

AMERICAN UNIVERSITY OF BEIRUT

INCORPORATING SUSTAINABILITY THINKING INTO
EXISTING LONG-TERM MASTER PLANS FOR THE
DEVELOPMENT OF MEGAPROJECTS: THE BEIRUT
CENTRAL DISTRICT CASE

by
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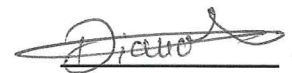
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AN ABSTRACT OF THE THESIS OF

Diana Jamal Mokhallati for Master of Engineering
Major: Engineering Management

Title: Incorporating Sustainability Thinking Into Existing Long-Term Master Plans for the Development of Megaprojects: The Beirut Central District Case.

The world's scientists have been under increasing pressure to establish the most efficient and innovative solutions to prolong the lifespan of all its depleting natural resources and thus enduring the survival of life on the face of planet earth. A sustainable strategy is now defined to have to address environmental concerns balanced with social and economic factors. This study takes a closer look at master plans because they affect more directly the three pillars of sustainable development. In fact this thesis attempts to propose a template for how to include sustainability thinking into existing long term master plans while developing each sustainable development pillar along with defining each criterion crucial to achieving this goal. This thesis then validates the proposed template by using the master plan of the Beirut Central District as case study to explore how the template can be utilized and how mitigations can thus be formulated.

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*To Abdul Rahman,
Dayana and Omar*

CHAPTER 1

INTRODUCTION

For the last 30 years now the world's scientists have been under increasing pressure to establish the most efficient and innovative solutions to prolong the lifespan of all its depleting natural resources and thus enduring the survival of life on the face of planet earth. The term Sustainable development was in fact first introduced in 1987 by Gro Harlem Brundtland in the report later known as "the Brundtland report" which targets mainly three fields: economic, social and environmental. Satisfying the needs of this triple bottom line will help reaching sustainable goals to the utmost efficiency. A sustainable strategy for any project should address environmental concerns balanced with social and economic factors. For this study, taking a closer look at master plans rather than buildings will exemplify far more the targets of sustainable development because it will address more clearly and at an equal scale the three fields.

1.1. Introduction

Long term master plans are problematic in this case because as we advance in our studies, research and findings, solutions are redefined. Updated efficient reactions to current problems become more available and the more the solutions change the more outdated the initial design is revealed to be. Here lies the issue of how we can adapt a current existing master plan to new updated sustainable solutions and maybe one day create a master plan that is flexible enough to always have the leeway to ease and facilitate this adaptation.

Sustainability involves the consideration of a more comprehensive approach.

What is intended is to create an overall environment that will enhance the living conditions for the community living within it while maintaining its natural resources for the generations to come.

Economically, the master plan should create and provide job opportunities needed for the design and construction of the project, improve business opportunities by providing the required services (mini markets, bakeries, pharmacies, etc.) for the workers, implement cost efficient construction methods due to reduced cost of transport and Reduce time required for building (compared to other methods of construction). Socially it should create “good” living environments that will cater to community needs, locate leisure / recreation areas at walking distance to help improve health physical ability and create an environment to encourage social integration and avoid conflicts and confrontation. The Environmental dimension is addressed at the site scale targeting energy, water, transport, wind, landscape, construction and waste.

The concept of “means and ends” was articulated by Daly (1973) to describe how natural capital is related to human wellbeing. The goal of a sustainable society is to produce the greatest possible ends with the least possible means with the Ultimate purpose in mind: wellbeing. A more diagrammatic illustration of these relationships can be seen below in Figure 1.1.

One of the critical roles being played in achieving the above goals is the Architect/Engineer (A/E). The A/E plays a vital role in creating such strategies and s/he must have the end-users benefit in mind before anything else. The A/E should assume the role of the “honest broker” participating in open decision processes while involving non-experts (stakeholders) to participate in the decision making. Futowicz and Ravetz said explained it more clearly when they explained that “Humans have attained the unprecedented capacity to modify the natural environment on a global scale and with

this capacity comes the need for a new type of responsibility” (Futowicz and Ravetz 1999).

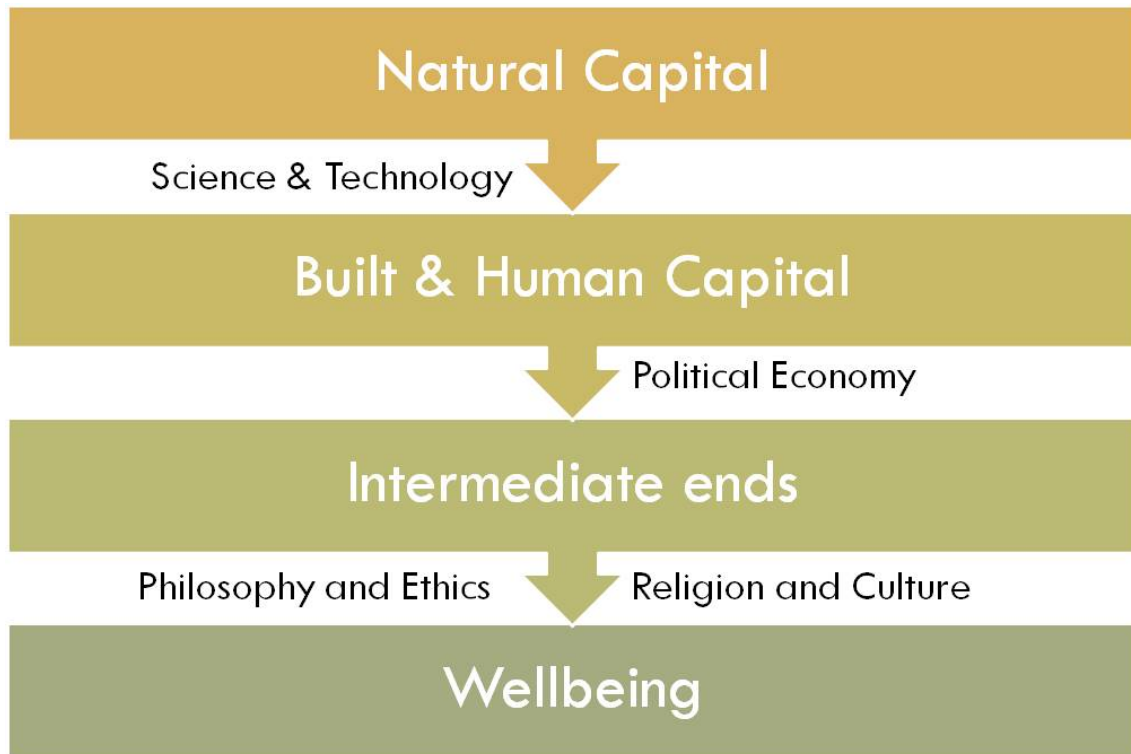


Fig.1.1. From Capital to Wellbeing

Technological actions of scientists and engineers are a necessary but not sufficient condition to progress toward ultimate wellbeing. Stakeholders’ benefit can only be defined after identifying the cultural social community needs and attributes which differ from one geographical location to another (Carew and Mitchell 2002). And thus comes the necessity to define the role of the A/E as “Honest Broker” more elaborately developed by Green in 2002: “The honest broker is an expert who investigates and describes a range of technical options of the realization of a desired service within the broad contextual constraints of the problem setting”. It calls on the expert to withhold judgment and reflect on, question, critique the fundamental

assumptions and values which inform their day to day practice. The A/E should define the values and perspectives and priorities (rather than an elegant technical or economical design alone) which will determine the eventual decision.

Framing the problem (part of the decision process) should include envisioning the problem in terms of service provision as opposed to the design, operations and maintenance. It is also a very critical part of the process to come up with the most efficient solutions and modifying the nature of the process as Green states “from selling products to producing services”. In our time, engineering practice appears to be largely unexamined and tends towards a business model indicating a lack of reflection and a lack of alignment between theory and theory in use (Green 2002).

In fact, sustainable standards nowadays are being developed by many entities to define and globalize the idea of sustainable development. LEED, BREEAM, QSAS, ISTIDAMA among others all aim to standardize different aspects of construction so that projects be it on a building scale or on a city scale can rate themselves and evaluate how efficient and sustainable they are. But is this process of standardization the best solution out there to be adopted? Can these standards be used in all locations or should each case in each region be treated differently according to different norms and attributes?

1.2. The Context and Problem Statement

In order to test the template for sustainability thinking proposed in this thesis, taking on an existing case study was an essential part of the study to explore the functionality and efficiency of this new wished-for way of assessment. The Beirut Central District (B.C.D) makes the ideal case example for it being half way through its phase of completion with another 20 years to go before it is assumed to be completed.

Before the civil war, the B.C.D. was a transportation hub, the center for

government cultural entertainment and economic activities and a real common neutral space for all Lebanese. After a very destructive civil war that had started in 1975, SOLIDERE (Société Libanaise pour le Development Et la Reconstruction du Centre de Beyrouth) initiated a different plan and vision for the area. According to its annual report, Solidere was given a 25-year lifespan; the company's duration was extended by decree in 2005 to 35 years from the date of registration, May 10, 1994, in Lebanon's commercial Registry.

The entity (Solidere) defines itself as supervisory body and lead developer controlling the pace, main components and quality of development in BCD, whether implemented directly by itself, third party developers or joint venture (Solidere Annual Report 2010).

The company's primary role was to restore and maintain the city's historic buildings as well as lay the foundations to attract third party property developments to the region. But after 18 years of existence, a very controversial outcome has become of the heart of Beirut; where Solidere claims in its report in 2010 to have "enhanced the city's intrinsic qualities through sound urban planning and by creating new infrastructure and landscaped spaces, attracting investors, visitors and residents", it is quite evident that it has also created a bubble catering for a specific social class of the community with its own needs, values and attributes that may not include nor portray Lebanese society as a whole.

Be that as it may, this thesis is not here to criticize or point out the politics behind such an initiative but rather to acknowledge and identify clearly this community, what are its characteristics and its needs and what are the strategies an entity can adopt after a thorough review of different sustainable strategies to help make this master plan that was created with no initial sustainable initiatives in mind, carry out a long term goal

to help reach its own triple bottom line.

1.3. Methodology

The methodology followed in this research involves:

- Reviewing the literature behind sustainable standards exercised on buildings and master plans which target the triple bottom line. Typically the global standards currently followed by the mainstream: LEED, BREEAM, QSAS among others.

- Visiting current sustainable strategies being undertaken in different cities and long term master plans.

- Identifying the key criteria to be targeted after a thorough analysis of all existing standards and henceforth identifying what an ideal sustainable master plan should include.

- Formulating the Template for Sustainability thinking

- Introducing the case of Downtown Beirut using public data and through interviews:

- Its history, the initial master plan, design intent and different land use assigned to each type of land,

- Analyzing how flexible the design is and what are the changes that happened through time to reach its current status,

- Identifying current future intents and visions in the years to come, and

- Identifying how it is currently serving its community on a social and economical level.

- Assessing the BCD masterplan sustainability status using the proposed template.

- Investigating ways through which the different sustainable strategies developed above (in 1-2-3) can be applied in the case of Beirut downtown tackling mainly the triple bottom line of sustainable development (social- economical and environmental).

This whole process which will lead to the conclusion of this thesis can be more summarized in Figure 1.2 seen below.

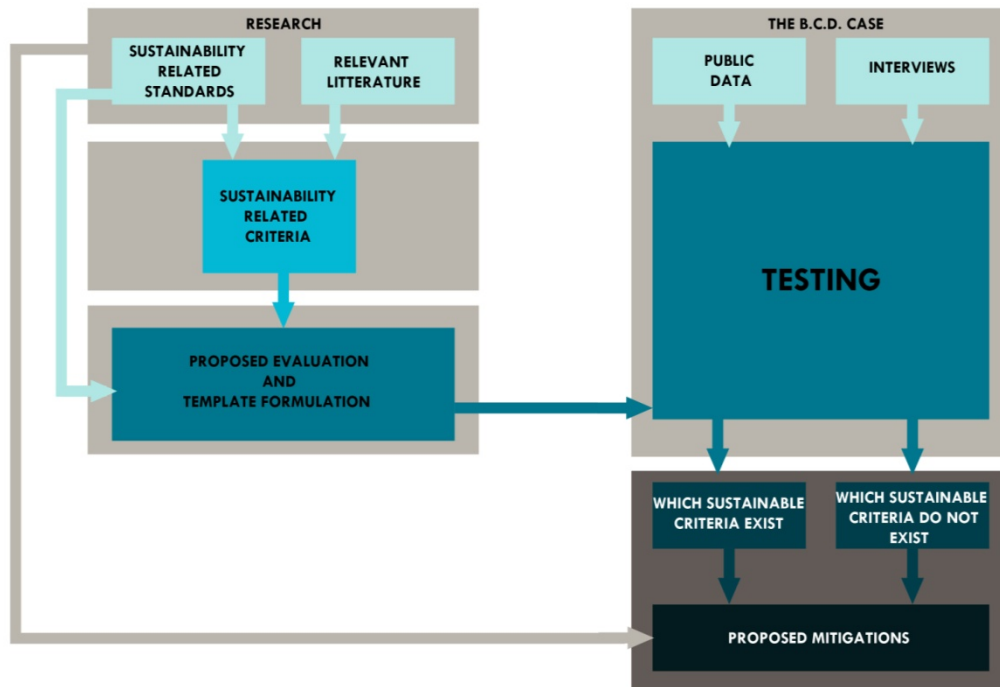


Fig.1.2. Methodology

CHAPTER 2

LITERATURE REVIEW

As explained in first chapter of this thesis, a thorough literature review of sustainability is needed to start exploring what it is and which aspects it addresses and impacts. Brundtland defines sustainable development most clearly in her report in 1987 by stating that "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". With that said the review of the literature that has been done on the topic starts by first analyzing the different definitions and understandings of the term "sustainable development" and second by tackling its three pillars: environment, economy and society.

2.1. Defining Sustainable Development

2.1.1. Historical Background

As per Azapagic, Perdan and Clift (2004) the concept of sustainable development as we know it today emerged in the 1980s as a response to the destructive social and environmental effects prevailing the approach to "economic growth". Several definitions emerged to determine what it really means. UNEP (United Nations environmental program) along with the world wildlife fund (WWF) and the international union for the conservation of nature and natural resources initially defined sustainable development as follows: "For development to be sustainable it must take account of social and ecological factors as well as economic ones, of the living and non-living resource base and of the long term as well as the short term advantages and

disadvantages of alternative actions.”

Based on the above, three priorities are highlighted: the maintenance of ecological processes, sustainable use of resources and the maintenance of genetic diversity. Sustainable development was later defined after the publication of “Our common future”, otherwise known as the Brundtland report in 1987, following the World commission on environment and development (WCED) whose main breakthrough is the global realization that the future of humanity is threatened. A clear description of the state of our world today was developed in the following statement taken from the report: “The earth is one but the world is not. We all depend on one biosphere for sustaining our lives. Yet each community, each country, strives for survival and prosperity with little regard for its impacts on others. Some consume the earth’s resources at a rate that would leave little for future generations. Others, many more in number, consume far too little and live with prospects of hunger, disease and early death”. With this introduction, the most famous definition arises clarifying that sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own. In this context, it is evident that the two major milestone events, that set the foundations for everything addressing sustainable development, are the issuing of the Brundtland report and the 1992 Earth Summit.

