

Sustaining Historical City Centres through Urban Regeneration

Amira M. Elnokaly (B.Sc., MPhil, PhD)^{1*}, Ahmed B. Elseragy (B.Sc., M.Sc, PhD)², Sarah A. Al Saadani (B.Sc, M.Sc)²

^{1*} Senior Lecturer, Lincoln School of Architecture, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS, <http://www.lincoln.ac.uk/lsa>, aelnokaly@lincoln.ac.uk

² Associate Professor, Dean of International Network and Affairs, AASTMT, London International Office, 170-173 Piccadilly, W1J 9EJ, ahmed.elseragy@aast.edu

³ Assistant Lecturer; Architectural Engineering and Environmental Design Department, Arab Academy for Science, Technology and Maritime Transport, www.aast.edu, sarah_alsaadani@hotmail.com

Abstract

Historical city centres usually symbolise the origins of the city. While these areas are usually endowed with a multitude of historic buildings, they are also the areas that are most prone to the undesirable and consequential effects of growth and urbanisation, including overcrowding, air emissions and poor environmental quality.

Urban regeneration of historic city centres serves as a fundamental catalyst for change, improving environmental quality of the natural and built environments, and upgrading conditions in inner historic areas. This paper analyses strategies that have been used in the Core City of Barcelona, Spain, and A focuses on the strategies that have been used to upgrade the environmental quality of this historical centre as a case from which many lessons can be learnt, thus attempting at diminishing undesirable effects and improving the urban and environmental quality of its urban spaces for the well-being of citizens.

Introduction

In order to comprehend the nature of cities, it is essential to look back into history and identify their beginnings, growth, development and the multiple layers time has bestowed upon them. It is interesting to note how the historical quarters of the city tend to represent their origins. The beginnings of most world-famous cities, such as Alexandria, Egypt, Istanbul in Turkey and Barcelona in Spain, were originally constructed in the area that nowadays represents the historical beginnings of these cities. Over the centuries, the city's urban fabric began to articulate with respect to this historical centre, and urbanisation accordingly occurred in a peripheral direction, as depicted in the diagram in Figure 1 below.

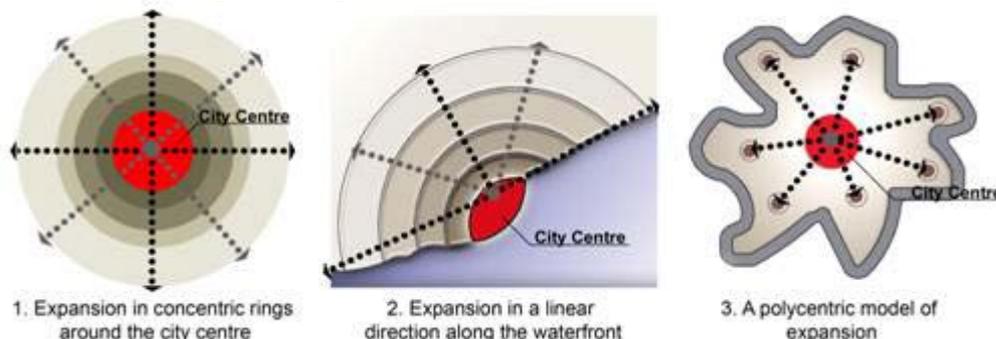


Figure 1. Diagram to show Urban Expansion that Radiates out from the City Centre, in a Concentric, Linear or Polycentric Direction.

Keywords:
Historical city centres,
Urban regeneration,
Environmental quality,
Core city of Barcelona,
Strategies and strategic plans.

Dr. Amira M. Elnokaly
(Lincoln School of Architecture, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS. / telephone / fax number / aelnokaly@lincoln.ac.uk)

The importance of historic centres is that they serve as a place of identity, memory and belonging (Carrion, 2005). Historic city centres tend to forge an urban identity for the rest of city, and for surrounding districts to adopt. In many cases, historic districts are representative of the entire city, the result of the outstanding multitude of historic buildings and heritage and archaeological sites, which manage to endure time, contradicting new functions and development that take place around them, at expeditious rates.

City centres usually tend to serve as the city's central business districts, or CBDs, as they are often referred to. This is owing to the high percentage of commercial functions, public buildings and offices that exist within. In this way, the city centre tends to both represent and reveal a great deal about the city's economic performance and success, thus adding notable eminence and value to it.

