situations associated with bioclimatic discomfort by heat.

Methods

To carry out this study, a survey was conducted through the administration of a questionnaire applied to a sample of the Portuguese population aged of 18 or more years. We opted for this criterion, since the results of previous interviews showed that the inclusion of children, will force to make substantive changes in the language of the questionnaire. It should be added that in the majority of the studies analyzed, on the perception of risk, this group was also not considered.

In the questionnaire we introduced some questions contained in the work done by Pereira *et al.* (2008) and Falcão *et al.* (2005). These authors after contact them, kindly showed their agreement on using their studies, as a starting point for conducting this research.

The questionnaire was administered to a sample of 600 people residing in the cities of Braga, Porto, Coimbra, Lisbon, Beja and Faro, considering this sample representative of the Portuguese Continental territory. The sample was based on information from the National Statistics Institute on the resident population in 2012, according to the level of education obtained by the 2011 census.

The collection of information was done through a questionnaire. The fieldwork took place between March and December 2011, with the help of interviewers, geographers recruited and trained that have received adequate training to the specificities of this study and the necessary guidelines for drawing up an inventory of information.

The questionnaire deals with the problem of climate change, including issues associated with signs that show this change, the causes, the consequences and possible mitigation of its effects.

Regarding the treatment and statistical analysis of collected data, a univariate analysis of variables, based on the absolute and relative frequencies of each variable and bivariate analysis of survey variables with the variables sex, region, age group and educational level took place.

A better understanding of opinions, knowledge and risk perceptions of the population,

about global climate change, can be the basis for taking action at structural and political levels and for environmental education purposes. The results of this study may provide clues to act more appropriately and effectively in order to change attitudes and behaviors of citizens, so that everyone can contribute to improve this situation.

Results and Discussion

At this point, we present the main findings of the study carried out on the perception of the Portuguese adult population on global climate change. The results of this research were the basis to propose some educational, structural and communicative strategies, in order to facilitate the implementation of measures that contribute to the mitigation of effects of climate change.

Table 1 shows the characteristics of the sample by gender, age, professional occupation and educational qualifications.

Sex	%
Female	50
Male	50
Age group	
18-24	10,1
25-34	14,3
35-44	22,7
45-54	21,9
55-64	14,0
65-74	9,6
+75	7,4
Professional occupation	
Active	70,5
Not Active (unemployed and retired)	22,4
Student	7,1
Education levels	
Can not read or write	0,4
Basic education	7,9
Secondary education or equivalent	6,2
Higher education or attends	50,5

Table 1 – Percentage of respondents by gender, age group, occupation professional and education level

As regards the analysis of the results to the question “Do you know what the term climate change means?” It can be stated that the term is recognized by 90% of the population surveyed, of which 71% give an opinion on the meaning of this phenomenon; while 10% did not know what it means. It should be emphasized the im-

portance of the percentage of respondents with higher education qualifications or attending higher education (50.5%), that has direct effect on the results.

The various answers to the question, “Refer what you mean by climate change”, they were categorized and later explored and could be said that 71% of respondents gave an informed opinion about the phenomenon.

Several answers have to do with heating or impacts directly related to this phenomenon (melting, increasing the mean sea level, desertification); secondly, with catastrophic impacts of natural phenomena and lastly, refers to the reduction of the ozone layer and human influence on the climate system.

About 43% of respondents understand climate change as the “polar ice melting” “increase in the mean sea level”, abrupt changes of time, “rapid cyclical changes”, “weather irregularity”. Other responses also refer to the phenomenon related to pollution and/or the ozone layer (20%), the influence of man and/or the scientific and technological development, and global warming and/or temperature variation (8%).

In a similar study conducted by Carvalho *et al.* (2004), presented at the 7th Congress of Water of

the Portuguese Association of Hydric Resources, regarding the social perception of climate change and flood risk, results of a survey questionnaire applied to the population of the region of Águeda, showed that the concept of climate change is also recognized by most population, with a negative perception, because respondents say that its effects are aggravated in recent years.

On our study, the question “Did you feel any change in the climate in recent years?”, 80% of the sample says felt changes in climate in recent years, the remaining 20% indicated not felt any change.

The analysis of the answers given to the degree of intensity of climate change indicates that the sample population has felt intensely (level 4-36%) and that these are mostly related to:

- “warmer and drier weather”;
- “short but intense rains”;
- “warmer summer with extension of longer heat season”;
- “minor demarcation of the seasons”;
- “irregular rainfall: dry/late torrential rains or outside normal season”;
- “occurrence of heat waves outside the summer season.”

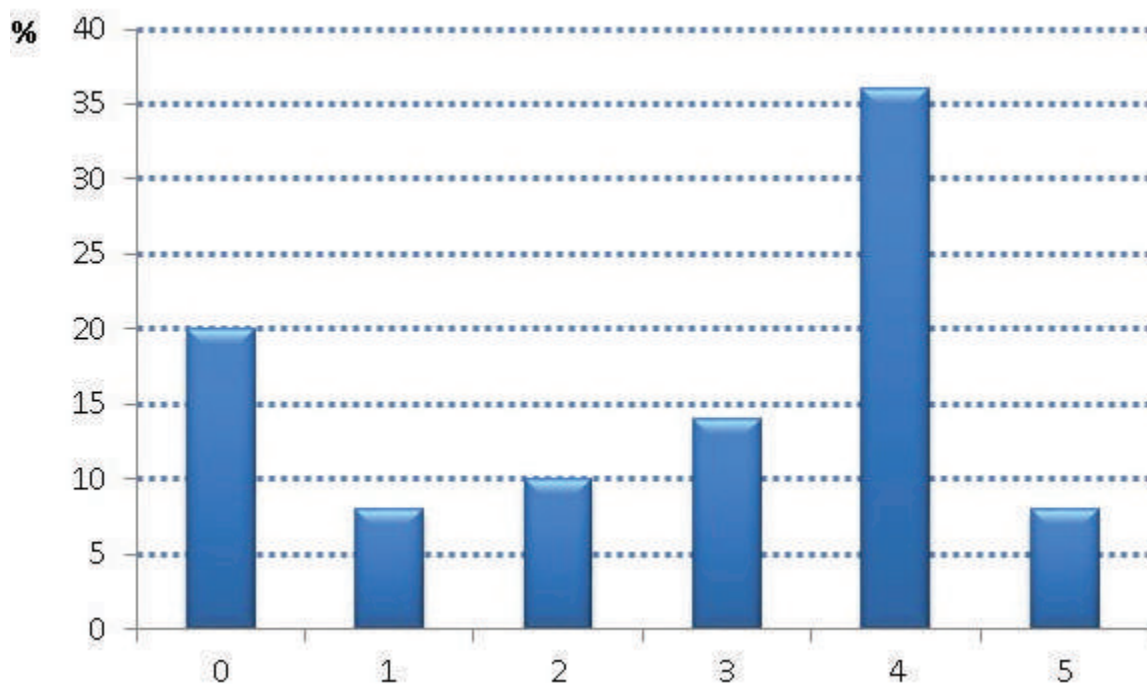


Figure 1 – Perceptions about climate change

Thus, in general, the answers refer to a change that is mainly associated with alterations in temperature and precipitation, similar conclusion to ascertained by Carvalho *et al.* (2004). In their study, the authors indicate that more than 80% of respondents consider, with regard to temperature, that there is an alteration, more than half of them reported an increase and finally, to a lesser extent, indicate the “irregularity and uncertainty of this element” (Carvalho *et al.*, 2004, p. 6). With regard to rainfall, the authors argue that the population is divided between the irregularity, the increase and decrease.

In fact, five of the six warmest years have been recorded in the Portuguese territory are in the 1990s, no wonder therefore that the population more easily record the recent past (Geraldes, 2001).

With regard to comfort or discomfort felt by respondents with regard to the weather during the four seasons, none said that he/she feels very uncomfortable (Figure 2). Most of the sample population stated that feels comfortable in spring and autumn, followed by the summer, with several causes contributing to these feelings in these seasons of the year.

Questionnaire respondents say they feel more comfortable during the spring, underlying the

fact that is the “beginning of the mild weather” or consider the “more pleasant temperatures”; in the case of autumn, much of them associating the season to the festivities related to St. Martin and, consequently, with the occurrence of the “summer of St. Martin,” a popular expression.

Those that say they feel uncomfortable in summer points out, in general, causes such as “more heat for a very prolonged period of time” or “higher than normal temperatures”; while respondents who reported feeling more uncomfortable during winter generally indicate the occurrence of “intense rains and thunderstorms” or “very low temperatures”.

Finally, a small percentage of respondents says that feel very comfortable during winter indicating that in the “last years this season has become milder.”

Concerning the greenhouse phenomenon, 98.1% of the respondents indicate that is aware of it, however, most of them have a wrong idea of the phenomenon, which is associated with a global average temperature without reference to the natural effect of the atmosphere heating. Anyway, it appears that most respondents associate the phenomenon to an increase in global warming.

On climate change, much of the sample believes that the climate is changing (68.6%), 9%

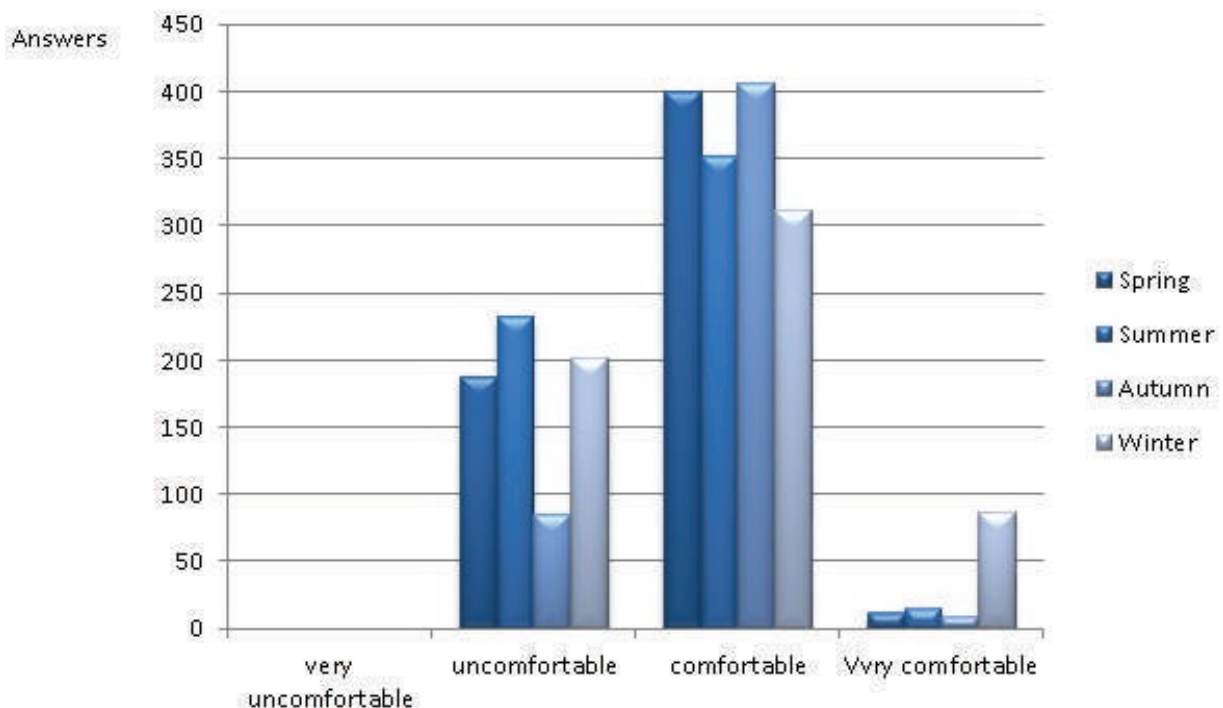


Figure 2 – Comfort levels in relation to the different seasons of the year

consider that no observes climate change, and 22.3% do not know.

Considering only respondents who identified climate change, 68% point to the main changes experienced on the alterations of temperature. Alterations in the mean sea level and precipitation is indicated by a lower percentage of respondents (Figure 3). The fact that the Portuguese territory is in the western end of the Iberian Peninsula, having a vast coastline, it may be the justification for much of the population understand the potential risks associated with coastal erosion, underestimating other elements that may have seen more changes in recent years.

Consequently, the rising of sea level is a process that occurs for a long time and that is felt in Portugal. Marine erosion, in some areas of the country, is evident The rising of sea level seems to contribute to increase the intrusion of salt water in drinking water and soil salinization hurting food production and causing flooding in some regions. These situations show that a great importance should be given to the rising of sea level in coastal planning.

In general, respondents consider that the changes tend to be worse (70.5%), and 22.1% says do not know. Only 7.3% have a more optimistic view of the future in climatic terms, in-

dicating that changes are likely to improve. To the question: “In your opinion, what is the development of the situation in the near future?” With this question we tried to analyze the perception about the sustainability, to evaluate the perspective of the population about the future of the Planet, and concluded, therefore, that the perception of the phenomenon of climate change is mostly negative.

Rodrigues *et al.* (2009, p. 3423), studied the perception of global climate change on Terceira Island in the Azores Archipelago, conclude that “people from Terceira Island consider that the effects of global climate change tend to be visible, but known, uncontrollable, involuntary, new, very threatening, catastrophic and unpredictable”.

Respondents that identified climate change; 51.3% said that the main cause of climate change is related to natural and human factors; for 42.5% the man is the main cause of climate change, 5.1% stated that the phenomenon is related to natural causes and 1% do not know.

The work of Carvalho *et al.* (2004) allows us to conclude, with regard to the causes that contribute to climate change that over 50% of respondents indicate human factors as the main cause of climate change. It can be said that the

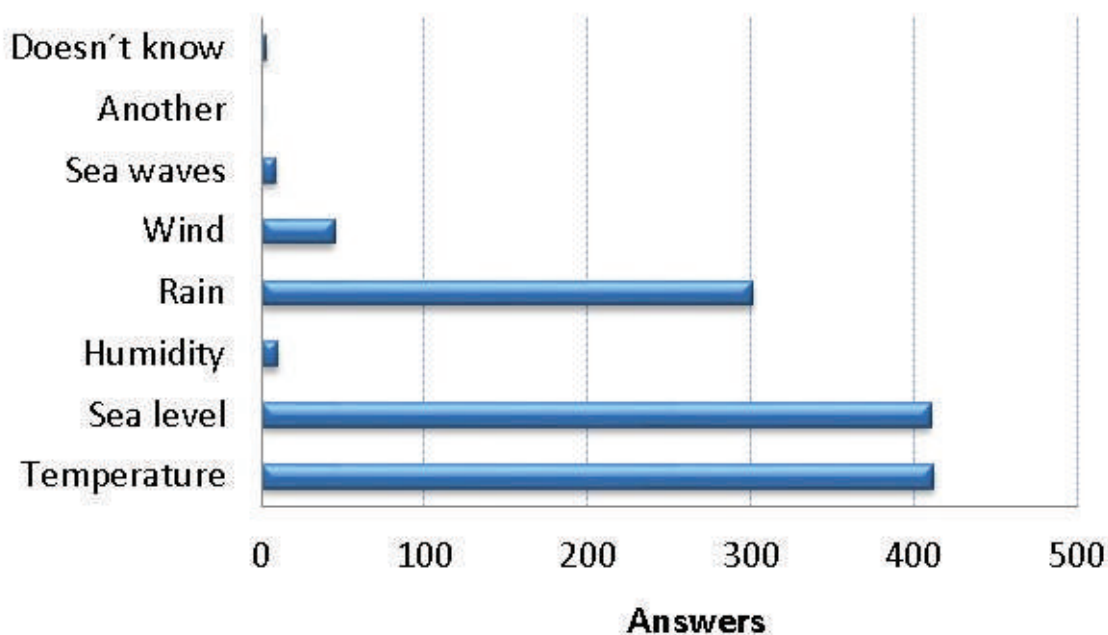


Figure 3 – Elements responsible for the change

Internet and television followed by the newspapers, are the main sources of information of most respondents about the subject.

Among the human factors the main contributors to the worsening of climate change (Figure

5) is pointed out the use of fossil fuels, the greenhouse gas emissions by industries and forest fires. At the same time, Carvalho *et al.* (2004, p. 6) particularly stand out “pollution, changes in the ozone layer, technological and scientific

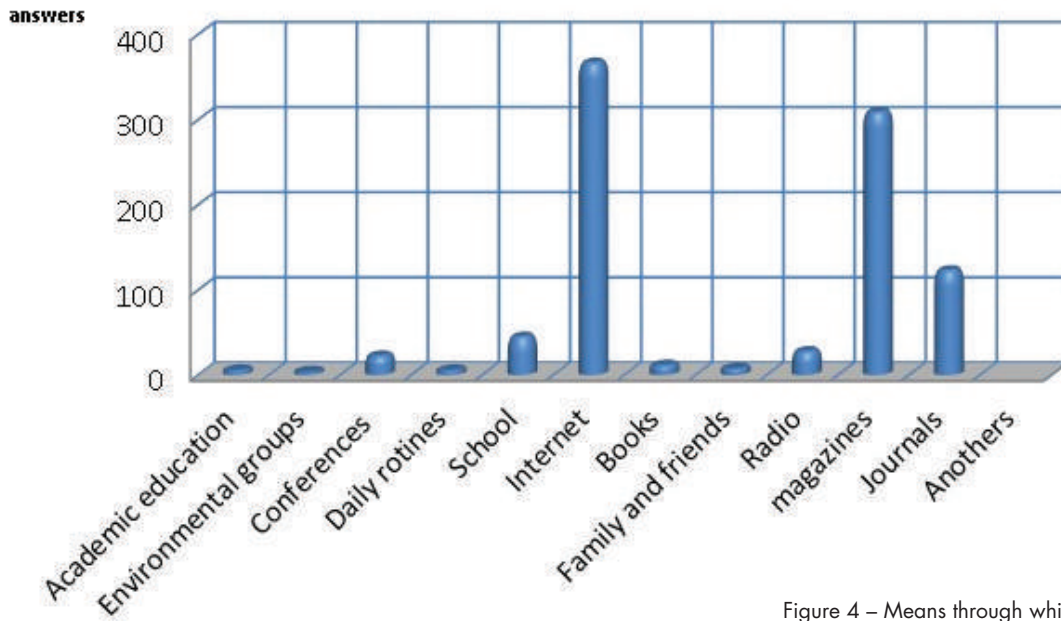


Figure 4 – Means through which people become aware of climate change

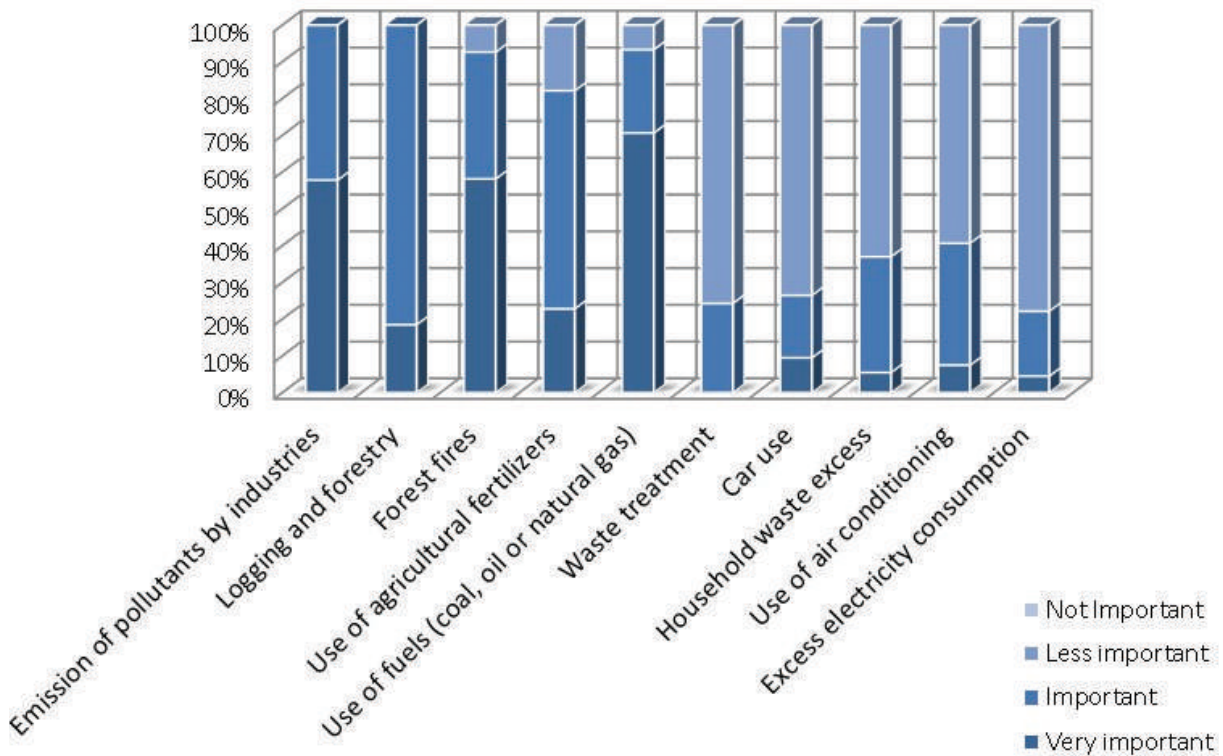


Figure 5 – The importance of each of the following phenomena to the aggravation of climate change

development, and the changes and/or interventions in the stars and space”, as the human factors most mentioned.

With minor importance to climate change is indicated car use, excess of electricity consumption and waste treatment.

In short, the analysis of results obtained in this issue shows that there are different perceptions on the topic. The inquired population does not clearly relate global climate change with their daily individual actions such as: excessive electricity consumption, waste treatment or the use of cars. Consequently, there is a need to develop a more conscious perception of individual environmental aspects in relation to global climate change. This raises the need to promote individual commitment in everyday actions to help reduce global climate change. Highlighting the consequences of climate change, respondents refer the rise of the mean sea level, the decline in agricultural production, the scarcity of water for human consumption and the increase in global average temperature (Figure 6).

Despite the perception of climate change is relatively consensual on the part of the population surveyed, 72% say that know some mitigation measures, dividing the remaining answers in “do not know or no answer”.

With regard to measures to be taken to combat climate change, are indicate the reduction and control of pollution (33%), reducing electricity consumption (24%), raising awareness of the problem (20%) and separation of waste (14%). The remaining (9%) refer to measures such as the creation of laws and supervisory systems in general. They stand out as sources of obtaining knowledge of measures to combat climate change the Internet, magazines, television, schools, newspapers, books and environmental groups.

Consequently, in order to mitigate the effects of climate change, analysis of results obtained in question 10, shows that most of the surveyed population considers that the increase in forest area, investment in renewable energy, the re-

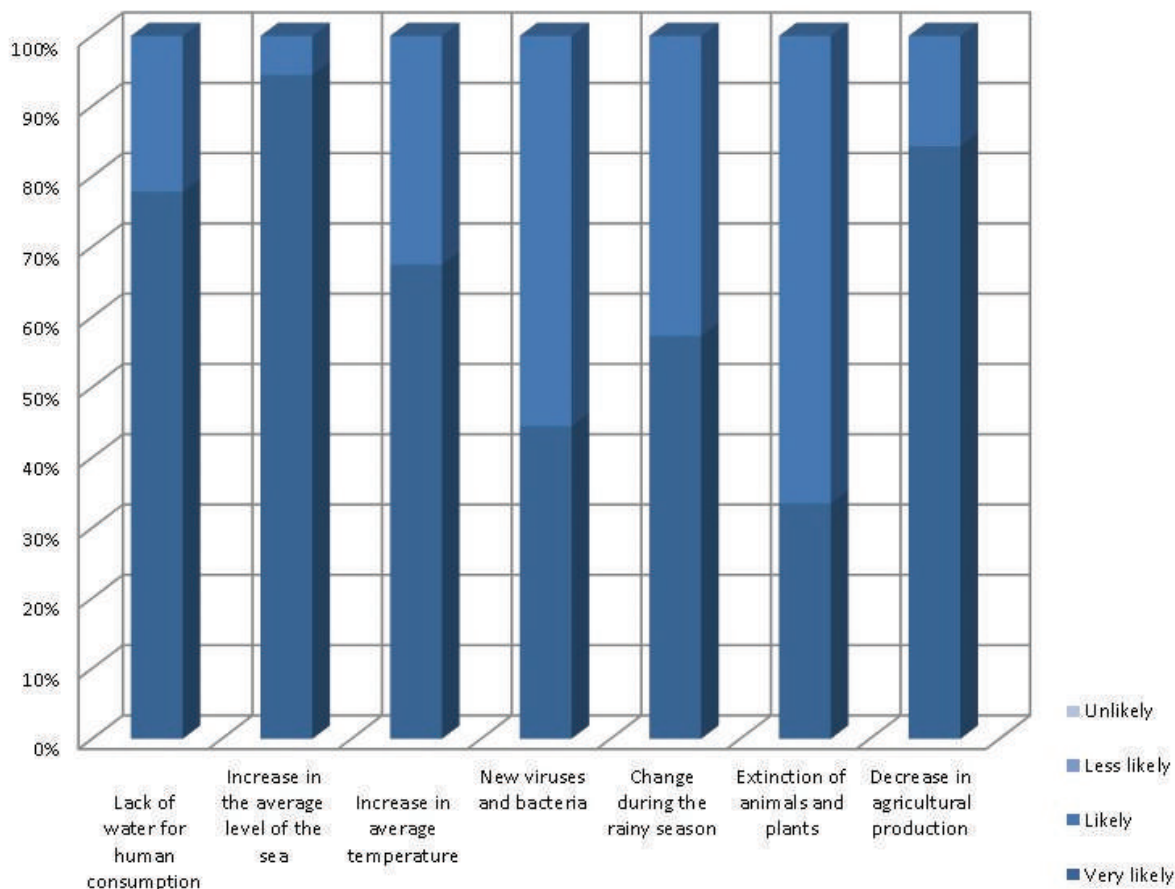


Figure 6 – Probability of occurrence of each of the following phenomena as a result of climate change

duction of emissions air pollution, as well as the application of more environmentally efficient technologies may be some of the most important solutions (Figure 7).

In practice respondents have implemented some measures aimed at improving environmental quality, of which: take short showers instead of immersion bath, follow the policy of 4 r's, caulking doors and windows to prevent heat losses, use of energy saving bulbs, composting,

use of public transport and planting typical trees of the region (Figure 8).

In short respondents consider themselves knowledgeable about the causes and consequences of climate change and at least two-thirds consider themselves documented regarding the means of combating climate change. A bivariate analysis of the results shows that the lowest levels of information (subjective) are reported among citizens whose qualifications are at the

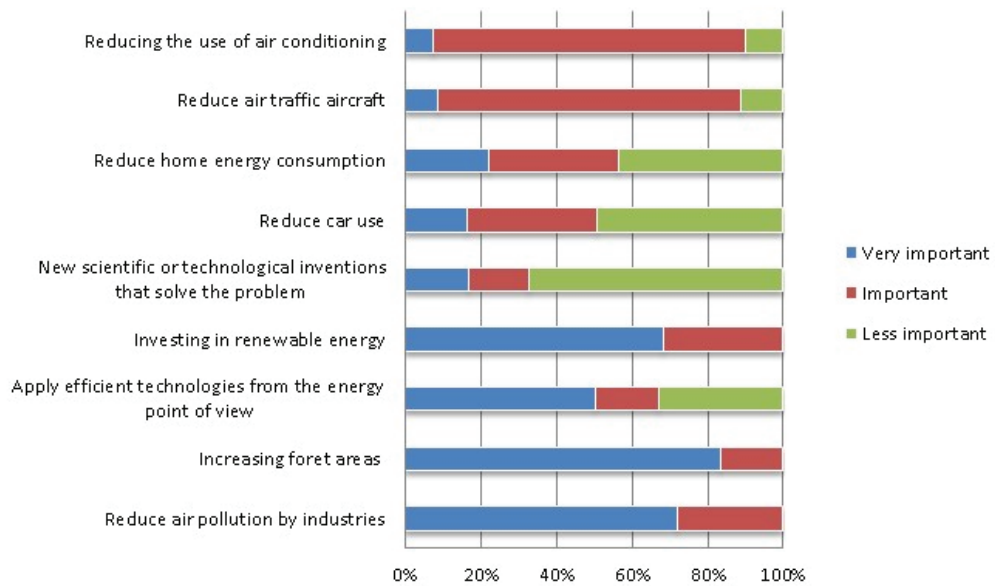


Figure 7 – The importance of each of these actions in addressing climate change

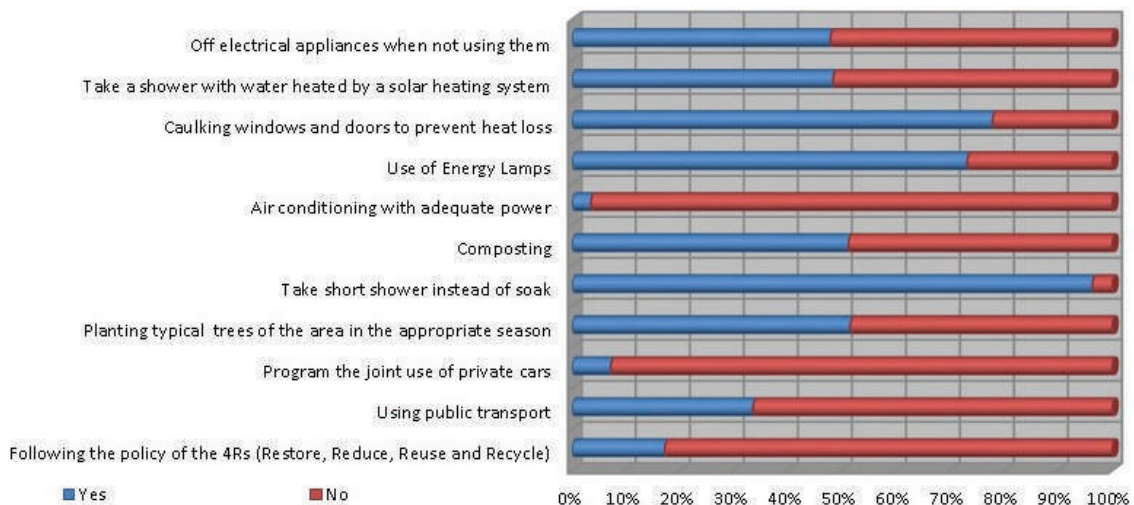


Figure 8 – Predisposition towards changes in order to improve environmental quality

level of basic education (Table 2). A socio-demographic perspective, as indicated in Table 2, it is observed that men declare themselves more informed than women about the causes and consequences of climate change and ways to combat them; the group of respondents over the age of 55 years said to be less informed about these issues than younger respondents, and the level of information declared by respondents increases with their level of education.

In a survey conducted, in 2008, on the social perception on climate change, on the causes, consequences and measures to be taken in relation to climate change (report made by the Directorate-General for Communication Public Opinion Monitoring Unit from the European Parliament) noted that over half of Europeans claim to be relatively well informed about climate change, however, there is still a large number of uninformed citizens. Portugal, the Czech Republic, Lithuania, Bulgaria and Romania are the countries whose respondents say they are very or fairly badly informed to the three variables (causes, consequences and measures to be adopted). With regard to the perception and information, the report notes situations identical to our question-

naire related to socio-demographic level, noting that young people, aged 15 to 24 years, as more knowledgeable about climate change, whether in relation to the causes or the consequences and on ways to combat climate change. The level of education has a particular importance, because there are differences between the Europeans that continued to study after the age of 19, claiming to be well informed and those with lower education levels that claim to have little or no information on the issue. Between men and women the differences in the level of information are not too prominent, concluding, nevertheless, that women are less informed than men.

Society aspires to live well, be healthy, to have certain goods that may be providing more comfort, and employment. Quality of life is acquired by consumption. Consumption generates the use of natural resources, energy, space, which can lead to pollution and scarcity of resources. As a result of human activity there has been an intensification of the greenhouse effect, the instability of the environment and excessive waste production. On the issue of waste, the results obtained by question 11 (Figure 8) show that only 17% of respondents practice the politics of 4 r`s. These

		Do you know what the term climate change means?	Do you know what the term greenhouse effect means?	Are you aware of the measures to be taken to combat climate change.
Sex	%	Total number of positive responses	Total number of positive responses	Total number of positive responses
Female	50	257	290	209
Male	50	283	299	223
Age Group				
18-24	10,1	79	102	54
25-34	14,3	98	122	53
35-44	22,7	105	104	69
45-54	21,9	102	87	78
55-64	14,0	71	76	67
65-74	9,6	56	50	64
+75	7,4	29	48	47
Literary Abilities				
Can not read or write	5,4	41	56	43
Basic education	7,9	88	68	62
High school or equivalente	36,2	202	232	125
University	50,5	209	233	202

Table II – Total number of answers by sex, age group and educational level

results demonstrate the need for raising awareness in changing attitudes in society about the sustainability at all levels. The knowledge of the population perception can influence government agencies through forms of popular participation in planning, management and development of public policies.