2.1.2. The Brundtland Report

Four basic conditions arise as a result of the Brundtland report:

- Accounting for the needs of current and future generations
- Reducing the exploitation of depleting natural resources
- Accepting intergenerational justice

- Adopting an integrated attitude towards development and natural environment (Plachciak 2010).

The main importance of the report lies in the fact that it clearly defines sustainable development while highlighting the environment as international governance as well as initiates work on development and sustainable practice.

In “Sustainable development in a post Brundtland world” (Sneddon, Howarth and Norgaard 2006) the authors illustrate the challenge between implementation and the need for development in developing countries. The challenge for developing countries lies in achieving firstly their priority: surviving economically (before worrying about social and environmental factors).

2.1.3. Principles of the Rio Summit

In the Rio 1992 United Nations conference on environment and development, otherwise famously known as the EARTH Summit, 27 principles were set:

- Humans are the center.
- Human beings have sovereign right to explore their own resources.
- Developmental and environmental needs of present and future generations.
- Environment protection is an integral part and shall not be considered in isolation.
- Eradicating poverty as an indispensable requirement and meeting the needs of the majority of the people of the world.
- Priority to least developed countries.
- Conserve and restore the health and integrity of earth’s ecosystem.
- Reduce and eliminate unsustainable patterns of production and consumption.

- Improving scientific understanding through exchange of knowledge.
- Participation of all concerned citizens.
- Develop appropriate and adapted environmental standards relevant to each climatic region. “Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.”
- Cooperate to promote an economic system that would lead to economic growth and sustainable development in all countries.
- Liability and compensation for the victims of pollution.
- Prevent relocation and transfer of any activities and substances that cause severe environmental degradation.
- Environmental approach shall be applied according to country capability.
- Polluters should bear the cost of pollution.
- Use of environmental impact assessment.
- Notification of states of any emergency or natural disasters.
- States shall provide prior and timely notification and relevant information to potentially affected states.
- Empower role of women in environmental management.
- Youth creativity should be mobilized to forge a global partnership.
- Indigenous people and other local communities have a vital role.
- Protection of the environment where people are under oppression, domination and occupation.
- Warfare is destructive. Protection of environment in times of war and armed conflict and co-operate in its further development.

- “Peace, development and environmental protection are interdependent and indivisible”.

- Resolution shall be done peacefully and by appropriate means.

- States shall cooperate in good faith.

Also signed in the earth summit were the framework convention on climate change, convention on biological diversity, forest principles and one of the pillars of sustainable development: AGENDA 21. In this context different aspects addressing the economy, society and community as well as the environment were clear to be the primary criteria to be tackled in order to obtain a sound basis for sustainable development. The means of implementing the developed principles are science and financing, education, international law/organizing for sustainable development. Whereas the groups with significant roles and whose involvement is vital in the implementation process are women, children/youth, indigenous people, non-governmental groups, local authorities, workers and trade unions, business/industry/science and technologists and farmers.

The summit’s socioeconomic goals are to combat poverty while changing consumption patterns, address population and sustainability while protecting and promoting human health, and finally, create more sustainable human settlements. The main purpose of this initiative and its resulting principles is the management of earth’s resources, be it protecting the atmosphere, managing land sustainability, combating deforestation and drought, sustainable mountain development along with enhancing agricultural/rural, biodiversity/biotechnology and minimizing waste (Azapagic, Perdan and Clift 2004).

2.1.4. Different Approaches to Deal with Sustainable Development

The concept of development is a never ending evolving concept that can be redefined according to era and community needs. Internationalization of environmental policies has been the key factor in encouraging sustainable thinking on a global scale however as Lafferty and Meadowcroft put it, “global trade, signified most pointedly by the power of the World Trade Organization, now serves as a locus for disputes over environment and development, a move that in effect de-prioritizes the environment as a focus of serious political action” (Sneddon, Howarth and Norgaard 2006). Dryzek explains it best when he says in 1999 that “Sustainable development’s function in the international system is to provide a conceptual meeting place for many actors and a shared set of assumptions for their communication and joint action”.

Some critics have elaborated on how sustainable development is a propaganda aiming to market the needs of underdeveloped communities for the sake of the green development of more industrialized nations (Escobar 1995; Sachs 1999; Fernando 2003). Richardson explains that the Brundtland report is a “sham” and a “political fudge”. According to him, it is very anthropocentric and will never be able to bridge and integrate economy and profit with social and human needs. As elaborated in Figure 2.1 hereafter, three approaches have been developed to deal with sustainable development: ecological economics, political ecology and development as freedom (Sneddon, Howarth and Norgaard 2006).

Given the main definition of sustainable development, one must acknowledge the fact that we do not only need to plan for the present need and cater for its users but should account for the future generations as well. However, as per Brandon in his article “sustainable development: ignorance is fatal- what don’t we know?” (2012), even the best assessment methods so far such as LEED and BREEAM although serve the

purpose of making our current societies sustainable, they “may not contain the values we need for the future”. He further continues to say “wrong short-term decisions now may make inter-generational justice impossible”. The process of change is at the essence of sustainable development especially taking in consideration the above mentioned.

Ecological economics	Political ecology	Development as freedom
Critique of neoclassical economic arguments (e.g., “development as growth” model)	Radical critique of global political economy and its ecological effects	“Internal” critique of development theory
Incorporation of ecological concerns into economic methodologies and theory	Sensitivity to structural forces impeding sustainability transformations; attention to discourse and power	Prioritization of political rights, basic human needs, economic opportunities and equity over aggregate economic output in development thinking
Concern with intergenerational equity, ‘degrees’ of sustainability, valuation	Incorporation of ecological concerns into critical social theory	Normative: human well-being; expansion of individual rights; maintain focus on development but with radical reorientation
Normative: ecological and social sustainability; environmental and social ethics; reform of existing institutions	Normative: social justice, equity and ecological integrity; radical changes necessary in existing institutions	

Fig.2.1. Approaches to Sustainable Development

Source: Chris Sneddon, Richard B. Howarth and Richard B. Norgaard. 2006. “Sustainable development in a post-Brundtland world”. *Ecological Economics* 57(2006): 253–268.

With that in mind, it is essential now to explore the many aspects that define the three pillars of sustainable development starting with the most globally addressed topic: the environment

2.2. The Environment

As deduced from the previously mentioned definitions the environment is one of the most recurring fields mentioned that needs to be addressed to be able to have a sound basis for sustainable development. It naturally includes several aspects that an entity should tackle in order to start ameliorating its sustainability status. In the

following, those same aspects are defined and explored and more clearly explained as to how they can affect the sustainable status of a project be it a building or a masterplan.

2.2.1. Related Aspects

2.2.1.1. Energy

Energy is the harnessing of forces of nature to do work for us other than the force of man/animal. With the development of industry energy became more cost effective and more widely used. Value of life is improving tremendously with our capability of harnessing nature's resources. The use of fossil fuels (gas, oil, petroleum) has been largely the cause of global warming. But thanks to much scientific research there have been many developments in the alternative energy resources field to be able to fuel our lifestyles and deliver our daily needs. These mainly revolve around using the sun and the wind, among other techniques as will be described below.

Fossil fuel alternatives fall under two types: nuclear and biofuel, the latter being available more abundantly because it is based on agriculture. However Nuclear power does have its drawbacks because it needs expertise, produces radioactive waste, and causes political tensions due to the creation of nuclear weapons.

One must take note that the energy sources that have been proven not to cause any Greenhouse gas emissions are solar, wind, hydro, biomass, tidal and geothermal. Following are some more elaborated examples of those resources:

- *Combined Heat and Power (CHP):*

District heating (DH) has been very beneficial in energy saving. It reduces CO₂ emissions and can provide its community with high quality heat at competitive prices. DH is usually produces using large CHP plants which are gas fired combined cycle plants using natural gas, biomass, waste or biogas (Omer 2012).

- *Wind Energy:*

Since the oil crisis in the 1970s wind energy has gained more popularity because it is non-depleting and non-polluting. In fact as per Omer, “wind power could supply 12% of global electricity demand by 2020, according to a report by the European Wind energy Association and Greenpeace.”

- *Hydraulic Energy:*

Water has been used as a source of energy ever since the days of Mesopotamia and ancient Egypt. There are different techniques to generate energy from water like storing a certain amount with a dam and different forms of hydraulic energy among which are ocean thermal energy, tidal-wave power.

- *Air Quality:*

It can be addressed at three scales, the regional, the local and the building level. Regional level, solution would be to implement regulations to reduce the acid emitting technologies and comply with international treaties where countries can be held accountable for their damaging effects on the environment. On a local level many solutions are applicable like carpooling, encouraging public transportation, enhancing pedestrian zones, use of shields around construction sites among others. On a building scale improving indoor air circulation using natural ventilation has been proven to be very sustainable and does not cause any harm to the air quality of the community the building is located in.

The innovative and final aim is to have energy autonomy for each sustainable community. It is to be able to function on its own without depending on a centralized energy source. Moving away from the “historically dominant large scale centralized energy supply models” towards a more distributed one where energy is provided and consumed by the same community (Rae and Bradley 2012).

The energy self-sufficient system can help a community become “autonomous” following these criteria:

- it must be capable of producing sufficient quantities of energy so as to meet the demand;
- it should provide energy storage to account for the temporal mismatch between demand and supply
- it must be able to operate on a ‘stand-alone’ or ‘off-grid’ basis. The system may be grid-connected, but crucially it should be capable of functioning independently (Rae and Bradley 2012).

2.2.1.2. Waste Management

Evaluation of environmental performances of products and processes are facilitated by the application of Life Cycle Assessment technique (LCA) (Blengini *et al.* 2012). LCA is a technique to recognize all the stages of a products life. Also known as “from cradle to grave”, LCA is the main driving assessment tool when it comes to waste management. And the three pillars of sustainable development are being addressed; a participatory process contributes towards defining acceptable solutions for all involved stakeholders.

Defining several aspects can help facilitate the process of waste management:

- Identification and description of the scenarios to be compared: amount of waste, composition, definition of technologies/strategies;
- Definition of the case-specific LCA methodological assumptions: system boundaries;
- Data collection, sources and responsibilities: mass balances, energy consumption and emissions for all the waste management subsystems; and

- Selection of energy and environmental indicators.

Waste management regulations aim to simultaneously achieve several objectives (Fischer, 2011). Such objectives include:

- diverting waste from landfills in order to improve the use of resources and reducing environmental impacts (EEA, 2009)
- Introduction of quantitative targets on recycling of selected waste materials from households and the construction sector (Snell and Hurst, 2009; Fischer and Davidson, 2010).
- Other common objectives are implementation of producer responsibility for packaging waste and the electrical and electronic equipment reduction of waste (Cahill et al., 2011) and methane emissions mitigation through separate organic waste treatment and reutilization (Marmo, 2008; Curtis et al., 2009).

Based on a study done on municipal solid waste management in the region of Castellon de la plana (Spain) (Bovea *et al.* 2010) several steps were taken to proceed with an effective process:

- *Definition of scope*

As illustrated in the diagram in Figure 2.2 scope involves the use of raw materials, energy and water which then get treated transported and then classified to be then reused and emitted as airborne, solid, waterborne emissions along with the remaining residuals.

- *Life cycle inventory includes:*
 - Precollection
 - Collection and transport
 - Pretreatment
 - Treatments

–Landfill

- *Assessment of the impacts of the life cycle*

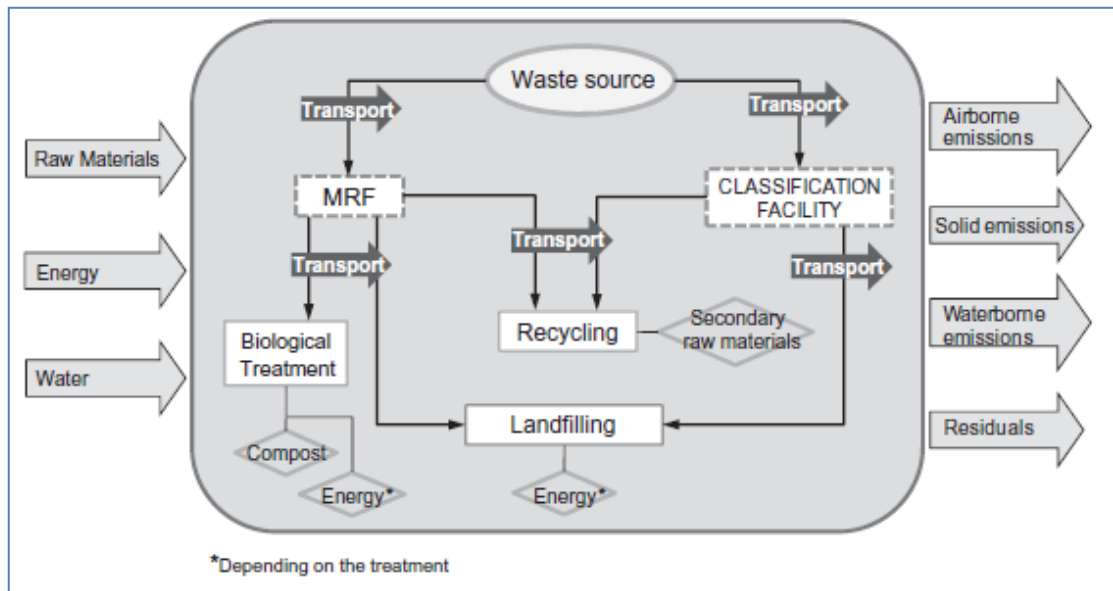


Fig.2.2. Scope of Solid Waste Management

Source: M.D. Bovea, V. Ibanez-Forés, A. Gallardo, and F.J. Colomer-Mendoza. (2010). “Environmental assessment of alternative municipal solid waste management strategies: A Spanish Case Study”. *Waste Management* 30: 2383–2395.

In addition to the scope above, there are several categories of informal waste collectors who also play a role in waste management as seen in the case study done in Spain depending on where recycling activities take place and what activities are involved (Sembiring and Nitivattananon 2010). These informal collectors include:

- Street waste pickers;
- Temporary storage site scavengers who pick up recyclable materials from temporary storage sites;
- Landfill site scavengers who collect recyclable materials from final disposal sites;

- Domestic servants/maids who collect recyclable materials from households, then sell them;
- Itinerant waste buyers who buy recyclable materials door to door;
- Municipal waste collection crews who segregate waste and sell to scrap dealers;
- Small scrap dealers who buy the recyclable materials directly from scavengers or itinerants;
- Small/large-scale enterprises who buy recyclable materials from scrap dealers; and
- Intermediates who usually connect large-scale enterprises with manufacturers.

Off course from the above it is recognized that some participants are very location specific and would not be available similarly in all cities. However the above list gives us a wide perspective of the importance of informal waste collectors to the waste management process in cities.

2.2.1.3. Sustainable Construction Materials

According to Pacheco-Torgal and Labincho, we use 60 billion tons of materials per year. Construction industry is the one major industry abusing the most of the raw materials available on the planet. In this context, in September 2000, the Millennium development goals (MDGs) were set and signed by 189 UN member states.