Challenges Facing Historical Centres

While historic centres are identitarian, core to the city both historically and geographically, they are also central to many challenges and obstacles. The explosion in urban population is partly to blame for this. In 2007, the world's urban population had exceeded its rural population, and by the year 2050, the world's urban population is expected to increase by up to 65% (UN-Habitat, 2006; UNESCO, 2008).

Historical city centres all over the world tend to witness a multitude of undesirable effects, the result of the overwhelming waves of rural migration taking place. Overcrowding and consequential unplanned growth have resulted in environmental degradation on a variety of scales. This is inclusive of localised environmental health problems, such as indoor air pollution and contamination of drinking water, and city-regional environmental problems such as ambient air pollution, inadequate waste management and resultant pollution of water-bodies such as rivers and lakes. This persistence and the overall laissez-faire attitude that is usually adopted by city administrations may contribute to pollution on a broader scale, and have extra-urban impacts such as ecological disruption, resource depletion, emissions of undesirable greenhouse gases and subsequent rise in anthropogenic heat in the ambient atmosphere.

Urban Regeneration as a Catalyst for Change

Urban regeneration and the conservation of historic city centres contribute largely towards upgrading environmental quality as the vast umbrella, thus serving as a fundamental catalyst for change. Development projects taking place in historic districts tends to attract a variety of economic activity and competition, therefore encouraging both new inhabitants and visitors to revisit and rediscover these restored vicinities of their cities. Moreover, upgrading the physical built environment, social fabric and urban spaces within the historical urban structure all contribute towards increasing their adoption as places for public congregation and activity. This consequently increases social interaction and cohesion between citizens. Furthermore, conservation and regeneration of historic city centres tends to re-affirm residents' feelings of identity and sense of belonging.

Furthermore, urban regeneration is often witnessed as an approach towards sustainability. According to Stren and Polese (2002), one of the main aims of sustainable urban policy is to *"bring people together, to weave parts of the city into a cohesive whole, and to increase accessibility (spatial and otherwise) to public services and employment (Stren and Polese, 2000)."* In addition, sustainable areas are those which are created to support sustainable living, with a prime focus being placed on economic, social and environmental sustainability (McDonld, Malys and Maliene, 2009). This is of distinguished importance in historic districts which tend to represent and symbolise a diverse set of ideals of the city's identity, including its history and culture on one hand, and its local economic viability on the other.

This paper aims at scrutinizing the city centre of the Mediterranean city of Barcelona, in Spain, which is also known as the Core City of Barcelona. The paper sheds light upon recent attempts that have been made at urban regeneration by the Barcelona City Council. The strategic plans that have been made for development of this core area are discussed further in this study.

The Core City of Barcelona, Background Information

The Core City of Barcelona is considered the central hub of the Metropolitan Region of Barcelona (MRB), the capital of Catalonia, in Spain (Domene and Sauri, 2006). As shown in Figure 2 below, the Core City of Barcelona is situated directly along the Mediterranean Sea. It is bounded by natural elements in several directions; the Collserola mountain ranges to the North and rivers Besos and Llobregat to the east and west respectively (Duarte, 2007).

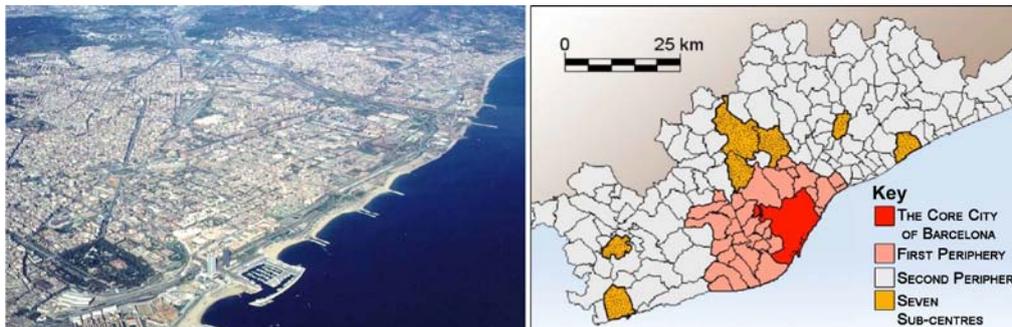


Figure 2. (Left) An Aerial View of the Core City of Barcelona's Mediterranean Location. (Right) Metropolitan rings surrounding the Core City.