Conclusion

The phenomenon of climate change that is a reality around the world, is recognized by most respondents. Among these some have an extreme sensitivity to the topic, and the concept of climate change interpreted as something that is related to climate and/or pollution, demonstrating the human influence on aggravation which according to the questionnaire sample will tend to worsen.

It is considered that if people are sensitized to the issues of climate/global warming changes can contribute to reducing emissions of greenhouse gas effect. On the other hand, citizens may use social pressure, electing and requiring the use of alternative energies. Thus, both will be to participate in the economic and energy sustainability of the country. Collective pressure can lead to changes in terms of environmental practices (Rouquette *et al.*, 2005). Although, climate change includes complex and difficult concepts to convey, it is essential that appropriate ways to reach out to the population, in accessible language, clearly, and include aspects that still are not well known, this information should be conveyed on television, in newspapers and magazines and the Internet. Population should change the behavior, gradually, without sudden changes, especially the adoption of individual measures to combat climate change. Finally, it is important to emphasize the message that everyone has a responsibility in solving the problems and that all are important in mitigation of global issues.

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Sustainable development: a challenge around the theme of water

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Abstract

Given its short history, it becomes relevant today to clarify - as much as possible - the concept of sustainable development and its subsequent operation. From a historical perspective and to clarify the terms of development and sustainability, the concept of sustainable development is understood to be based on four pillars - environmental, economic, socio-cultural and political. This paper is based on research that took place between 2008 and 2012, research that was sustained in the belief that education is the most effective mean that society has to face the challenges of the future, and sought to contribute to teacher self-training in education for sustainable development.

A virtual community of practice was created, composed by teachers of Basic Education of Physics and Chemistry from Portugal and from African countries where Portuguese is the official language, and also from different contexts. Education for sustainable development was the community purview. The water was the motivating and unifying theme because it established an ethical challenge simultaneously social, economic, environmental and political.

Today, in an era when the global perception of

phenomena is meaningful, the priority of a fair and equitable distribution of water is urgent, to ensure consumption in quality and quantity to all mankind and all living beings. On the other hand, the fight against poverty is a major challenge to achieve equitable and sustainable development and water plays an important role here.

The research concludes that water is considered an essential asset to life and particular attention is now required to it due to environmental attacks to which is targeted, as well as economic, social and political attacks related to access and quality of drinking water. Consequently water is a unifying and motivating theme in the education for sustainable development.

The sharing of ideas made in the virtual community of practice, between European and African teachers, created a new approach and more diversified learning strategies on the theme of water and sustainable development issues.

Palavras-chave

Sustainable development; Water accessibility; Community of practice; Teacher self-training

Background

The term sustainable development appeared for the first time in the early 1970s at the time of publication of the Meadows team's report - "Growth limits" (1972) - commissioned by the Club of Rome at MIT. Since then, various world conferences (Stockholm in 1972, Rio in 1992 and 2012, Kyoto in 1997, Johannesburg in 2002) and various approaches and studies, from academic and civil society, have been presenting different definitions of sustainable development and to its operation in the present society with the consequent repercussions on future generations.

Given that the concept of sustainable development is somewhat open, and probably will

remain so, this paper will start by clarifying the meaning of development and sustainability and thus of sustainable development.

Since the end of World War II, industrialized countries live according to a paradigm of economic development. This is the foundation of a highly optimistic ideology that advocates an indefinite economic growth, seen as a process of increasingly intensive use of capital, reducing labor force and extensive use of natural resources (Caporali, 1998). The economic growth after the war, and especially from the 1950s onwards, has brought great improvements in the standard of living and quality of life of the populations of industrialized countries but, together came the biggest environmental impact of human history

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and the widening gap between populations of countries with different levels of industrialization. From the 1970s onwards, people started to understand the limits of that dream.

Two solutions were then possible: to embrace a neo-liberalism and the consequent austerity policies, or accept the development of a new society, respectful of all people and of the biosphere that allows the society to exist (Villeneuve, 1998). "If the world's people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success" (Meadows *et al.*, 1972, p.24).

But today, the adaptation to a new sustainable development paradigm is still the great challenge to mankind! Not only due to the change in attitude needed by the industrialized countries, but also because the less-industrialized countries tend to repeat the path of the rapid and unsustainable economic growth of the more developed countries. It is necessary, therefore, to establish the distinction between growth and development. "When a country develops, it becomes different. The Earth's ecosystem develops, evolves, but does not grow" (Daly, 1993, p.268).

It is established now that there isn't any environmental problem, political, economic nor social does that belong to only one region or country, and therefore, any problem of development follows the same path. Development is always seen on a global scale and has global implications which, as stated by Villeneuve (1998), presents a challenge to the development of solidarity between people or individuals.

But the development must be contained within the limits of what is sustainable (Grann, 1987), which brings us to the second component of the definition. A question can arise: what is it that we want to be developed sustainably? The answer is whatever leads to the satisfaction of human needs, present and future, taking into account the Earth's capacities. These needs are of type:

- Economic: employment, livelihood, adequate access to consumer goods, among others;
- Social, cultural and spiritual: including health, safety, education, equal opportunities, freedom of religious expression, among others;
- Environmental: protection against environmental disasters, access to natural resources such as water, soil or air, and

- Political: freedom, peace, civic participation, among others.

These four aspects represent the pillars of the concept of sustainable development, in our point of view. We have adopted as the basis of our definition of sustainable development the description presented by the World Commission on Environment and Development (WCED, 1987), in the report "Our Common Future", better known as Brundtland Report.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of 'limitations' imposed by the state of technology and social organization on the environment's ability to meet present and future needs" (WCED, 1987, p.43). "In essence, it is a guided process of change in which the exploitation of resources, the direction of investments, the technological development and institutional changes are in harmony and increase the present and future capacity of satisfying human needs and aspirations" (WCED, 1987, p.47).

It is a document that provides an overview of development including people, species of animals and plants, ecosystems, natural resources (water, soil, air and energy). It integrates concepts such as fighting poverty, population growth, and education for all, among others. In 1991, the International Union for Conservation of Nature (IUCN) includes these factors synthetically in the definition of sustainable development: sustainable development is intended to "improve the quality of human life within the limits of the capacity of ecosystems" (IUCN, 1991, p.10). In 2007, the Fourth Conference on Environmental Education held in Ahmedabad, India, has in its final declaration an even broader view: "Our vision is a world in which our work and lifestyles contribute to the well-being of all life on Earth. We believe that through education, human lifestyle that support ecological integrity, economic and social justice, sustainable livelihoods and respect for all life can be achieved. Through education we can learn to prevent and resolve conflicts, respect cultural diversity, create a caring society and live in peace" (UNESCO, 2007, p.1).

The different definitions of sustainable development have some common characteristics: the search for better quality of life, equity, environ-

mental preservation, the relationship with the economic and social development, the notion of global system and limit, intra and intergenerational implications and the recognition of a generational solidarity (Villeneuve, 1998). It is this vision that sets the course of this work, particularly in the education field, where the four pillars of sustainable development (environmental, economic, socio-cultural and political) provide to education for sustainable development (ESD) transversely throughout the curriculum. It is also the school's duty to create and develop the competencies, attitudes, skills, behaviors and values of its stakeholders so that everyone may have greater critical intervention and responsibility as citizen of a simultaneously local and global society, living in a specific time, but increasingly more aware of the future consequences of their actions and decisions.

Covering global issues such as employment, food, energy, water, health, population growth, natural resources and poverty eradication, ESD brings an education to values, where the human element, and its relationship with the natural environment, social, cultural, political and economic, is recognized as essential for the development of a sustainable society.

The water, the four pillars of sustainable development and energy

The International Conference on Freshwater, held in Bonn from 3rd to 7th December, 2001, presented “water as the key to sustainable development” (p.23), and recognizes its connection with the pillars of sustainable development. The United Nations World Water Development Report 2015 states that: “the sustainable use and management of water is vital for welfare of all mankind today, and it is essential for building the future we want for all” (Bokova, 2015, p.vi).

This year of 2015 is of great expectations and hope. It is the final year of the Millennium Development Goals and in which the different states define a new global agenda for development. “Water is inextricably linked to the development of all societies and cultures. At the same time, this development also places considerable pressure on water resources - agriculture, energy and industry all have impacts on the use and governance of water” (Bokova, 2015, p.vi). Given that, “The linkages between water and sustainable development are numerous, complex and often subtle” (Miletto and Connor, 2015, p.vii), we will briefly approach the relationship between water

and the four pillars of sustainable development and between water and energy. The approach focuses on Europe and Africa, due the scope of the study.

Social

The access to water is a basic human need and a fundamental human right (Dervis, 2006). However, “around 748 million people today still do not have access to an improved source of drinking water, and water demand for manufacturing is expected to increase by 400% between 2000 and 2050 globally” (Bokova, 2015, p.iv). Statements like this prove that an approach to water issues must be taken within the social sphere.

“Poverty eradication is the greatest global challenge facing the world today and an indispensable requirement for sustainable development” (UN, 2012, p.1), and water plays an important role here (Heerden *et al.*, 2008). Water is considered one of the limiting factors to development (Aronson *et al.*, 2006), particularly with regards to the lack of access to freshwater and sanitation or access to water as a productive resource (WWAP, 2015).

Many regions of Africa suffer from irregular rainfall and water stress affects the lives of many of its inhabitants (Pinto, 2007; CEDARE-GWP, 2002; Santos, 2007; Bouguerra, 2005), in terms of food and public health, causing often seasonal or permanent migration of the population to urban areas with greater access to water and food (CEDARE-GWP, 2002; Blanc and Perez, 2008). In fact, water scarcity that many humans suffer is a violation of principles of social justice, in particular with regards to equal citizenship and civic participation, social minimum required to live, equal opportunities and fair distribution of goods (UNDP, 2006).

One of the social consequences and human rights abuse concerns gender equality. In many traditional cultures, the women, adult and young (Bouguerra, 2005), are the ones responsible for the collection and transportation of water intended for domestic use, to meet the family's needs: direct consumption, cooking, hygiene, health, agricultural production (Pinto, 2007). In many cases, women and possibly children, travel long distances (WWAP, 2015) without any help, and particularly if it is added the responsibilities of the management of home and family and agricultural production (Pinto, 2007), this does not allow them to participate actively in society (UNDP, 2006) or go to school. More-

over, the improper quality of drinking water - often obtained directly from rivers, lakes or tanks (WWF, 2010) frequently contaminated by pollution - and inadequate sanitation, cause various diseases such as cholera and childhood diarrhea (CEDARE-GWP, 2002). These diseases, plus death, prevent particularly children from enjoying their rights, namely education, and so the cycle of poverty is perpetuated (WWAP, 2015; UNDP, 2006; UN-W/A, 2006).

The issue of scarcity and many other problems associated with water are also due to the living standards of modern societies. In the UK, for example, each person spends 50 liters/day on average in discharges of toilet, more than 10 times of the total water available per person in many rural areas of Sub-Saharan Africa (UNDP, 2006). For a person living in a rich country, it is hard to imagine what it means to have insecurity of water with which many people live daily.

Economic

Not only water is an integral part of the Earth's ecosystem, it is a social and economic asset. It is therefore essential to maintain the life of aquatic ecosystems, while recognizing the environmental values of water protection, when making economic decisions on the distribution and use of water (Flint, 2004), since we have in account the impact that the health of ecosystems have on human health and on the socio-economic development. In fact, “economic development and water are intimately connected in many ways. Water is an essential resource for economic production and an 'enabler' of trade for most types of goods and services. Water is an essential input for the production of the food and electricity, as well as for many manufactured products. Investments in water infrastructure are key to unlocking therefore the full potential of economic growth” (WWAP, 2015, p.23).

The high exploitation that often seeks an agricultural production of high yield and short-term economic growth, has devastating consequences for the environment, causing a decrease in river water flows and the disappearance or drastic reduction of some lakes (Santos, 2007; UNDP, 2006), which in turn revert in serious economic consequences. These facts can be found scattered all over the planet, but frequently in emerging economies such as India and China (Santos, 2007).

Despite the possibility of some remedial action in areas of great ecological degradation, pre-

vention is always more beneficial in terms of environment, social and economic. Exploration of hydrological reserves to environmentally acceptable levels, prevention of pollution in supply of water from the source to the consumer, control of water losses in the transport and supply systems (Santos, 2007), waste water treatment and other ways to combat water pollution are some of the possible actions (CEDARE-GWP, 2006).

Also, the implementation of good water management policies that take into account the environment, tax incentives and transparent subsidies that promote good water harvesting practices in the industry and agriculture have had positive results, economic as well as social and environmental (UNDP, 2006).

Investments in the creation and improvement of hygiene conditions and quality of water distribution always have a high return potential (UNDP, 2006) in the quality of life of populations, particularly in health and productivity. “Investing in improved water management and services is a prerequisite to reducing poverty and achieving sustainable economic growth” (WWAP, 2015, p.21).

Environmental

Deforestation, water shortages, declining of biodiversity and climate change has put the welfare and development of all nations at increasing risk (WWF, 2008). “Aquatic ecosystems are at the centre of all life and all forms of development” (WWAP, 2015, p.28) and the availability of drinking water is probably the biggest prerequisite to human life (Blanc and Perez, 2008). Only 1% of water on Earth is accessible for direct human use (Flint, 2004; WWAP, 2006) but even so, there is enough water available to meet human and environmental needs (UNDP, 2006; WWF, 2010). Nevertheless, in 2010, 43 countries were in moderate to severe hydric stress (WWF, 2010). It is expected that this number will increase due to the growing demand of water (WWF, 2010) for food, for human consumption and for sanitation, and due to decreasing water supply (reserves) attributable to climate change (Kundzewicz *et al.*, 2007). In 2030, it is expected that “half of the world population will be living in high water stressed areas” (UNESCO-IHP, 2014, p.2), with the intrinsic implications on the health of ecosystems, food production (Blanc and Perez, 2008; WWF, 2008), quality of available water (CEDARE-GWP, 2002; Santos, 2007) and energy resources (UNESCO-IHP, 2014).

The challenge is large and urgent. Some priority actions are the preservation of pollution of the water supply systems; waste water treatment, for both domestic and industrial effluents, which implies investment in sanitation that protects from water pollution and reduce health risks; reuse and recycling of waste water (CEDARE-GWP, 2002); the battle against desertification, with protection of fertile soils, practice of non-intensive agriculture and other forms of ecological and environmental promotion. "We all live at the water's edge, whether we are at the end of a pipe or the bank of a river. We need water for our basic survival, for cultivating crops, for generating energy and for producing the goods that we use every day" (WWF, 2010, p.50). However, sometimes, the use of water is exploited. One example of this is the irrational consumption of water on agriculture, industry or for domestic use.

One of the major environmental problems related to water still remains the pollution: in agriculture (Flint, 2004) due to non-biodegradable agrochemicals (CEDARE-GWP, 2002; Bouguerra, 2005); and also to effluent discharges into rivers and lakes as "natural sewage" and/or inadequate treatment of waste and domestic/industrial water and poor sanitation, especially in Africa (CEDARE-GWP, 2002). The results of the degradation of water quality attributable to pollution is the degradation of agricultural soil and the consequent abandonment of land (especially in less industrialized countries), the economic burden on remediation processes, the reduction of drinking water needed to sustain ecosystems and future needs of water and the onset of diseases related to water (CEDARE-GWP, 2002). Diseases caused by water pollution are estimated to kill more than five million people per year. In terms of human life, this is undoubtedly the most serious problem of pollution of a natural resource (Santos, 2007).

Political

Water is a fundamental right for all mankind and a governance priority: defend the quality of water resources, manage the existing water so it can be reached to those in need, ensuring sanitation and waste water treatment, safeguard water supplies in quantity and quality for the consumers of today and tomorrow and all species dependent on them, among others. Whatever the socio-economic situation of the country, among the various political decisions that it are neces-

sary to take on, water and the distribution of water resources, the equity in access and use of water and sanitation are priorities (CEDARE-GWP, 2002; UN-W/A, 2006; MAOTDR, 2007; UN, 2011; UN-W/A, 2000).

Considering the local political involvement, people need to be effectively involved in the decisions of management and governance concerning water resources (CEDARE-GWP, 2002). The more knowledgeable the population is, the more effectively they can contribute to policy decisions that are centered on real needs of the population. People can also contribute to policy development.

An important aspect are the laws and strategies established among countries sharing the same water resources (groundwater, rivers, lakes, watersheds ...). In fact, according to the World Charter of aquifers, published by The United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2008, 273 existing aquifers on the planet are shared by more than one country (UNESCO, 2008). Twelve African countries receive more than half of its water sources from outside their borders that puts them in a situation of great interdependence (UN-W/A, 2006). The development of mutual strategies and long-term commitments and sharing and joint research, are important in this area. It should be noted the need for legislative regulation to safeguard that the projects take into account the protection of the environment and the social benefits of the people involved.

The more comprehensive the policy decisions and the management of water resources are, the more likely it is to generate a true sustainable development. It also should take into account the water interrelationships with "climate change, desertification, biodiversity, wetlands, dams, marine environment and sustainable forests", as well as mechanisms that should balance competing demands and the social, economic and environmental values of water. Moreover, they should reflect the links between surface and groundwater and between inland and coastal waters, the increasing urbanization, the land use planning, and the need to maintain the integrity of the ecosystem and the threat of desertification and environmental degradation.

At the level of supranational policies, like for example, the efforts to make a success of the Millennium Development Goals (MDG), although not fully achieved as 748 million people still lack access to safe water, made it possible for "more than half the world's population, almost 4 billion people, now has a piped water connection at

their homes. Concerning sanitation, from 1990 to 2012, almost 2 billion people gained access to improved sanitation and 77 countries have met the MDG target on basic sanitation" (UNESCO-IHP, 2014, pp.1-2). We should also highlight the preparation of the Global Agenda of Development post 2015 and the Goals of Sustainable Development. "UNESCO-IHP proposes a stand-alone sustainable development goal dedicated to water to ensure Water Security for Sustainable Development" (UNESCO-IHP, 2014, p.4).

The relation with energy

The sustainability of the development paradigm we live in now and its extension to a growing number of people is dependent on the current development models to the regional and global scale and how to face problems concerning the exploitation of natural resources. In this context, the energy is of particular importance because of its central relevance on models of social and economic development. The satisfaction of the energy demand required for the development of the next hundred years is probably the most important and difficult challenge facing us at the beginning of 21st century (Santos, 2007).

Our dependence on fossil fuels is enormous. The use of fossil fuels (coal, oil and natural gas) toward primary energy sources is 80% (Santos, 2007). This dependence has the disadvantage of generating a serious environmental problem of air pollution on a global scale, increasing of greenhouse gas emissions and consequent climate changes.

Moreover, the energy production based on fossil fuels or nuclear power requires large water consumption, especially for cooling systems (WWAP, 2015). In terms of the impacts on water, wind energy and solar energy are the most sustainable.

As for renewable energy sources hydro power accounts only for 2.2% of energy production. Hydro power is one of the primary forms of energy that produces less pollution and is safer. The use of water for electricity production contributes to the tightening of CO₂ emissions and also of SO₂, NO_x and ash, some of these containing radioactive elements (Madureira and Baptista, 2002). Nevertheless, the need to build dams has as main impacts the loss of soil that can be used for agriculture and ecosystems that may be rich in biodiversity, and the retention of sediments transported by rivers (WWAP, 2015; Santos, 2007). On the positive side, dams are

important for the storage of water resources and the regulation of flows of rivers and streams associated, thus avoiding the reduction of grave effects caused by droughts and floods. Thus, dams contribute to the quality of water and life on the river and hence to the quality of life of the population that depends on it (Madureira and Baptista, 2002) and dams can also be recreational sites for populations (WWAP, 2015).

The main question in the energy issue is to assure that users have energy at the time and place where it is necessary and under the appropriate form (Santos, 2007). However, about a third of the world population still doesn't have access to commercial electricity and must rely on biomass for heating and somatic energy to provide the mechanical energy. In 2014, more than 620 million of people (2/3 of the population) in Sub-Saharan Africa still lack the access to electricity, although the region is rich in energy sources: solar throughout Africa, in many countries hydro power, wind in coastal areas and geothermal in the valley of the East African Rift (IEA, 2014).

Despite the significant growth in recent years in proportion to conventional energy, renewables remain underdeveloped and under subsidized in comparison to fossil fuels (WWAP, 2015). In Sub-Saharan Africa renewable energy correspond only to 2% of the total. According to the scenarios of the International Energy Agency (IEA) it is unlikely that hydro power is the solution to replace fossil fuels, although its contribution to electricity production is very important (Santos, 2007). "Renewables, such as wind, solar PV and geothermal energy can make a substantial contribution to energy supply and freshwater demand at the local or national scales, even if remain marginal at the global scale" (WWAP, 2015, p.56).

Methods

A research that we conducted between 2008 and 2012 aimed to contribute to the self-training of teachers of Physics and Chemistry in ESD. It created a virtual community of practice composed of teachers of basic education in Physics and Chemistry of Portugal (Continental and Azores) and African Portuguese-speaking countries (Angola, Mozambique and Guinea Bissau). The community consisted of eight teachers who initially did not know each other and were from different contexts.

The virtual community of practice was the basis of this experimental research. It was cre-

ated in January 2008 to enhance the interaction between the teachers to engage them in building a module on the water, for pupils of primary and secondary education. This activity should provide the training in education for sustainable development to the same teachers.

Given the physical distances among different members of the community, a space in a computer platform was created (Platform Odyssey - Open University URL: <http://www.odesseia1.univab.pt/cursos/DesenvSustentFis>) as virtual site of interaction for the members of the virtual community of practice. This also allowed the teachers the possibility to access the digital network that limited the choice to schools in urban areas, especially in Africa. In the invitation, each teacher was given access to this platform through a user name and a password. The community was active until the end of 2010.

Education for sustainable development was the community purview. The water was the motivating and unifying theme. What is the reason for choosing the theme of water? Answer: to establish an ethical challenge, simultaneously social, economic, environmental and political. In fact water, which is variously distributed over the surface of the Earth and unevenly distributed along the year, is a priority of all ages and cultures. Today, in an era when the global perception of phenomena is evident, the priority of a fair and equitable distribution of water is urgent, to assure consumption in quality and quantity, to all mankind and all living beings. We developed a study on the relationship of water to the four pillars of sustainable development and the relationship of water with energy.

From the outset of the study, every member of the virtual community of practice was requested to search for teaching materials such as articles, films or other, on education for sustainable development and on drinking water and introduce them on the platform. The central proposal for the work to be developed by the community consisted of a module on the water that should later be taught to the students of the teachers involved in the research. The platform had also available a portfolio with some scientific articles, videos, news, legislation and even a list of bibliography, videos and websites on water. The portfolio intended to be a theoretical reinforcement that could increase the self-training of each teacher belonging to the community in the theme of ESD and specifically on drinking water. The completion of the module, with experimental and testing activities took place in June 2010.

The platform made the interaction among community members possible by exchanging and

sharing experiences with teachers who live in other cultures and different contexts, although numerous technical and communication constraints persisted.

During the period of the study, the researcher visited the different participating countries and met the teachers involved. In this way, she examined the problems concerning water consumption. She also observed local realities concerning the relationship of water with energy. For example, in Angola, one of the places visited was equipped with a small hydroelectric power station placed in the river passing the village. This had energy autonomy and a plumbing system of rainwater. With the civil war, the village had been practically destroyed. Unfortunately, the reconstruction process has not yet implemented a distribution system of drinking water or basic sanitation. Since 2013, the village regained power - albeit with some problems of distribution - but using a fuel generator (since it is an economic resource in Angola). The researcher encouraged the local administrator to recover the hydroelectric power station - that so many residents took pride in former times - but the economic infeasibility and the lack of support of the Angolan state, not allowed it to until now.

Results and discussion

During the research, the teachers who formed the virtual community of practice deepened their knowledge on water and sustainable development through formal and informal sharing on the computer platform. The chat, the forum, the exchange of emails, the questions to each other and a portfolio with scientific articles and multimedia materials were the basis for teacher training. As sharing among the different members of a virtual community of practice translates into learning (Wenger, 1991; Wenger, 1996; Wenger, 1998; Wenger et al., 2002), a learning taking place “from the own lives of the people who are learning” (Rodriguez Illera, 2007, p.119) and is inherent in practice (Lave and Wenger, 1991), classroom practice was deemed crucial to this investigation. Teachers were invited to create a teaching module on water and teach it to their students. The module was built together and the results of the construction and application were placed on the platform.

Because of experiences that are motivated by different cultural and geographical contexts, teachers of African countries showed more interest to real situations experienced by them, re-

ferring to issues of drinking water as essential to daily life, including their quality and access for human consumption. On the other hand, teachers of Portugal were more sensitive to the problem of water as an asset to be preserved, in order to ensure their quality and quantity to all people and ecosystems, now and in the future. The sharing among different teachers enhanced a more diversified approach and learning of the water theme and sustainable development issues.

“I felt the motivation to inform my students about the importance and care of water, especially for consumption. (...) The concept of consumption of drinking water is very diverse in various regions of the world. Speaking specifically of Africa and in particular in Angola, it can be seen that over 90% of the population has no access to drinking water. Since water cannot be supplied to the entire population, it makes the inhabitants of many areas consume river water and other sources directly (...). This theme is very relevant when it comes to sustainable development, as the water is source of life and all living beings depend on water” (A teacher of Angola).

“As a teacher, I should mention that this topic has already been discussed in some of my classes and shall continue to be a recurring theme, taking into account its importance for life. It is important that students know that in a number of areas of the World there is a shortage of water resources and that our water resources must be properly treated and cared for to be consumed safely and have good quality” (A teacher of Portugal).

Teachers revealed, from the beginning, the concept of the importance of personal and collective responsibility for sustainable development. The notion of global and local implications of the decisions made and the actions taken did not emerge as evident. The study also allowed the teachers involved to develop competencies in sustainable development.

“It was found that when faced with problematic situations in a personalized and individualized way, students get scared. They showed a lack of enthusiasm to personal/

individual commitment and awareness to the need for a rational management; it is not enough to preserve the quality (...) for those who bathe every day while others die of thirst or drink sewage-type of water (...)” (A teacher from Portugal).

“You can tell that our young people are not aware of the need to save water because they do not need to do it!!!” (A teacher from Portugal).

“In several occasions, the TVM program “View Mozambique” showed reports where you can see mothers and children who walk 5 to 30 km in search of water; in the same program is shown populations using water from rivers or ponds created by rain for own consumption, water without any treatment; still this program showed the abusive use of water in cities, barely closed taps, constant disruptions of the tubes transporting water, (...) Have you thought how you use water to brush your teeth, to wash your clothes and dishes, taking a bath? What is the relationship between the lack of water pressure in your home and the irregular use of water in your neighborhood?” (A teacher of Mozambique).

“For me, sustainable development concerns social and technological development of a society, responding to its needs, but without jeopardizing the environment and the future of resources, which, if exploited in excess, could not exist for the next generation” (A teacher of Portugal).

The results of this research are in agreement with the proposals of the International Conference on Freshwater held in Bonn, of the World Water Council (WWC, 2006) and of the World Conference on Education for Sustainable Development (UNESCO, 2009a; UNESCO, 2009b). In fact, the theme of water is revealed suitable for training in ESD because:

- It is essential to people's lives and ecosystems;
- Deals with issues concerning the relationship with the everyday life, urging concrete actions of citizenship;

- Concerns global and local dimensions simultaneously, cross time and space, that raises solidarity with all the inhabitants of the planet;
- Has a didactic scope and competencies to develop.

Conclusions

The research found that water is considered an essential good to life and particular attention to it is now required, due to environmental attacks to which is targeted, and attacks on economic, social and political aspects concerning the access and the quality of drinking water. Consequently, water is a unifying and motivating theme in education for sustainable development, both for teachers and for students.

As supported by the United Nations Conference (Rio + 20) “water is at the core of sustainable development as it is closely linked to it to a number of key global challenges” (UN, 2012, p.23), our study also reveals the theme of water is relevant in the context of sustainable development, in particular in education issues, and it gives the possibility to address the four pillars of sustainable development.

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Sustainable design surfaces for an industrial boiler

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Abstract

This study introduces a new perspective to an industrial system for biomass heating boiler water - such as firewood, forest residues, biogas, biodiesel - which remains the power source with a greater contribution to the primary consumer. The design of a boiler product is a complex and difficult process with technical requirements and a tight development cycle, involving several entities and producers. The technical knowledge requirement of the product and the spatial and social issues combined with the complexity and contradiction that characterize liquid modernity (Bauman, 2000) increases the difficulty setting of a product as an industrial boiler.

However, the energy advantage can be integrated into the architectural construction of a new and sustainable way. The energy and the communication can transpose a new cultural revolution that, increasingly, is imposed in spaces and buildings, facades or through a complete perspective of the architectural space. Today, there is the opportunity to have a third revolution. We miss the distributive and distributive energy communication, to reach a new economic model and collaboration in society, where each person has a responsibility to create its own energy. One of the aspects to be taken into account in the design of the boiler is the physical dimension. When the boiler is consisting of several modules may limit its versatility to buildings, thus ignoring the spatial values. The limitations and disadvantages will have to be

rethought in order to obtain improvements and virtues, which constitute a communication processing between the product and persons. To support this thesis the authors presents the progress, the methodology and the results of the research project “Plug & Heat”, developed in partnership with the Ventil company (Aveiro), in which is present the importance of developing an engaging structure of the boiler, capable of protecting, respecting the concept of space: with the respective cultural value and their social habits. It is expected to prove that, in the circumstances in which this product system is installed as the industrial sector, there is an introduction of new communication settings for an interaction, not only in the environment in which it operates, but also by whom will enjoy. Through this analysis, it is intended that, through a relationship between the area of knowledge (the Academia), industry (company Ventil) and design, there is an identity reinforcement and a prevalence both in functional capacity and the pragmatic industrial sector requires either a close link between product and citizen, culture and space, highlighting the value of design semantics.

Keywords

Product system, Epidermis vs Material, Comfort vs Interaction, Energy vs Communication, Industry.

Introduction

Globalization and population growth have forced rethinking strategies for energy consumption. Raw materials depletion and land occupation by society keep increasing, along with the dependence on secondary energy sources. Taking into consideration that “(...) all human activities generate environmental impacts to a greater or lesser extent, notably energy-related activities, indus-

tries, agriculture and transportation” (INE, 2009, p.19), sustainable consciousness must evolve and with it the daily consumption of massified sectors. The new approaches to energy are based on sustainability and socio-economic policies. The emphasis on sustainability as economic development factor answers concerns about future generations. The concept of sustainability establishes an alternative to traditional models of development based on secondary energy, which represent a worn-out

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consumption philosophy. Secondary energy is used due to easy implementation and acquisition, in contrast to primary energy, more expensive in immediate monetary terms but in energy terms more lucrative in the long-term. A social modernization in a multidimensional perspective involving economics, ecology and politics is the starting point for sustainable development.

The design of spaces or equipment involving these concerns is an important step, although sometimes resulting in problems concerning the context of insertion. In this research, the development of a biomass hot water heating boiler underlines the difficulty to apply apparatuses in context, considering the spatial implantation of buildings and the important economic factor attached to that application. Subsequently, the impact of energy in economy and buildings constitutes a design opportunity to create new scenarios to experience this category of equipment. As a projectual approach it will allow addressing different levels of interaction between the individual and the product, considering a person's life that has become a paid-for experience (Rifkin, 2001) instead of a collection of paid-for products; adding communication value and identity to the product.

Research Process

Aims

This paper intends to reveal that communication and energy are part of the construction. As argued by Palma (2011, p.70), “today we have the opportunity to go beyond previous paradigms, to launch a third industrial revolution, to switch from distributive communication to distributed energy, reaching a new collaborative economic model of society, where everyone has the responsibility to create their own energy.”; Following Robert Venturi's thinking (2005), nowadays architectural dimension should focus on designing surfaces as membranes able to articulate complexities, translating into thinking the skin of the product/boiler as a system of patterns (Alexander, 1977) in an enveloping macro-system.