According to meadows in 1972, if our patterns of consumption of renewable resourced remain as they are, the earth's capacity would be exhausted during the 21st century which would end human civilization as we know it. Rio summit in 1992 reconfirmed the above written while in fact going further into proving that we have

already crossed some limits.

It is important to note that the threat highlighted by the consumption of such a large quantity of material is not only the depletion of the renewable resources being consumed but rather how they are being extracted causing many damages mainly deforestation and loss of top soil. Construction industry consumes about 3000 million tons per year of material and It is still growing at a fast pace. In the next five years many countries are investing trillions of dollars to develop their infrastructures like the United States, China and India. The 7th MDG declaration states: “prudence must be shown in the management of all living species and natural resources in accordance with the precepts of sustainable development”. It includes many actions among which the Kyoto protocol must be respected, forest protection, biodiversity maintenance stop exploitation of water resources and intensify cooperation to reduce manmade disasters.

Eco-efficiency firstly employed and defined in the 1991 world business council for sustainable development is: “The development of products and services at competitive prices that meet the needs of human kind with quality of life while progressively reducing their environmental impact and consumption of raw materials throughout their life cycle to a level compatible with the capacity of the planet”. Evidently, part of being eco-efficient is implementing construction and demolition waste recycling. It is clear that along with its environmental benefits, it is also cost effective to practice such a strategy.

Part of eco-efficient strategies is also enhancing Nanotechnology which affects infrastructure materials among others. According to the European emission in 1981, nano science and nano technology is “the manipulation, precision placement, measurement modeling or manufacture of sub 100nm scale matter”.

As per Mitail Roco the senior advisor for nanotechnology to the NSF “early

payoffs will come in electronics, IT, medicine and health”. But nanotechnology can also benefit heavily the construction industry. Concrete as we know affects climate change because of its main ingredient portland cement. The latter generates 80% of the total CO2 emissions which in fact are 6-7% of our planets total emissions.

Nanotechnology can help in “greening” concrete by modifying and enhancing its mechanical properties and also its durability. In fact increasing durability of concrete from 50 to 500 years would have a great positive environmental impact. In addition according to Hegger “the increase in compressive strength’ in concrete would result in 50% less use of reinforced steel.

Use of nano particles also can benefit the service life of asphalt binder pavements. Nanoclay modifications would increase the stiffness and ageing resistance while also decreasing the moisture damage potential of asphalt mixtures. Other materials can also be improved using nanotechnology like high performance thermal insulators and silica nanogel relevant to the construction of highly energy efficient windows.

2.2.2. Courses of Action

2.2.2.1. Environmental Management

When addressing the environment, it is clear and essential to address the life cycle of all elements affecting it. That life cycle assessment is in fact also known as “cradle to grave” or “end of pipe consideration”.

Given that we occupy one planet our limited natural resources belong to one closed system (the globe) we receive solar energy and we radiate back that energy into space. The environmental burden here lies in assessing and being aware of how much energy and material are going into a certain product and how much energy contributing

to emission and waste.

Many international standards have been initiated to address this concern among which is ISO14000 (environment management standards. In fact rio summit highly recommended ISO14000 which was then requested by the business council for sustainable development.

Many steps can be taken when it comes to environmental management:

- Inventory of environmental aspects related to the company operations
 - Determine the hotspots (critical areas that need immediate attention and action)
 - Define percentage to be reduced
 - Define time frame
- List of all legal and related obligations
- Define status at start of operation
- Define scope and conditions
- Formulate policy and state target
 - Provide resources
 - Follow up
 - Monitor how things are going
 - Report and assess

Steps for the company's management system can also include:

- Establish an environmental management system
- Inventory and legal obligation
- Define scope and objectives
- Provide resources and training
- Assign responsibilities

- Establish a communication procedure
- Documentation system to be defined and applied
- Procedure to deal with emergencies
- Regular review and assessment
- Determine non-conformities and set procedures to deal with them
- Monitoring and reporting
- Internal audit

The above listed procedures can of course be enhanced using technology to organize the different data assembled and make it easier for the entity to take action as soon as possible and as efficiently as possible. In this context, new approaches to managing cities using technology are now being explored otherwise known now as SMART cities.

2.2.2.2. SMART Cities

Another leading sustainable initiative is “Smart city” initiated by IBM and transforming traditional cities into a hub of electronics collecting data and managing its resources at the most efficient level. In fact, it’s Smart Energy Grids add a layer of digital intelligence to traditional grid systems. These smart grids use sensors, meters, digital controls and analytic tools to automate, monitor and control the two-way flow of energy across operations—from power plant to plug. Smart Buildings with the ability to collect analyze and sort building data. In other words, they are smart buildings should not just be considered as data sources they are also considered as potential sources of co-generation power plants, reservoirs for water, even roof top farms. Smarter transportation means better systems for rail, air, public transit and freight. These can improve cities, economy and daily lives. In a smarter transportation system, travelers

and freight customers are empowered with information and tools to determine for themselves the best way to move from origin to destination, throughout all modes of transportation, with due consideration to cost, time, convenience and environmental impact. The world needs a smarter way to think about its resources and sensor networks, smart metering and advanced computing and analytics can ensure the efficient flow of those resources throughout the year.

“Present day redundancies have created tremendous inefficiencies, ballooning costs and silos of resources. Smart education technology”—analytics, early warning systems to identify at-risk students, cloud computing—can help our systems refresh outdated infrastructures with new functionality. They can become more interconnected, instrumented and intelligent.

In addition, while there is an increasing recognition that online social interactions cannot replace physical interactions, our public realm (from public space to social spaces like bars or cafes) don't seem to be adapted to our new way of meeting, sharing and collaborating. Architects and Urban designers are increasingly required to embrace a new palette of skills which integrate new technologies and digital services into the built environment and intern enable the lifestyle changes which are emerging. Cities around the world are currently in a state of transition as they seek to evolve in tune with the changing dynamics of urban culture. The way in which people work, rest, socialize, consume, interact and communicate has significantly altered in the past decade and is consequentially challenging the use and function of our cites. Other targeted initiatives are Smart Security and Safety, Smart Public Services, Smart Food, Smart Business, Smart Retail.

Smart cities and buildings should answer to the social needs and agendas. Even though technology alone can provide very efficient solutions they might as well be

rejected by society if the solution no matter how reliable it is, does not conform to its understanding and values. That's why here comes another essential non-technological and stakeholder oriented aspect that can be implemented and practiced at minimal cost: sustainable circulation.

2.2.2.3. Sustainable Circulation

Professor John Pucher, in his lecture entitled “Promoting Cycling and Walking for Sustainable Cities: Lessons from Europe and North America” given at the Harvard graduate school of design in October 2012 discusses how in fact walking and cycling are THE most sustainable modes yet to be used because they do satisfy the requirements of sustainable development:

- *Environmentally*: no pollution is created and no renewable resources are needed.
- *Socially*: financially affordable and physically possible to be used by all citizens except the physically disabled.
- *Economically*: minimal private and public cost, might take more time but increases healthy exercise which in turn decreases medical costs and increases health life expectancy.

Many ways to promote walking and cycling in cities:

- Use of specific material on the road to make it more bike friendly and less vehicle friendly
- Limit parking spaces and restrict motor vehicle use.
- Provide benches and walking spaces
- Create “shared streets” whereby streets are both pedestrian and vehicular but priority is given to the pedestrians

- Provide better cycling and walking facilities
- Introduce traffic calming strategies
 - *Policy measure*: Limit Speed per hour can also be limited to 30km/hour
 - Infrastructure measures:
 - Road narrowing;
 - Raised intersection and crosswalks;
 - Design traffic circles;
 - Implement speed bumps;
 - Introduce mid-block closures and artificial dead ends; and
 - Widen sidewalk and bicycle lanes.
- Traffic education for children whereby kids learn as the necessity and benefits of sustainable modes of transportations and get used to this healthy new lifestyle.
- Traffic regulation and enforcement of special lights organizing pedestrian, biking movements as well as vehicular circulation.

In conclusion, all of the above strategies can only start being implemented gradually and by stages starting with promotional events keeping the citizen informed and participating in the decision process. The main goal is to publicize health benefits of such a strategy and gain the vote of the government and its politicians so that some of the policies can be approved and made legal.

2.2.2.4. Use of Environmental Standards

Many standards have been developed to take on the challenge of making design and construction more sustainable and environmentally friendly. Taking a closer

look at one of the leading international standards will help us understand how such a process functions and affects the world we live in.

- *LEED*

LEED can be otherwise defined as a metric to assess how “green” a building and –or group of buildings are. Several degrees of sustainability can be reached according to the standards LEED sets: Certified being the lowest, Silver, Gold and Platinum being the highest level to be attained. Points are divided into subcategories which tackle different aspects of the environment: sustainable sites. Water efficiency energy and atmosphere, materials and resource, indoor environmental quality, innovation and design process and regional priority. Turner (2010) However all elements to be measured are based on a PRE-construction prediction and design specification. In fact post construction data has no effect and does not in any way affect the award the building will get by LEED. As stated by Turner (2010) “LEED rating is based entirely on its compliance to design standards not its actual performance”.

Cofounded in 1993 by David Gottfried a real estate developer and Mike Italiano an environmental lawyer and analyst, the USGBC (united stated green building council) was created. The aim was mainly to link business to the environment. As stated by its founding chairman Richard Fedrizzi “the great majority of environmental organizations had invested in keeping companies on the other side of the fence. David Gottfried thought we could do things differently.” It aimed mainly to transform the marketplace into a sustainability driven market.

Instead of leading with the environmental incentive, the essence of its marketing strategy was to lead with the business case as per its CEO Fedrizzi. As mentioned by Kamenetz (2007): “The business case isn't just that green building saves money on energy. It's that LEED certification sells buildings to high-end clients and

governments, gets architects and builders sparkling free publicity, and creates a hook for selling new products, materials, and systems to builders. It's a whole new commercial ecosystem.”

“The USGBC has managed to “Oprah-ize” the field of green building, making it “understandable – even sexy – to the masses”. Randy Udall and Auden Schendler²⁰⁰⁵ But this over simplification of standards made it a double edged sword to be targeted by critics and that’s why to strengthen their creditability “*Ensuring the Sustainability of Sustainable Design: What Designers Need to Know about LEED*” was issued by engineers Stein and Reiss.

Problem with encouraging the business side of it with a credit point strategy is that candidates and architects and engineers begin to “shop for points” with little regard to the main objective making the building sustainable taking in consideration what is really affective in their region and just worrying about scoring higher and getting the award necessary. LEED is evidently based on design for construction and not implementation of construction (Turner 2010).

We're concerned that LEED has become costly, slow, brutal, confusing, and unwieldy, a death march for applicants administered by a soviet-style bureaucracy that makes green building more difficult than it needs to be, yet has everyone genuflecting at the door to prove their credentials. The result: mediocre "green" buildings where certification, not environmental responsibility, is the primary goal ... and a discouraged cadre of professionals who want to build green, but can't afford to certify their buildings (Udall and Schendler 2005).

In the above expressed in 2005 by Randy Udall and Auden Schendler “LEED is broken let’s fix it” a clear attempt to justify why totally motivating people just based on a business initiative was becoming at the expense of the sustainable target (Turner 2010). Financially LEED also overstates its advantages which are hard to quantify be it increased worker productivity and reduced absenteeism. All implementations do not

impact first costs and on the contrary increase the cost of materials. Turner (2010)

The third and most updated LEED Version 3.0 published in April 2009 (until 2013) includes regional priority credits which give more importance to credits relevant to the area the project is being designed for. This update was implemented mainly to encourage designers to keep in mind how important their site location is and to find out what would really make their project the most sustainable. Turner (2010)

LEED ratings are achieved at four different levels (*Certified, Silver, Gold and Platinum*) and can now be applied under several types:

- LEED for New Construction & Major Renovations (NC)
- LEED for Schools New Construction & Major Renovations
- LEED for Core & Shell (CS)
- LEED for Commercial Interiors (CI)
- LEED for Healthcare (HC)
- LEED for Retail: New Construction (Retail-NC) or Commercial

Interiors (Retail-CI)

- LEED for Neighborhood Development
- LEED for Existing Buildings: Operations & Maintenance
- LEED for Homes

Credits within LEED categories are selected by the team in areas of: Sites, Location and Linkages, Water, Energy, Materials, Indoor Environmental Quality, Innovation.

LEED is only one of many standards developed. Following is a brief description of other national and international standards adopted.

- *BREEAM*

Launched in 1990 and developed by the Building Research Establishment

(BRE- www.bre.co.uk/) BREEAM is an Environmental Assessment Method for new and existing buildings which awards a sustainability rating based on a series of credit points. The wider aim of BREEAM is to minimize the adverse effects of buildings on the global and local environment.

The levels a project can reach vary from “outstanding” to pass. Different types of schemes exist as follow:

- BREEAM Ecohomes and EcohomesXB
- BREEAM Other Buildings
- BREEAM In-Use
- BREEAM Courts
- BREEAM Multi-residential
- BREEAM Education
- BREEAM Prisons
- BREEAM Healthcare
- BREEAM Offices
- BREEAM Industrial
- BREEAM Retail
- BREEAM International
- BREEAM Communities

- *ESTIDAMA*

A sustainability rating system which started back in 2008 in Abu Dhabi is in fact entitled after its literal translation of the word sustainability. ESTIDAMA (which means literally sustainability in Arabic) is founded upon four pillars which include the three formerly agreed upon concepts for S.D. environment, economy and social but also differentiates itself by emphasizing the need for a 4th dimension which is cultural. In this

way Estidama adapted the international standards to be more regionally oriented acknowledging that not all applications are feasible in the same way all over the world especially when addressing different cultures.

Rating system categories fall under several types:

- Pearl Community Rating System
- Pearl Building Rating System
- Pearl Villa Rating System
- Temporary 1 Pearl Building and Villa Program
- *QSAS*

QSAS like the above described international environmental standards consists of several categories, criteria, and measurements aim to better our living environment.

The goals set for the buildings in Qatar are the following:

- Address the urban context.
- Control existing site conditions
- Minimize depletion of fossil energy
- Minimize use of water resource
- Minimize use of materials
- Control indoor environment
- Enhance and maintain the project's cultural and economic value.
- Define the project's management and operations plan

Each goal constitutes a major category in QSAS. The QSAS categories include: Urban Connectivity [UC], Site [S], Energy [E], Water [W], Materials [M], Indoor Environment [IE], Cultural & Economic Value [CE], and Management & Operations [MO].

Scores range from -1 to 3 (-1, 0, 1, 2, 3) or 0 to 3.

QSAS has been developed to rate different building types. The building schemes that can be rated with QSAS include:

- Commercial
- Core & Shell
- Schools
- Residential
- Mosques
- Hotels
- Light Industry
- Sports
- Neighborhoods

2.3. Economic Approaches to Sustainable Development

Now to address the second pillar of sustainable development: the economy. A crucial determining factor critical to the development of any community.

Stephen Shmidheiny was head of the business group in rio 1992. He and his associates founded the World Business council on sustainable development WBCSD.