Left: Photo Courtesy Ajuntament de Barcelona. Right: After: DOMENE, E., SAURI, D., 2006, p1608.

It is important to identify Barcelona as an historical city, whose urban structure has evolved over time, until it reached the present state. As depicted in the diagram shown in Figure 3 below, the city began as a medieval town bounded by the sea, with a series of peripheral villages around it.

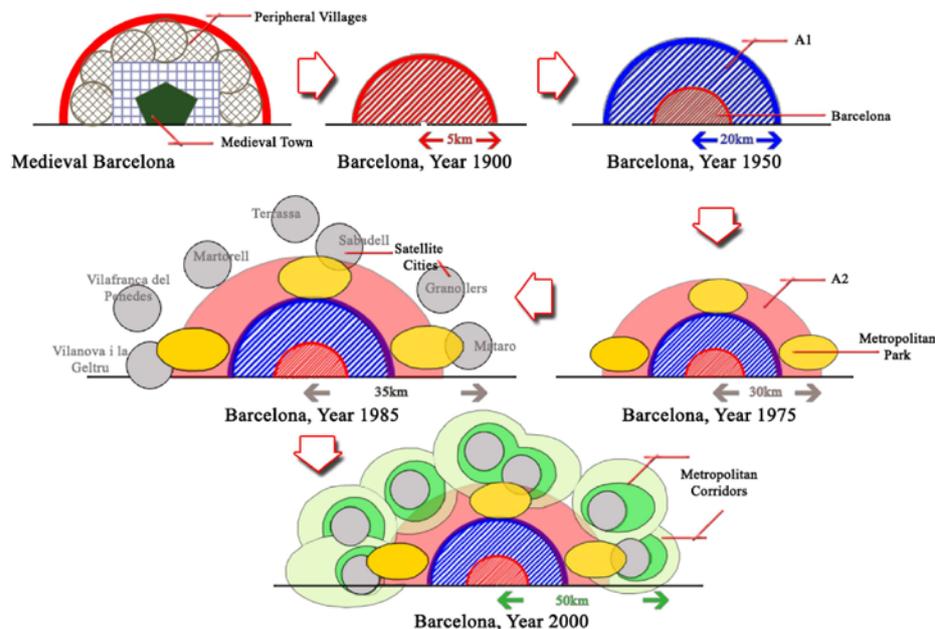


Figure 3. Evolution of Barcelona from a Medieval City to the Urban Metropolis Known Today. After: Muniz, I., Galindo, A., Garcia, M. A., 2003, p1310.

Throughout the 20th Century, however, notable development began to take place in a concentric direction, one which is highly characteristic of many cities in the Mediterranean region. This has consequentially resulted in the urban fabric found today; with the Core City at the centre, and seven metropolitan rings surrounding it. This Core City currently covers an area of 159.8km² (Asensio, 2002), and serves a population density of 366 people/ha (De Quijano, Gonzalez-Cabre and Munoz, 2002).

Urban Regeneration for the Improvement of the Ecological Performance of the Core City of Barcelona

A variety of strategies have been adopted by the Barcelona City Council, aiming at both urban regeneration and upgrading the ecological performance of the Core City of Barcelona, which is considered the city's historical centre. As part of the research conducted by the researchers looking at urban regeneration; environmental and ecological development conducted in some Mediterranean cities are classified under different strategies. These strategies can be classified under five main areas, as shown in the flow-chart in Figure 4 below.

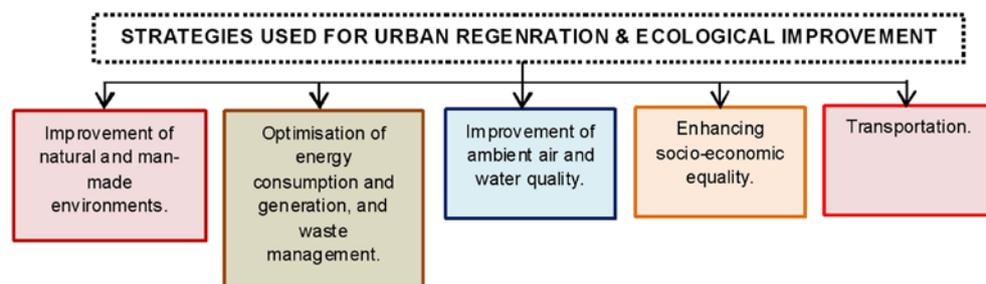


Figure 4. Strategies that may be used for Urban Regeneration and Upgrading the Ecological Performance of Chosen Districts of the City.