Related Work

Today, products must be interpreted, assuming liquid modernity (Bauman, 2005) as a part of the process. There are some projects that transform constraints into opportunities, such as the

Lullaby Factory by Studio Weave (2012). This project is an intervention carried out in 2012 at the Great Ormond Street Pediatric Hospital which turned a negative circumstance into a better condition. A new building was built in front of the Hospital, with a small hallway, an alley in between the two buildings. Facing a problematic surface design, the façade of the new building was conceived and designed as an open space, giving priority to a future spatial restructuring. It is important to underline that the Hospital was to be demolished in fifteen years, thus the large windows overlooking piping, draining tubes and vital connections installed on the outside of the Hospital.

The surface product system was intended to provide a magical place with a peaceful disrupting atmosphere, totally unconventional, taking advantage of this structure. Holding the patients as main concern, the development of the surface system created an extremely complex ‘steampunk’ landscape with an industrial allure, using consecutive musical instruments.

On the one hand, the instruments' physical shape was designed to solve aesthetic problems in a surface. On the other hand, the immaterial part of the musical instruments – sounds, melody – was solved in relationship with the building's façade. The project was complete with the intervention from the sound artist Jessica Curry, a reference in composing original soundtracks for videogames.

As explained by Studio Weave, “Jessica Curry has composed a brand new lullaby especially for the project, which children can engage with



Figure 1 – Detail of Lullaby Factory by Studio Weave
Source: www.studioweave.com (accessed 17.02.2015)

through listening pipes next to the canteen or from the wards by tuning into a special radio station”². The project was extremely ingenious in a social design and inclusive design perspective. Studio Weave solved a problem answering with simple thinking for a complex application, turning disadvantages of the façade into benefits for the project, studying hypothetical forms and deciding to add value in the perspective of hospital users.

The success of the intervention was due to a partnership between two distinct areas in their materialization, but complementary when the most important factor to consider is people who use the space. Beyond a physical approach, it is a social, cultural, human approach.

Participants and method

The system of patterns of a water-heating boiler is a pilot project that relates the design school with an industry of water heating boiler. Investigation in design, according to Roberto Verganti (2008), is a research conducted around specific reading instruments such as “those studying innovation processes promoted by enterprises in collaboration with designers and the world of creativity” (Verganti *apud* Soares, 2012, p.225). Masters Studies in Integrated Design differ from other Masters due to the approach it allows students in developing and building their thesis, since case by case the distance from real enterprise situations is shortened, involving added value and shared knowledge and experience between the teaching institution and the entrepreneurial world. Some industries, such as Ventil, are facing adaptation problems concerning their product-boilers, since now meeting new challenges, often facing spatial restraints causing standard models not to fit.

Thus, Ventil proposed a design collaboration and action through the Master Degree in Integrated Design. This pilot research was carried out in different stages. A first stage took place between Ventil and 3 designers, targeting the system of patterns of the water heating boiler skin. A second stage targeted the design of the system of patterns, and also the outdoor implantation of the new water heating boiler. The other partner

is an Agricultural College working in a former monastery whose historical values are visible everywhere, outside and inside. The monastery building and premises had its largest renovation during the intervention by the Portuguese architect Fernando Távora, keeping the strong historical value of the building and the sustainability of the surrounding environment, consciously embracing a contemporary approach, namely offering a new breath to timelessness, reaching a high-level of creative consciousness (Gomes, 1993), whereas each space composing the building is historical.

In this research, the project was developed in the principle that the equipment-boiler should be installed outdoors, requiring a sleeve casing, an architectural structure to solve weathering issues, highlighting a connection between product-space-people in the urban space. It is through structure and skin that communication between elements takes place.

Material and appropriation

The structure is mainly in metal, factory built on the Ventil plant, since metal is also the main material employed to produce boilers. Hence, the choice and application of the material was

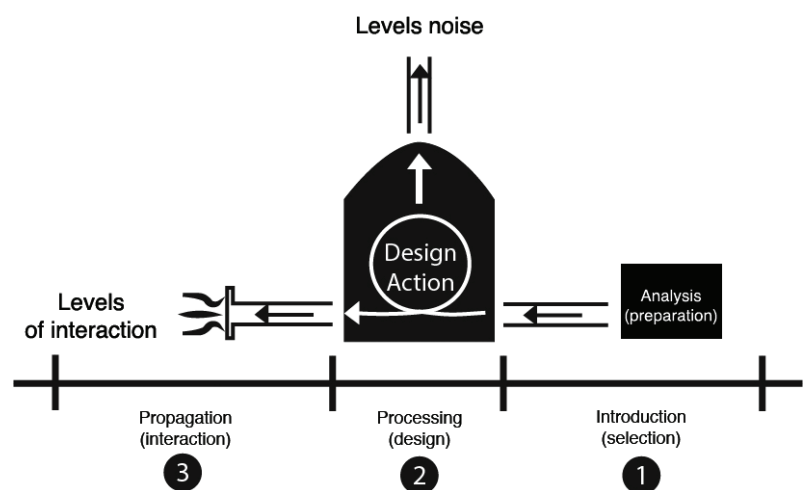


Figure 2 – Mental Map

Source: authors' material

determinant for the project. In the exceptional event of other materials, their characteristics will be established through networking with other companies. All the inner part sections will be determined by metallic girders, with structural

² <http://www.studioweave.com/projects/detail/lullaby-factory>. Accessed 18.09.2014

columns forming a skeleton standing on a concrete mount. One of the wider sides of the parallelepiped structure includes two folding doors with standard fitting system, while the opposite side and ceiling are composed of plates attached to the columns. The entire structure is in metal. The top framing secures acrylic plates, allowing sunlight during the day and performing as a light box during the night.

Technology and performance

The industrial boiler is an assembly of different modules. The process begins with biomass placed in the silo, remaining there for as long as necessary until the end of use. At the bottom of the silo there is a feeds crew axle transporting the material to the feeding feeds crew, connected to the boiler module, where burning and energy production takes place. The originated gases pass through the internal pipes and heat the water. Gases are then directed to the multicyclone, where pollutants particulate from the remaining air are filtered and cleaned. Clean steam from this process follows to the butterfly valve, which directs it to the chimney thus ending the process with steam expelled onto the atmosphere. Ventil products are manufactured with a strict quality control in all processes. Welds are performed by qualified workers and the final coating of paint is periodically tested to ensure corrosion resistance. The equipment is also subject to periodic testing to ensure the correct operation. The boiler to burn forest biomass has a three pass smoke-tube design with integrated flame tubes. The flame tubes were developed for the exclusive combustion of wood chipper, sawdust, wood shavings, pellets and other biomass-derived fuels. The combustion is also optimized, ensuring total compliance with existing restrictions regarding environmental emissions. The technical characteristics of biomass boilers performance are directly determined by the fuel characteristics, particularly rated thermal input, fuel consumption and system performance. Situations such as excessive moist on the biomass may cause a lower performance in energy production. After purchased, the system only requires periodic maintenance in some of the modules. Verification of the correct operation of the equipment and surpluses cleaning are some examples of such maintenance operations.

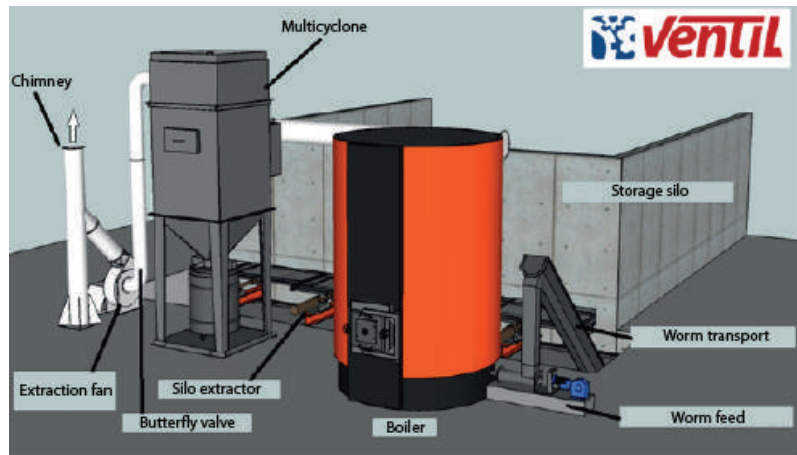


Figure 3 – Industrial boiler modules

Source: Ventil

Findings

Advantages of the process

The acknowledgment of the potential of the material. In the case of boilers production, the raw material to apply to the architectural structure is the one usually employed by the company Ventil: metal, namely, iron and steel, characterized by flexibility in their application. Their properties may be an asset for product design.

The market for biomass boilers is limited to indoors application, invariably with a metal coating to allow fast production and assembly, with minimum insulation requirements. Setting this material outdoors carries new implications in the introduction of this type of energy in the target market. The use of metal as the surrounding boiler structure coating enhances the relationship between the low production cost and the good behavior of the material in response to weather conditions, with zinc finish or paint.

The potential of increasing the use of this material by other industries promotes cross-fertilization (Cappellieri, 2006) and opportunities for other potential companies and the industrial sector.

A project with a different application than the one Ventil is used to doing may constitute an opportunity for the company to transform, pointing and revealing new applications for their products, recognizing the market demands have to be followed by sustainable energy demands targeting the future and the social impact of applying such products.

Disadvantages of the process

The lack of communication between some of the actors hindered the development of research. At Ventil, the need for a successive follow-up was identified as a slow process. The company is a reference in the market of industrial boilers, and every available time would chiefly be dedicated to internal issues such as foreign expansion. There wasn't enough time to answer all questions being posed, at the pace demanded by the project. However, management members volunteered to show the entire plant and didn't obstruct any direct relationship with the plant workers.

Market competition in the boilers sector is mainly an international issue, since sustainable energy policies and their application have a much greater impact in the North European market. This impact spins-off to the rest of Europe stemming from these countries, with a stable long-standing tradition in this sort of products, namely for cultural reasons related to the use of their own natural resources. There is little competition at a national level because the relationship with secondary energies is still very strong.

The pilot study

The project was developed in two different ways. On one hand, the process was adjusted to technology. On the other hand, the process was driven by design innovation, considering design research into new languages (Verganti, 2001) and design action focused on creating new markets. The development of the project was founded on abductive reasoning (Cross, 2006), linking the company, the Academia and other entrepreneurs. It is based on design's ability to convey cultural values (Chiapponi, 1999) to a given space. The architectural form is that of a parallelepiped. One of the sides is the main cause for the rest of the volumetric form. That side is composed of triangular profiles applied to a plate, with spacing between them, occupying the whole area of the sidebar. This solution is the result of the study carried out at the level of relationship with people. The chosen path was illusion and its application to shared social spaces, such as for instance with graffiti. Depending on the point of view regarding that side of the parallelepiped, three different images are viewed: one image seen from a corner side perspective, another image seen from the opposite side and a third image when facing the object. When passing in

front of the structure at a considerable distance it is possible to perceive the image configuration. Image formation and deconstructing is possible to see due to the triangular side profiles, which will mark each side with a part of the picture. Spacing between triangles was calculated to allow the application of the third image, visible when facing the side. The opposite side comprises a folding door, allowing access to the boiler storage and access to the technical area. The door follows the same triangular shapes of the opposite side in full harmony. The top sections are slightly inclined creating a lighting effect during the night, illuminating the surrounding area and becoming a reference point for those attending school.

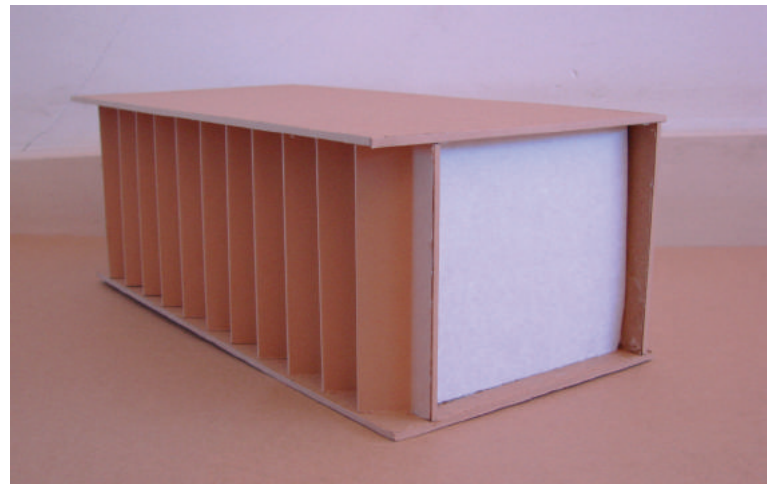


Figure 4 – Mockup of the structure

Source: authors' material

Conclusion

The findings from this study support that circumstances define a market that requires industrial products with innovative configurations to interact with their own environment and with people. It is therefore intended to explore new settings for product integration through design, meeting requirements of meanings and integration onto the space shared with individuals. The boiler sector reveals some gaps in the field of communication, and therefore this research profited from the problems of an industrial product, fulfilling its practical role as a machine, transforming problems into project opportunities and identity value. This approach allowed building bridges onto companies from different areas, such as Ventil Company. It is also through communication and connection between trades,

research and education that a visionary result is expected. It is expected from design teaching to be a determining factor for the answer to and solution of different problems related to products developed by industry, in a eventually paradigmatic approach. This research also highlights important issues for design teaching, especially concerning bridging the gap between students and the business world. Having the opportunity to deal with an ambitious project like this one reflects mature teaching and vision towards a better understanding of the world. The future of society is also shaped by environmental decisions, and by the importance of individual responsibility towards a sustainable world. This notion is now creating values in human relationships, in everyday activities, decisions and commitments, and in the business world. This way, design will serve as a liaison vehicle, an instrument for a better world.

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Comparing Resource Use and Environmental Impacts using a LCA database

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Abstract

One of the key strategies for sustainable development is decoupling, which aims at unlinking natural resource use from economic growth. Global targets for the reduction of resource use have been set e.g. by the International Resource Panel, by the European Commission and recently a corridor for a safe operating space for global material resource use has been proposed. Regarding these targets, the question is how they can be surveyed on the micro level. Up to now, no sum parameter measuring all abiotic and biotic resources has been considered for life cycle assessment. Moreover, current life cycle assessment databases lack specific input flows to calculate all abiotic and biotic resources used by a product system.

Another reason to calculate resource use is that it can be used as a rough estimation of the overall environmental degradation induced by a prod-

uct system. The environmental relevance of the resource use has been discussed controversially in the past. Currently resource use is mostly considered regarding the criticality of materials. Facing this, we developed a methodology for calculating the abiotic and biotic resource use with the indicator material footprint based on life cycle inventory data from the database Eco-invent. The methodology was tested to analyze in how far the environmental relevance can be estimated with the material footprint by comparing the resource use with selected environmental impact categories.

Keywords

Product system, Epidermis vs Material, Comfort vs Interaction, Energy vs Communication, Industry.

Background

Decoupling, which aims at unlinking natural resource use from economical growth, can be seen as one of the key strategies for a sustainable development (UN, 2011). It has furthermore become clear that an absolute reduction of resource use is needed: Bringezu (2015) recently suggested three targets for global resource use (societal perspective) which are in line with the Sustainable Development Goals proposition by the International Resource Panel (2014). The “10-2-5 target” is meant as an orientation for policies and its target values (10 t/person of total abiotic resources used per year and 2 t/person of total biotic resources used with 5 t/person being direct raw material consumption) have a suggested resource reduction factor ranging between 4 and 10. Furthermore, Lettenmeier *et al.* (2014) suggest a sustainable resource cap target from an end user perspective of 8 t/person per year for Finnish households, which would be a reduction factor of 5 from the current state.

Regarding these targets, the question is how they can be surveyed on the micro level. Up to now, no sum parameter measuring all abiotic and biotic resources has been considered for life cycle assessment (LCA). Moreover, current LCA databases lack specific input flows to calculate all abiotic and biotic resources used by a product system. This means that the material flow analysis, which builds the baseline for macroeconomic resource calculations, and LCA are calculated based on different data and system boundaries. Therefore results are difficult to compare and bottom-up or top-down approaches are challenging.

The consideration of abiotic and biotic resource would allow calculating mass-based indicators on the micro level, which are compatible with the macro level targets. The idea behind mass-based indicators is that all anthropogenic emissions are based on the extraction of natural resources. Reducing the amount of natural resources extracted, can in consequence also lead to a lower environmental degradation induced

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by a product system (Schmidt-Bleek, 1994).

The environmental relevance of these indicators has been discussed controversially up to now. Today, LCA understands resource use and the problems associated with it are mainly regarding the criticality of resources in an economical sense (Vadenbo *et al.*, 2014; Klinglmaier *et al.*, 2014). Nevertheless, the authors of this paper still see a need to consider the resource use additionally to the measurement of specific impact categories for several reasons. In spite of the great progress in LCA's impact assessment, it is unlikely that the environmental categories proposed according to today's knowledge such as in the product environmental footprint (PEF) (Manfredi *et al.*, 2012) actually cover all environmental interventions. This was already pointed out by Klöpffer (1997) and is still valid today. For instance, Life Cycle Assessment (LCA) does not allow an reliable assessment of all environmental impacts such as biodiversity (Curran *et al.*, 2011) or impacts on land use (Mattila *et al.*, 2011).

Facing this complexity, companies and institutions can benefit from a simple mass-based indicator allowing them to measure the current state of their impact on environmental degradation without the uncertainties of ex-ante approaches, with which LCA impact assessment goes along with.

Besides all of these arguments, it seems also reasonable to consider all abiotic and biotic resources to achieve an equal mass flow balance in life cycle inventories.

Against this background, the paper presents a methodology of how to calculate the amount of abiotic and biotic resources on a product level based on LCA data using the Ecoinvent database. The adapted database is then tested analyzing the environmental relevance of the material footprint by comparing the material footprint results with other selected impact categories.

In the first part of the paper the resource indicator material footprint is introduced, followed by a detailed description of the implemented adaptations to the life cycle database. In the second part, results of the calculations of the material footprint are displayed and compared to selected impact categories. Finally, conclusions regarding similarities and differences of resource use and the selected impact categories and further need of research are given.

Methods

The following steps show how resource use was determined and compared to environmental impacts in this study:

1. Selection of a resource indicator
2. Selection of impact categories
3. Selection of a LCA database
4. Adaption of the database to calculate the resource indicator,

In this chapter each step is described in detail.

Selection of a resource use indicator - the material footprint

To assess the resource use the indicator material footprint was chosen, which is based on the MIPS (Material Input per Service Unit) concept (Liedtke *et al.*, 2014; Lettenmeier *et al.*, 2009; Ritthoff *et al.*, 2002; Schmidt-Bleek, 1998). The material footprint covers two of the five categories of the MIPS concept: the abiotic raw material and the biotic raw material, which can either be added up and used as one indicator or separately accounted for (Liedtke *et al.*, 2014). The MIPS concept takes into account the same system boundaries as the material flow analysis does (Eurostat, 2012).

The category abiotic raw material considers all mineral resources. It includes economically used resources as well as extracted but not further processed material, like overburden from mining or excavated soil during infrastructure construction.

The category biotic raw material contains all plant biomass from cultivated areas as well as plant and animal biomass from uncultivated areas. Animals from cultivated areas (e.g. cattle breeding) are accounted for by the plant biomass input for their feed. Biomass is considered with its moisture content at the time of harvest (Schmidt-Bleek, 1998). Just as for abiotic material, not only the used extraction of biotic material is considered, but all organic material that is taken from the ecosystem. Hence plant waste that is taken from the ecosystem during trimming or harvest is also considered, even if it is not further processed.

As the moisture content of a plant species can vary significantly, the specific weight can also vary depending on the cultivation conditions. A possible solution to achieve consistent results could be a standardization of the moisture content (Wiesen *et al.*, 2014).

Selection of impact categories

For a comparison of the material footprint to other impact categories, preferably ones with high impacts on nature, the default impact cat-

egories of the product environmental footprint (EU, 2013) were analyzed more closely.

It does not seem reasonable to compare the material footprint to some very specific impact categories concerning e.g. human toxicity or ecotoxicity (e.g. cancer effects, non-cancer effects, particulate matter), as these categories are not expected to be dependent on the overall amount of extracted material but are mainly linked to the use of specific chemicals or materials. Impact categories concerning water (e.g. aquatic fresh water ecotoxicity, aquatic eutrophication or water depletion) should also result in fundamentally different impacts, as the material footprint does not consider water. For the determination of these impact categories the LCIA methods pack 1.5.4 supplied by Openlca was used (OpenLCA, 2015; Acero *et al.*, 2015). In Rodriguez and Ciroth (2014) the results of impact category calculations of the ILCD method with Openlca are compared to calculations with SimaPro. These show a high correspondence for almost all categories, but especially for resource depletion the obtained results are not in accordance. Because of this and our intention to show correlations between input based and emission based calculations, the two input based indicators resource depletion and land transformation were not regarded. As a result only four out of all 14 default impact categories were selected for a comparison

to the material footprint. These are: climate change (IPCC, 2007), ozone depletion (WMO, 1999), acidification (Seppala *et al.*, 2006), and terrestrial eutrophication (Seppala *et al.*, 2006). All 14 default impact categories of the Product Environmental Footprint and if and for what reason they were chosen for a comparison are shown in Table 1.

Selection of a LCA database – the Eco-invent database

A reliable comparison of environmental impacts and resource use is only possible when using the same inventory data. For this reason using a LCA database for the determination of the indicators is the most convenient solution. At present there exists no database considering all necessary input flows for the calculation of the material footprint. Two of the biggest LCA databases in terms of number of processes are Gabi¹ and Ecoinvent². They are also two of the most commonly used databases in Europe. Both contain a large set of life cycle inventory (LCI) data for basic processes e.g. for energy systems, building materials, metals, chemicals, packaging, transport services, waste treatment and agriculture and can be integrated in LCA software tools like Umberto or Openlca. Using data from

Product Environmental Footprint – Default EF Category	Correlations to the material footprint possible?
Climate Change	possible, as it concerns environmental impact
Ozone Depletion	possible, as it concerns environmental impact
Ecotoxicity for aquatic fresh water	No, as it is related to water
Human toxicity – cancer effects	No, as it is related to human toxicity
Human toxicity – non-cancer effects	No, as it is related to human toxicity
Particulate Matter/Respiratory Inorganics	No, as it is very specific
Ionizing Radiation – human health effects	No, as it is related to human toxicity
Photochemical Ozone Formation	No, as it is very specific
Acidification	possible, as it concerns environmental impact
Eutrophication - terrestrial	possible, as it concerns environmental impact
Eutrophication - aquatic	No, as it is related to water
Resource Depletion - water	No, as it is related to water
Resource Depletion – mineral, fossil	Not regarded as it is an input based indicator
Land Transformation	Not regarded, as it is an input based indicator

Table 1 – Chosen default categories of the product environmental footprint for a comparison with the material footprint

these databases increases the credibility and acceptance of environmental impact results, as the quality of the life cycle data is reliable and the origins of the data sets are transparent.

An important criterion for an adaptation is the structure of the life cycle database. Gabi is based upon system processes, which consider the entire life cycle inventory related to a product system from cradle-to-gate or cradle-to-grave in form of elementary flows³. This way inventories in Gabi do not allow retracing from which life cycle step the flows originate. Unit processes include elementary flows from gate-to-gate. All other inputs and outputs are included on the level of product flows, which link to other processes.

As a consequence the Ecoinvent database was chosen, because almost all processes (apart from some datasets such as plastics) are available as unit processes. As by the time of the analysis, Ecoinvent has not been available in version 3.1 yet, calculations are based on the old version 2.2. The adaptations described in this paper, however, can be carried out for version 3.1 in the same way.

As described in Wiesen *et al.* (2014) there are several challenges when adapting the database for both the calculation of the abiotic and the biotic raw materials. In the following section, the adaptations to the database are described.

Adaption of the Ecoinvent database - calculating abiotic raw material

Regarding the calculation of abiotic raw material, the Ecoinvent database only provides elementary flows from nature, which are economi-

cally used. For abiotic resources this means that:

- in metal mining processes only the net ores without tailings are considered
- in all mining processes overburden is not considered
- soil excavation e.g. for construction processes in road or building infrastructure is not available.

Saurat and Ritthoff (2013) describe, how tailings and overburden can be considered in Ecoinvent with the help of so called “unused extraction factors”. These factors relate to elementary flows from nature and are embedded in a characterization method which is implemented in the LCA software. The extraction factors are based on data published in Wuppertal Institute (2008). As described Wiesen *et al.* (2014) this approach does not yet fully meet the needs of the material footprint for several reasons:

1. Ecoinvent only provides location specific elementary flows for metals, such as nickel, copper or silver. Regarding hard coal and lignite there is only one elementary flow for each material. Table 2 shows for the example of hard coal that overburden can vary greatly depending on the country. The data show a high range from 0.75 kg/kg in China up to 17.6 kg/kg in Australia, with the world average being 4.28 kg of unused extraction per kg of hard coal (Wuppertal Institute, 2008). Hence it is necessary to add region specific values for overburden to the coal mining processes.

Country	Unused extraction factor for hard coal
Australia	17.6 kg/kg
China	0.75 kg/kg
Columbia 1	1.99 kg/kg
Germany	0.95 kg/kg
India	5.3 kg/kg
Russia 7	.3 kg/kg
South Africa 7	.56 kg/kg
USA	5.5 kg/kg
World average	4.28 kg/kg

Table 2 – Unused extraction factors of selected countries for hard coal extraction, taken from [28]

¹ Life Cycle Assessment LCA Software: GaBi Software

² Database - ecoinvent

³ Elementary flows consist of resources taken from nature or emissions to nature.

2. In addition to the overburden, the material footprint also considers excavated soil (Wiesen *et al.*, 2014), which can have a significant influence especially on the abiotic resource use of infrastructure, e.g. for the construction of railway tracks, roads, airport, landfills and gas pipelines. As there is no elementary flow for soil in the current Ecoinvent version, it cannot be considered by a characterization scheme.

3. In general, the approach of using unused extraction factors in a characterization scheme results in incomplete inventories. To come to more detailed conclusions, especially when overburden and tailings are dominating the results, a possibility might be to breakdown results to unused extraction and used extraction as described Liedtke *et al.* (2014) for which the consideration of overburden and tailings is elementary flow is required.

To address the (1.) problem, overburden in coal mining processes was not considered as a factor in a characterization scheme, but a new elementary flow “soil, overburden” was defined. This way differences in mining operation due to the accessibility of the coal and the resulting amount of overburden in different regions can be taken into account. The flow was included in existing hard coal mining processes for Russia, South and Middle America, Australia, North America, East Asia, East Europe, South Africa, West Europe and China.

For all lignite mining processes only one process “lignite, at mine” was originally available in the database, even though the following processes are partly regionalized. To be able to differentiate the abiotic material input here, the process “lignite, at mine” was used to create regionalized mining processes, adapting the amount of overburden and scaling the diesel consumption accordingly. This way differences in the overburden of lignite mining are taken into consideration for Austria, Germany, Spain, France, Greece, Hungary, Macedonia, Poland, Slovenia and Slovakia.

Regarding the (2.) problem, we defined the elementary flow “soil, excavated” adding it to excavation processes included in the database. As the processes only assess excavation in m³ an average soil density of 1.8 t/m³ was used for the assessment.

Addressing the (3.) aspect, we did not succeed in including elementary flows for tailings and for overburden (apart from excavated soil and the overburden for the processes described

above) in all processes, but used the characterization scheme from Saurat and Ritthoff. However, this should also be changed in the future.

Adaption of the Ecoinvent database – calculating biotic raw material

While the accounting for abiotic material lies within the system boundaries of the International Reference Life Cycle Data System ILCD and ISO (2006), the way of accounting for biotic raw materials differs from the LCA perspective. In LCA the system boundaries for agricultural processes include the crop harvested so that crops and seeds are considered to be part of the techno sphere (economy) because they are based on economically controlled processes. The Material Flow Analysis, on the other hand, which is the fundament of the material footprint, considers all biotic materials at harvest to be part of the ecosphere (nature) (Eurostat, 2012).

In the case of Ecoinvent, the database only provides biotic elementary flows for some wood types, given in m³ (Saurat and Ritthoff, 2013). These elementary flows were differentiated according to wood type (softwood, hardwood) to achieve more reliable results: It was roughly assumed that hard wood (e.g. beech) has a density of 1000 kg/m³ and softwood (e.g. spruce) a density of 800 kg/m³.

All further additional biotic flows, mainly crops, were added to the specific processes, taking into consideration the unused extraction factors, the moisture content of the plant at harvest, and if necessary the allocation factor and yields for side products. The characterization factor of the biotic raw material input $MI_{biot,P1}$ in kg/kg is calculated for an agricultural product P1 according to the following equation:

$$MI_{biot,P1} = \frac{Y_{P1} + Y_{P2}}{Y_{P1}} \cdot F_{alloc,P1} \cdot (1 + UUE) \cdot \frac{1 - w_{reference}}{1 - w_{at harvest}}$$

with Y_{P1} : Yield of product 1 in t/ha; Y_{P2} : Yield of product 2 (side product) in t/ha; $F_{alloc,P1}$: allocation factor to product 1; UUE: unused extraction factor for the plant in kg/kg; $w_{reference}$: moisture content of the product at time of reference; $w_{at harvest}$: moisture content of the product at time of harvest.

For some examples values are given in table 3. Yields and moisture contents were taken (Nemecek and Kagi, 2007; Nemecek and

Process in Ecoinvent 3.1 /2.2	Yield Y in t/ha	Moisture Content (w) of reference product	Moisture content w at harvest	Unused Extraction factor (UUE) in kg/kg	Allocation factor F (as used in Ecoinvent)	Material Footprint in kg/kg
Barley production, organic (grains)/ Barley grains organic	4.15	5 %	16 %	.237	91.3 % to grains	1.947
Barley production, organic (straw)/ Barley straw organic	2.92	5 %	16 %	.237	8.7 % to straw	0.264
Grass silage production, organic /Grass silage organic	8.10	0 %	65 %	.1	00 %	.143
Soybean production, organic / soybeans organic	2.81	1 %	16 %	.36	100 %	1.441

Table 3 – Examples for the calculation of the characterization factors for abiotic resource use

metals	
Primary chromium steel s	teel, converter, chromium steel 18/8, at plant
Primary low-alloyed steel	steel, converter, low-alloyed, at plant
Primary aluminum a	luminium, primary, at plant
Primary copper c	opper, primary, at refinery
plastics	
PET p	olyethylene terephthalate, granulate, bottle grade, at plant
High density PE	polyethylene, HDPE, granulate, at plant
paper and crops	
paper	
wheat w	heat grains IP, at farm
corn g	rain maize IP, at farm
cotton c	otton fibres, at farm
Further materials	
Glass c	oncrete, normal, at plant
concrete f	lat glass, uncoated, at plant

Table 4 – Chosen processes of the Ecoinvent database 2.2 for materials and crops for the comparison of impact categories

Schnetzler, 2011a; 2011b), allocation factors were taken from the Ecoinvent database directly and unused extraction factors taken (Wuppertal Institute, 2008). In table 4, the process names for the database in V2.2 are shown.

Testing the methodology

For a comparison of the results obtained via Ecoinvent twelve exemplary materials and crops were chosen. These consist of economical im-

portant and often used materials and products covering metals (chromium steel, low-alloyed steel, aluminum, copper), plastics (PET, HDPE), paper and crops (wheat, corn, cotton) and some further materials (glass, concrete). For the metals only metals from primary production were chosen, since there is no allocation necessary as would be for metals from secondary production. An overview of the materials and the used processes of the Ecoinvent 2.2 database are shown in Table 4.

Results and discussion

The concept of the material input should usually refer to a “service” like e.g. material input for nutrition per day, for transportation per km, or the use of a personal computer for a year. Here, materials per kg were chosen as examples, because for these the concept of abiotic and biotic material input is easiest to grasp.

Figures 1 to 4 display a comparison of the material footprint to climate change, ozone depletion and terrestrial eutrophication for some selected materials and crops. Since different impact categories have different units it is not possible to directly compare them to each other. As a workaround for the comparison the process with the highest impact in each category was scaled to a hundred percent. By doing so, the relation of the impacts of the different processes to each other can be shown. Additionally, the processes were arranged resulting in a score according to the order of the material footprint, from primary cooper with the highest material footprint to concrete with the lowest material footprint. All impacts and the specific results can be seen in Table 5.