As defined earlier, Eco efficiency was the main innovative term brought up which is based on the concept of creating more goods and services while using less resources and creating less waste and pollution.

Changing the patterns of consumption and production within the industry is one of the main factors of making the economy more sustainable.

2.3.1. The Role of the Architect/Engineer

The WBCSD encourages two concepts transparency and accountability:

Transparency being established with the publishing of all financial accounts and social and environmental impact so that accountability of all organizations can take place.

On a smaller scale it is also necessary to elaborate on the Role of the scientist and engineers in SD. Assuming the following responsibilities as per Azapagic, Perdan and Clift (2004) and becoming an “honest broker” requires:

- using your influence as an expert
- partnership with all- an integrated process of work
- creating solutions, improve efficiency
- changing your role from problem solver to problem formulator
- defining all stakeholders affected
- proposing alternative solutions
- raising awareness and give early warnings to avoid future problems.

2.3.2. Corporate Social Responsibility

As defined by the Commission of the European Communities CSR is “a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis” (CUC 2001). With that said the value of the stakeholder has been increased to match the shareholder. Joseph (2009) goes on to say that “CSR in reality is the alignment of business operations with social values”.

As we have discussed the three pillars of sustainable development are the social, the economic and the environmental. Knowing that the environmental can be addressed “directly” by reducing gas emissions, abiding by international standards among other approaches it is harder to assess the impact one organization can have on the social factor. Stability in the social and political fields have always been key to

economic growth. Given the above fact it is clear that this stability can lead to greater sustainability and indeed a more effective CSR.

It is a shift all companies need to take: from maximization of profit to optimization of profits. Companies should be integrated within the universal whole and should become an open subsystem of that universe. There are many ways for companies and organizations to become more socially responsible one of which are involving the community they serve. All stakeholders have the right to know about company initiatives its intents and how it serving them.

“CSR has moved from being a public relations tool or a feel-good factor to a key parameter to keep companies open and transparent.” Lynes and Andrachuck (2008) developed a model categorizing CSR into 4 parts:

- Levels of influence
 - Market system
 - Political-institutional system
 - Scientific system
 - Social system
- Different motivations
 - Long term financial strategy
 - Eco-efficiencies
 - Competitive advantages
 - Good corporate citizenship
 - Image enhancement
 - Stakeholder pressure
 - Avoid or delay regulatory action
- Catalyst to shape influences by encouraging CSR

- Level of commitment to CSR by the firm/organization

CSR is NOT philanthropy. The latter is not enough as explained earlier it should be a functional productive entity within the community taking care of its end users while optimizing its profits. This way consumers will be sustained and therefore businesses will remain and thrive within the community.

Nelson Mandela once said: “Without question, businesses must respond for its own good, and what is good for them is invariably good for the community.” CSR strategies have been addressed by Heslin and Ochoa (2008) under 7 principles:

- Cultivate needed talent
- Develop new markets
- Protect labor welfare
- Reduce environmental footprint
- Profit from byproducts
- Involve customers
- Green the supply chain

Burke and Loagsdon (1996) had previously elaborated on the need for 5 dimensions to relate finance to stakeholder interest which are as follows:

- *Centrality* (closeness to fit to the firms mission and objectives)
- *Specificity* (ability to capture private benefits by the firm)
- *Proactivity* (degree for to which the program is planned in anticipation of emerging social trends and in the absence of crisis)
- *Voluntarism* (the scope of discretionary decision making and the lack of externally imposed compliance requirements)
- *Visibility* (observable recognizable credit by internal and/or external)

stakeholders for the firm)

Another important factor to be discussed when it comes to the economy of a city is land-use and how they can help make it more sustainable.

2.3.4. Sustainable Land Use Strategies

According to a study prepared in May 2012, human footprint is estimated to have affected 83% of its land surface and has used over 60% of its ecosystem resources in the past 50 years. Latest developments of land use have shown that forest density has increased in high income countries and declines in low income countries. Loss of biodiversity being the main concern of well aware developed countries while middle to low income citizens of developing countries are in the process of solving their economical crisis with minimal attention to the environment.

Land Management is heavily influenced by the context it revolves around: the country the culture and its priorities. Land administration functions (land tenure, value, land-use and land development) are thus later on development to explore and maximize the profit from the assets available ne it natural resources, landscapes, views etc... to be able to finally improvement and act on an economic, social and environmental level.

The following tactics can be used to move a city into a more sustainable path:

- Increasing sustainability through density or “compacting a city” (decreasing pedestrian travel distance, decreasing exploitation of green fields, etc...)
- Integrating transportation and land use in an auto-dependent era
- Creating sustainable neighborhoods with walk-to-work neighborhood centers of locally-owned businesses, car-sharing on every block, walk-able neighborhoods and universal accessibility

Transportation and land use planning are should be interconnected and

designed and managed in parallel. With better coordination, communities can plan more comprehensively for housing, commercial and retail uses, and for the provision of education and other public services, all in the context of accessible transportation.

Strategies and Approaches:

- Transportation planning should be an inclusive and holistic process involving all communities and groups impacted by transportation infrastructure.
- Partnerships with non-traditional stakeholders can provide a new perspective and therefore strengthen planning.
- Fusing land use and transportation planning needs the support of strong leadership. Strong leadership, both at the individual and institutional levels, is crucial to give momentum and credibility to new ideas.
- Private developments can be key components of public projects. Private retail and commercial developments can provide important revenue streams for public projects, particularly transportation projects, and can bring the crowds necessary to animate urban spaces and infrastructure.
- Creative planning requires creative funding. Non-transportation funding sources - such as federal, state, and local government agencies, public and private foundations, non-profit groups, and the private sector can be used to supplement transportation funds for projects that have benefits in other areas such as housing, economic development or the environment. If local businesses feel they will benefit from a project, they may be willing to provide not only substantive input but also funding. Grant programs, such as the Transportation, Community and System Preservation (TCSP) Program, can support innovative aspects of larger projects, including the development of community-based planning efforts and the implementation of alternative transportation infrastructure.

A new World Bank report, “*Planning, Connecting and Financing-Now: What City Leaders Need to Know*” addresses several issues that cities rapidly urbanizing need to deal with like the following:

- Issue of migration and real estate
- Importance of financing infrastructure
- Planning
- Connecting
- Financing
 - Demand and supply of property rights
 - City’s creditworthiness
 - Securing commitments
 - Leveraging
 - Importance of private investors in developing countries

2.4. The Social Factor

Finally we get to our third pillar to explore: the community and how its involvement is key to sustainable development.

2.4.1. Community Development (A Historical Background)

One last pillar to be discussed when it comes to sustainable development is the social factor. I use the term community thereafter and not society because as Fred Powell explains in his “Think globally, act locally’: sustainable communities, modernity and development” article (2009) there is a distinction one needs to make between them. He refers to German sociologist Ferdinand Tönnies to clarify his distinction explaining that community is created by mutual bonds between people forming social relations.

Society on the other hand was described as “heartless, impersonal and hostile”. Society is generic, a given and includes different communities... He later on explains that we have come to a point where the modern world is constituted by an “impersonal technological society” replacing the sense of local community (Powell 2012).

Democracy has always been defined as bringing the power to the people. A more elaborated definition is defined by Fisher (2000) in his Citizens experts and the environment as “citizen participation” where different issues and concerns are discussed and argued with the aim of solving them in the most integrated and communal way satisfying the major needs of the community. Historically it was in fact the Agora in ancient Greece that was the stage for such an ideal example of democracy and citizen participation. It “equates the public sphere”. When technology took shape and became key in modernizing communities “Fordism” took its place as a movement for mass production of object as well as it symbolized the massing of communities in societies. Bureaucracy took place, a clear differentiation between the public and the state was established where the state was elected by the people to speak for them (a clear difference and evolution from the agora concept). However politics and capitalism did not help in making the state an organization by itself seeking to make money for the country and making the non-capital community needs less and less of a priority.. A creation thus of what we can call “Civil society” was established. “Civil society coexists in a triangular relationship with the state and the market”. It is the ethical representation of community with regards to sustainable development creating a modern agora of today’s’ world.

2.4.2. Community and Sustainable Development

According to Sihlongonyane 2009, historically community development efforts

to modernize were through education, agriculture and other social services. As clearly noticed the notion and understanding of “development” varies with time and so does the definition of community. To address that from a sustainability point of view we need to acknowledge that defining communities is on its own a drawback because it helps strengthen internal relations while also adding more animosity and segregation between the “other” communities.

“Community is now a layered concept. Layering also brings to the fore the idea that various notions of community are compounded”

To modernize a city in the current era according to Plachiak (2010) means the following criteria to be addressed:

- Empowering city settings
- Fortifying material profit
- Using science and technology
- Establishing a bureaucratic order (worker vs. factory owner)
- Individual enterprise and free competition

Listed below are some of the characteristics and priorities, as defined by Geisand Kutzmark, which are typical of a sustainable community (Rae and Bradley 2012):

- Goals that are rooted in a respect for both the natural environment and human nature and that call for the use of technology in an appropriate way to serve both of these resources;

- The placement of high values on quality of life;
- Adoption of a systems approach to organization and management;
- Supportive of lifecycles; and
- Responsive and proactive (Rae and Bradley 2012).

As explained in the section above, participation in decision-making has been key to establishing the wellbeing of all stakeholders ever since the days the Agora existed. However it does entail several problems for any planned facility (Joos *et al.* 1999).

- Specialized knowledge needed to carry on efficient process entails that a sovereignty of that “elite expert” take charge and have more say in the situation.
- Direct consultation of the voting public can only ask for a `yes' or a `no' position on the proposal. Which is not really always enough because some issues are subjective and more conditions are needed to make the information as accurate and beneficiary as possible

It is evident that in order to achieve the most sustainable solution we have to aim to strengthen the community and clarify its needs. The aim must be shifted from money and capital as the center of the universe to the human being as the driving force towards ultimate wellbeing (Powell 2012).

CHAPTER 3

EXISTING SUSTAINABLE STRATEGIES

After having examined the literature that has dwelled on the different aspects of sustainability and sustainable developed it is essential now to address the object of interest in this thesis: masterplans and cities in general. Exploring the different sustainable strategies being implement in the world today is needed to find out what kind of solutions are being used, where and how they affect the status of the masterplan's sustainability.

3.1. Existing Major Cities and Their Characteristics

Following is a table stating the different components of thriving cities in the world in England, the United States of America and South Africa. This global review will help define and compare what these major cities include and how this structure can help define an ideal sustainable model.

Table 3.1. Data from Existing Major cities

Beirut central District	Canary Wharf, London, UK	National Harbor, Washington DC, USA	Downtown, Pittsburgh, USA	Johannesburg CBD, South Africa	Cape Town CBD + CTICC, South Africa
Site Area: 1,900,000 m ²	Site Area: 280,000 m ²	Site Area: 400,000 m ²	Site Area: 1,700,000 m ²	Site Area : 1,100,000 m ²	Site Area: 1,700,000 m ²
32 main gardens and open spaces	- 81,000 m ² of landscaped parks (circa 30% of total area)	- 33 restaurants and cafes	- 5 shopping destination	- 20 Shopping Malls/Supermarkets	- 5 shopping destination
10 archeological sites	- Over 180 indoor and outdoor events held yearly	- 5 hotels- 4000 hotel rooms	- 17 leisure attractions	- 2 Universities	- 17 leisure attractions
19 religious buildings	- Over 40 exhibition spaces	- 45 shops and galleries	- 7 business destinations	- Public Transport : Metro, Busses and Taxi	- 7 business destinations
5 large parking facilities	- 90 shops	- 6 residential areas	- 7 Parks		- 7 Parks
3 museums	- 3 supermarkets	- 3 garages / parking	- 50 parking lots		- 50 parking lots
2 major shopping centers along with a multitude of small shops	- 8 banks	- 5 leisure attractions	- 13 galleries and exhibitions		- 13 galleries and exhibitions
25 banks	- 3 health clubs	- 2500 residential units	- 10 theaters		- 10 theaters
1 supermarket	- 65 cafes, bars and restaurants	- events & festivals	- 6 museum		- 6 museum
6 yearly cultural events			- 14 hotels		- 14 hotels

Further to the above table, the following key aspects can be derived:

- Public Transport Accessibility is a key component to the success of a business district.
- A central location is a major asset
- A good integration with public and leisure destinations (like a park or a waterfront) creates a very attractive environment to work, play and live.
- Mixed-use developments are the most resilient type of CBD, in particular when mixed with retail, hotels, and entertainment and leisure activities.
- The integration of a state-of-the-art international convention centre can boost the attractiveness of a business district.
- The use of marinas, parks and other green spaces acts as strong added value
- A Business District should work as 24/7 and 365 urban environment
- Security is crucial to attract businesses.

Further to the above aspects several initiatives are being implemented to ameliorate sustainability conditions. However one specific initiative worthy of mention addresses the continent of Europe as a whole: Roadmap 2050.

3.2. Roadmap2050

One of the most innovative and daring initiatives being taken is the roadmap 2050 which targets all of Europe as a continent mainly through strengthening governmental policies and their role in enforcing environmentally aware regulations to help reduce each country's carbon footprint. The Roadmap 2050 project is an initiative of the European Climate Foundation (ECF) and has been developed by a consortium of experts funded by the ECF. It includes strategies to reduce CO2 emissions by up to

80%,transform all energy to become renewable resources to wind, solar, hydropower, geothermal, biomass and nuclear. The study goes on to show assumed demand response and how to tackle the different changes ahead and how “decarbonizing the economy” will actually save Europe money and expand its GDP (Gross domestic product).

The study also goes on to show the different repercussions that will occur of the different actions to be taken are delayed concerning the economy and the environment and thus the wellbeing of the population.

The study concludes with a beautiful diagrammatic representation of an integrated European power grid based on renewable energies and even goes on to address neighboring continents and how they can profit from such an initiative.

This study really explores the concept of inclusive thinking strategies where even a whole continent can find a way to combine strengths and its advantages is in its countries collaboration and unity whereby resources are exploited to their full potential and the most sustainable end result is achieved.

3.3. One Example in the Region: A Vision Plan for the Dead Sea (Jordan)

According to ArchDaily, the 40 square kilometers master plan along the coast if the Dead Sea was developed by the American based firm Sasaki associates. The main challenge of this project was to address to existing local communities that were living in the area and to be able to build such a large project while maintain a high level of sustainability standards.

An extensive site analysis was conducted on the indigenous landscape and ecological systems that have formed the Dead Sea and continue to influence it: water recession, natural hot springs, native flora and fauna, native Tamarisk habitat, and Important Bird Area (IBA) flyways.

The plan is to take advantage of the Dead Sea's assets without exploiting them. Focus was aimed at attracting visitors to the Dead Sea as well as developing the measures necessary to protect these critical assets from exploitation.

The public realm was addressed by allowing access the Sea, engage in commerce, enjoy public open spaces and public services and amenities serve the entire project site. The needed functional facilities were identified after thorough analysis and programs like health care facilities among others were set to provide educational opportunities, affordable housing, and other industries and services entail an important commercial activity thus generating employment opportunities and services to residents.