Improvement of Natural and Man-Made Environments

Significant growth in green areas has taken place between the years 1994 to 1998, as part of the Region's Strategic Plan to protect natural spaces and biodiversity, and increase the breathable areas of green spaces within the city (Ajuntament de Barcelona, 2004). The following table reveals increases in green spaces that have taken place between the years 1994 and 1998.

Table 1. Growth of the city's green areas between 1994 and 1998 in hectares (ha).

From: Estadistic de la Ciutat de Barcelona, 1994-1998.

	1994	1995	1996	1997	1998
Urban Green*	856.8	912.6	923.4	933.4	939.4
Trees Along Streets	84.1	79.0	79.8	81.0	82.4
Parks and Gardens	13.8	16.5	17.5	22.4	27.0
Total	961.0	1014.4	1027.0	1043.1	1055.1

Furthermore, being a Mediterranean city, the beaches of Barcelona are considered an integral part of the historical city of Barcelona. Thus, the beaches located within the Core City of Barcelona undergo regular checks, under the Integral Management Programme for the Barcelona Coastal Area that was set up in 2004. This programme incorporates measures such as sand and water analysis, ecological sifting of sand and collection and recycling of waste materials found both in nearby waters and on the beaches. Some of these measures are highlighted in Figure 5. Moreover, environmental audits and checks are performed to ensure that environmental laws are strictly enforced.

A large part of the city council's commitment towards sustainability, involves protection and improvement of public spaces within the Core City, as man-made elements integrated within both the natural environment and the built one. Public spaces in Barcelona follow a distinct style and tradition that date back to Cerda's planning (Mackay, 1985). The need for development of the Core City's public spaces was initially recognised during the 1980s, and improvement began prior to the 1992 Olympic Games, in an attempt to transform Barcelona into the "City of Public Space" (Sokoloff, 1990). Consequently, entire districts, such as La Vila Olimpica, were designed, and existing urban areas such as the Raval Rambla, were further developed. The Raval Rambla continues to stand as an important aspect of Barcelonian public space design, giving priority to pedestrian activity, providing a meeting point and enhancing social interaction between citizens and tourists alike.



Figure 5. Measures Taken Under the Integral Management Programme for the Barcelona Coastal Area.

After: http://w3.bcn.es/XMLServeis/XMLHomeLinkPI/0,4022,375670355_376776332_3,00.html, (Accessed 8th June, 2009.)

Historical Buildings along with the new, which are also an integral aspect of the built environment in the Core City of Barcelona, are strongly encouraged to function in an energy-efficient manner, as the city has a considerably high solar exposure. This Barcelona Solar Ordinance Law, explored in detail in the following section, dictates that a minimum of sixty percent of domestic hot water demand is covered by solar thermal energy, both in new buildings and in those undergoing heavy renovation (European Solar Thermal Industry Federation, 2007).

Energy and Waste Management

Implementation of renewable energy systems in Barcelona is strongly encouraged through Barcelona's Energy Improvement Plan (Boix, 2002). Barcelona is endowed with an abundance of solar energy, receiving 2,351 hours of sunshine per year, which translates into 1,470.1 kWh/m² of solar radiation per year (Boix, 2002). This was recently put into good use prior to the implementation of the Barcelona Solar Thermal Ordinance Law in the year 2000 (Ajuntament de Barcelona, 2006a). The graph shown in Figure 6 shows the increase in the total solar collector surface area both before and after the implementation of the aforementioned law. Alternatively, this increase in solar thermal collector surface area has potentially reduced carbon dioxide emissions by up to 4,300 tonnes/year (The Barcelona Energy Agency, 2008).

Increasing dependence on renewable energy technologies (RETs) is further reinforced by the Building Technical Code (CTE- Código Técnico de la Edificación) (ETAP 2006). This code demands reductions in the energy demand of individual buildings, as well as reductions in mechanical thermal facilities. Moreover, it encourages the installation

of energy-efficient lighting installations as well as contributions from solar powered systems and photovoltaic installations for electricity consumption.