Compared to the material footprint, the indicator for climate change especially assesses the environmental burden to be higher for processes with a high energy demand, as these normally are associated with high carbon emissions as well, as can be seen in figure 1. This is especially true for aluminum and plastic processes. As the production of aluminum needs high amounts of energy it is not unexpected that this process also has the highest impact on climate change. One of the reasons for the high impact of cotton fibers is the emission of nitrous oxide (laughing gas) due to the use of organic fertilizers, which has a much higher impact on climate change than carbon dioxide.

The values for the material footprint on the other hand are high for materials like copper that need high amounts of ore and overburden for its extraction. For this reason, the indicator for climate change assesses aluminum to be the material with the highest impact, while copper is the material with the highest material footprint. However – also considering the order of the processes – steel, paper, wheat, corn, glass and concrete are assessed similarly with both indicators.

Following the indicator for ozone depletion, aluminum is the material with the highest impact, as shown in figure 2. As ozone depletion is strongly connected to the use of some specific chemicals like chlorofluorocarbons (CFCs), al-

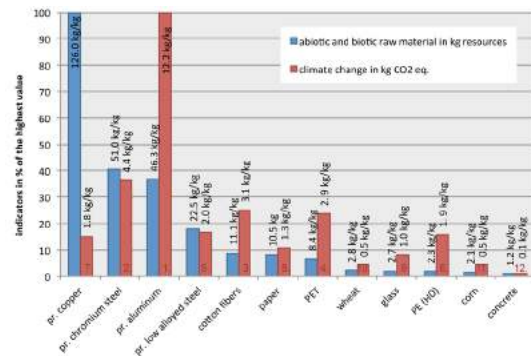


Figure 1 - Comparison of the material footprint to climate change for selected materials and crops

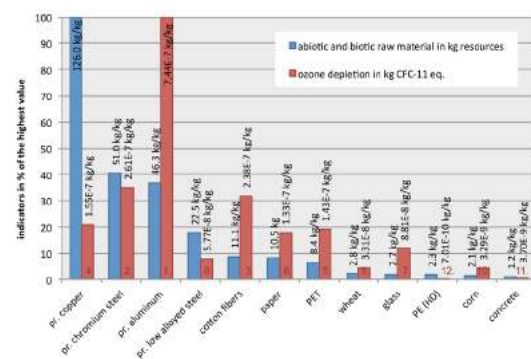


Figure 2 - Comparison of the material footprint to ozone depletion for selected materials and crops

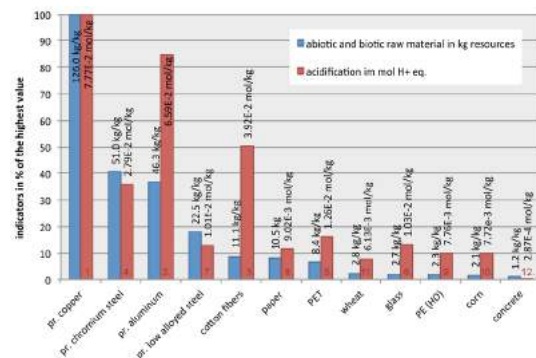


Figure 3 - Comparison of the material footprint to acidification for selected materials and crops

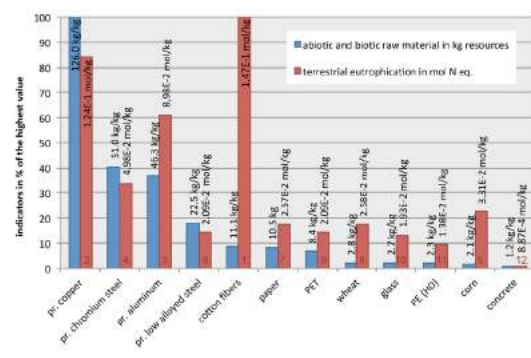


Figure 4 - Comparison of the material footprint to terrestrial eutrophication for selected materials and crops

most no similarities can be detected between ozone depletion and the material footprint. The order as well as the height of the impacts shows high differences. Apart from aluminum being the process with the highest impact, also copper, low alloyed steel, cotton fibers and plastics are evaluated differently with these two indicators. However, the three materials with the highest impact on ozone depletion: aluminum, chromium steel and cotton fibers are nonetheless within the top five materials of the material footprint.

The main drivers for acidification are combustion of fossil fuels, combustion of biomass, the deployment of organic fertilizers (Doney *et al.*, 2007) and mining (Dudka and Adriano, 1997). Hence it is not unexpected that for most of the selected materials the two indicators show similar impacts, as is shown in figure 3. Both the material footprint and the indicator for acidification assess primary copper as the material with the highest impact of the chosen materials. Still, the impact of especially cotton fibers and aluminum on acidification is higher compared to the material footprint.

Cotton fibers have the highest impact on terrestrial eutrophication (as shown in figure 4), as their production needs huge amounts of fertilizers which are one of the main sources of nitrogen (Smith *et al.*, 1997). Especially the impact of cotton, paper, wheat and corn on eutrophication

is indicated to be higher than their impact on resource use, but nonetheless of the three processes with the highest impact on terrestrial eutrophication (cotton fibers, copper and aluminum) two are not agriculturally based and all three are also evaluated with a high material footprint (top five). For the agriculturally based processes the biotic resources make up a big part of the material footprint: 76 % for corn, 72 % for wheat, 33 % for paper and 24 % for cotton fibers.

Conclusion

Adaption of the Ecoinvent database

To determine the material footprint using the life cycle database Ecoinvent, several adaptations to the database were necessary: Soil excavation related to infrastructure construction as well as waste rock and overburden from mining activities have been taken into account. Furthermore, new elementary flows for crops have been added. Upcoming updates of the database should, if possible, include these additions defining new elementary flows for abiotic unused extraction e.g. (e.g. “soil, overburden”, “rock, tailings”, “soil, excavated”) and for plant species (e.g. “potato, at harvest”). These inputs should, of course,

Impact category:	Material footprint	Climate change	Ozone depletion	Acidification	Terrestrial eutrophication	Average score in impact categories
Unit:	kg resources	kg CO ₂ eq	kg CFC-11 eq	mol H ⁺ eq	mol N eq	–
per kg material/crop						
copper	1 126.0 kg	7 1.8 kg	4 1.55E-7 kg	1 7.77E-2 mol	2 1.24E-1 mol	3.5 –
chr. steel	2 51.0 kg	2 4.4 kg	2 2.61E-7 kg	4 2.79E-2 mol	4 4.98E-2 mol	3 –
aluminum	3 46.3 kg	1 12.2 kg	1 7.44E-7 kg	2 6.59E-2 mol	3 8.98E-2 mol	1.75 –
low-all. Steel	4 22.5 kg	5 2.0 kg	8 5.77E-8 kg	7 1.01E-2 mol	8 2.09E-2 mol	7 –
cotton fibers	5 11.1 kg	3 3.1 kg	3 2.38E-7 kg	3 3.92E-2 mol	1 1.47E-1 mol	2.5 –
paper	6 10.5 kg	8 1.3 kg	6 1.33E-7 kg	8 9.02E-3 mol	7 2.57E-2 mol	7.75 –
PET	7 8.4 kg	4 2.9 kg	5 1.43E-7 kg	5 1.26E-2 mol	9 2.09E-2 mol	7.5 –
wheat	8 2.8 kg	10 0.5 kg	9 3.31E-8 kg	11 6.13E-3 mol	6 2.58E-2 mol	9 –
glass	9 2.7 kg	9 1.0 kg	7 8.81E-8 kg	6 1.03E-2 mol	10 1.93E-2 mol	8 –
HDPE	10 2.3 kg	6 1.9 kg	12 7.01E-10 kg	9 7.76E-3 mol	11 1.38E-2 mol	9.5 –
corn	11 2.1 kg	11 0.5 kg	10 3.29E-8 kg	10 7.72E-3 mol	5 3.31E-2 mol	9 –
concrete	12 –	12 –	11 –	12 –	12 –	11.75 –

Table 5 - Overview of results for all investigated impact categories by amount and score (lowest score is the best)

also be considered on the output side providing complete and comprehensible inventories.

There are some limitations and challenges remaining, which are addressed in the following:

- Regarding the flows for overburden and tailings, ores with a high ore grade are less and less available so that the average ore grade decreases over the years. Hence, the related flows need to be updated over the years and cannot be seen as set values.

- To improve the accuracy of the results for the material footprint the number of regionalized processes has to be increased, as e.g. the amount of overburden in hard coal extraction in Germany can differ greatly from that in China. This would improve the data quality for other indicators as well, because further flows such as energy use are also influenced by the amount of overburden.

- A shortcoming of the methodology is the rough assumption regarding the density of wood and soil. The densities should be specified step by step whenever a dataset is updated.

- A shortcoming of the methodology is the rough assumption regarding the density of wood and soil. The densities should be specified step by step whenever a dataset is updated.

Calculation results

As second part of the analysis, the adapted database was tested regarding the environmental relevance of the material footprint by comparing the material footprint results with other selected impact categories. This comparison is not very extensive, but allows some first conclusions regarding the environmental relevance of the material footprint: As the top three materials with the highest impacts of each impact category are within the top five materials of the material footprint (as shown in table 5), it can be assumed that the material footprint indicates an environmental relevance.

Moreover, some specific conclusions can be drawn:

- Metals with a low ore content and materials related to a high amount of overburden show a high relevance for the material footprint.

- Energy intensive materials are evaluated with a lower environmental relevance compared to climate change.

- Compared to terrestrial eutrophication the material footprint shows lower impacts for materials and processes linked to agriculture.

- Generally, acidification and the material footprint display a similar trend since mining, resource extraction for fossil fuels and the use of biomass have a high influence on both resource use and acidification.

- As ozone depletion is strongly connected to the use of some specific chemicals like CFCs, almost no similarities can be stated.

The next step to extensively analyse the environmental relevance of the material footprint should be a correlation analysis for all Ecoinvent processes and impact categories. This could be done with the help of software tools such as Brightway (2015), which allows extended graphical visualisations and has been tested with Ecoinvent.

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Clothing recycling as new value into Fashion cycle

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Abstract

This work comes from the PhD course research on Sustainability in Apparel Design aiming to promote the concept of circular economy in Fast Fashion Cycle. It intends to show how it is possible to create value through the processing of discarded garment to produce raw materials and introduce them again into another cycle of clothing.

Although the proposal work involves concepts related to solid waste management and sequential transformation processes, it aims above all to contribute to a more sustainable fashion design which the selection of materials can incorporate salvaged materials in place of virgin materials. At first we will present the impor-

tance of the materials stage of the Garment Life Cycle to understand better the way clothes can be recovered. The results we intend to show are textile experiments from unwanted clothing (discarded) are made up from natural fibers, more particularly in cotton or wool.

The research will work according to European legislation in matter of waste recovery, being a priority the laboratory tests continuity to improve the quality of materials will be obtain.

Keywords

Sustainability, Clothing design, Recovery, Recycling, Life cycle

Background

Considering the fast-fashion one of the biggest environmental problems in the landfill disposition of waste, performing strategies to minimize all impacts and valuing textile waste that will be considered into another lifecycle is an act of great urgency, especially in an area which there are so much diversity of materials and processes (Fletcher and Grose, 2012). A garment collection covers multiple products and each one belongs to a specific Lifecycle. Therefore, only a clothing collection have multiple lifetimes because each garment is made up of one type of material, it is produced by specific machines and it is used or discarded according to a consumer/user owns way care (Morais, 2013).

The issue of raw materials in traditional clothing chain is also not simple because a fabric production carried out many operations and it may be woven or nonwoven. For woven materials is required that fibers may be transformed into yarns and for unwoven materials it doesn't needed at all: fibers are directly used on a nonwoven material processing (Collier and Tortora, 2001).

In the fast fashion or high street brands the most used fabrics surfaces are produced by the

weaving process or by the knitting process. For both methods it must be used fibers (which may be natural, artificial or synthetic) and yarns.

Actually, there is a textile material recovery process to produce a kind of materials which does not require yarns production but usually these materials are incorporated in other types of products such as heat insulation, fillers furniture, automobile industry, etc. This type of recycling process does not require a careful quality as those would demand in the clothing industry. Therefore, is a challenging developing a recycling loop that goes around and comes around Fashion Cycle.

In the last years some industrial companies have elaborated a textile loop but this recovery is only made in specific materials, such as polyester.

Methods

Garment Lifecycle Assessment

Successful design projects are compatible with the best management practices and with a careful Lifecycle Management (SETAC, 2007). So we

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need to firstly introduce the importance of Materials and Design phases on the Garment Lifecycle.

The traditional Garment Life Cycle is based on a linear model, which the resources are extracted in masse, manufactured into garments, supplied to retailers, and then sold to consumers, who rapidly dispose of them to purchase a new product.

The Design phase is usually represented as a specific stage before the Garment manufacturing phase and after a Materials phase (Gwilt, 2014) but it should be placed where there is a Product Development. In Fashion industry there is a product development in all steps until the garment manufacturing. Therefore, Materials phase must be separated in Fibers, Yarns and Fabrics phases because each one is very important for the final product performance. Proprieties of some garments, such as color, smell or even the ability to breathe better depends on Fibers phase, for example. Thus, Design phase is displayed by an orange spot between Yarns and Garment phases as shown in figure 1.

All type of products have a similar processing way being different in the type of the materials are used.

According to Ashby (2009, p.10) “we consume roughly 10 billion (10^{10}) tones of engineering materials per year” and despite of the average level of global materials consumption is decreasing, per-capita consumption is growing more quickly because the emerging economies. Textiles materials are just a small part of all these materials which society depends on. Fast fashion is one of the biggest environmental problems be-

ing necessary initiatives between designers and producers focusing on textile waste to reduce its impact. Using textile waste or discarded clothing to create value into a Garment Lifecycle changes the view of product’s lifecycle and it goes according to the «cradle to cradle» philosophy (Braungart, 2002).

Textile waste management strategies

The textile waste sector has had a long history of recovery working. Rag collectors and shoddy manufacturers have been reusing and recycling fibers for hundreds of years as well as individuals have been repairing and reconditioning their own household’s textiles and garments for next generations. But despite these actions most textiles are recycled into low-quality end-uses because of the lack of technological innovation in the recycling industry and the market dominance of cheap virgin fibers (Fletcher, 2008).

Organized from the least to the most resource intensive, there are three main different textiles waste management strategies: Reusing, Upcycling and Downcycling.

Reusing strategy happens on products that have the same function than older ones which they come from. Examples of that are products resold as nearly new garments for second hand shops or markets in developing countries.

Upcycling is a type of reusing which happens on products that are already out of fashion and then they will be reworked into higher quality ones. Upcycling differs from Reusing because it

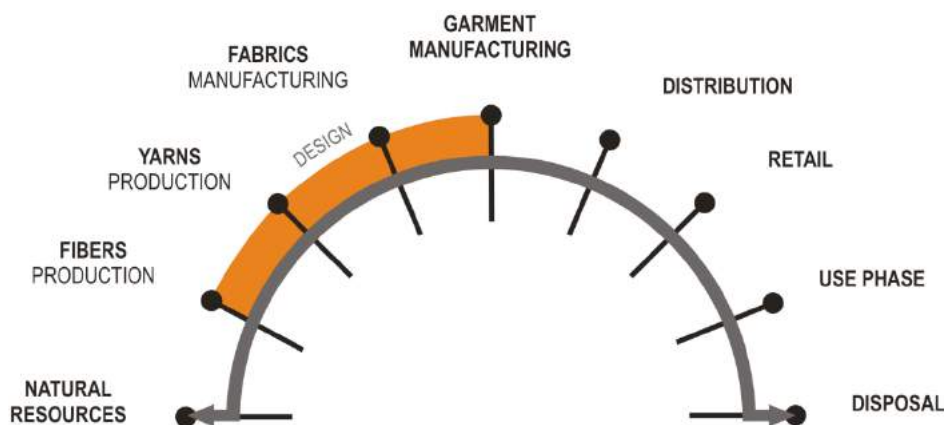


Figure 1 – Garment LifeCycle and Design phase displayed by an orange spot

needs of a Design Development Product. *Romance was Born*, from Somewhere and Junky Styling are companies that reuses textiles materials from unwanted clothing to make new garment.

Downcycling is a type of recycling, which materials are reused, disassembled and shredded to make lower quality products that don't have the same function of clothing, such as carpet underlay, mattress filling or insulation material.

Other alternatives

In addition to the waste management strategies there is already an effort in the manufacturing of renewable fibers such as Lyocell and Bamboo or biodegradable fibers such as PLA (polylactic acid fibers). Lyocell is a fiber made from wood pulp dissolved directly in amine oxide solvent (non-toxic) and extruded to form fibers. In its process more than 99,5 per cent of the solvent is recovered and reused. Bamboo is a fiber that has a quickly growing and regularly renewability but its industrial processing has high-impact waste emissions, as well as happens in all manufactured fibers. PLA fibers are biopolymers made from sugars mainly derived from corn that are melt-spun in a similar process to the conventional oil-based polyester (Fletcher and Grose, 2012). However these fibers only decompose in special conditionals and by industrial facility.

Proposal work

Nevertheless, we think we have to develop strategies to recycle those fibers are already in our wardrobes. Thus, our aim is recycle all clothing as much as possible to produce yarns again to be used for weaving and knitting fashion products. But for that it is necessary to have a good policy waste management after the clothing Disposal phase to identify and separate it by composition and color. Then we use a shredding machine to cut discarded clothing in small pieces like fibers and it will be produced the yarns with a carding machine. This mechanical recycling process offers a low-impact alternative to other fibers sources with reduced energy and chemical consumption, being more suitable for natural fibers. An advantage of that is a possibility to produce fabrics without going through the dyeing process, since this is one of the most pollutant finishing processes. Separating clothing by color it doesn't need to dye the yarns or fabrics will be produced.

Results

In cooperation with some national companies we developed experimental samples of yarns and fabrics that came from discarded clothing in natural fibers, wool and cotton.

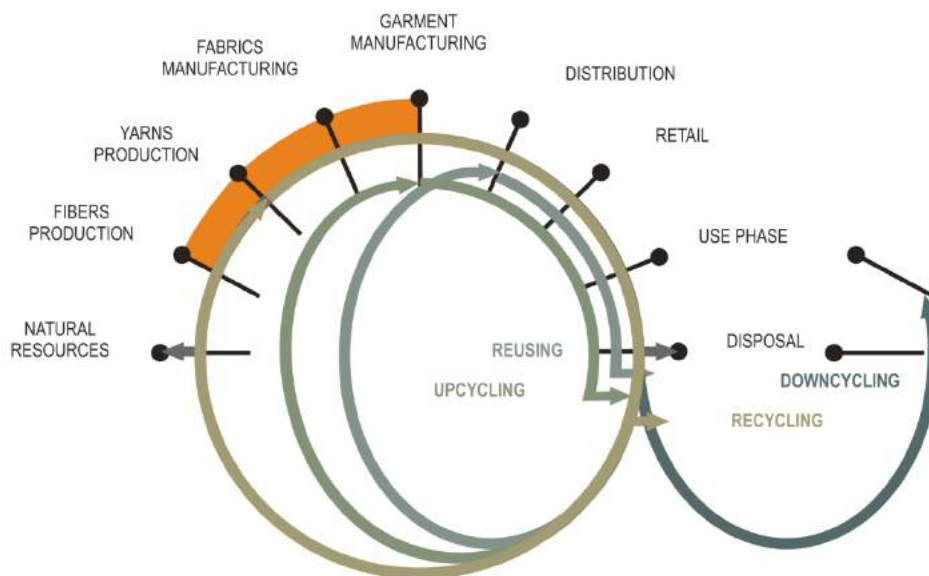


Figure 2 – Garment lifecycle displaying different waste management strategies¹.

¹ In Reusing strategy, the new lifecycle begins with a redistribution and resale phases. In Upcycling the new lifecycle begins at the "garment manufacturing" phase instead of distribution as happens with reusing. In Downcycling the new lifecycle begins in materials production of other product. Recycling strategy is the aim of this proposal work, closing the loop of Garment Lifecycle and making products for the same function of clothing.

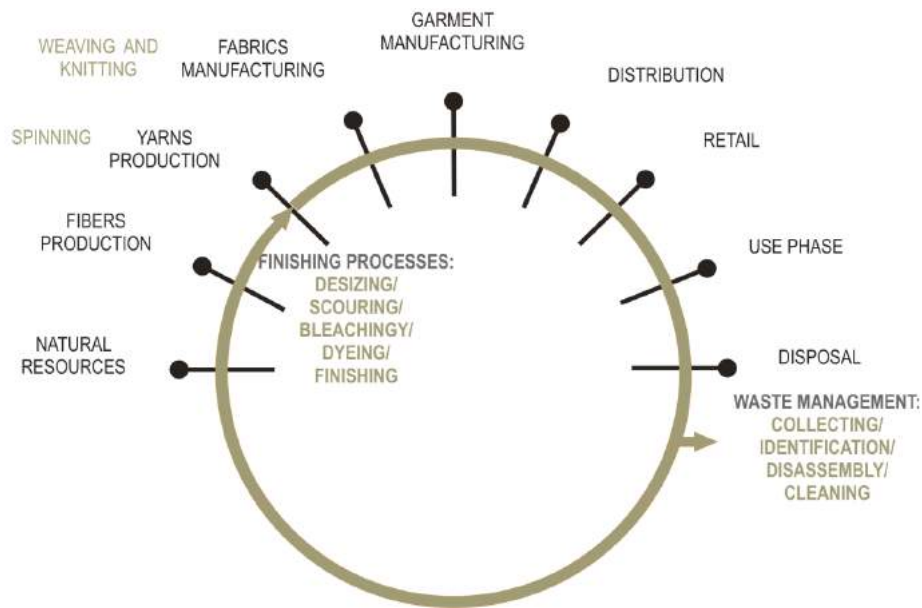


Figure 3 – Garment and Textiles Recycling Proposal Work

Mirafios company usually produces threads by open-end technology for textile market instead of fashion clothing market. Jomafil company reuses textile waste to produce materials such as mattress filling or automotive upholstery. Tavares Company produces all type of wool threads using carding machines for any textile or fashion market.

Ecolã company produces a Portuguese traditional fabric named burel, usually made with wool yarns.

Therefore, with Mirafios company we developed a green recycled cotton yarn from unwanted and discarded green t-shirts which after their shredding were mixed with 10 per cent of polyester fibers. After the recycled yarn made we drove to Minho University to use knitting machine and produce a green sample jersey knit. The result was positive because none of the needles from de knitting machine hindered the manufacturing process.

With Jomafil company we firstly ask for recycled wool fibers that came from discarded clothing to send to Tavares company to produce wool yarn. Tavares company made 70 per cent of recycled wool mixed with 30 per cent of polyester fibers. After this we went to Ecolã company to find out a possibility of weaving a fabric. We solved the weaving process introducing recycled wool yarns in the weft threads and wool virgin yarns in the warps threads to ensure the final fabric resistance.

Discussion

Recycling fibers

As with other waste management strategies such as reusing, upcycling and downcycling, clothing recycling saves resources, especially in the type of mechanical process. However, the method of extracting fibers from fabrics has not been developed. Most of the national Portuguese companies which working on it they are small, they don't have time to spend in innovation and have afraid to damaged their machines - a fact which reflects our fast fashion market that involves the dominance of cheap virgin fibers (Fletcher, 2008).

As it was explained in the results of this proposal we realize that it is possible to make woven and knitted fabrics with recycled cotton yarns and recycled wool yarns. Although it was tested a type of yarns which had taken a minimum percentage of polyester fibers to ensure the final fabric resistance we would like to keep going this working to try different resistances of yarns on different machines.

This process, that shreds clothes into fibers, has been made a long-time ago (in downcycling) but it is never used into fashion clothing because the fibers are usually produced tend to make a low quality yarn. The great challenge is to find longer fibers and develop quality to change this.

There is also a textile chemical recycling for main-made fibers which the most available is polyester (usually made from plastic bottles) but

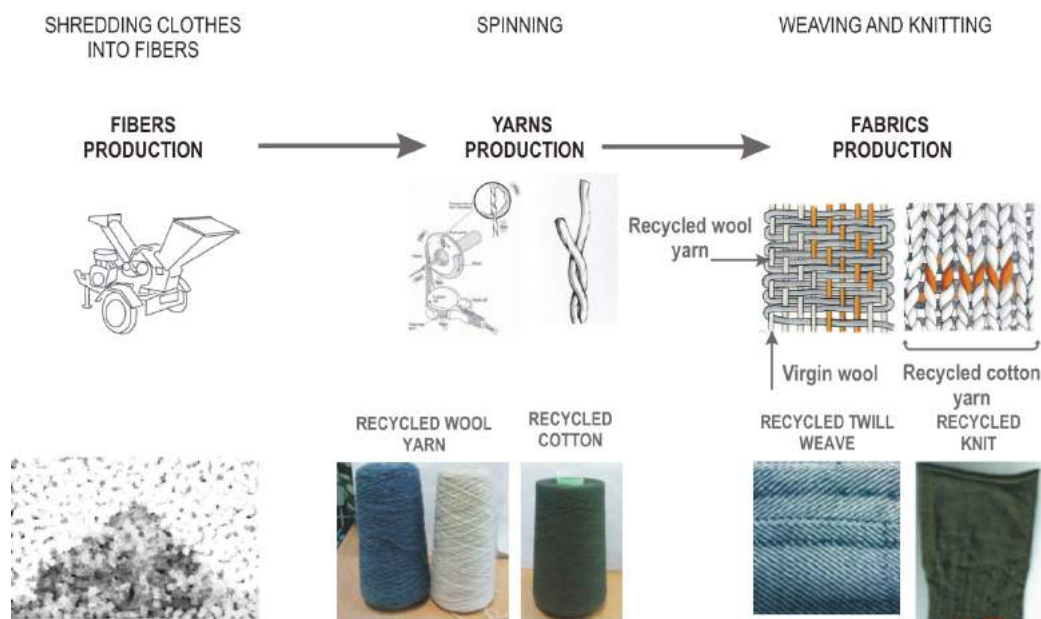


Figure 4 – Experimental samples of yarns and fabrics were produced

Source: authors' material

chemical recycling has got used more energy intensive than mechanical recycling in natural fibers – the major critiques related to the fibers recycling. So, the less energy it is spent since the beginning of natural fibers production, the less energy it will be spend in their fibers recovery. This is a valid data which maximize embodied energy on recycling natural fibers comparing with the modern types of manufactured fibers.

Limitations

Despite of textiles being collected separately from other rubbish and being recycled, the great limitation is not connected with the activities of reworking fibers but with the wasteful industrial system.

The following scheme (in figure 5) shows different routing possibilities of discarded clothing that comes from Portuguese family homes, being difficult to calculate and reworking on them.

Conclusions

A garment system goal of zero waste influences all stakeholders of a supply chain: farmers, brokers, designers, producers, retailers and consumers but working on clothing recycling interests would influence others contributors from the Garment Lifecycle such as textile collectors.

The mechanical recycling process were pre-

sented has an effect on the types of materials and chemicals are used, being important to shred clothes only with cent percent of a fiber composition. This will contribute for a better waste recovery and even other similar market opportunity, as corporative garment, where we would find a great amount of clothing in the same color and same composition.

Recycled yarns, fabrics and clothes made with mechanical recycling process remain in a niche market until recycled materials will regularly be specified in mainstream products or until they will be banned from the landfill.

According to legislative framework that is forcing the progressive recovery of textiles this working proposal is a way to solve the environmental impact based on clothing that is discarded very quickly. It eliminates problems of overflowing landfill at the same time it will be a fundamental change in economic points of view, moving a linear system to a circular one where all resources becomes sources for new goods (Chapman, 2005; Fletcher and Grose, 2012).

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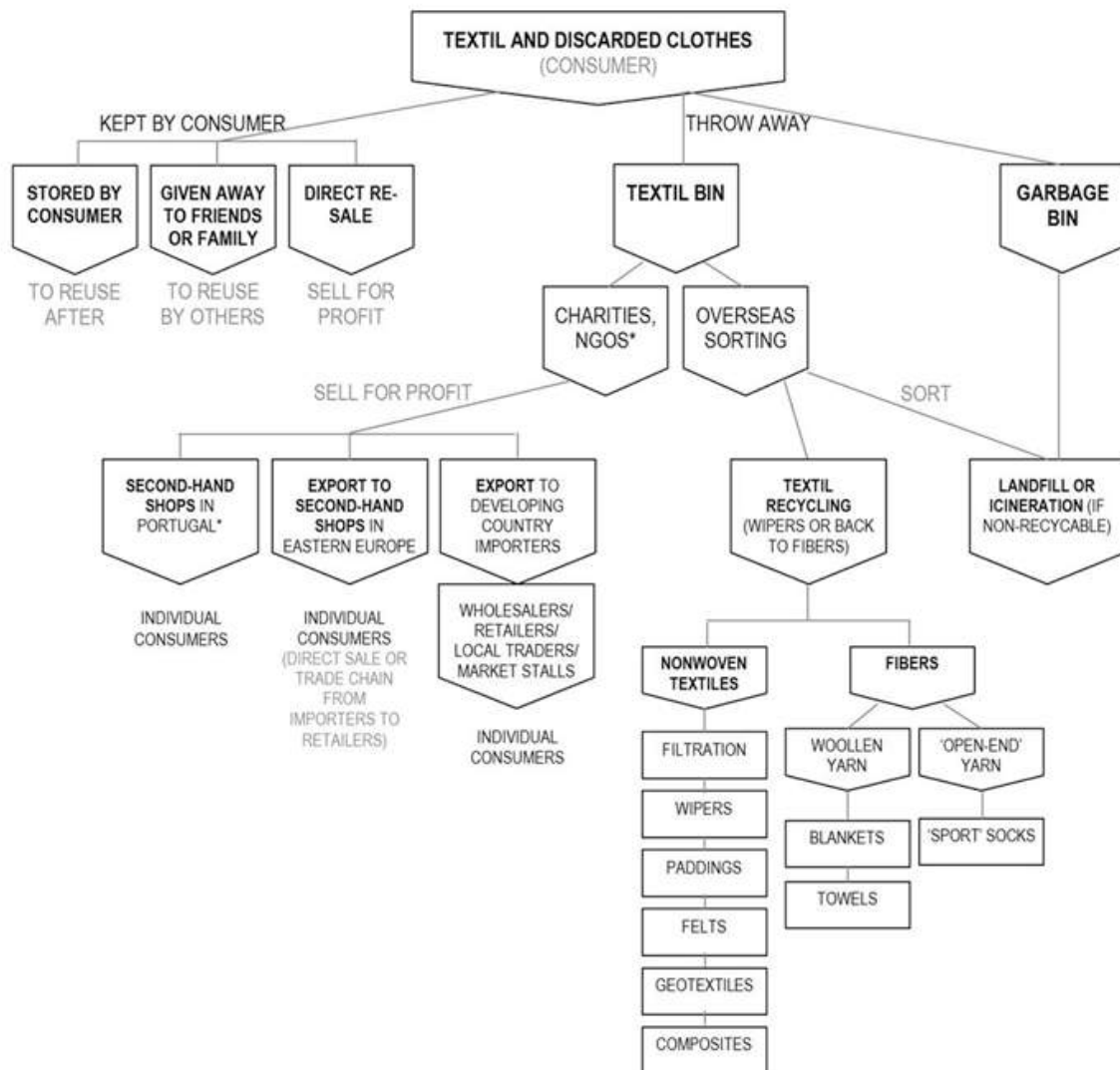


Figure 5 – Different routing possibilities of discarded clothing in Portugal²

Source: authors' material

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² It shows how it is very difficult to calculate all post textile waste, being very important to have a specific collecting waste such as door-to-door waste collection systems.