A Waste Water Treatment Plant (WWTP) will recycle water for irrigation this way addressing the currently existing problem of insufficient waste infrastructure. Public transportation allowing the whole site to be connected from within and to its neighboring regions reduces reliance on private vehicles. Minimization of solar heat gain on buildings by centralizing and compacting buildings in different districts was implemented.

In conclusion, it is evident that's aspects aimed for are being repeated in the two described sustainable initiatives above in 3.2 and 3.3. They evidently address the three pillars of sustainable development at all possible scales and aim to address the following issues:

- Improve the well-being of all stakeholder;
- Strengthen connectivity;
- Take advantage of resources in a sustainable and efficient manner;
- Conserve the natural habitat;
- Provide commercial markets;
- Revolutionize the infrastructure to make sure no resources are going to

waste; and

- Pave the way for future sustainable developments.

3.4. Waste Management in Cities

Based on an article in the “Architects Newspaper” (Fung 2012), turning waste into energy is an existing initiative being taken on by many metropolitan cities like San Francisco, Seattle and many European cities. In parallel other cities are simply reducing co2 emissions by exporting garbage via barges and trains instead of by trucks.

London has addressed the issue using an innovative solution: gasification plants suitable for urban settings. In this context gasification helps burn waste in an oxygen free environment releasing gas as usable energy.

One of the major revolutionary mechanisms was in fact implemented in Barcelona since its Olympic debut in 1992. Its use of pneumatic tubes provides an automated waste collection beneath the city streets.

Garbage by stakeholders is deposited into portholes on the streets and an underground network takes it away to a collection plant. Not only is the garbage collected more innovative in this manner but in addition after its collection organic waste is then converted into biogas which heats buildings. Envac, the Swedish company behind the implementation of this system, has also established similar mechanisms in Disney world and parts of London, Montréal and Stockholm.

As per Barcelona’s sanitation director: “Pneumatics arranges and releases public space. It’s the best advantage with noise reduction and decreasing heavy traffic as well.”

One must admire how innovative these systems are and recognize that the main aim is to update waste infrastructure, reuse resources if possible while decreasing any

harm to the environment. However these technologies require financing which is their main drawback although current existing initiatives have shown that financial benefits for the city do happen but only on the long run when the system takes place and the cycles take their course.

3.5. IBM Smart Cities

IBM has taken on address sustainable development using its own expertise: technology. It aims through address several elements of the city and upgrade them technologically to increase efficiency and minimize environmental degradation. It includes the following described systems of implementations.

- *Smart Energy Grids:* Smart Grids adds a layer of digital intelligence to traditional grids system. These smart grids use sensors, meters, digital controls and analytic tools to automate, monitor and control the two-way flow of energy across operations—from power plant to plug.

Examples: Smart grid projects are already helping consumers save 10% on their bills and are reducing peak demand by 15%.

- *Smart Buildings:* The ability to collect, analyze and sort building data quickly is critical to the real-time energy and performance optimization of a smarter building. But smart buildings should not just be considered as data sources they are also considered as potential sources of co-generation power plants, reservoirs for water, even roof top farms.

Examples: Smarter buildings can reduce energy consumption by as much as 40% or more through occupancy censored lighting and smart energy demand meters,

- *Smart Transportation Systems:* Smarter transportation means better systems for rail, air, public transit and freight. These can improve our cities, our economy and

our daily lives. In a smarter transportation system, travelers and freight customers are empowered with information and tools to determine for themselves the best way to move from origin to destination, throughout all modes of transportation, with due consideration to cost, time, convenience and environmental impact.

Example: The technology would instantly process the real-time traffic, rail and weather information and provide an accurate and instant view of the fastest way to get to his or her destination.

- *Smart Traffic Systems:* Our rapidly urbanizing planet depends on getting people and things from here to there. Rethinking how we get from point A to point B means applying new technology and new policies to old assumptions and habits. It means improving the drivers' experience, not just where and when they drive. And it could lead to advances in the cars we drive, the roads we drive them on, and the public transit we might take instead.

Example: Seeing a city's traffic in a consolidated, real-time view can help anticipate problems, alleviate congestion and decrease emergency-response times.

- *Smart Water Systems:* Whether too much or not enough, the world needs a smarter way to think about water. Sensor networks, smart metering and advanced computing and analytics can ensure the efficient flow of clean, plentiful water throughout the year. It is estimated that for every million dollars spent on water efficiency in the United States; 10 trillion gallons of water can be saved and increase economic output by as much as \$2.8 million.

Example: A cloud-based, meter-driven portal helps residents of Dubuque, Iowa, conserve resources and save money with better utility-usage information.

- *Smart Governance:* As governments institute structural changes in the way agencies measure performance and deliver services, data analytics and new delivery

modules such as shared services can help lead the way for more transformative efforts and a measurable return on investment and improved quality of life.

Example: Today, common platforms are the basis for many of the unique iterations of smarter government already in evidence. Sometimes that's as simple as using social computing applications like Twitter to report the daily cash flow for the state of Rhode Island. Or it could be as complex as creating a virtual world for the training of a nation's intelligence agents.

- *Smart Education:* One of the greatest challenges lies in making our education technologies more efficient. Present day redundancies have created tremendous inefficiencies, ballooning costs and silos of resources. Smart education technology—analytics, early warning systems to identify at-risk students, cloud computing—can help our systems refresh outdated infrastructures with new functionality. They can become more interconnected, instrumented and intelligent.

Example: Using analytics, everything from student attendance to the energy use of a school building has a place in identifying targets for improvement; enhance learning and spot troubling trends earlier.

- *Smart Security and Safety:* Patterns revealed through analytics help decision makers anticipate—rather than just react to—problems, and dispatch first responders to the scene faster. The results, such as predictive policing, mean better citizen-centered service...whether minimizing inconveniences, overseeing emergencies or stopping crime.

Example: With increasing crime rates, the City of Memphis Police Department (MPD) needed to improve response time. Using predictive analytics software, the MPD has reduced serious crime by more than 30 percent and expanded its effective coverage area without a proportional increase in staff.

- *Smart Public Services:* Information insights—coupled with clinical collaboration—can dramatically improve quality of service, safety and outcomes, while also improving the cost-effectiveness of core public services. The smarter approach to healthcare is one that turns data into clinical and business insights for better outcomes. It instruments processes with those insights in real time for point of care decisions and productivity.

Example: Healthcare - Using tools like electronic medical records, wireless computing devices and health support networks, innovators are making health care systems smarter and more affordable.

- *Smart Food:* Technology is shaping how it grows, how it tastes and how it gets to your plate. Consumers are hungrier than ever for information about their food. They are better informed about nutrition and more aware of the environmental and societal impacts of everything they buy. With innovative digital technology and powerful solutions, smarter food chains can reduce waste, reduce its environmental impact and be of a higher quality.

Example: Track and trace technology, including 2D and 3D barcode and radio frequency identification (RFID) that allows producers and consumers to track food from "farm to fork."

- *Smart Business:* Smarter commerce turns customer insight into action, enabling new business processes that help companies buy, market, sell and service their products and services. New ways to reach and retain customers—from personalized services to mobile availability—have to be delivered quickly, securely and, ideally, before customers even know they want them.

Example: To act with agility, organizations have to increase communication and collaboration, and improve decision-making processes. Business process

management (BPM) and service-oriented architecture (SOA) can power a flexible, dynamic, cloud-ready infrastructure.

- *Smart Retail:* To earn and retain customers, retailers are looking for hidden connections to transform how they do business. Organizations don't just use analytics to find information; they use smarter analytics with sophisticated algorithms to establish new business models. The forces driving this need for pervasive customer-centric analytics include the rise of the perpetually connected, hyper-informed consumer; social media's influence on consumer brand sentiment and purchase intent; and new complexities in product, category, supply chain and marketing.

Examples: For a German bakery chain, the weather forecast helps determine demand. A zoo in the US is able to create real-time program changes based on park visitor flow.

- *Smart Waste:* Twenty first century cities struggle to manage and dispose of the ever increasing amount of waste they produce. Instead of unwieldy garbage cans and noisy trucks, smart waste systems are providing efficient solutions.

Example: Pneumatic Trash Collection; a vacuum-powered system literally sucks garbage to the dump. Buildings are hooked up to the garbage grid, but there are also portals in public places around town. The benefits: No trash in public, easier disposal, fewer trucks on the streets, and lower vehicle emissions.

- *Smart Public Spaces:* While there is an increasing recognition that online social interactions cannot replace physical interactions, our public realm (from public space to social spaces like bars or cafes) don't seem to be adapted to our new way of meeting, sharing and collaborating. Architects, Urbanists and designers are increasingly required to embrace a new palette of skills which integrate new technologies and digital services into the built environment and in turn enable the lifestyle changes which are

emerging.

Example: New technologies combined with new building techniques are offering exciting new perspectives to create multilayered interactive spaces, which can interact with users and quickly respond to their needs. The redevelopment of Gorky Park in Moscow is an example of such an initiative.

- *Smart Living*: Cities around the world are currently in a state of transition as they seek to evolve in tune with the changing dynamics of urban culture. The way in which people work, rest, socialise, consume, interact and communicate has significantly altered in the past decade and is consequentially challenging the use and function of our cities.

Example: A growing trend in our cities, is the creation of ‘third places’; an alternative work/leisure place to one’s home (first place) or office (second place). A ‘third place’ is a hub of interaction, networking and creativity which provides a convenient workspace for the growing number of remote workers within our cities. The collaborative and creative atmosphere of a third space not only acts as a platform for networking and work but establishes a creative setting for new ideas, innovation and leisure.

3.6. Stakeholder Satisfaction in the City

Based on an Ericsson consumer lab insight summary report done in May of 2012, it seems that those with highest satisfaction levels are people living in Stockholm, Mumbai, Johannesburg, New York, Tokyo, London and Los Angeles. The key aspects that lead to their satisfaction are as follows:

- Availability of restaurants, cafes, pubs, etc...
- Availability of shopping malls, food markets, etc...

- Availability of entertainment facilities
- Mobile network coverage
- Water distribution
- Public cleanliness
- City authority communication
- Parking facilities
- Air quality
- Road traffic situation/street system

This of course also differs and depends on different aspects of each stakeholder, their gender, age group values and interests. Another interesting finding in the report is the relationship between end user or stakeholder satisfaction and availability of green spaces. The more abundant green spaces and landscapes the more satisfied and less congested and claustrophobic the citizens feel. Commute distance and comfort level using the different ways of transportation is also a major factor playing a role in stakeholder satisfaction.

In conclusion, many criteria define a sustainable masterplan. Each affects directly or indirectly the environment, society and the economy. In the next chapter these criteria will be defined and explored and then linked to formulate a template for sustainability thinking for existing masterplans.

CHAPTER 4

PROPOSED TEMPLATE FOR SUSTAINABILITY THINKING

To be able to assess a master plan sustainability level, some sort of a template should be formulated. This template, as concluded from the literature review, must address firstly the three pillars of sustainable development: the environment, the economy and society.

In this context each pillar is define by different characteristics and criteria some of which is shared by other pillars and other specific to its own aspects and needed elements.

4.1. Derived Criteria

Further to the research done based on sustainable standards and relevant literature review many criteria were derived that define the different aspects a sustainable masterplan should address.

Society can be classified into two subcategories: stakeholder satisfaction and sustainable community (both dealing with the needs of society and stakeholders using this masterplans). It is important here to re-iterate that what is meant by stakeholders is not only the residents living in the area, but also all end users that use the space on a daily basis from employees to tourists to consumers to business entrepreneurs to service employees etc... mainly every single individual affected by the masterplan on way or another. That's why criteria relevant to this pillar/category include social equity, comfort, safety, availability of services, cleanliness etc...

The economy includes three subcategories. Role of architect engineer is

important dealing mainly with the relevant authority taking care of the operations of the masterplan. Their authenticity, genuine input, transparency are all crucial aspects when it comes to being aware that the whole point is not to get paid by the end of the day but to actually do the job and guarantee stakeholder wellbeing. These architects and engineers might belong to governmental authorities or private companies depending on the case of the masterplan and what kind of entity is taking care of managing it. Also part of the main aspects dealing with the economy is CSR or Corporate social responsibility. This subcategory addresses the entity managing the masterplan as a whole and how it implements initiatives to make this masterplan sustainable including developing new markets, exploring new stakeholder talents among others. Last subcategory included in this pillar is Land use strategy which is also essential when addressing masterplans. Given that we are trying to sustain large areas of land, their status in the real estate as well as their functional distribution is very important for a suitable sustainable outcome.

The environment as it is the most explored and developed aspect in sustainable development is heavily inspired by the sustainable standards and more specifically LEED given its leading status in the market. It is subcategorized into six areas: sustainable sites, water efficiency, energy and atmosphere, materials and resources, smart location and linkage and neighborhood pattern and design.

Following is a summarized diagram showing which criteria is included in each category.

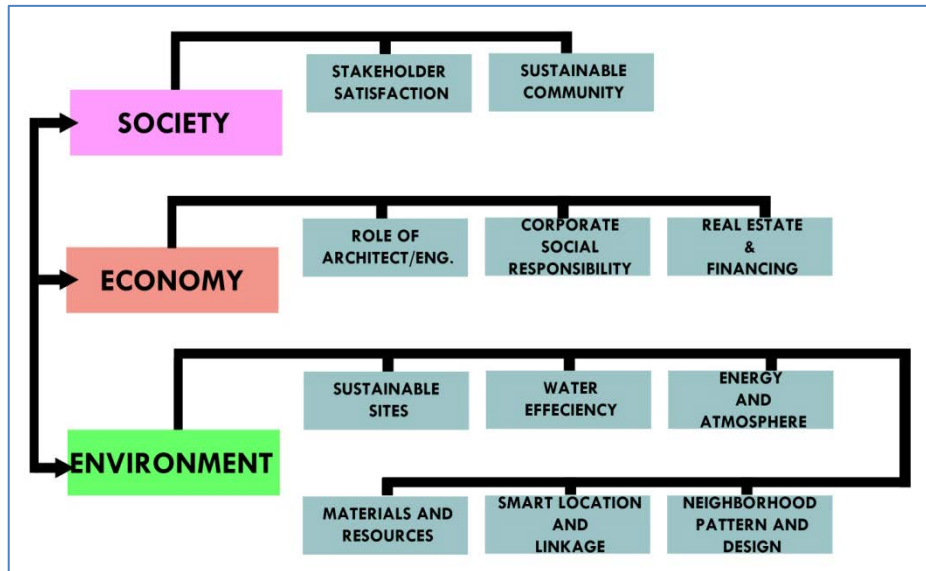


Fig.4.1. Classification of Derived Criteria

4.2. The Template

The template will be thus divided into 3 categories each category addressing one of the pillars of sustainable development (economy, society, and environment).

Each category will then be subdivided into its relative sustainable criteria deduced from sustainable standards and literature review done.

In this context each criteria clearly will “weigh” differently then another in each pillar category. Each with its own definitions, aspects and what it affects relates differently to the outcome and how sustainable the masterplan is. However it can be noticed that we can divide the deduced criteria into two batches, one of which is key to its sustainable outcome given its heavy direct impact and its connection to the three pillars at once. The other batch includes the other more pillar specific aspects which are also important but do not impact the outcome as much as the latter. Criteria in each category will thus fall under two classifications: Key and Contributory.