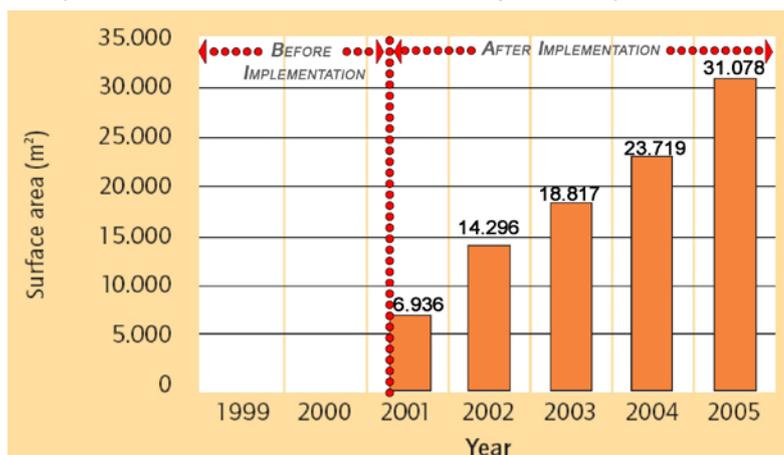


Figure 6. Evolution of the Solar Collector Surface Area After Implementation of the Solar Thermal Ordinance Law in August 2000.

After: The Barcelona Energy Agency, Ajuntament de Barcelona, 2006a, p6.

Waste, on the other hand, is managed through a pneumatic refuse collection system which was originally introduced in the Olympic Village for the 1992 Olympic Games (Carbonell, 2005). This system entails two main aspects; a fixed aspect and a mobile one. The fixed aspect is comprised of a series of interconnected underground tubes, where waste is initially disposed of through a suction system, before it is finally processed in central treatment plants (Sita and Ros Roca, 2005). The mobile aspect, on the other hand, involves lorries that feed rubbish into the suction system (Sita and Ros Roca, 2005). This is depicted in the diagram shown in Figure below. This system is advantageous in terms of visual impact, as well as reductions in potential contamination and pollution. Additionally, the installations also involve 'selective collection,' where each disposal point incorporates more than one opening for efficient waste segregation.

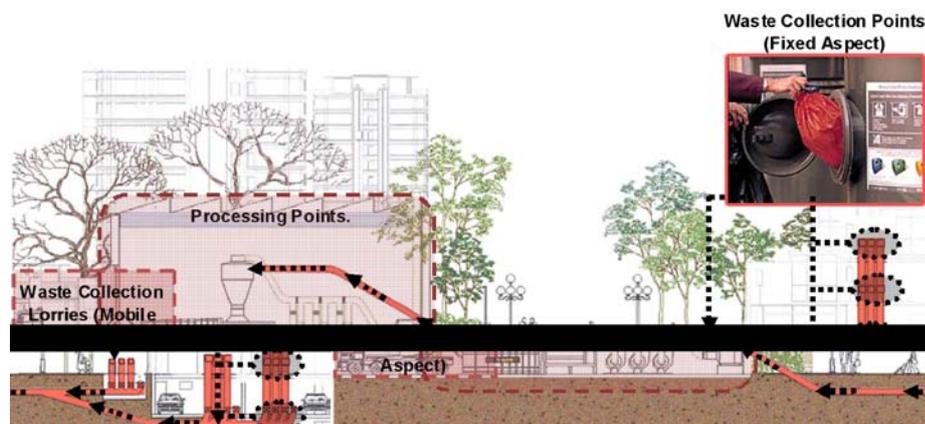


Figure 7. Diagram Showing the Network of Underground Tubes Serving the Pneumatic Waste Collection System in Barcelona, Connected to Processing Points.

After: SITA and ROS ROCA, 2005, p2.

Ambient Air and Water Quality

Similar to most urban centres, various pollutants can be found in the ambient air of the city. However, according to recent figures, levels of pollutants such as particulate matter (PM), nitrogen dioxide (NO₂), carbon dioxide and monoxide (CO₂ and CO), lead (Pb) and ozone (O₃) have not exceeded permissible levels (De Quijano, Gonzalez-Cabre and Munoz, 2002). However, the existence of particulate matter and ozone emissions within the ambient air have been found responsible for deaths, and there are suggestions that traffic is the main source of such pollutants (De Quijano, Gonzalez-Cabre and Munoz, 2002).