Architectural Dimension of Sustainability: Re-establishing the Concept of Recycling

Milan Šijaković^a, Ana Perić^b

Abstract

Building related processes as water pollution, landfill waste, global warming gases, energy, material and land loss, are undisputable proofs of the devastating effects of the construction industry on our environment. Given that only a small percentage of a total building stock is made out of new work, it is not enough to develop strategies and principles for a sustainable design only for the new projects, but for the existing buildings as well. Therefore, it is essential that, through repurposing, we consider what can be done with what we already have if we are to significantly benefit the sustainability agenda in the future. This research focuses on the concept of architectural recycling as a method for reaching the sustainable architectural design. In the first place, two concepts, two extremes in dealing with already existing buildings will be analysed: 1) preservation as radical stasis and 2) destruction as radical change. These polar ideas will be analysed through writings and statements of its supporters, mainly those of John Ruskin, Eugène Viollet-le-Duc and Rem Koolhaas. This analysis will enable the formulation of the concept of architectural recycling as 'preservation through change', viewed as a sustainable response to

rapidly changing conditions. Thus, the concept of a sustainable architectural design, with its principles and strategies, is also presented and analysed. Interventions aimed at repurposing and improving existing buildings, as an alternative to construction of new buildings, prevent the occupation of more soil and unnecessary use of more energy and materials. Architectural recycling refers to the process of altering the existing building, by using all of its available, useable material, in order to make it suitable for the new function. Unlike other terms which relate to intervention on the existing building, recycling implies the notion of change. Through this process original building is altered, in order to make the accommodation of new function possible, while using as much of the original buildings' material as possible. The elaboration of the concept of architectural recycling, as a key method for reaching the sustainability agendas, is the focus of this research.

Keywords

Preservation, Destruction, Recycling, Sustainable design

Introduction

The subject of this study refers to the topic of recycling of the existing building stock in the context of the sustainable architectural design. However, such specific research subject should be firstly explained in more general context. Namely, current trends in city development, such as rapid urbanization, the spread of poverty in urban areas and, for the first time in history, the fact that most people live in cities, do not lead to sustainable communities (Perić, 2013). Such trends have led to the ecological crisis reflected in the climate change, pollution and decrease of non-renewable resources. Construction industry is responsible

for the consumption of about 50 per cent of the natural virgin materials, more than 40 per cent of the produced energy, and around 80 per cent of prime agricultural land (Edwards, 2005). The waste associated with the construction and demolition processes constitute one of the biggest waste streams produced in Europe (Cepinha, Ferrão and Santos, 2007). By overexploiting resources, a society may compromise its ability to meet the essential needs of its people in the future (Jochem, 2004). The environmental sustainability, as one of the components of a sustainable development, was recognized as especially important for this study, considering the impact the building sector has on the environment.

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Sustainable architectural design laid down the principles for the design of sustainable buildings. However, it is not enough to develop principles for a sustainable design only for the new projects. The existing buildings must also be taken into account given that structural issues are usually not the reason why buildings come to their end-of-life, but rather the shift of the building's original purpose, making the existing building unsuitable for new roles and functions (Lee, Trcka and Hensen, 2011). Edwards (2005) highlights that existing buildings are central to any strategy for carbon-emission reduction. They are durable goods which can reach 100 years or more of useful life. Building renewal can extend the use of the existing buildings with diverse benefits, such as the exploitation of the existing urban infrastructure (with no need for new site development) and the lesser generation of residues in relation to a totally new construction (Cepinha, Ferrão and Santos, 2007). The process of readapting existing building for other purposes has a number of benefits, such as saving new materials from being used, and cutting the associated environmental impacts of producing and transporting those materials (Lee, Trcka and Hensen, 2011). Edwards (2005) explains that in a sustainable city, brownfield sites are exploited and existing buildings recycled. As only a small percentage of the total building stock is made up of new works, it is essential that, through repurposing, we consider what can be done with what we already have if we are to significantly benefit the sustainability agenda in the future.

Therefore, it is assumed that for the solution of problems concerning the negative effects of the building sector on environment a new approach to the existing building stock is needed. Interventions aimed at repurposing and improving existing buildings, i.e. architectural recycling, as an alternative to construction of new buildings, prevent the occupation of more soil and unnecessary use of more energy and materials. By repurposing the existing building, while using all of its available, useable material, the building's working service life is increased, and so the rentability of the resources already applied (Cepinha, Ferrão and Santos, 2007). Extraction, processing and transport of the new material is diminished through the process of recycling. Thus, the need to manufacture new components and products is lessened which has direct economic and environmental advantages (Couto and Couto, 2007). Architectural recycling is also seen as a process which can mediate between the radical stasis, reflected in the rigid rules of preservation,

and the radical change which new construction implies. Therefore, the study aims at elucidation of the concept of architectural recycling as an environmentally sustainable alternative to both demolition and preservation, as two most frequently applied and extremely opposed concepts towards architectural intervention. In short, the notion of architectural recycling as 'a preservation through change' is interpreted as a sustainable response to rapidly changing conditions.

Methods

Since the subject of this study relates to the architectural recycling, as a key method of the sustainable architectural design and as a sustainable alternative to both demolition and preservation, the study focuses, the first place, on different approaches in dealing with the existing building stock. Namely, opposed concepts of architectural preservation, i.e. radical stasis, and destruction, i.e. radical change, are critically analysed as two extremes in dealing with the existing buildings. A systematic review of the concepts of preservation, restoration and destruction is presented based on the sources by John Ruskin, William Morris, Eugène Viollet-le-Duc and Rem Koolhaas, respectively. Furthermore, the analysis of the concepts of preservation, on one side, and destruction, on the other, elucidates the concept of architectural recycling and enables its positioning between these polar concepts – stasis and change.

Secondly, the research focuses on the concept of architectural recycling as a key method for reaching the sustainable architectural design. Thus, the concept of a sustainable architectural design, with its principles and strategies, is presented and analysed. Based on the thorough overview of the body of literature in the field of sustainable architectural design the notion of recycling is presented as a crucial method which ensures environmentally sustainable design. In addition, architectural recycling is elaborated as a process providing the continuity of the existing facilities' utilization through the alteration of their use.

Preservation vs. Destruction

Two opposing concepts, i.e. preservation and destruction, representing the extremes in architectural interventions are selected for the analysis. Preservation implies actions aimed at maintain-

ing the building in its existing state and thus, advocates the retention of the status quo. At the other end of the scale, destruction implies complete tearing-down of the building and clearing of the site. The analysis of these concepts enables the elucidation of the concept of architectural recycling as ‘preservation through change’ and as a key method of the sustainable architectural design. In the following subchapters, these concepts are further analysed.

Preservation vs. radical stasis

Burman (1995) points out that the instant you make any kind of intervention, however subtle, to a building you change it. He underlines that the most influential contribution to the debate about the philosophy of repair in the 19th century was made by John Ruskin. According to the same source, the most important of Ruskin’s many writings which refer to buildings, and the preservation of buildings, is “The Seven Lamps of Architecture” (Ruskin, 1849) and, in particular, chapter “The Lamp of Memory” where Ruskin introduces the idea of trusteeship: “(...) it is again no question of expediency or feeling whether we shall preserve the buildings of past times or not. We have no right whatever to touch them. They are not ours. They belong partly to those who built them, and partly to all the generations of mankind who are to follow us” (Ruskin, 1849). In “The Lamp of Sacrifice” Ruskin (1849) refers to buildings as a legacy of builders given that “all else for which the builders sacrificed, has passed away—all their living interest, and aims, and achievements” except for, “one evidence [that] is left to us in those grey heaps of deep-wrought stone” - their buildings. He argued that the architecture of the past should be recognized as inheritance and preserved as a living memory. More precisely, Ruskin equals the term restoration with destruction, and explains it as “the most total destruction which a building can suffer: a destruction out of which no remnants can be gathered; a destruction accompanied with false description of the thing destroyed” (Ruskin, 1849). He considered that restoration work would cause greater damage than the actual decay of the building. Also, Ruskin believed that “death was the final fate of all beings and things in this world and that the physical ruin of the object should be the result of a more suggestive process than that rational intervention which might try to recover the ‘formal unity’ of the work”. Furthermore, instead of recreating

its original form, the memory of what a building could have become should be cherished (Mozas, 2012). He concludes that “it is impossible, as impossible as to raise the dead, to restore anything that has ever been great or beautiful in architecture” (Ruskin, 1849).

Contrary to Ruskin, who argues that any restoration work simply destroys the building and its integrity, Eugène Viollet-le-Duc believed in restoration, i.e. the conservationist school of thought based on the assumption that historic buildings could be improved, and sometimes even completed, using current day materials, design, and techniques. In his seminal work “On Restoration”, Viollet-le-Duc (1845) explains that: “The term Restoration and the thing itself are both modern. To restore a building is not to preserve it, to repair, or rebuild it; it is to re-instate it in a condition of completeness which could never have existed at any given time” (Viollet-le-Duc, 1845). Reiff (1971) argues that “this does not mean that he [Viollet-le-Duc] replaces what has never existed, but that a railing changed in the fourteenth century, chapel decorations that had faded away by the sixteenth, and stained glass and statues destroyed in the eighteenth, would all be restored to their original state, although they had never actually co-existed”. According to the same source, the term restoration implies the process of bringing back all possible elements of a building to its original state. Viollet-le-Duc (Viollet-le-Duc, 1845) highlights that “in restorations there is an essential condition which must always be kept in mind. It is, that every portion removed should be replaced with better materials, and in a stronger and more perfect way. As a result of the operation to which it has been subjected, the restored edifice should have a renewed lease of existence, longer than that which has already elapsed”. Mozas (2012) points out that Viollet-le-Duc’s rational approach was opposed to Ruskin’s romantic historicism.

Burman (1995) states that “International Charter for the Conservation and Restoration of Monuments and Sites – The Venice Charter” begins with a series of definitions which have provided a quarry for debate ever since. For instance, Article 6 of the Venice Charter states: “The conservation of a monument implies preserving a setting which is not out of scale. Wherever the traditional setting exists, it must be kept. No new construction, demolition or modification which would alter the relations of mass and colour must be allowed”. Rogić (2009) explains that although the type and extent of change to

the existing building fabric has been the central theoretical debate of architectural conservation, the consensus always existed regarding the idea that the intervention must be minimal. However, there are different opinions on the importance of the existing building stock and especially on the role of the preservation. This is elucidated in the following subchapter.

Destruction vs. radical change

According to Koolhaas, a dichotomy is created for the architects by the rapid urbanization and the increasing difficulty of building in heritage areas (Fairs, 2014). Koolhaas points out that “unbeknown to us, a large part of the world’s service is under a particular regime of preservation and therefore cannot be changed” which means that “the world is now divided into areas that change extremely quickly and areas that cannot change” (Fairs, 2014).

Koolhaas (2004) points out that preservation is no longer a retroactive but a prospective activity. Namely, the phenomenon of preservation escalated to the point that today, we can think about preserving things in the very moment they are produced. OMA (2010) is stressing that a new system, mediating between preservation and development, is needed. The increase of the scale and scope of preservation calls for the development of a theory of its opposite: not what to keep, but what to give up, what to erase and abandon. Through the phased demolition the idea of permanence of contemporary architecture can be dropped, revealing the tabula rasa, beneath it, ready for liberation (OMA, 2010). Pestellini (2011) explains that one of the OMA’s strategies towards preservation is to approach preservation on the opposite side, i.e. destruction. More precisely, the destruction is seen as a method for preserving specific area of context.

In OMA’s project for the transformation of the existing urban fabric of La Défense, Paris, the entire territory has been seen as a strategic reserve, an expansion zone, which can allow the city to modernize itself constantly. Pestellini (2011) explains that some of the fabric of La Défense is the product of a very cheap process and can be referred to as ‘junk architecture’. The strategy OMA developed was to remove the existing tissue, which was regarded as irrelevant, allowing the city to grow on the area liberated by the demolition.

Economic viability of a building expires after 20, 25 or at the most 30 years and, thus, the

strategy involves the process of demolition every 25 years, leaving the space for the new development (OMA, 1991). This approach would control the size of the city as well (Pestellini, 2011). The strategy involved the projection of a grid over the entire area. Through this grid a new system of selective demolition, as buildings meet their successive expiration dates, is to be applied (OMA, 1991). The grid acts as a filter, preserving the objects which are selected to stay while accommodating their geometries and generating a string of hybrids along its perimeter to achieve coherence. The presence of this grid does not imply homogeneous density, as it incorporates the coexistence of solid and void, density and emptiness (OMA, 1991).

Recycling - preservation through change

The influence of human activity on numerous subtle changes in the environment over time is becoming increasingly clear, from the bleaching of coral reefs and the polluting of oceans by regular oil spills, to the damage of human health caused by harmful processes, materials and buildings (Cepinha, Ferrão, & Santos, 2007). According to Edwards (2005), out of all resources consumed across the planet fifty per cent are used in construction, as shown in the Figure 1, which makes it one of the least sustainable industries in the world.

However, contemporary human civilization depends on buildings for its continued shelter and existence even though our planet cannot support the current level of resource consumption (Edwards, 2005). The definition of the sustainable development coined in the “Brundtland report” (WCED, 1987) has spawned a series of sub-definitions to meet particular sectorial needs. For example, Foster and Partners defines the sustainable design as the process of creating energy-efficient, healthy and comfortable buildings, flexible in use and designed for long life (Edwards, 2005). The Buildings Service Research and Information Association (BSRIA) refers to sustainable construction as a process of creation and management of healthy buildings based upon resource efficient and ecological principles (Edwards, 2005). The ‘Earth Summit’ (1992), United Nations Conference on Environment and Development (UNCED), included environmental degradation and resource depletion into their agenda. The discourse was broadened in “Agenda 21”, and the “Rio Declaration” laid

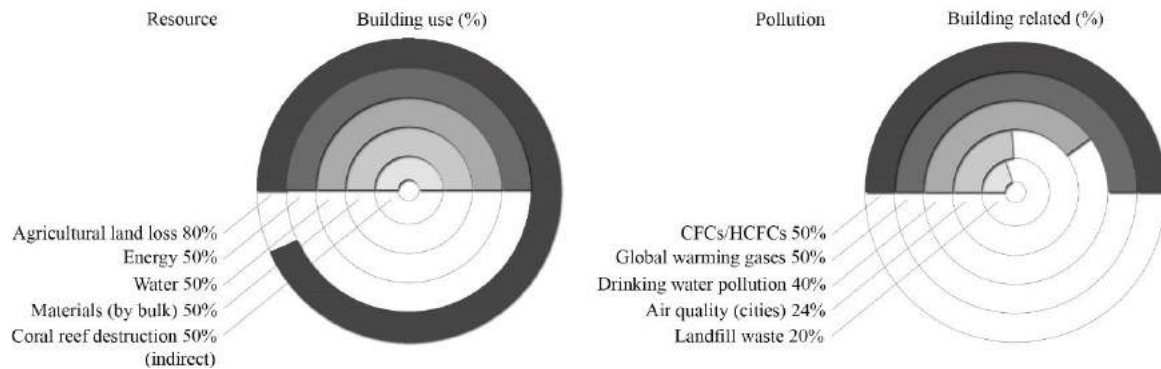


Figure 1 – Global resources used in buildings and global pollution

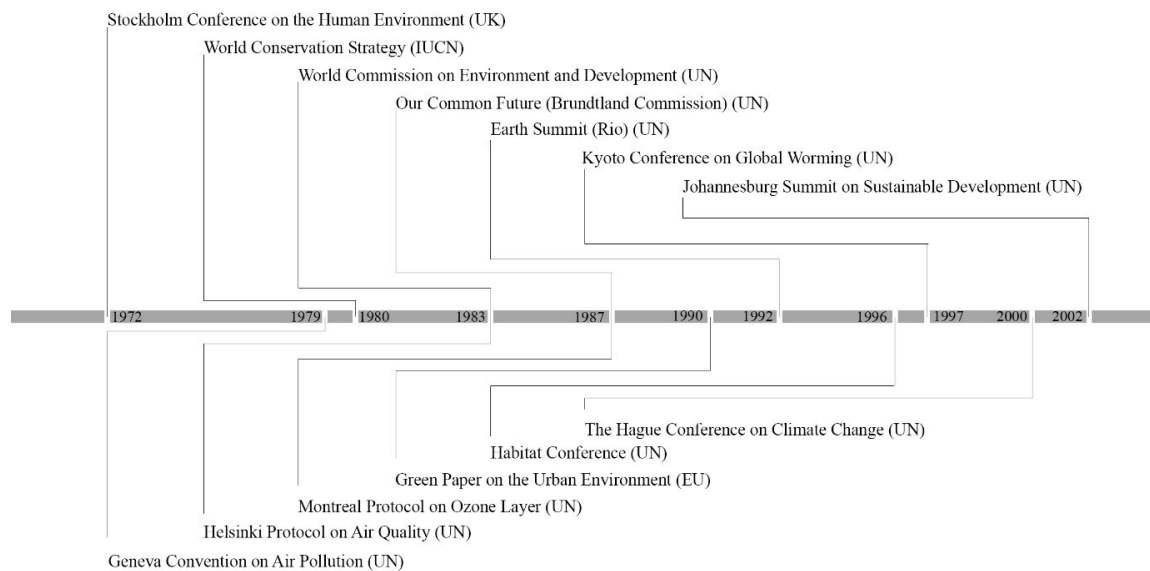


Figure 2 – Major global environmental agreements

down the principles of sustainable development. With the “Declaration of Interdependence for a Sustainable Future” at the Chicago Congress of the International Union of Architects (IUA) in 1993, architecture also joined the movement, and many national bodies and institutions of architecture began producing energy and environmental policies (Szokolay, 2004). Figure 2, designed according to Szokolay (2004), presents chronological overview of major global environmental agreements.

The International Council for Research and Innovation in Building and Construction (CIB) presented the Agenda 21 on Sustainable Construction. This document confirms the impor-

tance of the construction industry in the issue of sustainability (Cepinha, Ferrão and Santos, 2007). Given that buildings and cities are long-lived, as shown in the Figure 3, designed according to Edwards (2005), they play a fundamental role in the realisation of sustainable development.

The link between the sustainable development and the construction industry is extremely important considering the impact of this sector on all dimensions of the sustainable development; 1) contribution to national wealth – economic dimension, 2) offer of the raised number of work ranks – social dimension, and 3) raised tax of natural resources consumed and environ-

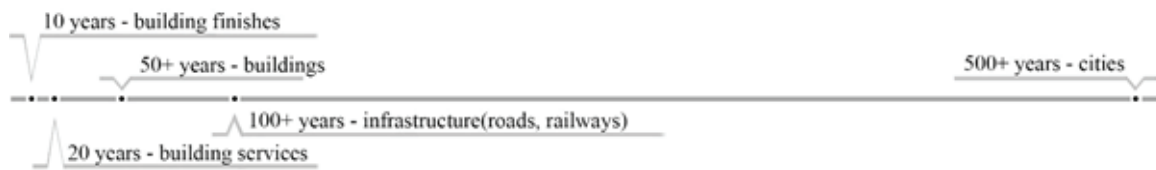


Figure 3 – Typical lives of different aspects of construction

mental loads produced – environmental dimension (Cepinha, Ferrão and Santos, 2007). As stated earlier, about 50 per cent of the natural virgin materials are consumed, at the world-wide level, by the construction industry, which is far beyond the sustainable level. More than 40% of the produced energy is consumed, in The Organisation for Economic Co-operation and Development (OECD) member countries, throughout the live cycle of the buildings, and approximately one third of the GGE (Greenhouse Gas Emission) total emissions are produced by the built environment (OECD, 2003). Edwards (2005) stresses that this percentage is even higher. Namely, 60 per cent of all resources globally go into construction (roads, buildings, etc.), nearly 50 per cent of energy generated is used to heat, light and ventilate buildings and a further 3 per cent to construct them. Further, 50 per cent of water used globally is for sanitation and other uses in buildings, 80 per cent of prime agricultural land, lost to farming, is used for building purposes, 60 per cent of global timber products end up in building construction and nearly 90 per cent of hardwoods (Edwards, 2005). The environmental capital locked in buildings is enormous, as is the waste footprint, making them one of the biggest users of raw material. The waste produced from the construction and demolition activities constitute one of the biggest waste streams produces in Europe (Cepinha, Ferrão and Santos, 2007). Rob Watson, founding father of LEED and an international pioneer in the modern green building movement, highlights: “Buildings are literally the worst thing that humans do to the planner. Nothing consumes more energy; nothing consumes more materials; nothing consumes more drinking water, and human beings spend up to 90% of their time indoors so if they are getting sick from their environment, in fact, they are getting sick from their indoor environment not from their outdoor environment” (Kubba, 2012).

The “Declaration of Interdependence for a Sustainable Future” (IUA/AIA, 1993) addressed the sustainable design in the following way: “Buildings and the built environment play a ma-

major role in the human impact on the natural environment and on the quality of life; sustainable design integrates consideration of resource and energy efficiency, healthy buildings and materials, ecologically and socially sensitive land-use, and an aesthetic sensitivity that inspires, affirms, and ennobles; sustainable design can significantly reduce adverse human impacts on the natural environment while simultaneously improving quality of life and economic wellbeing”. According to De Garrido (2012), a truly sustainable architecture is one that meets the needs of its occupants, in any time and place, without jeopardizing the welfare and development of future generations. Furthermore, sustainable architecture involves using strategies with the aim at: optimizing resources and materials; reducing energy consumption; promoting renewable energy; minimizing waste and emissions; minimizing the maintenance, functionality and cost of buildings; and improving the quality of life of their occupants (De Garrido, 2012). The “Whole Building Design Guide” (WBDG) has established a set out rules and principles regarding sustainable design. WBDG’s objectives are to: 1) avoid resource depletion of energy, water, and raw material; 2) prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and 3) create liveable, comfortable, safe, and productive built environments. Principles defined in the WBDG are: “1) optimize site potential; 2) optimize energy use; 3) protect and conserve water; 4) use environmentally preferred products; 5) enhance indoor environmental quality; 6) optimize operations and maintenance procedures” (Kubba, 2012).

All the above mentioned definitions of the sustainable building design confirm that only through parallel consideration of site, energy, materials and wastes can truly sustainable architecture be conceived. According to Szokolay (2004) these four components constitute the basis of a sustainable architectural design. First, the land is a non-renewable resource and all building activity disturbs the land. These disturbances should be minimised and its use should be avoided whenever possible, which would lead

to the preservation of the biodiversity. Szokolay (2004) highlights that the use of already disturbed derelict land or the rehabilitation of neglected or disturbed land is desirable. Preservation and cleaning-up of land, as a non-renewable resource, has become a key issue in Europe. Protection and reuse of land and sites, and the need for brownfield development are powerful drivers for new approaches to sustainable city planning (Roaf, Horsley and Gupta, 2004).

On the other hand, the energy conservation is a central concern in the quest for sustainability, as it is expected that, by the year 2050, the world doubles its use of energy (Edwards, 2005). European Commission declared that the sustainable design is one of the priorities for the future of the construction sector (EU Commission, 2007). In order to achieve the sustainable construction, one of the main points that had to be addressed is the improvement of the energy performance in buildings. Thus, first, we have to recognize the amount of energy used to construct the building, and minimize it through good practices, as well as consider the type of energy used, looking, whenever possible, for renewable sources (Cepinha, Ferrão and Santos, 2007). By improving the energy performance of buildings a vast set of objectives can be reached, such as: “1) reduction of the global needs of energy production; 2) reduction of the emissions of carbon dioxide, and consequently of GGE; 3) improvement of comfort in households and workplaces; 4) contribution for cleaner cities; 5) improvement of urban regeneration; 6) improvement of the health of the population and promotion of the social inclusion; 7) increase the standards of living of the European citizens” (Cepinha, Ferrão and Santos, 2007). Further, as building are responsible for about 40-50% of the energy use in each member state of the EU, it makes them the main users of final energy. The residential sector is responsible for two thirds and the commercial sector for one third of the use of the energy in the buildings (Cepinha, Ferrão and Santos, 2007).

Besides the land and the energy, material is the one of the basic components of a sustainable architectural design. Due to the exponential growth of the population (as our society gets more developed the standards and requirements get each time bigger) the search and consumption of the materials increased to a hallucinating rhythm, whereas the amount of available resources presented a completely inverse scene (Yeang, 2001). Through the extraction, processing, transport, use and disposal, materials used in construction industry have enormous envi-

	Raw material availability	Environmental impact	Embodied energy	Product life span	Freedom from maintenance	Product re-use potential	Material recyclability
Plantation-grown sawn softwood	4	4	4	3	2	2	1
Hardwood from native forests	2	2	5	4	3	4	1
Wood fibre hardboard	4	4	2	3	2	1	3
Medium density fibreboard (MDF)	5	4	3	3	3	3	2
Particleboard (chipboard)	5	4	3	3	3	1	4
Plywood	4	4	3	4	3	3	1
Glued laminated timber	4	4	4	4	3	4	2
Plastics (synthetic polymers)	3	2	3	4	4	1	3
Stabilised earth (cement or bitumen)	4	5	4	3	3	1	5
Building stone (sawn)	3	2	3	4	4	4	3
Clay bricks	4	3	4	5	5	2	3
Cement-concrete products	3	3	4	5	5	1	3
Fibrous cement (pine fibre)	4	4	3	5	5	1	1
Glass	3	3	3	5	4	3	4
Steel	4	3	3	4	3	3	5
Aluminium	4	1	1	5	4	2	5
Copper	2	1	2	5	5	1	5
Lead and zinc	2	1	2	5	5	1	5

Figure 4 – Environmental rating of various building products

ronmental impact. Natural resources used in construction, as roads and buildings, account for about one-half of all resource consumption in the world (Edwards, 2005). According to Szokolay (2004), material selection must be influenced by the embodied energy, but also by a number of other issues affecting sustainability of their use. Lawson (Lawson, 1996) developed a method which gives an ‘environmental rating’ of various building products on a straightforward 5-point scale: 1: poor, 2: fair, 3: good, 4: very good and 5: excellent (Figure 4).

Lastly, our towns and cities produce huge amounts of waste, which includes solid (refuse or trash), liquid (product of our sanitary arrangements: the discharge of baths, showers, basins, kitchen sinks and laundry tubs) and gaseous (mostly motor vehicle emissions and the discharge of power stations) wastes, and architects can have a strong influence on how wastes are disposed (Szokolay, 2004). Furthermore, the average waste produced is about 1 kg/pers.day in the UK, 1.5 kg/pers.day in Australia and up to 2.5 kg/pers.day in the USA. Collection, handling and disposal of waste is a problem, given that we are running out of space for the creation of garbage dumps (Szokolay, 2004). Combination of cheap energy, technical sophistication and

abundance have caused excessive waste, and according to some predictions, global waste production will double over the next twenty years (De Graaf, 2012).

Through the analysis of the sustainable design principles the importance of the repurposing of the existing building stock, as one of the most effective methods for reaching the sustainable architectural design, and thus reaching general sustainability agendas, was confirmed. Therefore, only through the optimization of natural and artificial resources, reuse of the existing structures and materials and reduction of energy consumption and waste, can a truly sustainable architecture be reached.

The concept of architectural recycling implies the use of the existing building stock and its alteration for the accommodation of new function. Through this process buildings are saved from the total demolition and replacement. However, the practice of recycling is the practice of transformation, i.e. recycling demands change – the right amount of change. Through this transformation a new, viable use is affiliated to the disused building. Thus, recycling cannot be compared to preservation, which persists in maintaining status quo, nor to total replacement of a given building. Through this process a balance is searched for between the radical stasis and radical change. The concept of architectural recycling, i.e. ‘preservation through change’, embodies the principles of the sustainable architectural design (preservation of the embodied energy of building materials, cutting pollution and waste, and lowering impact on new land) and allows the building to evolve and adapt to market needs, while producing minimal environmental impact.

Conclusions

Two radical concepts, extremes, in dealing with the existing building, - preservation as a radical stasis and destruction as a radical change, have been analysed. The concept of preservation, promoted by John Ruskin and later William Morris, implies securing and maintaining of the formal and material condition in which the given building is found. Any alterations and upgrading are seen as a lie and a total destruction of the building’s integrity. Ruskin believed that the collective memory and history are embodied in buildings which should, therefore, be preserved as found and without alterations. For Ruskin the only honest way to deal with the existing build-

ings is to preserve it in its original state. However, Ruskin’s passive model of preservation embalms the buildings as a monument, a museum piece, and prevents a wide range of conversion schemes (which could respond to the market needs by incorporating new functions) to be implemented. This passive model of preservation no longer meets the needs of the ever-changing society. On the other hand, Viollet-le-Duc embraced the concept of restoration as a logical step in the evolution of the treatment of the original building. According to Viollet-le-Duc, restoration improves and completes original building with the introduction of new, better and stronger materials, thus, bringing a building in a state which never existed before. While Ruskin advocated passive preservation, Viollet-le-Duc promoted preservation of building through change of use, enabling in this way the continuity of the building occupancy.

On the other hand, according to Koolhaas, destruction has been seen as an answer to over-preservation which escalates relentlessly and claims new buildings and territories every year due to its elastic and vague selection criteria. He points out that preservation has become progressive action which rapidly limits construction due to its strict regimes. Koolhaas argues that through demolition space can be liberated and should serve as a strategic reserve. Further, all architecture that bears no meaning and is a product of a cheap processes should be considered as ‘junk architecture’ and therefore demolished. According to Koolhaas, the process of demolition should be considered a repetitive action, which needs to be implied every 25 to 30 years, corresponding to the buildings economic viability expectancy. However, demolition requires additional energy to break the building into smaller, less useful pieces. As the high proportion of this demolished building becomes waste, the stored material and energy is essentially dissipated and lost. To replace the building also entails additional energy and the use of virgin materials inherent in new construction.

Building related processes as water pollution, landfill waste, global warming gases, energy, material and land loss, are undisputable proofs of the devastating effects of the construction industry on our environment. As demonstrated in the subchapters above, construction industry is one of the least sustainable industries in the world. This worrying fact was recognised by professionals in various fields which, through summits, conferences and agreements, laid down the principles of the sustainable development and

sustainable architectural design. Given that only a small percentage of the total building stock is made up of new works, this inevitably means that existing buildings play a key role in reaching the sustainable agendas. Through architectural recycling substantial material, energy and economic savings can be achieved. Through this process the embodied energy of building materials is saved and the environmental impact associated with excavation, production and transportation of the new materials is avoided. Further, the land, as a non-renewable resource, is preserved and the production of waste, associated with demolition and new construction, is minimised.

Therefore, architectural recycling has been positioned between two polar and radical methods of dealing with the existing building, preservation as radical stasis and destruction as radical change. Architectural recycling – a ‘preservation through change’, is a process which, contrary to passive preservation (which persists in maintaining status quo) or total replacement, through the right amount of change responds to the changing conditions while exploiting the original building to a high degree. Through this process the balance is created between the preservation and destruction, i.e. stasis and change, in order to allow the building to alter its original function and adapt to the new requirements. Through the architectural recycling, i.e. ‘preservation through change’, the original building is allowed to evolve and adapt to market needs through transformation and change of function, while producing least possible environmental impact.

In time of accelerated economic, social and environmental change, architecture has to be in a constant state of transformation. Flexibility is the key feature which should be nurtured as it allows the existing building to adapt to newly emerging conditions. Architectural recycling is undoubtedly a key method of a sustainable architectural design as it allows the continuity of the building occupancy through the transformation of our building stock while reducing the impact on our environment.

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Furniture design for a flexible use of dwellings

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Abstract

The dwellings in old city centres are usually smaller than those found in new residential areas. The usual approach to make old dwellings meet current space standards is to change their spatial configuration. These changes demand building works that are expensive and not always technically feasible. Instead, we propose to increase the efficiency of domestic space use through furniture that allows multiple (*e.g.*, cooking, dining and living at the same time) or successive (*e.g.*, living during the day and sleeping during the night) uses of domestic spaces. This option is cheap and fully reversible, being therefore more sustainable.

The paper presents a survey of furniture used to ensure the flexible use of dwellings. It focus on furniture used for sleeping, dining and living. Three research questions are addressed: What conceptual approaches can be used to design furniture that enables a flexible use of space? Which operational strategies are more frequently used to design these pieces of furniture? Are these pieces of furniture mass produced or prototypes? The following tasks were carried out: i) set the selection criteria, ii) make an object data sheet, iii) gather and classify data, and iv) analyse results. The criteria to build the sample of furniture was the variety of type of objects (*e.g.*, bed, table, cabinet, sofa), the diversity of strategies used to ensure flexibility (*e.g.*, swivel, telescopic, assemble) and the innovation or relevance in furniture design evolution. For the analysis, each piece of furniture was classified in a table according to the object type, the dwelling function and the strategy to ensure flexibility.