A key criterion would be crucial to the masterplan being sustainable whereby it addresses the social, economical and environmental factor at the same time while a

contributory criterion is specific to each sustainable pillar. Table 4.1 illustrates further the derived criteria thus concluded and their classification.

Table 4.1. Derived Criteria

PILLARS	Proposed Sustainable criteria	Classification
Environmental	Sustainable sites--Building Exterior and Hardscape Management Plan Maintenance equipment-Snow and ice removal-Cleaning of building exterior-Paints and sealants used on building exterior-Cleaning of sidewalks, pavement and other hardscape.	Key
Environmental	Sustainable sites--Pest Management Plan The plan must employ best management practices that significantly reduce harmful chemical use, energy waste, water waste, air pollution, solid waste and/or chemical runoff (e.g., gasoline, oil, antifreeze, salts) compared with standard practices.	Key
Environmental	Sustainable sites--Heat Island Reduction—Nonroof Place a minimum of 50% of parking spaces under cover. Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated roof or be covered by solar panels that produce energy used to offset some nonrenewable resource use. Implement a maintenance program that ensures all SRI surfaces are cleaned at least every 2 years to maintain good reflectance. — Roof Use roofing materials with a solar reflectance index (SRI) ² equal to or greater than the values in the table below for a minimum of 75% of the roof surface. Install and maintain a vegetated roof that covers at least 50% of the roof area. Install high-albedo and vegetated roof surfaces	Key
Environmental	Energy and Atmosphere--historic resource preservation and Adaptive Use	Key
Environmental	Smart location and linkage--Locations with reduced Automobile Dependence To encourage development in locations shown to have multimodal transportation choices or otherwise reduced motor vehicle use, thereby reducing greenhouse gas emissions, air pollution, and other adverse environmental and public health effects associated with motor vehicle use.	Key

“Table 4.1 – *Continued*”

PILLARS	Proposed Sustainable criteria	Classification
Environmental	Smart location and linkage--bicycle Network and Storage	Key
Environmental	Smart location and linkage--housing and Jobs proximity	Key
Environmental	neighborhood pattern and Design--Connected and open Community To promote projects that have high levels of internal connectivity and are well connected to the community at large	Key
Environmental	neighborhood pattern and Design--Walk able Streets To promote transportation efficiency, including reduced vehicle miles traveled (VMT).	Key
Environmental	neighborhood pattern and Design---Compact Development To conserve land. To promote livability, walk ability, and transportation efficiency, including reduced vehicle miles traveled (VMT)	Key
Environmental	neighborhood pattern and Design--mixed-Use Neighborhood Centers To cluster diverse land uses in accessible neighborhood and regional centers to encourage daily walking, biking, and transit use, reduce vehicle miles traveled (VMT) and automobile dependence, and support car-free living.	Key
Environmental	neighborhood pattern and Design--mixed-income Diverse Communities To promote socially equitable and engaging communities by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community.	Key
Environmental	neighborhood pattern and Design--transit facilities To encourage transit use and reduce driving by providing safe, convenient, and comfortable transit waiting areas and safe and secure bicycle storage facilities for transit users.	Key
Environmental	neighborhood pattern and Design--Access to Civic and public Spaces To improve physical and mental health and social capital by providing a variety of open spaces close to work and home to facilitate social networking, civic engagement, physical activity, and time spent outdoors.	Key
Environmental	neighborhood pattern and Design--Access to recreation facilities To improve physical and mental health and social capital by providing a variety of recreational facilities close to work and home to facilitate physical activity and social networking.	Key
Environmental	Sustainable sites--LEED Certified Design and Construction	Contributory

“Table 4.1 – *Continued*”

PILLARS	Proposed Sustainable criteria	Classification
Environmental	Sustainable sites--Alternative Commuting Transportation Reduce the number of commuting round trips made by regular building occupants using single occupant, conventionally powered and conventionally fueled vehicles. For the purposes of this credit, alternative transportation includes at a minimum, telecommuting; compressed workweeks; mass transit; walking; bicycles or other human-powered conveyances; carpools; vanpools; and low-emitting, fuel-efficient ¹ or alternative fuel vehicles.	Contributory
Environmental	Sustainable sites--Site Disturbance—Protect or Restore Open Habitat To conserve existing natural site areas and restore damaged site areas to provide habitat and promote biodiversity.	Contributory
Environmental	Sustainable sites--Construction Activity pollution prevention	Contributory
Environmental	Sustainable sites--Storm water Quantity Control a storm water management plan that infiltrates, collects and reuses runoff or evapotranspirates runoff Implement an annual inspection program of all storm water management facilities to confirm continued performance. Maintain documentation of inspection, including identification of areas of erosion, maintenance needs and repairs.	Contributory
Environmental	Sustainable sites--Solar orientation	Contributory
Environmental	Sustainable sites--Light Pollution Reduction INTERIOR LIGHTING Implement a program to ensure that the lighting control system is being properly used to adjust lighting levels during all after-hours periods. EXTERIOR LIGHTING Partially or fully shield all exterior fixtures 50 watts and over so that they do not directly emit light to the night sky. Measure the night illumination levels at regularly spaced points around the perimeter of the property, taking the measurements with the building’s exterior and site lights both on and off.	Contributory
Environmental	Water Efficiency--Minimum Plumbing Fixture and Fitting Efficiency Demonstrate fixture and fitting performance through calculations to compare the water use of the as-installed fixtures and fittings with the use of UPC- or IPC-compliant fixtures and fittings, as explained in the LEED Reference Develop and implement a policy requiring	Contributory

“Table 4.1 – Continued”

PILLARS	Proposed Sustainable criteria	Classification
	economic assessment of conversion to high-performance plumbing fixtures and fittings as part of any future indoor plumbing renovation. The assessment must account for potential water supply and disposal cost savings and maintenance cost savings.	
Environmental	Water Efficiency--Water Performance Measurement Have in place permanently installed water metering that measures the total potable water use for the entire building and associated grounds. Meter data must be recorded on a regular basis and compiled into monthly and annual summaries. Applicants are also encouraged to meter gray or reclaimed water supplied to the building	Contributory
Environmental	Water Efficiency--Water Efficient Landscaping To limit or eliminate the use of potable water ¹ , or other natural surface or subsurface resources available on or near the project site, for landscape irrigation.	Contributory
Environmental	Water Efficiency--Wastewater management	Contributory
Environmental	Water Efficiency--Cooling Tower Water Management	Contributory
Environmental	Energy and Atmosphere--Energy Efficiency Best Management Practices—Planning, Documentation, and Opportunity Assessment	Contributory
Environmental	Energy and Atmosphere--Minimum Energy Efficiency Performance To achieve increasing levels of operating energy performance relative to typical buildings of similar type to reduce environmental and economic impacts associated with excessive energy use.	Contributory
Environmental	Energy and Atmosphere--infrastructure Energy Efficiency	Contributory
Environmental	Energy and Atmosphere--Fundamental Refrigerant Management To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to global climate change.	Contributory
Environmental	Energy and Atmosphere--Existing Building Commissioning—Investigation and Analysis Through a systematic process, to develop an understanding of the operation of the building’s major energy-using systems, options for optimizing energy performance and a plan to achieve energy savings.	Contributory
Environmental	Energy and Atmosphere--Existing Building Commissioning—Implementation To implement minor improvements and identify planned capital projects to ensure that the building’s major energy	Contributory

“Table 4.1 – Continued”

PILLARS	Proposed Sustainable criteria	Classification
	using systems are repaired, operated and maintained effectively to optimize energy performance.	
Environmental	Energy and Atmosphere--Existing Building Commissioning—Ongoing Commissioning To use commissioning to address changes in facility occupancy, use, maintenance and repair. Make periodic adjustments and reviews of building operating systems and procedures essential for optimal energy efficiency and service provision.	Contributory
Environmental	Energy and Atmosphere--Performance Measurement—Building Automation System To provide information to support the ongoing accountability and optimization of building energy performance and identify opportunities for additional energy-saving investments.	Contributory
Environmental	Energy and Atmosphere--Existing building reuse	Contributory
Environmental	Energy and Atmosphere--Performance Measurement—System Level Metering To provide accurate energy-use information to support energy management and identify opportunities for additional energy-saving improvements.	Contributory
Environmental	Energy and Atmosphere--On-site and Off-site Renewable Energy To encourage and recognize increasing levels of on and off-site renewable energy to reduce environmental and economic impacts associated with fossil fuel energy use.	Contributory
Environmental	Energy and Atmosphere--District heating and Cooling	Contributory
Environmental	Energy and Atmosphere--Emissions Reduction Reporting	Contributory
Environmental	Materials and Resources--Sustainable Purchasing Policy To reduce the environmental impacts of materials acquired for use in the operations, maintenance and upgrades of buildings.	Contributory
Environmental	Materials and Resources--Solid Waste Management Policy To facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills or incineration facilities.	Contributory
Environmental	Materials and Resources--recycled Content in infrastructure	Contributory
Environmental	Smart location and linkage--imperiled Species and Ecological Communities To conserve imperiled species and ecological communities.	Contributory

“Table 4.1 – *Continued*”

PILLARS	Proposed Sustainable criteria	Classification
Environmental	Smart location and linkage--Wetland and Water body Conservation To preserve water quality, natural hydrology, habitat, and biodiversity through conservation of wetlands and water bodies.	Contributory
Environmental	Smart location and linkage--Agricultural Land Conservation To preserve irreplaceable agricultural resources by protecting prime and unique soils on farmland and forestland from development.	Contributory
Environmental	Smart location and linkage--floodplain Avoidance To protect life and property, promote open space and habitat conservation, and enhance water quality and natural hydrological systems.	Contributory
Environmental	Smart location and linkage--Brownfield redevelopment To encourage the reuse of land by developing sites that are complicated by environmental contamination, thereby reducing pressure on undeveloped land.	Contributory
Environmental	Smart location and linkage--Landfill redevelopment sustainable reuse of landfill with minimum harm to the sea environment.	Contributory
Environmental	Smart location and linkage--Site Design for habitat or Wetland and Water body Conservation To conserve native plants, wildlife habitat, wetlands, and water bodies.	Contributory
Environmental	neighborhood pattern and Design--reduced parking footprint To design parking to increase the pedestrian orientation of projects and minimize the adverse environmental effects of parking facilities. To reduce public health risks by encouraging daily physical activity associated with walking and bicycling.	Contributory
Environmental	neighborhood pattern and Design--Street Network To promote projects that have high levels of internal connectivity and are well connected to the community at large	Contributory
Environmental	neighborhood pattern and Design--transportation Demand management To reduce energy consumption, pollution from motor vehicles, and adverse public health effects by encouraging multimodal travel.	Contributory
Environmental	neighborhood pattern and Design--visit ability and Universal Design To enable the widest spectrum of people, regardless of age or ability, to more easily participate in community life by increasing the proportion of areas usable by people of diverse abilities.	Contributory

“Table 4.1 – Continued”

PILLARS	Proposed Sustainable criteria	Classification
Environmental	neighborhood pattern and Design--Local food production To promote community-based food production, improve nutrition through increased access to fresh produce, support preservation of small farms producing a wide variety of crops, reduce the negative environmental effects of large-scale industrialized agriculture, and support local economic development that increases the economic value and production of farmlands and community gardens	Contributory
Environmental	neighborhood pattern and Design--tree-Lined and Shaded Streets	Contributory
Environmental	neighborhood pattern and Design--Neighborhood Schools	Contributory
Economical	CSR--Cultivate needed talent	Key
Economical	CSR--Develop new markets	Key
Economical	CSR--Protect labor welfare	Key
Economical	Land use--functional compactness (limited travel distance allowing potential for more green spaces and densifying residential areas)	Key
Economical	role of A/E--using your influence as an expert	Contributory
Economical	role of A/E--partnership with all- an integrated process of work	Contributory
Economical	role of A/E--creating solutions, improve efficiency	Contributory
Economical	role of A/E--changing the role from problem solver To problem formulator	Contributory
Economical	role of A/E--defining all stakeholders affected	Contributory
Economical	role of A/E--proposing alternative solutions	Contributory
Economical	role of A/E--raising awareness and give early warnings to avoid future problems	Contributory
Economical	CSR--Reduce environmental footprint	Contributory
Economical	CSR--Involve stakeholders in the decision making	Contributory
Economical	CSR--Green the supply chain	Contributory
Economical	Land use--Demand and supply of property rights	Contributory
Economical	Land use--City's creditworthiness	Contributory
Economical	Land use--Securing commitments	Contributory
Economical	Land use—Leveraging	Contributory
Economical	Land use--Importance of private investors in developing countries	Contributory
Economical	Land use--clear framework for future expansion	Contributory
Economical	corporate policies--Centrality (closeness to fit to the firms mission and objectives)	Contributory

“Table 4.1 – Continued”

PILLARS	Proposed Sustainable criteria	Classification
Economical	corporate policies--Specificity (ability to capture private benefits by the firm)	Contributory
Economical	corporate policies--Proactivity (degree for to which the program is planned in anticipation of emerging social trends and in the absence of crisis)	Contributory
Economical	corporate policies--Voluntarism (the scope of discretionary decision making and the lack of externally imposed compliance requirements)	Contributory
Economical	corporate policies--Visibility (observable recognizable credit by internal and/or external stakeholders for the firm)	Contributory
Economical	sustainable community-- Community outreach and involvement To encourage responsiveness to community needs by involving the people who live or work in the community in project design and planning and in decisions about how it should be improved or how it should change over time	Contributory
Economical	sustainable community--natural environment oriented initiatives	Contributory
Economical	sustainable community--social oriented initiatives	Contributory
Social	pedestrian connectivity	Key
Social	accessibility to public spaces	Key
Social	protection in public spaces	Key
Social	Water distribution	Key
Social	social equity	Key
Social	Air quality	Key
Social	comfort using spaces	Contributory
Social	Safety	Contributory
Social	commute distance	Contributory
Social	comfort in transportation facilities	Contributory
Social	availability of green spaces	Contributory
Social	comfort in green spaces	Contributory
Social	availability of services near public spaces	Contributory
Social	cleanliness of public spaces	Contributory
Social	Availability of restaurants, cafes, pubs, etc...	Contributory
Social	Availability of shopping malls, food markets, etc...	Contributory
Social	Availability of entertainment facilities	Contributory
Social	Mobile network coverage	Contributory
Social	Public cleanliness	Contributory
Social	City authority communication	Contributory
Social	Parking facilities	Contributory
Social	Road traffic situation/street system	Contributory

Given that sustainability as a whole and more specifically concerning masterplan is a continuous status to maintain and continually thrive to achieve and ameliorate, the result of such a template should not be a score the entity in charge should try to satisfy once more a minimum grade to achieve for marketing purposes. Unlike the green marketing established by the current leading standards like LEED and BREEAM this template should be efficient and highlight the aspects existing and most importantly define what is lacking giving the entity leeway to start implementing the needed initiatives as soon as possible, in this context the result of this template are success percentages and noting the number of criteria yet to be addressed. It is a binary process that assesses the intended state of the masterplan at date of completion and this way highlights the lacking aspects and makes way for the necessary and needed mitigations. This whole process can be more clearly illustrated in the proposed template for sustainability thinking below in Table 4.2.