Being a coastal city, with the historical city centre located directly on the waterfront, the city's water quality is highly crucial. As previously mentioned, the quality of the city's beaches are carefully and regularly monitored. However, water scarcity has been found to be a problem in Barcelona (Cazurra, 2008). The city is supplied with water through reservoirs in the River Llobregat, by a transfer from the River Ter 100m to the north, and local aquifers (Cazurra, 2008; Domene, and Sauri, 2006). This has proved insufficient in the past, and drought alerts have been issued from 1995 to 2005 (Domene and Sauri, 2006). Moreover, water from the River Llobregat has found to have a high composition of elements that make it unhealthy to drink (Turiel-Fernandez et al., 2003).

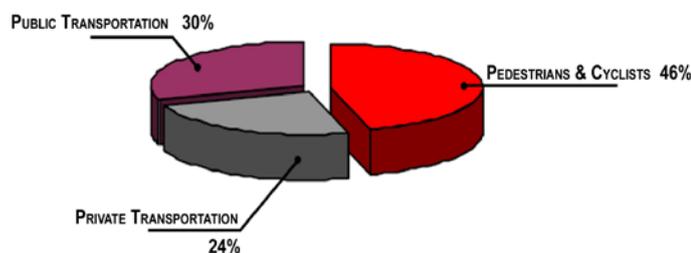
Enhancing Socio-Economic Equality

It is arguable that the success of Barcelona's economic activity and employment is related to the Olympic Games, which were held in Barcelona in 1992 (Millet, 1997; Trullen, 1997). The Olympic Games, as well as the urban transformation that took place to accommodate them, has benefitted the city in many ways. For example, the Olympic Village, located on the seafront, has helped provide a model of sustainable urban infrastructure and services that have been used in many areas of Barcelona. Apartment buildings constructed for the Games became quickly attractive to potential buyers later on. Easy accessibility to public facilities, health services and disabled mobility considerations may have been principal aspects that contributed to this. Urban infrastructure, such as the pneumatic waste collection network previously mentioned above has been followed as a model installed all over Barcelona.

Transportation

It is interesting to note that improvements in the area of transportation tend to generate progress in other areas related to ecological sustainability as well. The transportation sector is responsible for a large proportion of atmospheric emissions, namely carbon monoxide (CO), sulphur dioxide (SO₂), lead (Pb), particulate matter (PM₁₀) as well as others, all of which contribute to global warming. Consequently, reductions in motor traffic could lead to lowering the percentage of unwanted emissions into the atmosphere. Reductions in motorised traffic would also reduce the amount of already finite fossil fuels combusted for their energy.

Transportation is one of the key areas in which the Barcelona City Council has been striving to improve. One of the primary measures taken to improve transportation within the Core City is the Barcelona Mobility Pact, a "working tool," drawn up to encourage investment in the transportation sector and improve discipline on the roads (Ajuntament de Barcelona, 1999). The Ajuntament de Barcelona (1999) stated that its first goal is to, "achieve high quality, integrated public transport". As a result, the city's public transport network is inclusive of metro lines, rail lines, bus lines and tram lines. Moreover, 30% of the population depend on public transport, as depicted in the pie-chart shown in Figure 8.



In accordance with two of the Barcelona Mobility Pact's main aims, "to increase the surface area and quality of public areas...for pedestrian use," and "to promote the use of bicycles as a regular means of transport" (Ajuntament

de Barcelona, 1999), primary attention has been given to improving public spaces to accommodate for pedestrian activity, as well as increasing the percentage of cycling lanes. The following table reveals that, between the years 1990 and 2004, cycling

de Barcelona, 1999), primary attention has been given to improving public spaces to accommodate for pedestrian activity, as well as increasing the percentage of cycling lanes. The following table reveals that, between the years 1990 and 2004, cycling

de Barcelona, 1999), primary attention has been given to improving public spaces to accommodate for pedestrian activity, as well as increasing the percentage of cycling lanes. The following table reveals that, between the years 1990 and 2004, cycling

lanes within the Core City of Barcelona have gone from 7.3km to 124.4km. In the pie chart shown in figure 8, it is shown that nearly half of the population depends on the pedestrian and cycle lanes that has undergone enormous developments between 2003 and 2007.