The classifications obtained for all items in the sample were summed up to draw conclusions. The results are that the pieces of furniture more frequently used to ensure flexibility are room dividers for sleeping privacy, expandable/collapsible dining tables for dining, and container expanding systems for living. Multifunctional objects that maximize the use of space were found for the three functions. The strategies that are applied more frequently to promote furniture flexibility are hinging, telescopic and assembling. These strategies are applied in pieces of furniture that have robust structures and are made of long lasting materials. In contrast, the least used strategies are inflating, rolling and compressing. These strategies are applied in pieces of furniture made of soft materials and associated with objects of short term use. Finally, most used strategies are applied to mass produced objects. In contrast, less frequent strategies are applied on prototypes that serve conceptual or artistic purposes.

The main conclusion drawn from the study was that there are many past and present solutions of furniture that ensure a flexible use of the dwelling. The results shed light over a subject that is not common in mainstream furniture design. The strategies organized and illustrated in the paper, provide inspiration for more sustainable furniture designs.

Keywords

Domestic Furniture, Design, Dwelling, Flexibility

Background

Architecture and design have been walking side by side with social and technological developments, in order to facilitate users' relationship with their home environment. Personalization and adaptability in the dwelling have been valued throughout time by many proposals of flex-

ible architecture and design (Hertzberger, 1999; Habraken, 2000; Schneider & Til, 2001; Paiva, 2002; Lemos, 2006, Morellup, 2001).

The dwellings in old city centres are usually smaller than those found in new residential areas. The frequent approach to make old dwellings meet current space standards is to change their spatial configuration. These changes de-

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mand building works that are expensive and not always technically feasible.

Family structures vary along time in an increasingly unpredictable way (Guerra, 2000). Marriage, birth, divorce, cohabitation and death are significant events. In addition, use of domestic spaces change due to new ways of living, such as the increase of professionals working from home and the new possibilities enabled by information and communication technologies.

As a result, at some moment of household life, dwellings in city centres may seem spatially unfit to their needs. Therefore, a research on furniture design is being conducted in order to study solutions that make the most of domestic space and enable a flexible use of dwellings.

The research is structured in the user centred methodology of *design thinking* (Cross, 1982; Brown, 2009). In the first phase (*empathy*) the study focused on understanding of contemporary housing challenges and collecting architecture and design proposals for a flexible use of space. The second phase (*definition*) aimed at identifying main space use constraints in dwellings and analysing furniture that enables a flexible use of domestic spaces. During phase three (*ideate*) new furniture solutions will be pursued. Phases four and five will be centred in prototyping and testing those solutions.

This paper presents results of phase two. The purpose is to answer the following research questions:

1. What conceptual approaches can be used to design furniture that enables a flexible use of space?
2. Which operational strategies are more frequently used to design these pieces of furniture?
3. Are these pieces of furniture mass produced or prototypes?

Previously, domestic activities that face more use constraints were identified (Gomes *et al.*, 2015): i) *having privacy*, ii) *receiving guests*, iii) *storing personal clothes and objects*. Therefore this paper focus on furniture used for these activities.

The following section presents the research methodology. Results are described on section three and their discussion is made in section four.

Materials and methods

To answer the research questions, a survey of furniture used to ensure dwellings flexibility was carried out. The four main steps were: i) set the

selection criteria, ii) make an object data sheet, iii) collect data, and iv) analyse results.

Set the selection criteria

The criteria set to select the furniture that makes up the sample was:

1. *Having variety*: Since one of the objectives of the survey was to understand the variety of existing solutions, furniture with similar solutions was avoided.

2. *Being relevant and inspirational*: The furniture collected had to be relevant and inspirational for the research. Furniture could be mass produced, a limited edition or a prototype.

3. *Keeping an open mind*: No preconceived ideas guided the collection of the sample. A wide range of solutions was pursued.

Make an object data sheet

A data sheet was prepared to organize the data collected for each piece of furniture. The data sheet is divided in three sections:

1. *Object ID*: contains the basic information, such as name, designer, year, producer, country and photos.

2. *Contextualization*: presents a description of the object, such as social context, production, materials, cost, usability, durability and sustainability.

3. *Operationalization*: indicates in a table the activities for which the object can be used, the object type (*i.e.*, *bed*, *space divider*, *seat*, *table*, *container*), conceptual approach (*i.e.*, *multi-functional*, *modular*, *reconfigurable*) and flexibility strategy (*i.e.*, *articular*, *reticular*, *pivoting*, *telescopic*, *assembling*, *pulling*, *compressing*, *folding*, *crease*, *rolling*, *bellows*, *inflating*) (Lemos, 2006).

Collect and classify data

A sample of furniture was built according to the criteria set. The sample is made of 111 pieces of furniture. There is a wide variety on pieces of furniture: 40 for *sleeping*, 30 for *having pri-*

vacy, 51 for storing personal clothes and other belongings, 24 for eating in group (family or guests) and 52 for recreation in group. The total of pieces of furniture per activity is more than 111 pieces of furniture because some of them are multifunctional. Each piece of furniture was described in the data sheet. The set of data sheets were compiled in a book.

Analyse results

Once all pieces of furniture of the sample were described, the main information was gathered in a synthesis table. Conceptual approaches and operational strategies more frequently used were summed up with this table.

Results - Conceptual approaches

Three conceptual approaches were found in the design of furniture that enable a flexible use of

space: modular, multifunctional and reconfigurable. Most pieces of furniture are reconfigurable (97) (figure 1). The number of pieces that are multifunctional (62) or modular (27) is less significant. One piece can combine three conceptual solution types (figure 2), two (figure 3) or just one (figure 4).

Operational strategies

The operational strategies more frequently used are assembling (40), articular (31), telescopic (28) and pivoting (18) (figure 5). These strategies are used in pieces of furniture made of hard and long lasting materials. Therefore, the pieces are designed for long-term use and for being operated frequently without detrition.

Assembling means joining several elements in one piece of furniture, which may be disassembled later for storing or to have a different configuration. An example is Tandem, a sofa-based system, for seating, sleeping and eating. Its parts

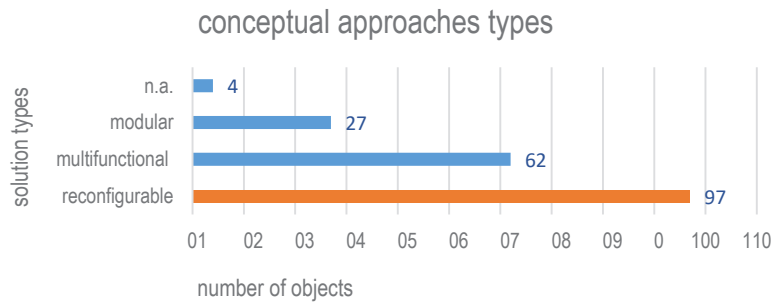


Figure 1 – Conceptual approaches types in the sample



Figure 2 – *Multiplo*. Hey Team, 2010. Italia. Modular, reconfigurable and multifunctional solution (left)

Figure 3 – *Ercolino*. Giulio Manzoni, Italia. Reconfigurable and multifunctional object for sleeping and storing (middle)

Figure 4 – *Flexible Love chair*. Flexible Love. Reconfigurable expandable chair (right)



Figure 5 – Operational strategies in the sample

are assembled and disassembled in order to assume different configurations, according to the user's needs (figure 6).

Articular means joining two elements or more by flexible junctions that can be moved. It is mostly seen with the use of hinges. An example is *Ospite*, a collapsible seat from Vico Magistretti (figure 7).

Telescopic means enabling components to slide with minimum detrition in the contact areas. This strategy is often found in drawers. An example is the *transformer shelf* from Martin Seamer (figure 8), which has multiple sliding shelves that allow different configurations.

Pivoting means that a pivot holds many components overlapped that can be rotated and

exposed. A sample of the use of pivoting is the *360° container*, a set of drawers by Konstantin that enables the drawers to rotate 360° degrees (figure 9).

The less used strategies in the sample are *compressing*, *pilling*, *inflating*, *bellows*, *rolling* and *creasing*. These strategies are associated with soft materials. The exempt is *pilling*. Although there are many pieces of furniture that use this strategy, most of them have an identical approach (e.g., pilling chairs).

Production type

Most of pieces of furniture of the sample are mass produced (93). Prototypes and author pieces are less frequent (figure 10). More frequent strategies are applied to mass produced objects. In contrast, less frequent strategies are applied on prototypes that serve conceptual or artistic purposes.



Figure 6 – *Tandem*. Emmanuele Magini, Campeggi, Italy. This object serves the function of sleeping, receiving guests and eating. The reconfiguration of the proposal is done with the strategy of *assembling* (upper image)

Figure 7 – *Ospite*. Vico Magistretti, Campeggi, Italy. Collapsible seat using the articular flexibility strategy (lower image)

Discussion

Beyond enabling the flexible use of space, furniture should be: i) sustainable, ii) inclusive, iii) reconfigurable, iv) durable, and v) able to be upgraded. Furniture that adapts to dwellers' needs over time is more *sustainable*, since it is in line with a policy of non-disposable objects (Manzini, 1993). To accomplish this goal, furniture should be made of long lasting materials, *i.e.* should be *durable*. It is not easy to predict future changes of users' needs or aesthetics preferences, hence furniture should be *reconfigurable* to accommodate these changes. Furthermore, it should also be *upgradable*, enabling users to acquire pieces of the system over time. Finally, furniture should be *inclusive*, since capabilities of users vary along time.

Some of the most innovative pieces of furniture collected in the survey are prototypes. This finding raises three questions: i) What is the commercial viability of those proposals? ii) Do the proposals need further developed to go into production phase? iii) Is the furniture industry keen to invest in innovative concepts? Whatever the answers, the innovative pieces of furniture are importance to trigger creative thinking.

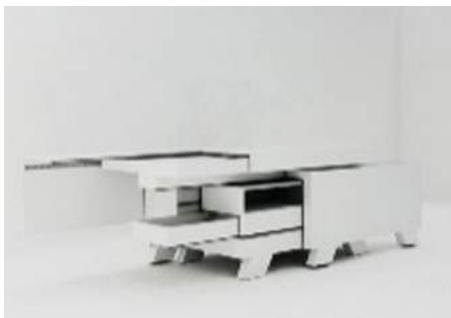


Figure 8 – *Transformer shelf*. Martin Saemer, Germany. A group of sliding shelves allows the object to gain varied configurations (right)



Figure 9 – *360 Container*. Konstantin Grcic, Magis, Italy. A storage device that has a set of drawers joined by a pivot aluminium pole. Each drawer can independently swivel, in order for all constants to be accessed easily (left)

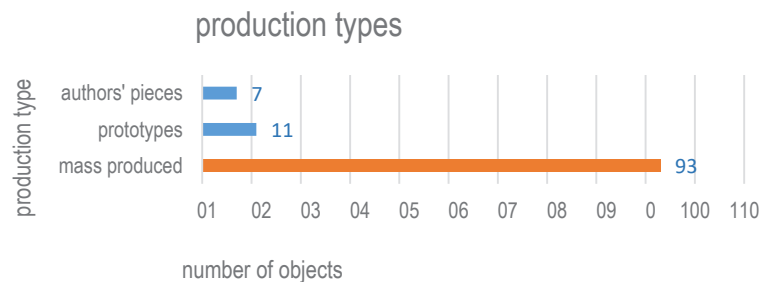


Figure 10 – Production types in the sample

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Energy Yield from Waste Tires Using Pyrolysis Method

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Abstract

The demand for energy in the world has increased with the rapidly developing industry. In contrast, today fossil fuel resources used as primary energy ones have been also decreased quickly. On the other hand, one of the greatest environmental issues of the era is the rise in the amount of the solid waste. Used tires are one of the solid wastes caused the increase in question. Waste tire has an important energy potential. The aim of this study is to produce liquid fuel from waste tires using pyrolysis method. For

this purpose, some tests are carried out to determine optimal temperature and pressure values when liquid yield is the highest. In the conclusion of tests completed, it is found out that liquid yield can be provided from waste tires and the provided yield can be used by different organizations as fuel.

Keywords

Energy, Pyrolysis, Recovery, Waste Tire

Introduction

Worldwide, 1.5 billion tyres are produced per year and the majority of these eventually end up as waste tyres contributing a significant portion of the solid waste stream (ETRMA, 2011). Tyres are designed to withstand harsh mechanical and weather conditions as ozone (the most damaging factor on rubbers), light and bacteria, making difficult their recycling and/or further processing. Also they are bulky and do not degrade in landfills (Leung and Wang, 1998). The tyre lifetime in a landfill is considered to be between 80 and 100 years (Clark *et al.*, 1993). Therefore, the increasing numbers of used tyres constitute a serious threat to the natural environment (Sugözü and Mutlu, 2009; Sienkiewicz *et al.* 2012). On the other hand, since rubber from tires have a calorific value higher than coal as well as considerable amount of carbon black, it seems reasonable to find a route to take advantage of its high energetic and raw material potential in order to progress in the search of alternative fuels, CO₂ emission mitigation and the reduction/recycling on raw materials (Martinez *et al.* 2013).

During the past 10–15 years, several fundamental and applied studies showed that if carefully controlled, tyre pyrolysis can produce a number of valuable yields. By pyrolysis, the rubber portion of used tires is transformed into gas, oil and char. Pyrolysis is the thermal decom-

position of organic materials in the absence of oxygen, cracking them down to simpler organic compounds. It relies on the addition of heat to break chemical bonds, providing a mechanism by which organics decompose and vaporize. Most tyre pyrolysis processes operate within a temperature range of 250–500°C, although some processes are reported to operate at up to 900°C. At temperatures above approximately 250°C, shredded tyres release higher amounts of liquid oil yields and gases, while above 400°C, the yield of oil and solid tyre-derived char may decrease relatively to gas yield. Pyrolysis can be classified as atmospheric, vacuum, catalytic, fast or slow according to the operation parameters applied. According to pressure applied, pyrolysis can be atmospheric or vacuum. The operating parameters of pyrolysis are temperature, heating rate and particle size (Antoniou and Zabaniotou, 2013). The pyrolysis temperature is one of the main governing variables on waste tire pyrolysis (Martinez *et al.*, 2014).

Waste tire pyrolysis seems to be more attractive in comparison with other thermo-chemical processes because of its minor environmental impact and the recovery of solid and liquid material. Its yields are easily manageable and then valorised separately according to different objectives. The production of a liquid fuel yield, the major yield in waste tire pyrolysis, increases the ease of handling, storage and transport and hen-

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ce the yield does not have to be used at or near the recycling plant (Martinez *et al.*, 2013). Also the application of pyrolysis technology to the treatment of waste tyres was found to be economically feasible (Pilusa *et al.*, 2014). Because of these advantages, pyrolysis method has recently received renewed interest and attention to tackle the waste tyre disposal problem while allowing energy recovery. Therefore, the aim of this study is to produce liquid fuel from waste tires using pyrolysis method.

Material and Methods

Pyrolysis unit is cylindrical, stainless steel and has a capacity of 1000 m³. A thermometer showing a maximum of 600°C and a barometer working up to 15 bar is set up on the unit. The unit has three outlet valves. The opening of the unit is surrounded by a circular seal to provide leakage (Figure 1).

In tests, three Soxhlet extractor with 360 mm in length is used for condensing gas. To collect condensed gas, a conical flask is added to extractor with pipes. Gases that can not be liquified are collected in the gas collection bags at the end of the test.

Before starting the test, waste tires used as raw are cut into small pieces and separated from wires. Sample quantity is taken as 300g and it is put to pyrolysis unit. After tightly closing the opening of pyrolysis unit, argon gas is passed through the unit to provide anaerobic conditions necessary for the pyrolysis. Then, pyrolysis test is begun by heating of a gas tube.

Firstly, gas tube is set to 4.5 degree. Pressure and temperature measurements are done in each 3 minutes. It has taken 33 minutes to get the first liquid yield. When the pressure is 5 atm liquid yield is filled to glass bottles. After getting the first liquid yield when the pressure is zero the second treatment is continued. For second treatment, pressure and temperature measurements are done in each 4 minutes. After 44 minutes when the pressure is 3.72 atm the second liquid yield is gotten. When the pressure is zero third treatment continues. For this treatment pressure and temperature measurements are done in each 10 minutes. After 30 minutes when the pressure is 0.6 atm the third liquid yield is obtained. At the end of the pyrolysis test, the obtained yields are weighed.

Results and Discussion

The observed temperature and pressure values related to the time for all liquid yields are presented



Figure 1 – Pyrolysis unit

in Table 1. Heating rate are 4.5 degree for the first yield and 5 degree for the other yields. Reaction durations for yields are 33, 44 and 30 minutes, respectively. Catalyzator is not used for all yields.

The increase or decrease in the temperature and pressure depending on the time is important for liquid yield. In this study, it is found out that the yield increment decreases with the increase of temperature and decrease of pressure (Figure 2-3). As a matter of fact, Akyıldız (2011) has stated that the optimum pyrolysis temperature and heating rate are 400°C and 5°C/min for liquid yield. Rodrigues (2001) and Laresgoiti *et al.* (2004) have also reported that pyrolysis temperature over 500°C has no effect on the increment of liquid yield. On the other hand, Karthikeyan *et al.* (2012) have stated that pyrolysis temperature beyond 375°C lead to decrease of liquid content in most of the pyrolysis processes and also liquid yield obtained is relatively greater volume in presence of catalyst as compared to pyrolysis in the absence of catalyst. The results of these studies mentioned above are similar to those obtained in the current study. In contrast, the general trend is an increase in liquid yield as the temperature increases (Juma *et al.*, 2006; Suhanya *et al.*, 2013). Pangaliyev (2014) has determined that the highest liquid yield is obtained at 700-800°C for the pyrolysis. Also, Islam *et al.* (2008) has indicated that the lower temperature causes decrease in the liquid yield.

Liquid yields obtained at the end of the pyrolysis process are weighed and yield increments are calculated (Table 2). In addition, samples taken from these yields are sent to related institution for determining their composition. Figure 4 has showed liquid yields and outletwater.

The First Yield T			he Second Yield			The Third Yield		
Time (Minute)	Temperature (°C)	Pressure (atm)	Time (Minute)	Temperature (°C)	Pressure (atm)	Time (Minute)	Temperature (°C)	Pressure (atm)
0	175 0	.5 0		351 0	.8 0		437 0	.0
3	180 0	.7 4		364 1	.3 1	0	440 0	.2
6	230 0	.9 8		375 1	.7 2	0	445 0	.5
9	255 1	.5 1	2	389 2	.0 3	0	452 0	.6
12	286 2	.0 1	6	393 2	.5			
15	293 2	.5 2	0	404 2	.7			
18	306 3	.0 2	4	412 2	.9			
21	311 3	.5 2	8	415 3	.2			
24	330 4	.0 3	2	425 3	.4			
27	340 4	.3 3	6	428 3	.6			
30	360 4	.8 4	0	432 3	.7			
33	420 5	.1 4	4	435 3	.7			

Table 1 – The observed temperature and pressure values related to the time for all liquid yields

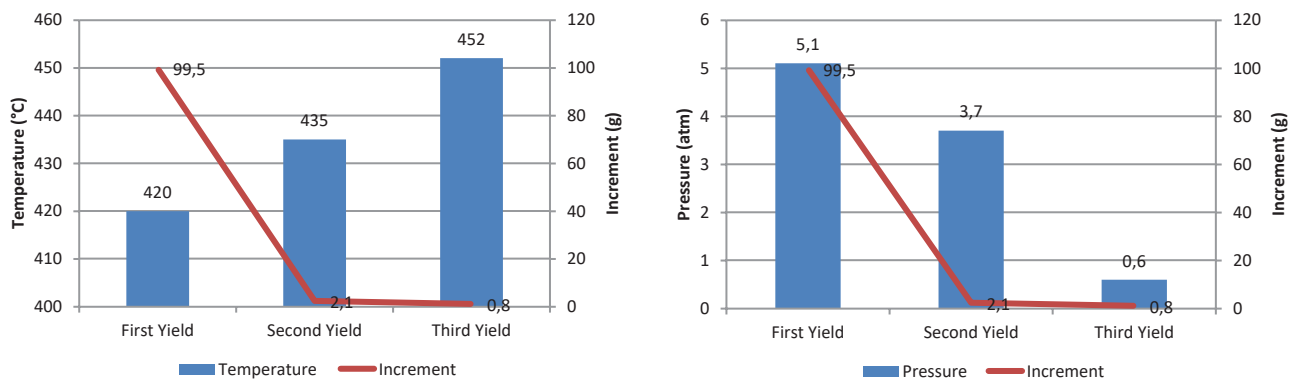


Figure 2 (Left) – The relation between yield increment and temperature

Figure 3 (Right) – The relation between yield increment and pressure

Conclusions

Tests in the current study has showed that energy can be produced from waste tires. The yields obtained by pyrolysis techniques can be a suitable alternative to fossil fuels and natural gas. The wastes occurring after energy yieldion can be removed by applying various methods without damaging the environment and also used as a material in the construction field. The development and use of advanced technologies are required for both the development and utilization of new energy sources,

and effective waste disposal all over the world. To provide contribution to national economy, plants used pyrolysis techniques should be encouraged and also enterprisers should be supported for establishing new pyrolysis plants. The issues related to the regulations should be resolved.

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Yields	The first weighing (Empty container) (g)	The last weighing container+ yield (g)	Increment (g)
Outlet water (OW)	696.8	704.6	7.8
First	237.0	336.5	99.5
Second	226.3	228.4	2.1
Third	205.7	206.5	0.8

Table 2 – The weighing results for all yields

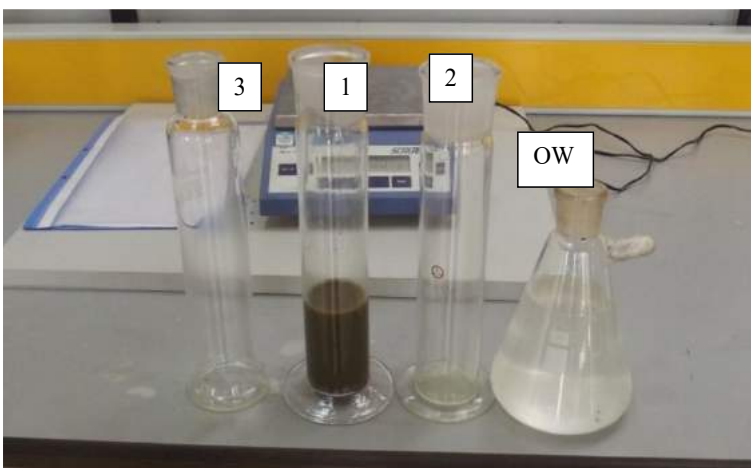


Figure 4 - Liquid yields and outlet water (OW) obtained at the end of the pyrolysis test

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New materials and products from synthetic textile waste: a model and framework for the management of the development & research team

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Abstract

This paper presents the continuity of the studies previously described by the authors in another two papers, which presented a model based on the abductive reasoning as an alternative to approach the problem of synthetic textile waste, and its application in new materials development, as well as preliminary process model for the Research & Development (R&D) activities. In this paper is presented and discussed the management of the R&D team here considered as a “creative group”. The main questions that guided this dimension of the investigation included: “how to select the right members for the team?”, “how to manage their work?”, “what is the most suitable structure for organizing their work?”, “what is the best process for this team?”, “what is the best leadership style for this team?”, “how they must interact?”, and “how to stimulate them to think about the project in a more entrepreneur way, considering eventually building their own businesses models based on the findings of the research?” The active-research was the main research

method, conducted with a team of 16 researchers, being two professors of design and one of chemistry, ten bachelor students of fashion design, one specialist in fashion design, two of graphic design, one bachelor student of chemistry, and one master student on chemistry. This team conducted a set of activities related to the design process and empirical experiments in laboratories, as well as exploratory workshops for product and business models development. As a result, the authors present a conceptual model and framework for the team management and leadership, based on the literature and the R&D process model initially proposed. The next activities include the refinement of the proposed model, and its validation with two different research teams: a sample and a control one.

Keywords

Textile waste, New material, Design-oriented method, Team management, Creative groups.

Background

The context and problem of synthetic textile waste and a Brazilian research project

The production of synthetic fabrics has shown significant growth in recent years worldwide, spurred by increased consumption, with significant environmental impacts. Most of the global production is presently located in China (49 %), followed by India (7%), Pakistan (3.8%) and Brazil (2.9%) (Abravest, 2010). In Brazil the average waste generation is estimated by the 26.000 Brazilian industries to be about 1400 kg/year per company (Sebrae, 2004). The donation of waste is a common practice in the Brazilian garment industry,

and there was in the last years an excess of waste offered in the market (Sampaio *et al.*, 2014). Although the garment sector does not generate solid remainder of great striking power, these remainders are generated in large volume. The toxicity of the remainder is not significant, but the high volume affects other environmental variables, such as CO² emissions and non-renewable natural resource exhaustion, and that is why the textile waste causes a critical environmental impact (Martins *et al.*, 2011).

The most common destinations for clothing discarded during production or post-consumption is the reuse, recycling, incineration and sending to landfill. According to Allwood *et al.* (2006, in WRAP, 2010) in the UK, for example, annually 1.12 million tons of clothes (30

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kg/capita) are discarded, representing about 8% of the total weight of household waste (WRAP, 2012). Of this amount, 350,000 tonnes (31%) go to landfills, 47% are reused in other countries (34%) or in the UK itself (12%), 14% is recycled and 7% is incinerated, as pointed out by Oakdene Hollins Ltd et al (2006, in WRAP, 2010).

Regarding the recycling of textile waste, Life Cycle Analysis (LCA) studies done by ERM (cit. in WRAP, 2012) showed significant reductions in energy use and in emission of greenhouse gas (Korhonen, Dahlbo cit. in WRAP, 2012). The benefits of recycling compared to incineration were also identified. In general, recycling can occur in two ways (Bastian, 2009): in or out of the process. In this sense, the creation of new materials from recycled textile waste involves recycling out of the process as the materials to be developed are not necessarily incorporated back into the clothing production. Instead, they can integrate other processes, such as products for construction industry, architecture, decoration, accessories, footwear, gardening and so on.

In the case of synthetic textile materials, one difficulty for recycling is the variety of materials available, being polyester and polyamide the most significant. A study done by Nike pointed polyamide 66 as the worse environmental performance material among the 25 most commonly used materials for the company. Nevertheless, there are already initiatives for recycling polyamide 66 (Bodero and Cansell, 1999; Booij *et al.*, 1997; Frentzen *et al.*, 1997; Kasserra, 1998).

Polyamide 66 (trade name *nylon 66*) is used in the manufacture of various compound fabrics such as *Lycra*, *Cordura*, *Coolmax*, *Thermolite* and *Supplex* that use different materials in its composition, which further complicates recycling. They are widely used by Brazilian manufacturers of clothing; however, there is not an adequate knowledge on how to properly dispose this material waste.

A recent study done by Brazilian researchers in a company of Londrina, Paraná (developed at the State University of Londrina – UEL, in partnership with Mulher Elástica, a Brazilian garment company), indicated the waste of raw materials, lack of proper disposal and lack of appreciation of

the waste as major problems concerning the use of *Supplex*. The waste were usually donated to artisans, or collected by a collection company, which was responsible for the destination (Martins *et al.*, 2013). So, a partnership with the UEL Chemistry Department was established with the aim of developing new forms of synthetic textile waste recycling, including the creation of new materials. This partnership has been particularly successful, and initial results indicated that the *Supplex* is a challenging recycling material, and that this can be done in an environmentally appropriate manner.

The design thinking approach, innovation, and the abductive reasoning as startpoint for framing the problem

This R&D project emphasized the role of design to solve the environmental problems of textile waste (environmental values) and, at the same time, generating and delivering values for users (both emotional and functional), organizations (profitability, brand value, public recognition, and improvements in the internal processes). In the design thinking context, the generation and deliver of value is how the concept of innovation is well understood. So, innovation can be seen in

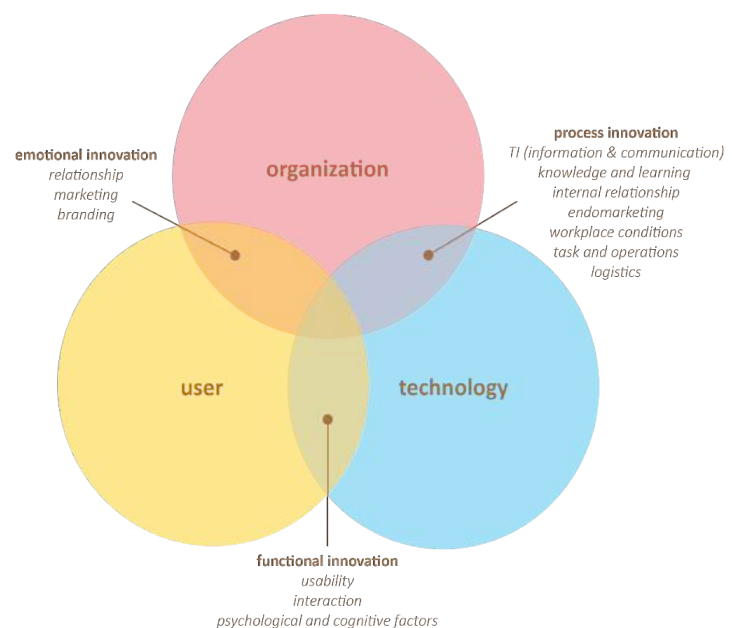


Figure 1 – The three dimensions of design thinking, and its “innovation spaces”: functional, emotional and of process
Source: Adapted from Brown, 2008

terms of the interactions (“innovation spaces”) that occur in these three main dimensions (Figure 1) (Brown, 2010).

Starting from the Brown’s model and the “innovation spaces”, the contribution of a new R&D process and team management model can be seen in terms of the following aspects, as is the Figure 2. Beyond the values previously described, an effective R&D process and team management can also promotes gains from other three specific interactions:

- Enriching and strengthening the way the R&D team and organizations (frequently as businesses) interact to produce innovations;
- Enriching and strengthening the way the R&D team and users (frequently as consumers) interact to produce a deeper understand of behaviours, attitudes, habits, needs and desires;
- Improving the internal processes and activities related to R&D by the inclusion of other

knowledge areas (as design and sciences), and thus promoting an effective group learning.

It can be noted that all these three forms of benefits are strictly related to the work process the R&D team, whether in the form as it relates to the organizations or users, or even in the form of develop its activities to produce and manage new knowledge and innovations.

The abductive reasoning of design thinking

Considering the relevance of the creative thinking when facing complex problems (including sustainability and innovation), and the fact of this kind of reasoning, also known as abductive reasoning, is very common in the design area (Dorst, 2011), the authors proposed, in a previous paper, a model to frame problems related to waste and its conversion in new materials (Figure 3).

According to this model, the desired benefits (value) includes environmental values (reduction of the environmental impact), user values (both emotional and functional ones) and economic values (e.g. differentiation, competitiveness, cost reduction and image gains). Following the Dorst proposal, the objects (“what”) include both the development of a new material from the recycling of textile waste, new products to be developed with this material and new businesses to deliver value for economy for companies, people and government.

Then, the principle of operation (“how”) is reflected in the objective of designing and testing a methodology that enables the development of new materials from synthetic textile waste. This methodology include issues as innovation (value generation), collect and analysis of environmental, technological economical and legal data (as intellectual property and legislation) and too about the R&D process and team management, including the role of the leadership.