4.3. Mitigation Process

Once results are shown in the score columns then assessment is made and mitigations can take place.

It is then based on several factors that the entity can start taking action giving priority to key criteria as they are critical to the sustainability of the Masterplan. Each missing criterion is then to be addressed as early as possible depending the following:

- Time
- Complexity of implementation
- Finances needed
- Availability of necessary assets relevant to the criteria

Table 4.2. Proposed Structure for the Template

Proposed Template for Sustainability Thinking							
Pillar Category	Criteria	Classification	Applied	Not Applied	Results	Mitigation Assessment	
pillar 1: Environment	criterion 1	key	<input type="checkbox"/>	<input type="checkbox"/>	a_{p1} = Total number of key applied criteria out of x_{p1}	percentage of key applied criteria out of x_{p1}	$(x_{p1} - a_{p1})$ = number of key criteria to address
	criterion 2	key	<input type="checkbox"/>	<input type="checkbox"/>			
	⋮	key	⋮	⋮			
	criterion x_{p1}	key			b_{p1} = Total number of contributory applied criteria out ($y_{p1}-x_{p1}$)	percentage of contributory applied criteria out of ($y_{p1}-x_{p1}$)	$(y_{p1}-x_{p1}) - b_{p1}$ = number of contributory criteria to address
	criterion $x_{p1}+1$	contributory	<input type="checkbox"/>	<input type="checkbox"/>			
	criterion $x_{p1}+2$	contributory	<input type="checkbox"/>	<input type="checkbox"/>			
⋮	contributory	⋮	⋮				
criterion y_{p1}	contributory						
pillar 2: Economy	criterion 1	key	<input type="checkbox"/>	<input type="checkbox"/>	a_{p2} = Total number of key applied criteria out of x_{p2}	percentage of key applied criteria out of x_{p2}	$(x_{p2} - a_{p2})$ = number of key criteria to address
	criterion 2	key	<input type="checkbox"/>	<input type="checkbox"/>			
	⋮	key	⋮	⋮			
	criterion x_{p2}	key			b_{p2} = Total number of contributory applied criteria out ($y_{p2}-x_{p2}$)	percentage of contributory applied criteria out of ($y_{p2}-x_{p2}$)	$(y_{p2}-x_{p2}) - b_{p2}$ = number of contributory criteria to address
	criterion $x_{p2}+1$	contributory	<input type="checkbox"/>	<input type="checkbox"/>			
	criterion $x_{p2}+2$	contributory	<input type="checkbox"/>	<input type="checkbox"/>			
⋮	contributory	⋮	⋮				
criterion y_{p2}	contributory						
pillar 3: Society	criterion 1	key	<input type="checkbox"/>	<input type="checkbox"/>	a_{p3} = Total number of key applied criteria out of x_{p3}	percentage of key applied criteria out of x_{p3}	$(x_{p3} - a_{p3})$ = number of key criteria to address
	criterion 2	key	<input type="checkbox"/>	<input type="checkbox"/>			
	⋮	key	⋮	⋮			
	criterion x_{p3}	key			b_{p3} = Total number of contributory applied criteria out ($y_{p3}-x_{p3}$)	percentage of contributory applied criteria out of ($y_{p3}-x_{p3}$)	$(y_{p3}-x_{p3}) - b_{p3}$ = number of contributory criteria to address
	criterion $x_{p3}+1$	contributory	<input type="checkbox"/>	<input type="checkbox"/>			
	criterion $x_{p3}+2$	contributory	<input type="checkbox"/>	<input type="checkbox"/>			
⋮	contributory	⋮	⋮				
criterion y_{p3}	contributory						

Realizing that every mitigation process is case sensitive, it cannot entail a generic system of logic to follow. Each case must be treated according to its specific circumstance

CHAPTER 5

APPLICATION OF THE TEMPLATE USING THE B.C.D MASTERPLAN

5.1. The Beirut Central District

The Lebanese Company for the development and reconstruction of Beirut Central district s.a.l (Solidere) was founded in 1994 and initially given a 25 year life span. The company's duration was extended by decree in 2005 to 35 years from the date of registration, May 10, 1994 in Lebanon's commercial registry.

Solidere is a joint-stock company with an initial capitalization of 1.82 billion\$ of which 1.17 billion\$ were contributions in kind of property right holders and 650 million\$ cash subscriptions following an oversubscribed initial public offering (IPO).

The master plan goal and intent was to restore all heritage buildings, preserve all found archeological remains, provide a developed and new infrastructure as well offer Extensive public space coupled with the sound and necessary urban planning

5.1.1. Land Areas

The Beirut city center reconstruction and development project covers 191 ha (472 acres) 118 ha (292 acres) originally constituting the traditional city center and 73-ha (180 acre) extension reclaimed from the sea. Public space is of 98 ha (242 acres) of which 59 ha (146 acres) in roads and 39 ha (96 acres) in landscaped open space. In fact, 93 ha (230 acres) are allocated for development, including 22 ha (54 acres) of retained, public or religious property.

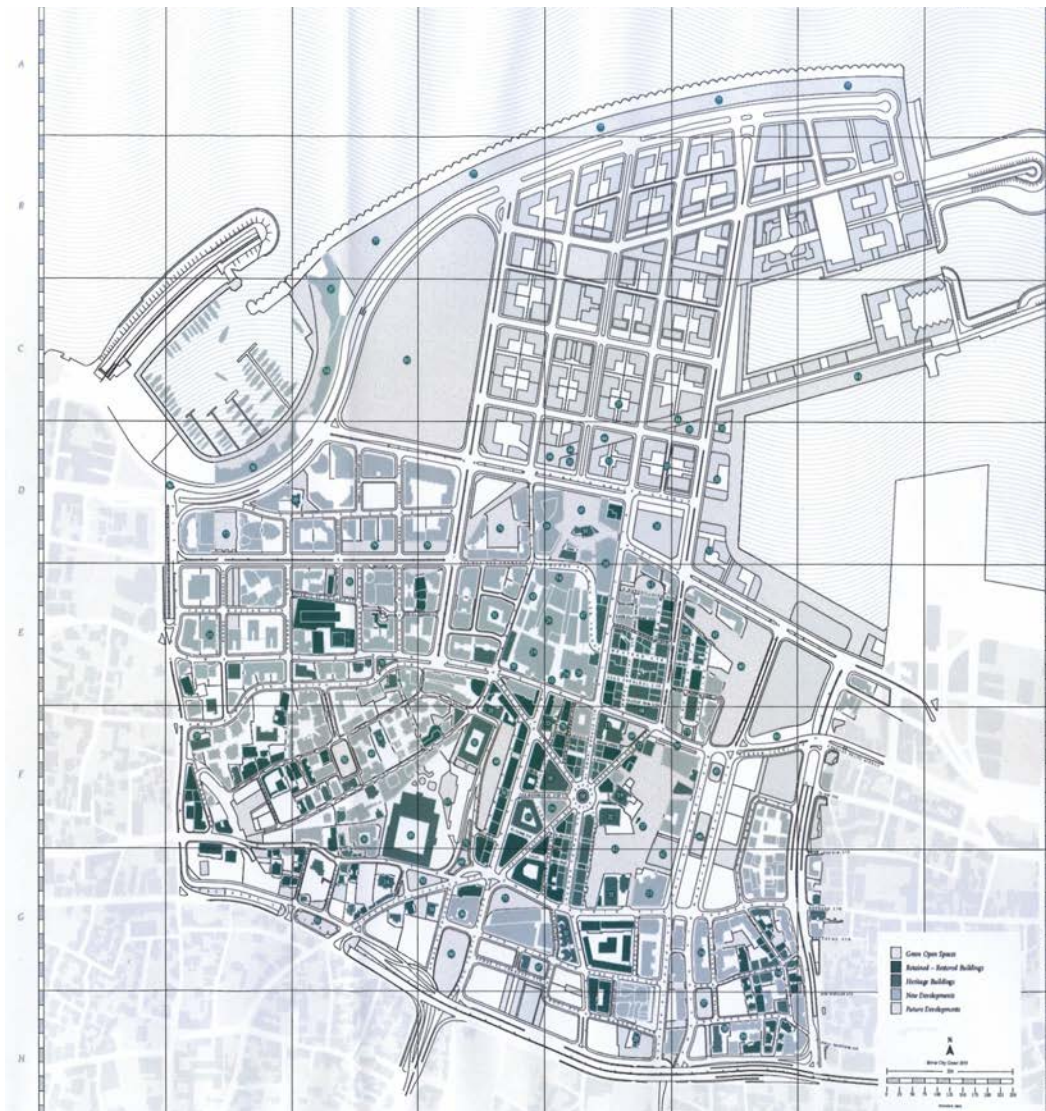


Fig.5.1. The Beirut Central District Masterplan
 Source: Solidere. 2010. "City in Layers." Solidere Annual Report.

The New infrastructure includes Underground power, Storm drainage, Sewage (only area in Beirut where they have different routes), Domestic water Telecommunication and broadband networks (latest technology for internet and TV through fiber optics included in the infra), Street lighting using (using photocells only lighting when its dark out- traffic lights in some areas are controlled by sensors calculating amount of cars passing through the area and thus directing the lights to help make traffic flow more efficient) and improve systems of irrigations.

Also includes: 10year program of environmental reclamation harbor works and sea defense installations to international standards to create the waterfront district, Extensive public space coupled with the sound and necessary urban planning, Tree lined sidewalks, pedestrian walkways

The master plan includes many diversified functions: culture and heritage trails, Civic institutions, Squares and public spaces, Religious buildings, International and foreign institutions, Shopping and dining, Art and music arenas.

5.1.2. Phases of the Masterplan

As explained previously, the masterplan now is in the middle of its journey to completion. It was in fact the plan to have it completed over two phases. Following is the list of tasks to be tackled during each phase.

Phase 1:1994-2004

- Detailed sector planning
- Infrastructural works in the traditional city center and the original landfill treatment and land reclamation works in the Waterfront District, in addition to the marine works, defense structures, Beirut Marina and sea promenades. Landscaping and private underground parking design and execution.
- Restoration of the historic core; renovation of the banking district, Starco and Lazarieh commercial centers.
- Redevelopment of Saifi, Zokak El Blatt and northern Wadi Abou Jamil neighborhoods.
- Beirut Souks design and underground construction.
- Major new real estate projects: UN House, Saifi Village, Embassy Complex, Rue de France multiuse complex, Bank Audi, Medgulf and Bankers' Association

headquarters, Monroe Hotel, Al-Bourj and Atrium office buildings, 24 Avenue du Parc and Park View Realty residential buildings.

Phase 2: 2005-2030

- Completed works
- Consolidation of the urban fabric by developing Beirut Souks, Saifi and Wadi Abou Jamil urban villages, prime new areas in the Serail corridor, Hotel district, Ghalghoul sector and Martyrs' Square Axis.
- Waterfront District: land reclamation, master planning, infrastructure and landscaping design with part delivery, including Corniche car park.
- Major real estate projects: Beirut Souks core, Jewelers' Souk and entertainment center, Marina Towers, Beirut Tower, Platinum Tower, Le Gray and Four Seasons hotels, Zaitunay Bay.

Ongoing projects

- Finalizing landscaping in Hotel District, Wadi Abou Jamil and north of Foch area
- Major real estate projects: Beirut Souks department store and entertainment center, Solidere high-end office building, furnished apartments and other real estate and hospitality developments.
- The Landmark and other gateway towers on the city center southern edge; projects on the Martyrs' Square Axis; northeast gateway towers.
- Waterfront District: finalizing infrastructure, landscaping Corniche promenades and Waterside Park, developing Eastern Marina, launching high-rise developments.
- This phase will mark the internationalization of the project, re-launching Beirut as a world city of the region, a favored location for international businesses,

financial and specialized services and institutions, a tourism destination and a prime residential area.

5.1.3. Existing Aspects of the Masterplan

Areas of the BCD include 876,000 m² of public spaces, 592,000m² of roads and 284,000m² of green spaces distributed on 62 parks. Before Solidere's formation, a survey took place to take into account and identify all the structures that could be preserved.



Fig.5.2. Public spaces in the BCD
Source: Solidere. 2012.

The plan required that those of heritage value be faithfully restored to their original external fabric, while others were permitted some flexibility, including limited

structural additions. Solidere took the lead in the restoration process and affirmed that heritage buildings can survive and create value provided that they are adapted to the needs of contemporary life and business. The city center is conceived not as a single homogenous central district but as a cluster of city quarters or sectors.

The materplan comprises *10 sectors* (8 in the traditional city center and 2 in the waterfront): Each with its own unique character.

- Sector A, Park and Waterside, comprising leisure facilities, two marinas, a city waterside park and a landscaped seaside promenade.
- Sector B, Hotel District, high-density mixed-use area with a number of prominent hotels.
- Sector C, Serail Corridor, mixed-use area of medium density with controls on building height and tiled roof scape preserving a visual corridor to the sea.
- Sector D, New Waterfront District, high-density mixed-use area on reclaimed land, with carefully located high-rise buildings.
- Sector E, Souks, named after the former late Ottoman markets, with the new Beirut Souks as the focus of commercial and shopping activities.
- Sector F, Wadi Abou Jamil, medium-density residential area with new clusters added to a number of retained Levantine houses and buildings.
- Sector G, Conservation Area, forming the political, financial, religious and cultural focus of the city center, with late Ottoman and French Mandate heritage and a zone of high archeological opportunities.
- Sector H, Martyrs' Square Axis, mixed-use district extending along the highly symbolic civic space, aims to reconnect the city and enhance its relation with the New Waterfront.
- Sector I, Saifi Village, with medium-density residential development among

a concentration of retained residential buildings recreating a traditional urban neighborhood.

- Sector J, Ghalghoul and Beirut Trade Center, with gateway buildings planned along its edges to mark key entries to the city center.

High quality design is assured through a pre-selection and listing of approved local and international architects for each individual parcel, and developers are encouraged to run design competitions between chosen architects.

After delivering completed infrastructure and public domain to the Council for Development and Reconstruction (CDR), Solidere provides assistance and supervision when and where needed. It remains in charge of maintenance of open spaces, including the irrigation network and landscaped areas. Damage that occurs to public property around the city is documented and reports to municipal authorities and when commissioned, repair works are carried out at cost.

Solidere offers a multitude of services including the ones offered by the municipality like security surveillance, door to door waste collection, street and sidewalk furniture cleaning, pest control and CCTV surveillance system (cameras) installed to cover all parts of the city center. Further to the above service two regulations were issued to improve the city center image as a whole and maintain the architectural value of its real estate:

- Quinquennial Maintenance Program: requires the refurbishment of the external envelope of all city center buildings on a five-year recurring basis.
- Health and safety regulations on active constructions sites, streets, public domains, and during events held in the city center to ensure the wellbeing of tenants, visitors and the neighborhood as a whole.