Table 2. Evolution of Barcelona's cycle network and increase in length of cycle lanes.
EMTA, 2004. <http://spicycles.velo.info/Project/tabid/75/Default.aspx> Accessed August 3rd, 2008.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Cycle Paths (km)	7.3	7.3	21	21	31.4	57.7	59.4	72.2	92.8	108.6	110.2	116.1	119.1	121.7	124.4
Variation		0.0%	187.7%	0%	49.5%	83.8%	2.9%	21.5%	28.5%	17.0%	1.5%	5.4%	2.6%	2.2%	2.2%

Furthermore, the pact incorporates health and safety goals, such as, "promoting the use of less polluting fuels, and control(ing) air and noise pollution caused by traffic," "improve(ing) citizen's information and preparation, and improve(ing) road signals and signs" (Ajuntament de Barcelona, 1999). This is visible in the large amount of traffic signals and signage erected throughout the Core City.

Discussion

It is interesting to note that the Barcelona City Council has used several strategies to that have contributed towards urban regeneration of its historical city centre. This has solved problems that have resulted from overcrowding, pollution and environmental degradation, while preserving the Core City of Barcelona as an area whose unique identity serves as a place of memory, and forges an example for other parts of the city to follow. This is inclusive of governmental policies, strategic plans, energy-efficiency codes and laws that have recently been implemented and various City Council publications such as the Mobility Pact.

It is, however, important to note that the 1992 Olympic Games have had a significant background impact and played a strong role in improving both the city's infrastructure and local economy. Despite that, both architects and planners pay a detrimental and never-ending role in the formation of such governmental policies and strategic plans. Nevertheless, it is disappointing to see that such an important development issue and urban regeneration be left behind by governments to the last minute to be implemented for a football taking place or a huge sport gathering like the Olympic games/ World Cup. The outcome of which is often a massive investment at all levels.

Concomitantly, local awareness and ensuing public participation are important factors that contribute positively to the improvement and regeneration of any urban area. Moreover, allowing the public to have a say in the development that takes place within the city enhances their personal sense of belonging. All members of the community, often representing a range of socio-economic groups, are encouraged to contribute with their ideas. As a result, citizens are empowered, and each inhabitant begins to contribute, with what little part they can, in both decision-making and in safeguarding and maintaining the beauty of their city. In the case of the historic centre of Barcelona, the empowerment of its citizens and sense of belonging have had a detrimentally positive contribution towards the development and success of the urban regeneration of its Core City.

Conclusion

Urban regeneration of cities' historical centres indisputably adds notable value, eminence and physical integrity to the city, and promotes cultural heritage. Furthermore, urban regeneration can be considered a road towards sustainability, as urban regeneration often tackles many detrimental environmental problems, which have recently been considered characteristic of crowded city centres and urban environments.

The Metropolitan City of Barcelona is an example of an historic city, which originated as a humble medieval town and has expanded in a linear direction alongside the waterfront, achieving the metropolitan status it is known for today. What remains of this medieval town has been periodically transformed over time to become the Core City of Barcelona, its CBD and a popular tourist attraction. The 1992 Olympic Games held in Barcelona was one of the main driving forces that promoted urban regeneration of this historical city centre, and thus encouraged a push towards sustainability and an improvement of environmental conditions. However efficient this proved, it is still important to mention that it should never be left for spontaneous events (cultural) to initiate this type of good practice in urban regeneration of cities.

However, policies and systems that were originally intended for the Olympic Village were further spread to monitor wider areas of the Barcelona city, including its historical centre. Regeneration and beautification projects which aimed at increasing green areas within the Core City and transforming it into a '*city of public space*' (Sokoloff, 1990) have continued throughout the years, and are in constant focus. Moreover, the City Council has placed a prime focus on generating energy from renewable sources, namely solar energy and solar thermal energy, which is available in abundance in this Mediterranean Region. On the other hand, the City Council has also made considerable efforts in the area of transportation, setting a set of goals to reduce the harmful effects vehicular traffic are known to cause, and using a variety of strategies to achieve them. While it is arguable that sustainability has ultimately been achieved, serious efforts and attempts, through both large-scale and small-scale regeneration projects are continually being devised and implemented, to overcome undesirable environmental problems, and transform this historical centre into a sustainable section of the city to the largest possible extent.