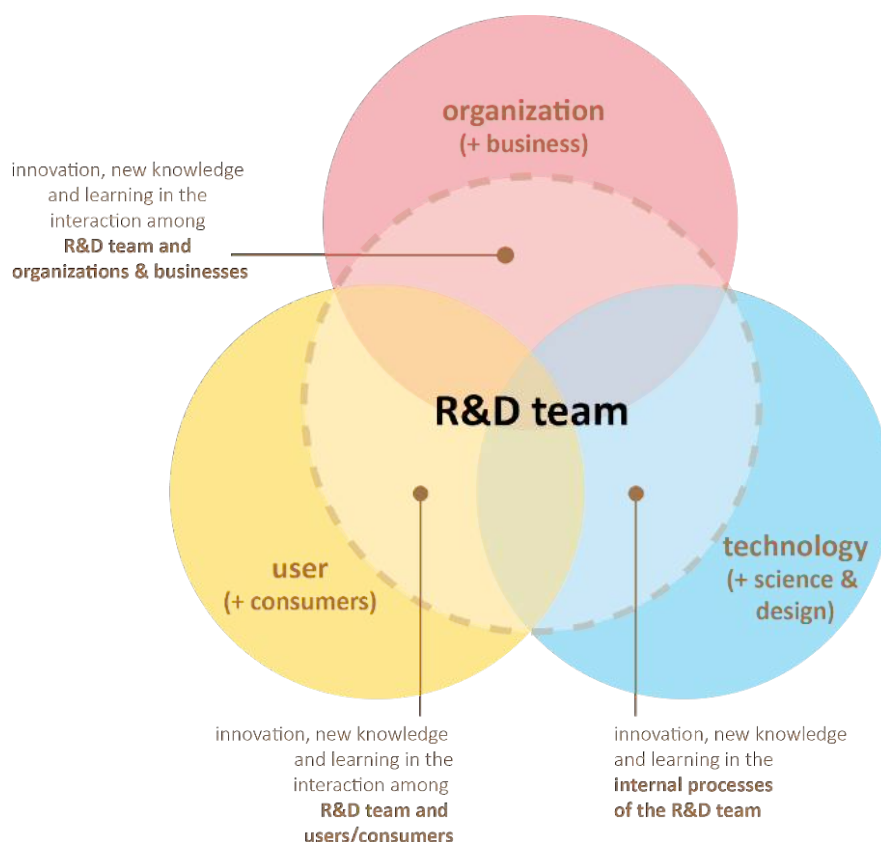


Figure 2 – Innovation and design thinking in the perspective of R&D process and team management

Source: authors’ material

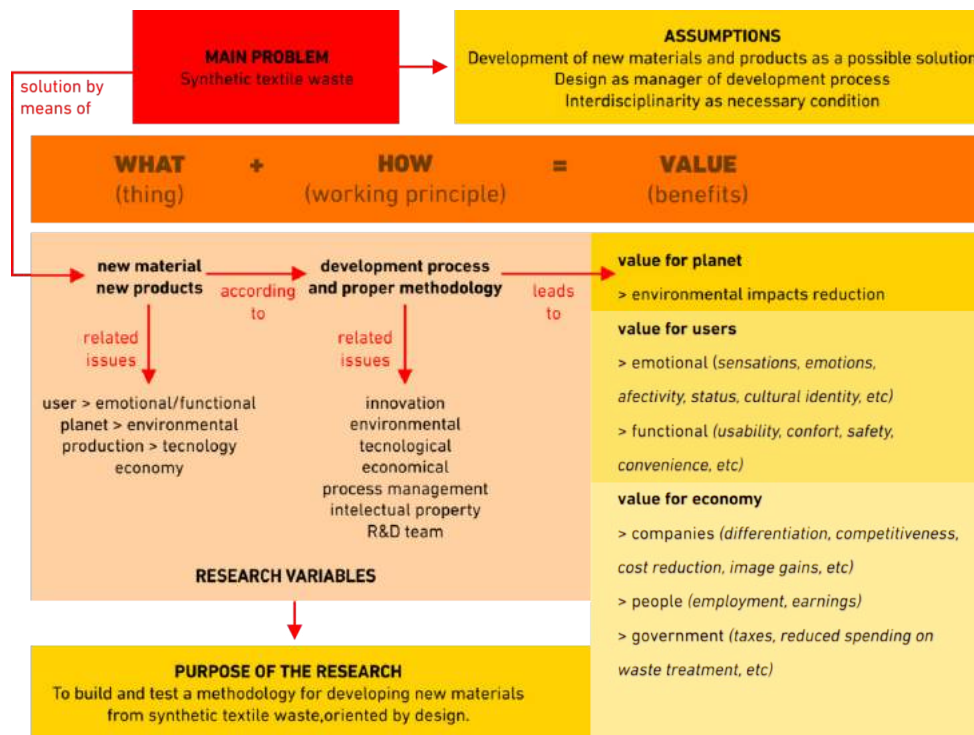


Figure 3 – Abductive-2 reasoning model (Dorst, 2011) applied to the research proposal (Sampaio et al, 2014)

Adapted from Dorst, 2011 and Sampaio et al, 2014

A brief explanation on model, framework and methodology

Since this paper presents a proposal of a model and framework for the management of the R&D team, this section aims to present and discuss some definitions about three terms which are frequently cause of confusion. This section becomes more significant because the model and framework presented in this paper will serve as a basis to construct a methodology for the management of R&D process and team, as a result of the doctoral studies being conducted by one of the authors. The following taxonomy (Tomhave, 2005) were identified from the most abstract to the most concrete:

- **Model:** Tomhave (idem) proposed that model is a high level construct representing processes, variables and relationships, abstract in nature and generally detailed on how to be implemented, and ideally technology-independent.

- **Framework:** Less conceptual and more detailed than model, framework is a type of structure which set assumptions, concepts, values and practices designed to directly impact implementation.

- **Methodology:** It is the lower-level among these three constructs, and consists in a set of practices, procedures and rules to implement the proposals. In science, methodology is usually defined as a set of techniques and processes to produce scientific knowledge, as well as the study of these methods. In the study presented in this paper, the aim is to build up a methodology according to the first definition.

Research methodology

The preliminary model for the R&D process already developed, as well as a preliminary model for team management and leadership presented in this paper, were built by the authors as a result of a research in which it was used a lot of methods and tools, including: literature critical review - it included data collect and analysis (in papers, congresses, reports, books and other relevant sources) about the main problem of the research (synthetic textile waste), the proposed approach (design and materials development), the expected values, the objects (materials, products and business design), and the issues related to the methodology expected as a result of this study (R&D process, team man-

agement, innovation and others); semistructured interviews: this tool was used to complete the lack of information on some of the themes of the literature review, by talking directly with R&D coordinators that have the mission of manage R&D projects and teams in areas related to this study. It was taken one interview until this moment, and others will be performed in the next months.; active research: this method has originated in the social sciences, and have been increasingly used in organizations to enlarge the understanding of the problems by the teams, and to solve them in a collaborative and participatory process (Thiollent, 2005). It was applied with a group of Design and Chemistry teachers and students, in order to build a deeper comprehension about the problem of textile synthetic waste, and develop innovations in new materials, products and businesses. This group was organized in seven teams, each one with a leader: one for chemical experiments, one for physical experiments, one for data collection on environmental aspects, three for product and business development and one for graphic design activities. The product and business teams were responsible, each one, for a specific group of users-consumers, for whom they must develop a proposal from the concept to the prototype.

The R&D process

The three “what” (new material, new product, new business) of the model were included in a preliminary model for the R&D process (Figure 4), in which these three elements are organized in three distinct levels of action: material design, product design and business design. Additionally, a fourth level is added, specifically for the environmental aspects, the life cycle design. This level could be integrated to the product design level, as it is done in some design methodologies but, due to the importance of the environmental dimension for a research about waste, it was put in a specific level.

This R&D process model is presented and explained in another paper (Sampaio *et al.*, 2015), and is the first of the three stages of the methodology that the authors aim to build and assess. The second stage refers to the team management, and the third is dedicated exclusively to the leadership aspects. Once provides an overview of the stages and its relationships, this model can be seen also as a kind of pre-framework, if more details be added to the structure in order to enable the implementation.

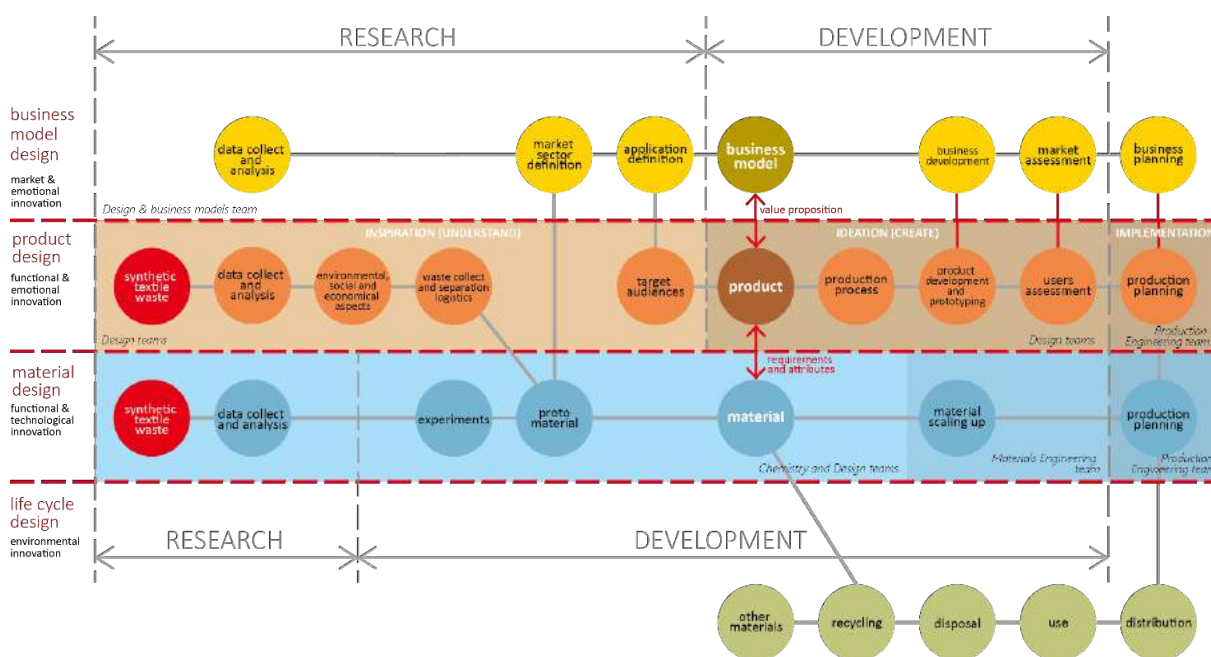


Figure 4 – Preliminary model for the R&D process in new materials from synthetic textile waste

Source: authors' material

The R&D team

Innovation, R&D activities and Brazilian R&D peculiarities

The Brazilian Federal Law 10.973, 2004, defines innovation as “introduction of novelty or improvement in the production or social environment that result in new products, processes and services”. Similarly, the Oslo Manual (OCDE, 2013) consider innovation as “introduction of a new good or service or significantly improved in terms of its characteristics or provided uses”. According to the Oslo Manual (idem), innovation process can be divided in three main activities: R&D, innovation in product and process, and innovation in marketing and organizational. This study is concentrated in the first, but aims to develop innovations in the two others, in a disruptive level, even if incremental innovations may also be achieved.

In this study, the context in which the R&D is carried out is also relevant; the authors conducted the research in a Brazilian research group established in a public university, and this implies in some specific characteristics. In these type of university, the research is strongly funded by the government, both local and federal.

Etzkowitz and Leydesdorff (2000) explain this model as a “Triple Helix I”, in opposite to the laissez faire model (“Triple Helix II) practiced in highly liberal countries as USA and Sweden. Despite this, it have increased the participation of other actors (companies, laboratories and other organizations) in the Brazilian innovation system, as an attempt to change the model for something near to the “Triple Helix III”, in which the knowledge flows no more only from the university to the companies, but in reverse.

Moreover, the tripod teaching-research-extension practiced in public Brazilian universities implies in a frequent participation of graduate students, in the majority very young and unexperienced, but frequently very intelligent and creative. As experienced by two of the authors in their teaching and research activities along the last years, this is particularly noticeable in the design courses, due to the very arduous and demanding entry process in the public universities in Brazil. Otherwise, one frequent difficult found by the R&D project coordinators in Brazil is the inconstance in the liberation of funds by the government, what frequently cause disorders like lack of resources, interruption in scholarships payment, among other problems.

Knowledge society and the role of teams and creativity in innovation

The meaning of knowledge has changed during the history of humankind; in antiquity, and until the beginning of the industrial revolution, it was seen as something generic, focused in the individuals and their self-knowledge, self-development and self-identity, by using grammar, logic and rhetoric. With the advent of French enlightenment in the 17th century, the emergence of “scientific knowledge” has changed this meaning, and emphasized the practical character of the knowledge (Drucker, 1999).

Since then, the search for practical results has been guided the scientific research, and this fact was reinforced in the 20th century, with the growth of globalization and the new technologies, that affected communication, production, transportation, health, food and many other human activities. In this new reality, innovations are developed not by lonely individuals, but by teams composed of people with very distinct and frequent complementary knowledge and competences (Drucker, 1999). So, interdisciplinarity emerges as a necessary condition for these teams.

Considering that the most important resource to produce innovations in the “knowledge society” (Drucker, 1999) is people and their brains (specially in R&D teams), and their capacity of producing always new and more creative answers for the R&D problems and deliver value for users, companies, government and environment, creativity can be seen as another essential resource for innovation. Emphasizing the role of knowledge and creativity, this kind of group is called by Drucker (1999) as “knowledge team”, but also as “creative team” in a sociological approach by DeMasi (2003) and as “great groups” by Bennis (1999) from a North-American corporate point of view. All these approaches are convergent to the idea of teams organized to produce innovation in an interdisciplinary way, and using knowledge and creativity as a main resource.

The R&D team as a creative group

Bilton (cit. in Dolan, 2010) comments that the idea of creative groups goes back to the Renaissance time in Europe, during the period between the 14th and 17th century, when groups of artisans, painters, sculptors, architects and other professionals were formed to carry out projects commissioned by the church or by the nobles (Dolan, 2010).

Advancing to the 18th century, DeMasi (2003) identified a lot of groups formed in different areas of knowledge which he called “creative groups”, and which had many common characteristics as: strong, but charismatic and non-authoritarian leadership, high sense of mission and responsibility, high level of involvement and motivation, respect for the diversity, mutual confidence, flexibility, privileged spaces and moments to dialogue and discussion, high level of informality in the relationships, high level of creativity and stimulating environment for that, among many other aspects. strong, but charismatic and non-authoritarian leadership, high sense of mission and responsibility, high level of involvement and motivation, respect for the diversity, mutual confidence, flexibility, privileged spaces and moments to dialogue and discussion, high level of informality in the relationships, high level of creativity and stimulating environment for that, among many other aspects.

Creativity, in particular, it was one of the central factors of these groups, and have been studied from several approaches since the end of the 18th century. DeMasi (2003) identified that the scientific researches on this theme started with a very biological and hereditary approach in the end of the 18th century, and strongly focused in the individuals, not the teams. Since then, the interest in creativity increased, and gradually included psychological, anthropological, socio-environmental, systemic, epistemologic and sociologic aspects. The scientific investigation on creativity gained importance specially after the 2nd war, with the emergence of the big north-american companies, and the exodus of some of the best scientists from Europe to USA, due to the war.

The previous emphasis on individual creativity in the first decades of the 20th century has changed to an increasing focus on the creativity of groups, because of the growing need for innovation in the organizations. So, the large knowledge about creativity accumulated along the previous years, specially in the psychology, anthropology and sociology were largely used by the American companies to form, enable, empower and manage the teams, what was significant in the success of the USA companies in the post-war years (DeMasi, 2003).

All in all, on the other side of the planet another type of creative team also emerged, in a very different context: the Japanese companies, mostly destroyed by the 2nd war. Inspired by the need, but also by an old social tradition of collectivity, dialogue and search for consensus in the decisions, emerged the J-form teams; in fact,

this model of organization was one of the foundations of the very revolutionary Toyota Production System (Dolan, 2010).

Specifically in terms of the R&D teams, Drucker (1987) pointed out that the first research laboratory inside an industry it was created in 1872 by Hefner-Alteneck, a Siemens engineer, with the aim to create new products and processes, and also to identify new applications and markets for them; for that time, this can be seen as a very innovative proposal, and also inspired the study presented in this paper.

R&D team as an adhocratic form of organization

Drucker (1999) considers that innovation requires systematic effort and high level of organization, as well as decentralization and diversity, in opposition to the centralized planning. This implies that a bureaucratic structure can not be the best form of organization for creative groups; in fact, the literature pointed out that the most successful innovation groups in history have been structured in a very flexible and non-hierarchical way. The most common models of organization with these characteristics have an organization structure called “adhocracy”.

Adhocracy is a term firstly used by Bennis and Slater (1964), referring to the military “task-forces” in that time, and popularized by Tofler (1970) who considered this as the organizational model of the future. Waterman (1990) defined adhocracy as any organization that breaks with the bureaucratic processes, simplify the process and adapts to the situations as they shown.

Some of the main characteristics of adhocracy are:

- Organic organizational structure, based on cooperative groups and teams
- Temporary positions and tasks;
- Non-hierarchical and decentralized organization
- Modular design, formed by specialists;
- Structure is undone when the goals are achieved;
- Minimum formalization of procedures and behaviours;
- Minimum standardization of processes;
- Specialization of the work based on the members formation and competence;
- Coordination and control by the own group;
- Ill defined roles, subject to readequations;
- Communications sometimes incomplete.

Adhocratic organizations, in two main forms: “new adhocracy” and “J-form”. “New adhocracy” is a model strongly based in the renaissance cooperatives described before, and influenced many organizations in the creative arts, like cinema, music record companies, scenic arts and others, and recently, journalism and professional sports (Dolan, 2010). The R&D groups in the universities, mostly, also have worked according to this model, emphasizing the focus in the goals and targets, low level of formality and bureaucracy and most friendly work environments.

Similarly, the “J-form” teams are also characterized by the aspects described above, but with an own characteristic: the search for consensus in the decisions, that are taken only after an exhaustive dialogue and discussion, with respect for all the opinions and ideas, in a non-conflicting process; this is a significant difference from the western groups, and the success of Japanese companies like Toyota and Sony seems to confirm the value of this approach.

Another interesting way to see the creative groups and teams is using the Mintzberg (cit. in Dolan, 2010) analogy with the sports teams, as he says:

“I must, however, complain about baseball. That strikes me as the professional bureaucracy, football as machine bureaucracy, rugby as adhocracy, and our beloved hockey as (sometimes) a political arena” (Dolan, 2010, p. 40).

This analogy were also used by Drucker (1999), which argues that there are at least three types of teams, according to the type and level of leadership, interaction and flexibility of roles, among other aspects: baseball teams, football teams and tennis doubles. The first is a very static organization, strictly controlled by the coach, and wherein each player occupies a specific position; the second demands a more dynamic movement of team members, but is also dependent of the orientations of the coach, who defines the strategy; the last is a more flexible and non-hierarchical structure, what demands high level of articulation and autorregulation among the two members. Each one of these forms can be used by the creative teams, depending on the context, as found in the literature, but the last two were identified most frequently by the authors.

R&D team as a learning organization

According to Argyris and Schön (1978) organizational learning is a permanent reflexive and questioning process, that the organization members use to develop shared knowledge, based on the learning from each other. The final goal is to develop the team ability of “learn to learn”, also called deuterio-learning, overcoming the steps of single loop learning (individual learning based only on explicit knowledge) and double-loop learning (changing the mental models of the organization and its members from the cultural and objective knowledge).

Senge (1990) proposes that, to build a learning organization, the group and their members must be proficient in five disciplines:

- **Systemic thinking:** The ability of understand that, as in the nature, the human events are interconnected, and it is important to pay attention not only in the parts of the system we are in, but also in the whole.

- **Personal mastery:** It starts by clarifying what is really important for the individual, its aspirations, because this is the basis of any human entrepreneurship.

- **Mental models:** The set of predefined ideas, opinions, generalizations and images which we have about the ourselves, the others and the world, and that influences our behaviours and attitudes.

- **A common goal definition:** It is essential to create and communicate a clear vision about the future to inspire people, and this one of the first obligations of any leader.

- **The group learning:** It depends on the individuals learning, but goes beyond them, due to the synergy of intelligences. It starts with dialogue and recognition of interaction patterns that hinder it.

Since these disciplines are being dominated, the innovation process can be started. Following the idea of learning organization, Beckman and Berry (2007) proposed that innovation process can be seen as a learning process. If Owen (idem) proposed that the innovation process include both identification and selection actions of problems and solutions, Beckman and Berry pointed out that, to perform these actions, are needed at least four learning styles: Divergent,

Assimilative, Convergent and Accommodating. The process proposed by them is based on two polarities axes, that put the activities in terms of abstract-concrete and analysis-synthesis, resulting in four quadrants of actions: reflexive observations about the context (concrete informations) and conceptual framing of insights (in abstract level) which are basically analytic steps, and ideas imperative (still abstract) and solutions creation (active and concrete experimentation), that demands ability of synthesis (Figure 5) (Beckman, Barry, 2007).

These learning styles are relevant for the definition and management of the team roles for the innovation process and, specifically in this study, for the R&D team. This is an important activity that can be considered in the first step of the R&D management process: the project planning.

The team management

Project planning

There is a lot of models for the project planning for R&D, but usually they contain more or less the same elements, which include: problem descrip-

tion, goals, targets, motivation, opportunities, risks, expected benefits, theoretical foundation, key partnerships and resources, funding sources, teams, competences and roles, tasks, framework, methodology, methods, tools, communication strategy and channels, schedule and a preliminary list of references. This is a structure commonly used by government agencies in Brazil, in official notices for funding new research projects.

In terms of the team management, is specially relevant the item related to team definition, which can include: the necessary competences and intelligence types for the project, and the roles related to these elements, team size, available budget and remuneration policy, availability of scholarships, contract time, days and working hours, among other elements.

The set of tools that can be used in project planning includes: mindmaps (manually or using softwares like XMind or Freemind), SMARTER targets (McGrath and Bates, 2014), SWOT analysis (idem), system maps (Halen *et al.*, 2005), project planning and schedule (using softwares like GanttProject or Microsoft Project), Balanced Scorecard (Assen, 2010).

Since the project planning be submitted and approved, it is time to form the R&D team, which includes two distinct phases: recruitment and selection.

Recruitment and selection

The team formation starts with the dissemination of the vacancies available for the R&D project in the channels chosen by the project managers. The requirements for these vacancies, already defined in the project planning, must be explicated for the candidates in this stage. So, the selection phase begins, and a variety of techniques and tools can be used. Terra (2000) argues that the selection of creative members is one of the most important decisions for knowledge-based organizations. According him, the cognitive, creative and motivational abilities, can be improved and facilitated, but not changed in their essence, because they are built along the life of the person (Pitcher, 1995; Quinn *et al.*, 1996).

Badawy (1988) emphasizes the importance of evaluate the adequacy of the candidate to the culture of the organization, as well as its interpersonal ability to work in teams, because the innovation process demands different roles, skills and creativity levels.

According to Terra (2000), and citing contributions of other authors, Psychology can con-

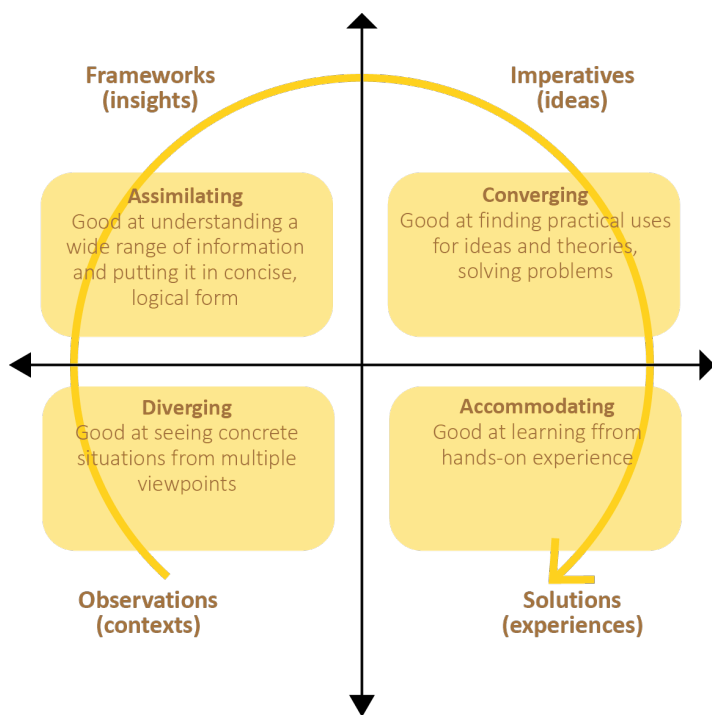


Figure 5 – The four learning styles (Beckman and Berry, 2007), based on the innovation process of Owen (1997) Adapted from Beckman and Berry, 2007; Owen, 1997

tribute to the formation of creative groups in four distinct categories:

- **Measuring the ability to think creatively:** This includes cognitive aspects connected to creativity, like fluency, flexibility, originality and elaboration, all related to divergent thinking. Tools like the Torrance Tests can be useful to measure these characteristics.

- **Assessing the personal characteristics associated to creativity:** The most common are tolerance to uncertainty and ambiguity, self-confidence, unconventionality, originality, intrinsic motivation, intelligence above average, determination to success, humour and nonconformity. Not all these characteristics are found in all the creative individuals, and they vary as the age, gender and professional occupation, according to King e Anderson (1995). Among the most known related tools, are the KAI, 16PF e OPQ tests;

- **Assessing the biographical characteristics and of past products associated to creativity:** This implies in a historical assessment of the past creative work of the candidate since his childhood, based on factual data, and serves to preview future creative achievement. Hocevar e Bachelor (1989), Shapiro (1985) and Badawy (1988) consider this tool more reliable than the previous, mainly in áreas like scientific research, engineering and design, but less effective to evaluate recente college graduates (Terra, 2000).

- **Measuring the motivation to work:** Parmeter and Garber (1971) identified the high level of intrinsic motivation as the main feature of creative people, based on a study carried out with 110 scientists. In addition, Kabanoff and Rossiter (1994, apud King and Anderson, 1995) suggested the importance to measure the motivational historical when selecting creative professionals (Terra, 2000).

For Keller (1978) the assessment of creative features is always approximate and subject to revisions, and the psychological approaches must be applied carefully. Hamel and Prahalad (1994) emphasize the importance of hiring persistent and resilient individuals, and the company ability of develop their own creative capacity; in this perspective, training programs can assume a relevant role. Shapiro (1985) see with restrictions this way, although recognize the importance of

training people; for him, each individual should have its own approach to develop its creativity, from ideal working conditions given by organizations (Terra, 2000).

In order to better understand the people who will be assessed for the vacancies, is useful for the project managers to know about the diferente forms of intelligence, as proposed by Gardner (1995) in terms of seven: logical-mathematical, linguistics, musical, spatial, intrapersonal, interpersonal and naturalist. Goleman (1999) in turn, focused him attention to the emotional dimension of intelligence, also called “emotional intelligence”, as the way people face with their emotions and the people around. Some individual aspects affected by emotional intelligence include self-conscience, motivation, persistence, empathy, social features and leadership (Goleman, 1999).

In relation to the intrinsic temperament of the individuals, some authors like Robbins and Finley (1997) and Robbins (2008) consider that, although be important, they are not decisive for the success of the team. For them, what really matters is the behaviour, and indicates the importance of investigate the candidate’s behaviours in past projects as an indicator.

Despite this, the temperament tests are very used by many team managers around the world, as one of the tools to better know the candidates. One of most known are the Myers & Briggs Type Indicator (MBTI) (Wicklein, Rojewski, 1995), a tool based on the Jung psychological types, that frames the personalities in terms of the people preferences of think and act, based on four dichotomies: extroversion-introversion (E-I), sensitive-intuitive (S-N), thinking-feeling (T-F) and judging-perceiving (J-P). The combination of these dichotomies result in 16 different personality profiles in which people can be framed.

Other tests are also used, as the Eysenck Personality Questionnaire (EPQ), a tool that frames the temperaments in terms of two polarities: introversion-extroversion and emotional stability-neuroticism.

The variety of personal profiles is pointed by Belbin (1993) as a relevant fator to success when forming teams. For him, the team must be formed considering the complementarity of roles, what allows a better balance between strong and weak points of the team. Belbin proposed that the ideal team demands three groups of roles, as follows:

- **Roles oriented to action:** Former, Implementer and Finisher;

- **Roles oriented to people:** Coordinator, Team worker and Resources-investigator;

- **Brain roles:** Evaluator-monitor and Specialist.

Belbin also defended the importance both of self-evaluation and evaluation by others as a way to improve the team as a whole.

In a later work, Kelley (2005) proposed a similar approach based on roles, but centered in the innovation process. This demands a confluence of competences to be carried out. According to Kelley (2005), these competences can be seen in terms of ten specific roles (personas) organized in three distinct categories, and who participate in the different moments of the process:

- **Learning roles:** Anthropologist, Experimenter and Cross-pollinator;

- **Organization roles:** Hurdler, Collaborator and Director;

- **Construction roles:** Experience Architect, Set Designer, Caregiver and Storyteller.

These roles seem to be useful to build up tools for the selection and training stages of R&D creative teams.

Motivation

The seminal study carried out by Mayo (1933) in a GE factory in the thirties pointed out the relevance of interaction, recognizing, approval and participation in the workplace, instead of the work conditions and economical rewards (DeMasi, 2003; Chiavenato, 1983). Ten years after, Maslow proposed that the human needs could be hierarchical, although not universal neither rigid, in the following order: physiological, safety, belonging and love (low level needs); esteem, self-realization, knowledge search and aesthetic needs (high level needs). For Maslow, motivation is a both internal and external phenomena, and it is up to the organization to create conditions to attend the human needs (Maslow, 1943). McClelland *et al.* (1955), for instance, proposed the human needs in organizations in terms of three types: realization, affiliation and power.

Based on the studies of Mayo and Maslow, Argyris (1957) and McGregor (1966; 1960) argued that there is in the organizations a constant

tension between two systems, the individual and the organization; in this situation, the individual aims to meet his needs and enlarge his self-determination, whereas the organization must contain these needs by means of rules. In this context, Argyris (*idem*) puts the possibility of self-realization as a strong factor of motivation, and points out that no work is more motivating than the creative team. McGregor (1966) for instance, proposed two forms of relationship between the organization and the person, called X Theory and Y Theory. In the first, there is no self-motivation, and work is seen with aversion by people, who consider it just a way to make money. In the second, people see the work as natural in the life, and they are creative, competent, responsible and naturally self-motivated for the work.

Herzberg (1959) identified two groups of influencing factors for motivation and satisfaction in the work: the “hygienic factors”, including payment, stability, prestige, environment and a capable leader, and the “motivating factors”, like correlation between vocation and well done job, recognizing, appreciation, compatible responsibility, possibility of professional and human growing. “Hygienic factors” does not motivate to work, but can diminish the motivation, whereas “motivating factors” can leverage it. Specifically about the creative groups, DeMasi (2003) identified that they tend to have higher levels of motivation than other groups, like executives.

Shapiro (1985) and Badawy (1988) proposed the following list of principles for R&D teams motivation:

- Encouraged behavior tend to be repeated;
- Positive reinforcement is more effective to motivate researchers than punishment;
- Motivation based on fear tends to generate ambiguity and uncertainty;
- There should be distinction between training need and motivation need;
- There should be clear and concrete explicitation of the desired performance;
- The researchers characteristics are distinct, and must be considered, including: time horizon is longer, the goal is the invention, not the sell; they are oriented to products, not to market, they tend to identify with peers more than the company;
- The main motivation systems for R&D professionals are related to task, including challenge aspects, creativity, imagination and flexibility;
- Adequate resources to carry out the activities.

These principles can serve as the basis for reward systems, as below.

Assessment, measuring and reward

Shapero (1985) and Badawy (1988) list the following characteristics for effective reward systems:

- Performance assessment is an important incentive;
- Reward must be immediate to the behavior desired to be repeated;
- Reward must be given as the researcher moves to the desired goal;
- The assessment of creative work must be multidimensional;
- One should avoid excessive emphasis on external rewards, as safety, salary and prestige, but on internal, as personal improvement opportunities and new challenges offering. The ideal is the combination of two;
- One of the evaluation criteria for R&D professionals must include the financial performance of the company;
- The division of activities for the R&D professionals in subactivities can favour their performance evaluation.

Attitudes and emotions

According to Robbins (2008), the team management includes the daily challenge of dealing with many aspects related to behaviours and attitudes of people, including:

- **Resistance to change:** Some people can be difficult to deal with changes, whereas others can enthusiastically adopt them. Flexibility, freedom and autonomy for the team members to organize and develop their work can be useful to diminish the resistance of the most reactive; clear communication about the change effects, involvement of the resistants in the decision-making process and rewards are also part of the solution of this problem.
- **Different levels of expectancy and involvement in relation to the work:** This aspect is related to individual differences about the need for self-realization, because some people find it in the work, but others in the art, education, social interaction, religion and so on. This is strongly related to the level of involvement and,

for instance, in the performance. To accept this fact is important for the leader, in other words, it is not mandatory to deliver stimulating challenges for all, but only for that who see the work as a place for self-realization. In the case of R&D teams, this is not a big problem, because creative groups usually have high levels of self-commitment (DeMasi, 2003). Despite the differences in the level of expectancy, it is important to establish a minimum level of involvement in order to achieve the goals defined in the beginning of the project, and this can be done by the definition of the minimum level of acceptable performance.