References

- Ajuntament de Barcelona, 1999, *Mobility Pact Barcelona*, Barcelona City Council ed., Department of Public Way, Barcelona City Council, Barcelona, Spain.
- Ajuntament de Barcelona, 2004, *Barcelona Works towards Sustainability*, Barcelona, Spain. (Barcelona.)
- Ajuntament de Barcelona, 2006a, *The Barcelona Solar Ordinance, A Local Contribution to Global Sustainability*, Barcelona Energy Agency, Barcelona, Spain.
- Ajuntament de Barcelona, 2006b, *Indicadors Basics i Balanc de Mobilitat 2005*, Sector de Seguretat i Mobilitat, Barcelona.
- Asensio, J., 2002, "Transport Mode Choice by Commuters to Barcelona's CBD" *Urban Studies* 39(10): pp1881-1895.
- Boix, J., 2002, *The Barcelona Solar Ordinance, A Case Study About How the Impossible Became A Reality*, EUROSOLAR Spain: Johannesburg.
- Carbonell, J., 2005, *The Olympic Village, Ten Years On: Barcelona: The Legacy of the Games, 1992-2002.*, Centre d'Estudis Olímpics UAB, Barcelona.

- Carrion, F. M., 2005, "The Historical Centre as an Object of Desire," *City & Time* 11 (3).
- Cazurra, T., 2008, "Water Reuse of South Barcelona's Wastewater Reclamation Plant," *Desalination* 218 (2008): pp43-51.
- De Quijano, E. D., Gonzalez-Cabre, M. and Munoz, N. V., 2002, *Health Impact Assessment of Air Pollution. ENHIS-1 Project: W5 Health Impact Assessment Local City Report*, Public Health Agency of Barcelona, Barcelona, Spain.
- Domene, E. and Sauri, D., 2006, "Urbanisation and Water Consumption: Influencing Factors in the Metropolitan Region of Barcelona," *Urban Studies* 29 (9): pp1605-1623.
- Duarte, C. M., 2007, "Transforming Metropolitan Barcelona: Between the Post-industrial and the Knowledge City" *Sustainable Urban Areas International Conference*. June 25-28th, 2007, Rotterdam.
- ETAP. 2006, "Spain's New Building Energy Standards Place the Country Among the Leaders in Solar Energy in Europe," Webpage, (accessed March 24th, 2008), available at <http://ec.europa.eu/environment/etap>.
- European Solar Thermal Industry Federation, 2007, *Best Practice Regulations for Solar Thermal*. European Solar Thermal Industry Federation, Bruxelles.
- Mackay, D., 1985, *Modern Architecture in Barcelona (1854-1939)*, The Anglo-Catalan Society, University of Sheffield.
- McDonald, S., Malys, N. and Maliene, V., 2009, "Urban Regeneration for Sustainable Communities: A Case Study," *Technological and Economic Development of Economy, Baltic Journal on Sustainability*, 15 (1): pp49-59.
- Millet, L., 1997, "Olympic Villages After the Games," in *Olympic Villages: A Hundred Years of Urban Planning and Shared Experiences: International Symposium on Olympic Villages*, Eds. De Morgas, M., Llines, M. and Kidd, B., International Olympic Committee, Lausanne.
- SITA and ROS ROCA, 2005, *Pneumatic Collection of Domestic Waste: Innovating for the Environment*.
- Sokoloff, B., 1990, "Public Spaces and the Reconstruction of the City," *Arch. & Comfort/Arch. Behav.* 6 (4): pp339- 356.
- Stren, R. and Polese, M., 2000, *The Social Sustainability of Cities: Diversity and the Management of Change*, Toronto University Press, Toronto.
- The Barcelona Energy Agency, Webpage, (accessed March 25th, 2008). Available at <http://www.barcelonaenergia.cat/eng/observatory/bcnenergy8.htm>.
- Trullen, J., 1997, "Barcelona as a Flexible City. Industrial Mix, Firm Size and Industrial Localization in a Polinuclear Metropolis," *European Network on Industrial Policy (EUNIP) International Conference "Rethinking Industrial Policy in Europe," October 3rd, 1997, Barcelona*.
- Turiel-Fernandez J. L, Gimeno, D., Rodriguez, J. J., Carnicero, M., and Valero, F., 2003, "Spatial and Seasonal Variations of Water Quality in Mediterranean Catchment: The Llobregat River (NE Spain)," *Environmental Geochemistry and Health* 25 (1): pp435-474.
- UN-Habitat, 2006, *The State of the World's Cities 2006/07: the Millenium Development Goals and Urban Sustainability*. London, UK: Earthscan Ltd.
- UNESCO , WHO , CIGF and Space Group, 2008, *Historic Districts for All: A Social and Human Approach for Sustainable Revitalization*.