- **Different levels of performance:** Performance is usually strictly related to the involvement level, as well as to the excellence level of the team members. According to the Pareto's Principle, about 80% of the results are usually obtained by only 20% of the members, also known as "high performance collaborators". One significant aspect of these type of person is the frequent immersion, in the work, in a mental state called by Csicszentmihaly (1996) as "flow", characterized by a high concentration in the object which is being studied or developed. This seems to be common in the R&D activities.

- **Competitive instead of collaborative behavior:** Not all people want and know how to work in teams, and some of them are too much competitive to work with others, what does not mean that could not be useful for the project. If the leader delays with this situation, there are at least two options: relocating the individual to another function in which he can apply his talent for the benefit of the project, or disconnecting him, if it is not useful for the project and team.

- **The habit of create and nurture rumours:** One of the most dangerous risks for the team work is when one or more members use to create difficult situations by rumours, because this can affect the integration and confidence in the team. The leader must identify and neutralize as soon as possible any source of negative and false message, by means a transparent, clear and objective communication, and thereby avoiding a lot of conflicts.

- **The risk of "herd thinking":** This is a significant risk to creativity and innovation when working in teams, and specially in creative teams, but can be minimized if the leader use to listen everybody in the team impartially. Covey (2001) also suggests to discuss the risks

before the benefits when making decisions, and to choose a member to play the “devil’s advocate role” in the meetings; the “six thinking hats” of De Bono (2008) can also be used to stimulate different points of view.

- **Conflicts:** The behaviors and attitudes of team members and the leader can result in conflicts that must be managed by the leader. They can be seen in terms of two categories: functional conflicts, if present in a moderate level, which helps the team to grow, and dysfunctional conflicts, usually derived to relationship problems. This last demands a quick action by the leader, before the problem get out of hand. In fact, one of the most important functions of the leader is to manage the emotions of the team members, whar requires him a high level of emotional intelligence.

To deal with the behaviours and attitudes above, Robbins (2008) points out that is fundamental for the leader to lead by his own example, more than by words, and suggest that leaders should not manage sitting in his chairs; instead of this, the should be in frequent contact with the team and follow their activities, using the technique of “manage by walking around (MBWA)”.

Work conditions and resources

As firstly pointed by Mayo (1933) the existance of suitable workplace conditions can be less importante for the workers than social interaction, recognizing, approval and participation; Herzberg (1959) for instance, classified work conditions as “hygienic factors”, that does not motivate to work, but can diminish the motivation if get below acceptable levels.

De Masi (2003) identified that creative groups commonly used to convert their work environments in places stimulating to creativity, and, independently of the knowledge area, they usually had a high level of aesthetic sense.

This aspect is presently relevant in the studies of innovation teams, and can be quite favored by disciplines like human factors, interior design, lightning design and others.

Information and communication

Information is a crucial resource in the “knowledge society”, and the raw material for decision-making processes frequently present in innovation and R&D processes. Information management

includes the stages of research, selection, filtering and proper use, and requires appropriate systems and channels (Covey, 2001) as well as competences of team members and the leader to use it. Also, information influences the communication process, both inside the team and with external actors.

As pointed out before, team motivation, behavior and attitudes are also related to the quality of communication, both among the members and with the leader. The team is commonly composed by different people, with differences in terms of gender, culture, age, formation, congition, interaction and communication styles, and communication must be adapted to these differences (Robbins, 2008). These differences can produce noise in the communication, resulting sometimes in poor comprehension of the messages. Based on the Neurolinguistics Filtering Principles, Grindler and Bandler point out that people use elimination, distortion and generalization resources to filter the messages received, so it is important for the team members to understand these mechanisms in order to establish a more emphatic and effective communication.

In addition, Robbins (2008) argues that, specially for the leader, is important to provide constant feedback for the team members in the communication process, what can avoid surprises in the end of the project.

Combined with honesty and openness, empathy can allow a communication process based on listening to the other more than speaking, which also requires frequently enough time to listen (Covey, 2001). This act of listening everyone in the team should be extended to the external partners, and specially the client, as defended by Peters (1985) as a necessary condition for effective innovation.

Decision-making

Robbins and Finley (1997) consider that, despite the importance of decision-making processes in the team management, many leaders fail in this aspect. They explain that there are at least seven different decision-making styles that leaders should master:

- **Consensus:** All the team members can opine and should agree with the result. This method can lead to very innovative answers, but is time-consuming and requires high level of ability by the members.

- **Majority:** Decisions are made by voting, in

a democratic process. It requires less time than consensus, but some members can remain dissatisfied, what can difficult the implementation.

- **Minority:** When just some members are able to decide, the time is short or the decisions are not strategical, the decision is delegated to a subcommittee of a few members of the team.

- **By mediation:** Is based on negotiation, haggle and cheating, an usually the only satisfied at the end are the moderate. The most experienced opinions can be cancelled by the younger, and can lead to a weak commitment by the team.

- **By specialist:** Useful when the knowledge of a person is much more relevant to base the decision than the member teams, making the discussion irrelevant. Commitment of the team is null.

- **Authority domain without discussion:** The most authoritarian style of decision-making. Is useful when there is no time for discussion, the team hopes that the decision be made by the leader, or the team members are not able and well informed to decide.

- **Authority domain with discussion:** Also known as “participant decision-making”, is used when the final decision is responsibility of the leader, but supported by a discussion with the team. It demands both communication ability of the team and a leader willing to decide.

Robbins and Finley argues that there is no right or wrong style of deciding a question, but the important is that the team could choose, before the decision-making, what method will be used, because this can avoid many unnecessary conflicts (Robbins, Finley, 1997).

Creativity: selection vs. training

Quinn *et al.* (1996) advocate the use of training as a tool to promote creativity, as well as Parnes and Harding (1962), the precursors of this resource, but these last also state that creativity can not be taught, but only stimulated. Kelley and Caplan (1993) agree with the importance of training, based on studies carried out between 1986 and 1993, that pointed the preponderance of work strategies on psychological characteristics, including cognitive ones (measured by IQ tests). In opposition to the behaviourist theories,

and specially to Herbert Simon, about the possibility of changing individual characteristics and his judgement ability, decision-making process and risk assumption, Pitcher (1995) consider that people selection is more relevant than training. Despite this, most of researches about the use of creativity training seems to indicate de usefulness of this tool, so it is possible to infer that creativity training can be expanded also for innovation and R&D teams.

The team leadership

Historically, industrial revolution demanded a kind of leader with more authoritarian and centralizing features. But with the increase in the workers awareness about their own condition, organizations gradually started to search for new ways of interaction, and leadership began to have characteristics more focused on workers motivation. In this direction, Likert (1961) and Slater and Bennis (1964) proposed the “participative management” as an effective way to manage organizations using a more democratic management style, in opposition to the authoritarian style of the previous decades. Slater and Bennis (1964) already pointed in that decade a change in the leader profile, from a heroic role to another focused on the team work; he confirmed this perception in later years, based in a series of studies with north-american creative groups as Disney, Xerox, Apple and Lockheed (Bennis, 1999).

Presently, in the “knowledge society”, the intellectual capital of workers became central, and the role of the leader is, mostly, to search for new ways to take care of the team and its knowledge, and to make it more motivated and productive, na idea defended by authors like Levitt (1976), Mintzberg (1973) and Katz and Kahn (1978).

Characteristics of the leader

Base on a study carried out with European creative groups of the 1850-1950 period, De Masi (1999) identified that their leaders had the following characteristics:

- Almost heroic dedication to the project and team goals;
- Efficacy in creating the work environment with an uncommon atmosphere;
- Strong orientation to the task, to the group or for your own, with equivalent tensions;

- Charismatic and competent;
- Attention to preserve and nurture the memory and history of the team;
- Frequent acceptance and respect, and even eventual veneration by the group.

Bennis (1999), for instance, pointed out four common features in the “great groups” leaders:

- They offer orientation and meaning for the team members;
- They inspire and sustain confidence, enabling disagreement without compromising the work process;
- They tend to action and curiosity, and a natural disposition to risk of failure;
- They promote the hope for the group get over the difficulties, by using tangible and symbolic resources.

Independent of the time in which the groups were studied, the characteristics of leadership in creative groups seem to be the same, combining high levels of personal features, as empathy and charisma, with technical competences, depending on the area. It is also relevant to consider that the most suitable style of leadership for each team is strongly dependent on the cultural context in which the team is inserted, whether the organization or in the last instance, the society itself.

Roles of the leader

Levitt (1976) emphasizes, beyond the technical skills in management, the importance for the leader to domain personal and interpersonal competences, including way of acting, personality and work philosophy, which must be attuned with cultural and work standards of the organization, and also of people who he will work with. For Katz and Kahn (1978) is the performance and the way the leader deals with people and the situation what will determine or not his success. This performance depends on the leader abilities, that can be technical, human and conceptual.

The expectations of the organization about the leader also relevant to this performance, according to Mintzberg (1973) and manifest in the form of ten leader roles, organized in three categories: interpersonal (interaction and influence), informational (information management) and decisional (decision-making).

One of the “empowerment” precursors, Moss Kanter (1983) highlighted the importance of

leaders assume the role of “change masters”, considering the need for change for organizations survival. For this, she argues that the “change masters” should: focus the attention on the tasks and results, not in the procedures; organize and empower teams, giving them total responsibility for their participation in the end result; and create an environment that evidence the value of people involved in the project.

Senge (1990) for instance, shows the importance of building a learning organization in which the leader have the fundamental role of conduct the learning process. For this the leader must develop, in yourself and in others, the five learning competences also described in the section “R&D team as a learning organization”, what demands the assumption of three distinct roles: leader as designer (to design the organization guidelines, strategies and systems by integrating the learning disciplines); leader as guide (to guide the team in the cycle of thinking, doing, assessing and reflecting, always focused in a relevant goal collectively established); and leader as teacher (to help the team see the reality in a more systemic way, emphasizing the availability of creative resources and possibilities, instead of limitations).

Results

Team management

Based on a critical assessment of the literature, the first proposal for the team management model was built considering six stages (Figure 6):

- **Project planning:** This first phase is done basically by the manager(s) of the R&D project, and results in a document that contains the problem description and justification, goals and targets, motivations, risk and opportunity analysis, mission and vision statement, key partnerships and resources, team and roles characterization, tasks description, workflow, schedule, expected results, intellectual property and other legal issues, and communication and dissemination strategy. Tools like mindmaps, SMARTER targets, system maps, SWOT analysis, Balanced Scorecard are commonly used in this phase.

- **Team members selection:** Include two main aspects: recruitment and selection of the team members. In the first the requirements for the candidates are established, as well as the channels in which the opportunities will be of-

ferred; in the second, the recruited candidates are then selected, based on the roles, competences, intelligence types, personalities, creativity capacities and other personal characteristics defined as necessary for the team. For this, a lot of tools are used, as interviews, group dynamics, portfolio analysis and creative challenges, among others.

- **Team preparation:** Since the team members are chosen, it is necessary to prepare them for the activities, what include de definition of the team size and the distribution of functions, considering aspects as flexibility and heterogeneity, among others. Motivation is also a relevant topic in this phase, including special attention to the members needs, expectations and emotions, as well as their social integration, which affect the involvement, as pointed out in the literature. Considering the R&D process as a learning process, it is also important to provide activities and tools to improve learning competences in the team, including: common goal definition, collective learning, personal domain, mental models and systemic thinking. The tools for this phase can include workshops, group dynamics, training classes and the use of techniques to improve the dialogue and discussion, as well as others.

- **Conditions and resources:** The availability of conditions and resources for the team should include: information technologies, systems and channels that allow an effective and efficient flow of information along the team; financial resources that are enough to achieve the goals of the project; a work environment that is physically and psychologically healthy, safe and stimulating for the team; technical infrastructure, including equipment, softwares, library and other resources. Human factors, including both micro and macroergonomics provide valuable concepts, methods and tools that can be in this phase.

- **R&D process implementation:** Once the team is prepared, motivated and integrated, and the conditions and resources are made available, it is time to work. This phase is particularly demanding for the project manager, that can be able to lead the team in its communication, considering the different interaction styles and preferences of the members, and removing barriers for the clear and effective communication. The deliver of constant feedback to each member about his performance is also relevant to allow improvements during the process, and to prevent eventual surprises for him when the project is in the end. At the same time, an effec-

tive implementation demands to the leader must be always attentive to the attitudes and emotions of his team, being capable of manager the conflicts when they appear. This implies that some aspects must be carefully considered, as freedom of opinion, participation, autonomy, equity (win-win approach), empathy, synergy and respect for individualities. The reduction of bureaucracy to the minimum necessary and the technique of “manage by walking around (MBWA)”, can help to motivate the team and keep their focus on the project. The implementation also includes frequent decision-making moments, that must be closely monitored and, if necessary, oriented, and the team must be conscious of the most suitable type of decision-making for each moment. Beyond this, the management of creativity, both individual and collective, is crucial to redefine the project problems and to obtain creative answers for them. A lot of creative techniques are available for this, including the classical brainstorming sessions, the six thinking hats of DeBono, morphological box and many others.

- **Assessment, mensuration and reward:** Once the work is completed, the results should be evaluated and measured, for two reasons: first, to verify if the goals established in the beginning were really achieved and in what level, and second, to reward the teams and individuals according to their merit in the final results. If the aim is to appreciate and stimulate the collective efforts, more than the individuals, this phase must emphasize the use of measurement tools with this focus. The individual performance also can be evaluated, but aiming to reduce the “social inertia”, as pointed out by the literature. Finally, if the learning of the team is one important competence present in the phase of the preparation, this also must be evaluated at the end of the process; this can be done by using the 360 Degree Feedback, a tool whose function is to deliver to the team member relevant data for his personal improvement.

For each stage, it was identified a set of tools that can be used to operationalize it. Even if some of them seek to organize the results in terms of a number, these tools are basically qualitative in its essence.

In this model, is possible to note that the R&D process is positioned as one of the stages, in other words, the R&D process is contained in the team management model. This was a relevant finding in this study, because the author who conducted the active research initially supposed that was the R&D process that should include the team.

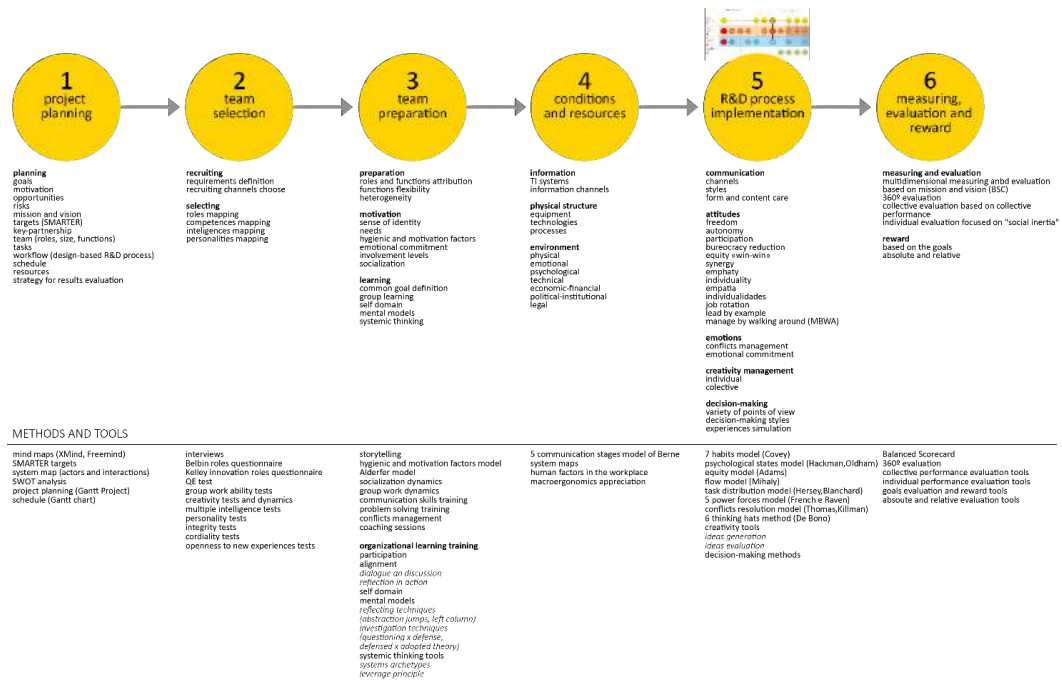


Figure 6 – Preliminary model for the team management

Source: authors' material

So, this finding seems to point to a team-based methodology or, ultimately, a methodology with a very humanistic approach, based on empathy, respect, consideration, dialogue and discussion, diversity and other human-based characteristics. These aspects found in the theory of creative groups are, not by chance, some of the fundamental aspects of the design thinking approach.

But another essential characteristic found on creative groups it was the primacy and relevance of the leadership (DeMasi, 2003; Bennis, 1999). So, this element should be also integrated in the team management model as a necessary condition for the success of the team.

As well as the R&D process model presented before, the R&D team model also can be considered as a pre-framework, if more details be added to the structure to allow its implementation.

Leadership management

The various characteristics, competences and functions of the leader in a creative team were organized in six distinct dimensions, that were the basis for the leadership model (Figure 7):

- **The leader as an individual:** The first

dimension of the leadership is dedicated to develop and/or improve individual characteristics related to self-knowing and self-improving that are important for the later action as a manager, as pointed in the literature. It includes self-conscious, self-confidence, integrity, responsibility and search for truth. The set of tools and methods that can be used in this dimension includes a variety of temperament tests, multiple intelligences tests, emotional intelligence tests and training, and also other non-usual techniques, like meditation.

- **The leader as a manager:** The management of the R&D team and process requires a distinct set of skills of the leader, including: organization, communication, autorregulation, intrinsic motivation, broad, clear and anticipatory view, persistence, perseverance, be attuned to the organization and creative-abductive thinking. The leader can use tools and techniques like self-questionnaires, checklists and tests, which can be build based on the theories of Belbin (1993), Kelley (2005), Mintzberg (1973), Moss Kanter (1983).

- **The leader and the people:** To act as manager, is essential for the leader to develop

and/or improve interpersonal competences, as communication, empathy, motivation, aggregating capacity, assertivity, genuine interest and appreciation for the people, recognition of their value, and the ability to lead by example. For this, the leader may use the sets of tools and techniques already presented in the team management model, and included in the phases of team preparation and R&D process implementation. The ability of manage conflicts and maintain the team integrated, motivated, nourished, aligned and focused are central in this leadership dimension.

• **The leader and the information:** If information is the raw material that feed the leader decisions, is important for the leader to develop competence in how to manage it. This include the stages of search, selection, filtering and proper use of information, that can be better conducted if the leader has at its disposal the right tools and techniques; to identify them is one of the next tasks in our investigation.

• **The leader and the decisions:** To make decisions is one of the most frequent tasks of the leader. This is an essential competence to manage teams and processes, and implies that the leader should know the various styles and processes of decision-making, and share them with his team. So, this dimension covers a set of decision-making tools and techniques that will be identified in the next stage of this study.

• **The leader and the learning:** R&D is seen, in this study, also as a learning process.

For instance, this requires the leader to develop specific competence in manage the team learning along the process. Based on the Senge (1990) proposal, the leader must assume three distinct roles of learning: designer, guide and teacher. Each of these roles can be developed and/or improved using proper tools and techniques. Some of them were already been identified in the literature, and integrated in the team management model, specifically in the stage 3 (team preparation) and 5 (R&D process implementation), others will be investigated in the next stage of this study.

Conclusions

This paper started from the identification of a relevant problem (synthetic textile waste) with environmental, economic and social implications, and findings about it, obtained in a Brazilian research project, which included the use of design thinking as both conceptual (using abductive reasoning) and operational approach to frame it. Design was applied here in an interdisciplinary way, combined with other knowledge areas, as Chemistry and business innovation. By means of active research, preliminary results (materials, products, patents, business models) obtained with the research team in that project indicated the utility of this proposal to deliver environmental, economic and user values.

These findings proved to be useful to develop a model for the R&D process, already presented by the authors in another paper, as part of a doctoral study by one of the authors, and it was the basis for the second stage of the study: the R&D team management.

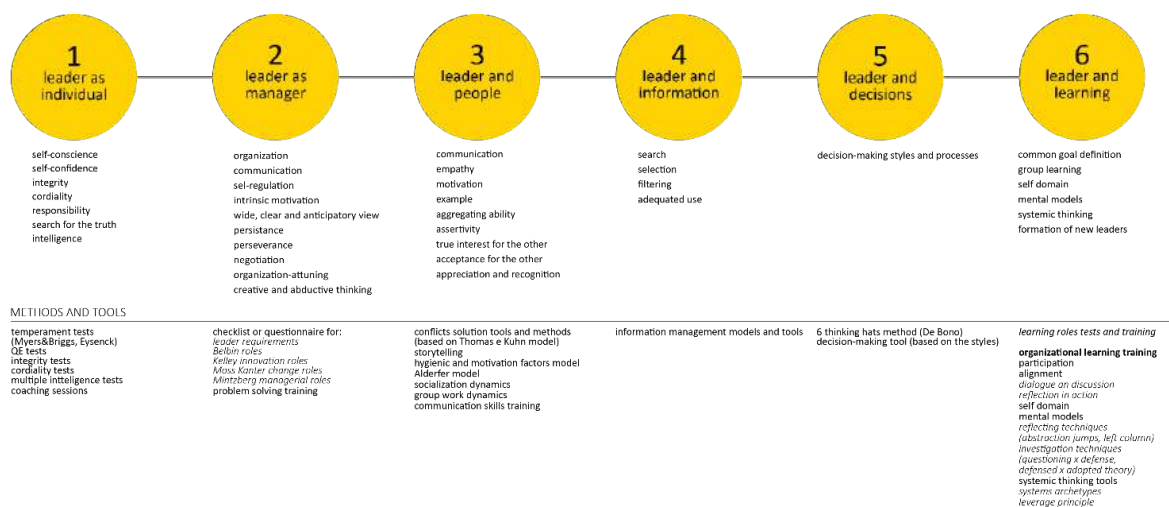


Figure 7 – Preliminary model for the R&D team leadership
Source: authors' material

About the R&D team, and based on the experience with the active research, it was possible to note that Brazilian R&D teams have their own peculiarities, due to a specific institutional and scientific context, which affects the way the research groups work. Allied to this, the literature critical review and the use of interviews allowed understanding the place and role of R&D teams in the knowledge society as a learning organization, as well as the relevance of creativity and the need of an adhocratic organizational structure. These aspects demands a high level of leadership and management, and the authors proposed here that they could be operationalized by means of an effective management model, including three elements: the process, the team and the leadership.

The results presented in this paper seems to indicate that the various aspects of team and leadership can be integrated in a model in a logical and comprehensive way. In fact, the aspects identified in the literature, active research and interviews are present both in the team and leadership management. It is possible to conclude that the integrated model is based on a humanistic approach (also present in design thinking), and strongly centered in leadership. However, in this model, the leader is not the end of the model, but the element whose function is mainly one: to make the team members innovate, improve and learn continuously. Thus, the leader in this model must assume, as main roles, to be he organizer, energizer and guide of the process.

After construction of R&D management model here presented, the next activities include the refinement of the proposed model, and its validation. Once the integrated model is composed of three distinct models (process, team and leadership), the next stage of validation will be for each one of them. Thus, the first validation step will be for the R&D process model, using two different research teams: a sample and a control one. The second validation step will be for the R&D team model, using the same teams configuration.

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(Un)Useful Architectures – An entrance for FA

Margarida Louro^a, Francisco Oliveira^a, Fernando Moreira da Silva^a

Abstract

This article was developed from the pedagogical experience carried out within the course (Un) Useful Architectures, lectured by teachers from Faculdade de Arquitetura (Fernando Moreira da Silva, Margarida Louro and Francisco Oliveira) during the 1st semester of the academic year 2014/2015. The central subject was the critical reflection on the concept of experimental architecture and its various assertions of ephemeral, reusable, transformable, adaptable, etc..., applied to practical contexts of specific intervention. Thus from the practical experience developed by several students, we reached to the present intervention, a critical reflection that focuses on the following key points: conceptual innovation and the scale of the (un)useful architectures; methodological, projective and constructive processes; analysis of case studies on larger scale: object/building/territory. It is intended to promote a reflection on innova-

tive construction solutions that will encourage effective response instruments to the multiple needs, experienced by contemporary cities, reusing materials, techniques or spaces. It is intended a transversal approach to different and training areas interconnecting themes of architecture, urbanism and design. The main objective is to explore new paradigms of architectural and urban quality under sustainable development, from an integrated understanding of the (un)usefulness on going in certain contexts and identifying and imposing rules of innovative and viable organization.

Keywords

Experimental Architecture, Ephemeral Architecture, Reusable Architecture, Transformable Architecture, Adaptable Architecture

So it was on this basis that it was designed the program of the exercise that was developed by five groups of students, having as statement the intervention and requalification of the entrance area of Faculdade de Arquitetura (FA) covering the outer space turned to Sá Nogueira street, and the area that accesses to building 2 – the court of the administrative building. Thus, from the emblematic idea of space and of its implicit feature of “entrance” in the building of FA, it was intended to take this interventional reflection as a new way of thinking, and appropriating this space enhancing it as “the entrance” in the building of the faculty. By promoting new approaches and new uses such as: seating/waiting areas; promotional media; support for large-scale areas (periods of registration, enrolment), etc..., this intervention was assumed to be a challenge on a pilot project-space. It proposed creative responses in terms of certain assumptions and functional arguments, associated with large utility spaces as social/meeting and ludic spaces and on the other hand, constructive

design using sustainable building premises such as recycling and reuse resources.

The five proposals are:

1. **FLUX AMONG FLUXES** developed by the students: Anna Sienzi, Andrea Ottaviani, Beatriz Bento

This intervention had as main starting point, the understanding of the needs of an input space that marks the entrance into which is the Faculty of Architecture, currently a public space, depersonalized, empty and anonymous. Thus, the intention of the project was to give a “new” entry to this space, making it more attractive, remarkable and useful. Thus it was intended to take advantage of a great feature of this space related to mobility, concurrency, and to the current flows, by building a path in the axial direction that marks the entrance at the Faculty of Architecture, and seeks to meet the space needs through a ephemeral building with a provisional

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character. This construction is based on an undulating shape a metal structure that builds the design of a flow that accompanies each person on his/her way through the space. All panels are based on that metal structure and its plans are filled with colourful wires or cables stretched between the iron bars. This system also provides a lighting infrastructure that during the night period allows more quality to space, to its users and to the urban surroundings. Since this is a place that is also inhabited during the early evening, it makes sense to turn it into a space with more light, more life and more energy. A place where the view of the city is extremely remarkable, especially for its lighting. So it is desirable to make the space of the Faculty into a place that even far away can be seen with the energy and the life that identifies it. It should also be noted that these panels are adaptable to a range of functions and can be removed from the space or adapted taking into account the needs of the different ti-

mes of the year. Turn entry into a new place, or especially in a place that is part of every day, an event, a playful moment or a space for new moments. Understanding the urban and architectural context of the surrounding of the Faculty of Architecture, made possible to create an object that is foreign to this universe but hopes to become part of this context and add to it all the design features with the purpose of a living space, showing that it could not be there but that makes all the difference when it passed to be.

2. **DINAMIC ATMOSPHERES** developed by the students: João Lopes, Pedro Cardia, Inês Ferreira

The starting point for this proposal was the intervention and rehabilitation of the zone situated in the west front of Architecture Faculty of the University of Lisbon, which contains three



Figure 1 - Flux among fluxes

Source: Anna Sienzi, Andrea Ottaviani, Beatriz Bento, 2015



Figure 2 - Dynamic atmospheres

Source: João Lopes, Pedro Cardia, Inês Ferreira, 2015

main entrances, entries that serve this space both to receiving students, as well as employees, teachers or guests.

As this is an area of reception of the school, it was assumed that it should have a careful treatment that enhanced the character and the image of the institution. It was intended to emphasize the identity of the arrival point, connecting all the west area from block 4, passing by the administrative area and reaching the area of the cafeteria through a discontinuous element that will contaminate the spaces as if it were a human being.

This element consists of a mobile infrastructure that can adapt to needs of different spaces, having in its basic constitution a metallic structure that will be wrapped with strips of ply which are embedded in the epoxy resin that will confer stiffness to the structure, creating a standard full/empty that will form different environments with a strong spatial role.

A kind of a raised "cloak" that may have multiple functionalities that can be covers, floors or seats.

3. **(IN) BOXES** developed by the students: M^a Leonor Freitas, Afonso José, Fábio Cabral, Cristina Paniagua

The initial premises of this intervention were raised from the idea of upgrading the entrance area of the architecture faculty, enhancing it as a "gateway" in the built set of the area. Thus, motivated by the idea of recycling and reuse of materials, the students elected a plastic fruit box made of high-density polyethylene (HDPE) as a working material, from which they designed their proposal. This configuration had as premises the search for a organic form, sustained in structural arches, that promotes a fluid space able to interconnect the different areas of the building set, and to promote spaces with different features of passing through or of staying. The chosen material can be perfectly adapted to the desired effect, due to the lightweight, robustness and abundance in nature. The use of this combination of materials, as well as an iconic and affirmative college entrance, allowed to the



Figure 3 - (In) boxes

Source: M. Leonor Freitas, Afonso José, Fábio Cabral, Cristina Paniagua, 2015



Figure 4 - The entrance
Source: Margarida Monteiro, 2015

creation of spaces able of interaction, socialization, that constitute a break with the daily college routine, not belonging to the interior, but not only from the outside, existing in a space shared between the two, creating a join between them.

Is conceived a unitary body, one continuous piece that moves the outer space of the college, contamination that begins at the entrance near the office - the main point - and spreads along the “streets” forming protected areas, sun and rain shelters and occasionally local seating areas.

4. THE ENTRANCE by the student: Margarida Monteiro

This proposal had as argument of the project, the creation of an “Arrival Square”, by setting up a geometric deck that is configured three-dimensionally, creating walkways, curbs, benches, sitting areas, etc... The main objective was to create an entry space that dilutes and distributes by the remaining buildings and college spaces.

Thus it sets up an axis that joins the two dimensions of access to the college (high elevation on the north side) and the lower level (the south side of the canteen). In these two extremes were assumed two entrances, and along the street bordering of the college it was created a transition access of lower level, combined with common leisure spaces where may even happen some events or activities.

Project assumptions also took into account sustainability and reuse. Thus, both the street furniture and flooring of the blocks would be made from the reuse of materials. The street furniture has a light inert core and concrete, in order to reduce the amount of concrete in the block, and hence its weight. Outside this core it would then have a concrete layer to supply con-

sistency. As for pavement blocks, blocks would be made from recycling inert construction and waste. Another important consideration is related to ground movements. An attempt was made along the idealization of the project touching lightly the ground and not requiring large land transport. The main idea is just to move it into the place of intervention in order to create a more controlled slope.

5. UNDER CONSTRUCTION by the students: Filipa Pimpão, Helena Simões

Under Construction is a performing action that occupies the entry space of the Faculty, through a set of modules that are grouped together and create spaces for moments of social relations. The concept is based on the reuse of structural scaffolds that can give rise to a variety of programs and events, such as workshops, meeting places, exhibition places of work, concerts, or to an information centre.

Under Construction is thus an architectural installation that transforms simple scaffolding boosted in a potential space. Easy to build, versatile, reliable and affordable, it is used a scaffolding type, covered by a translucent skin of metal. The perforated sheet metal used in scaffolding, acts as a support for information, artistic display, image projection screen, and also protects the solar incidence providing shelter. It is a visual and structural component that impresses with its dynamic and sense of lightness, an element that visually transforms the integrity of the scaffold.

Two uses:

MODEL MUSEUM creates a three-dimensional maze. The idea of the labyrinth is based

on the concept of exploring the environment around us through the concept of getting lost. Its complexity undergoes makes the user to become an integral part of the intervention experiencing actively the versatility and discovering and creating their own path through the various places of work and art exhibition, and its combination with the discovery of the surrounding space.

STAGE MODEL shows up with a simpler structure but with enough dynamism. Its “U” shape invites us to position ourselves as a centre of expectant that something amazing happens designed for school music and fashion events.

In summary, the proposals demonstrate the critical and creative capacity of intervention, based on the initial assumptions of (un)useless



Figure 5 - Under construction
Source: Filipa Pimpão, Helena Simões, 2015

architectures. Proposing new concepts focused on the formal, constructive and functional coherence, basic foundations of making architecture.

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