Parking facilities are designed as per needed requirements and are scattered

religiously around the BCD area to allow efficient parking as often as possible. In fact the capacities of each parking are as follows:

- Beirut souks capacity: 2,500 spaces
- Khan Antoun bay square parking : 400 spaces (still under construction)
- Weygand street car park (4 levels): 108 spaces
- Harbor square (4 levels): 320 spaces
- Beirut marina parking (under the cornice road): 400 spaces

Commuting shuttles are available free of charge to serve all employees and end-users of the designated parking lots. As seen in figure 5.3 the shuttles make sure to touch base with all corners of the BCD to serve the employees mainly and all users of the BIEL parking generally to reduce traffic jams and provide stakeholders with a comfortable means of transportation to reach their needed destination.

Temporary parking lots pending the completion of sufficient underground spaces, vacant lots provide up to 3,000 spaces in the traditional city and another 3,000 spaces in the eastern section of the waterfront district with a free shuttle service.

Future plans include:

- martyr's square 2,000 spaces (guidelines were developed by its urban consultant Renzo piano building workshop (Italy) and transport planning consultant Ove Arup International (UK). The guidelines consider the integration of the remains of the Petit Serail on site k, the proximity of the car park to the proposed Beirut City Museum north of Martyr's square and the landscape scheme of the square.

- 2 parking facilities for the waterfront district beneath the cornice road and the other beneath the planned city park to provide 1,200 and 800 spaces respectively.

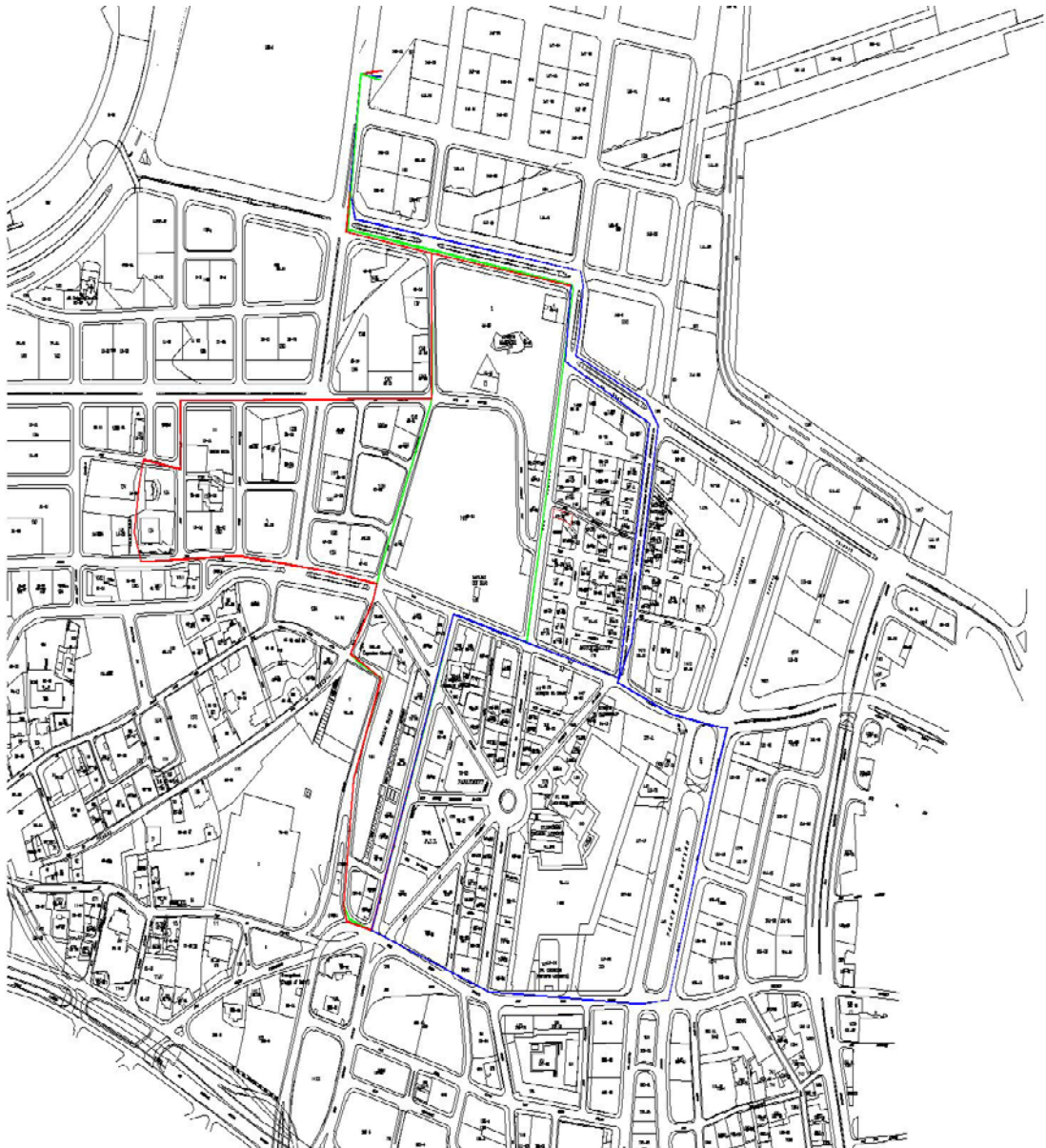


Fig.5.3. Current Alternative Commuting Shuttles Circulation

Rotation of buses every 15 to 20 minutes for all users of the BIEL parking lot.

Buses are monitored and controlled by GPRS for optimum efficiency.

Buses take 3 routes to serve all existing and operating sectors of the BCD

however no bus stop transit facilities are available in the BCD. Shift times and schedules are described in the following table

Table 5.1. Rotation schedule of public buses

Time	Number of buses	Capacity of buses
7:00am to 7:00pm	4 mini buses	11 passengers
7:00am to 7:00pm	2 buses	33 passengers
7:00pm to 11:00pm	2 buses	33 passengers

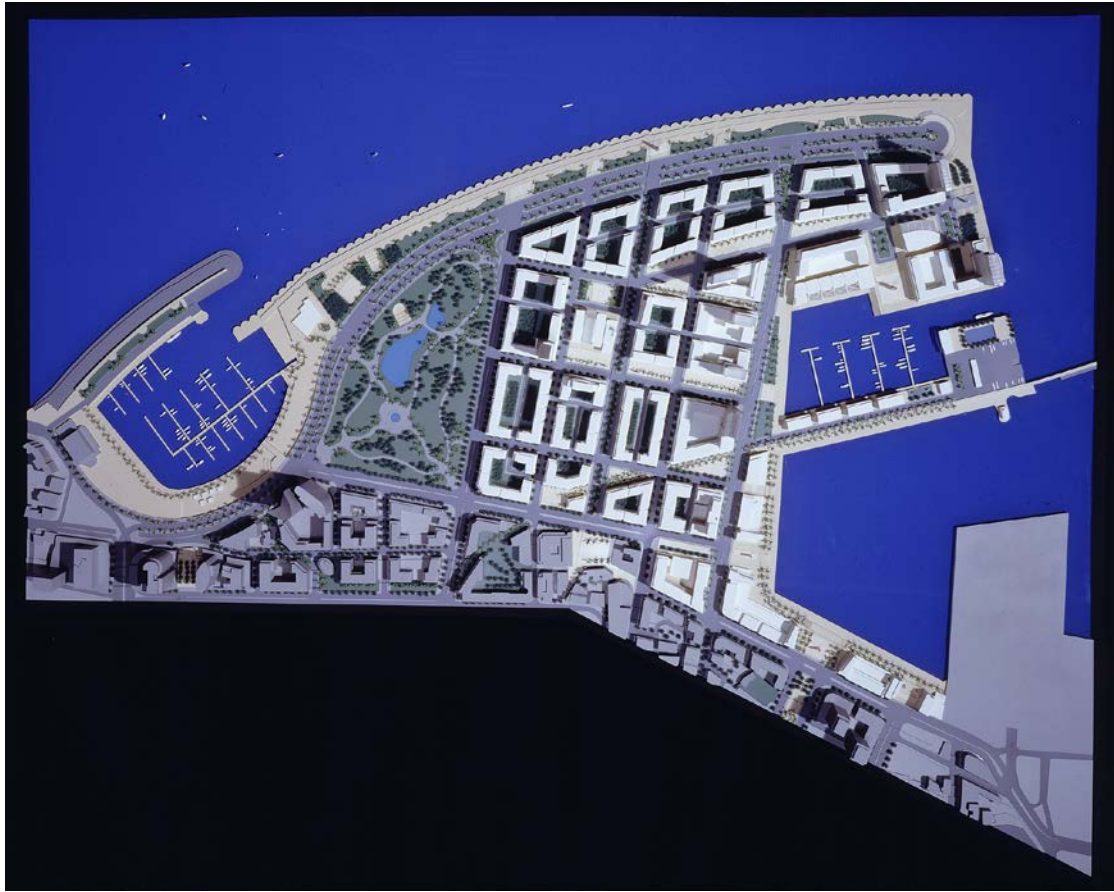


Fig.5.4. A top view of the proposed masterplan of the New Waterfront District
 Source: Solidere. 2012.

The Waterfront district is now an ongoing construction which includes a City park of 80,000 sq.m. as seen in Figure 5.4 above. This 730,000 sq.m of reclaimed land was elaborated in 2001 by a consortium of American firms led by Skidmore Owings and Merrill (SOM) for urban design including Sasaki for landscaping and Parsons Brinckerhoff for transport planning.

The Waterfront District aims to be the new Beirut destination. Commanding spectacular views to the sea and to mountains snowcapped through winter and spring, the 73 ha of reclaimed land, enclosed by a terraced sea defense system able to withstand centennial storms, are designed as a natural continuation of the traditional city center. Some 29 ha of development land will offer 1.7 million sq m BUA to form a prime, active, multiuse district with distinctive architecture.

The development density will be higher than in the traditional city center, with nearly 60 percent of the reclaimed land set aside for public spaces. These consist of a waterside city park, sea corniche, quayside and sea promenades, squares and gardens, plus walking, jogging and cycling trails.



Fig.5.5. A 3D design proposal of the new waterfront design
Source: Solidere. 2012.

Marinas, waterside leisure, lifestyle, cultural and other entertainment are among visitors' attractions. Beirut Marina quays and the 1.3 km-long sea corniche and promenades, varying in width from 45 to 110 m, have become a popular pedestrian area. Upon completion of the Eastern Marina, the city center will offer a 3.5 km uninterrupted extension of the Beirut shoreline, providing more than four times the space of seafront promenade currently available in the city.

Solidere aims to develop the Waterfront District as a model of urban development, as shown in Figure 5.5, destined to become a major destination, the district is already hosting several temporary cultural and leisure activities, as per Beirut Exhibition Center (BEC), a biking and walking trail that leads from the traditional city center to the waterfront promenade, and is planning a number of other cultural and leisure activities along a pedestrian spine.

The waterfront masterplan also included two phases. Phase One (1994 – 2004) saw the completion of marine works, defense structures and sea promenades, the finalization of Beirut Marina, and major advances in landfill treatment and land reclamation. In its part relating to the waterfront district, the Master Plan (ratified by Council of Ministers' decree in 2005) recognizes Beirut as a prime tourist destination and aims to turn the district into a mixed leisure, residential and commercial area. It is based on a 2001 planning study by a consortium of US firms including Skidmore Owings & Merrill (SOM) for urban design, Sasaki for landscaping and Parsons Brinckerhoff for transport planning. Phase Two of the Master Plan (2005 – 2030) has seen the completion of land reclamation and involves finalizing and implementing the district landscaping design and infrastructure. It also includes initiating real estate projects and developing the Eastern Marina.

The Waterfront District infrastructure, including the road network, is planned

for completion by 2014. The detailed design of the Eastern Marina, by Cowi (Denmark), has been completed and approved by CDR. All the structure details were verified by a 3D model test to meet international standard wave and stability criteria. Construction is planned for completion by end 2014.

Chris Blandford Associates (UK) were the winners of a limited competition launched in 2010 to design the landscaped features of all infrastructure and roads, including sidewalks, shared surface and pedestrian streets, medians and traffic islands, streetscape, street furniture, lighting, trees, etc. The landscape concept for the sea corniche promenade is in progress. A natural continuation and termination of the existing Beirut Corniche, the promenade is also the largest street in the Waterfront District, with the strongest relationship to the coast. It will have a great sense of openness and freshness, facing north to the sea with views of the coast and Mount Sannine to the east. A significant green medium will add to its local identity.

The 400-space under corniche car park was opened to the general public in January 2012. The landscape scheme accommodates such car park surface elements as: access via an external staircase and lift from the corniche pavement; planting details; emergency access routes from underground stairwells; and approaches to planting and hard surface at the car park entrance to maintain visibility. Landscape design is being finalized for the Beirut Marina breakwater parking area, boardwalk and quays.

The leading element in creating a significant public domain within the Waterfront District, the 78,000 sq.m waterside city park will also be the largest public green area in Beirut. It was the subject of a design competition among six of the world's leading landscape architectural firms: Land (Italy), Martha Schwartz Partners (US/UK), Olin Studio (US), Sasaki (US), West 8 (Netherlands) and Wirtz (Belgium). The concepts are under study and a winning design will be announced in the future.

Adjacent to Beirut Marina, Zaitunay Bay, owned by Beirut Waterfront Development s.a.l., a 50/50 joint venture between Solidere and Stow Waterfront Development, is conceived as an urban beach extending the Beirut Corniche by a series of overlapping platforms reminiscent of sea waves, to provide outdoor spaces and public areas for artwork.

The quayside facilities on the south include 17 waterside restaurants, five specialty stores, two activity centers and public facilities, totaling 6,000 sq m of floor space. Stretched along the Beirut Marina, the one-story construction remains below street level, its roof forming a continuation of the Corniche.

On the northeast is the apartment and yacht club building, expected to be inaugurated in September 2012. Its 14,000 sq m of floor space over four stories and three basements accommodate 53 serviced and furnished apartments plus a yacht club on upper levels, with commercial space on ground level.

The Eastern Marina Development is an anchor project of the Waterfront District. The site, a prime location, has its north, south and west sides overlooking the Eastern Marina, with the south side also overlooking the Beirut Port First Basin.

The development will incorporate a private luxury and contemporary urban Beach Resort. It will accommodate a resort hotel, plus a residential component comprising serviced condominiums and low-rise residences, cabanas and bungalows, with quayside retail, with views of the traditional city center, the sea and the mountains. It will benefit from landscaped private open space as well as public pedestrian and vehicular access to the marina quay along and parallel to the Ottoman Wall Walk, and be serviced by an underground car park. The architect assigned to the Beach Resort will provide guidelines for the respectively residential condos, commercial and retail components.

Several Developers' Projects are under way or already operational. Ten lots have been sold to third parties on the waterfront. Among them, Mika Land Development, on lot 1493 Marfaa, is under design by Foster + Partners (UK) and R & K Consultants to offer 32,000 sq m of residential space. The project is a mixed use combining retail, offices, residential and entertainment areas. The architect aims to design a green intelligent building, using the most environmental friendly techniques.

Pending infrastructure installation and real estate construction, a variety of cultural, recreational and lifestyle activities have already established the Waterfront District as a destination, with several temporary projects serving to test various land use concepts. Temporary exhibition halls, conference areas, a banquet pavilion and seaside restaurant were earlier built on the northeastern area leased to BIEL until 2013.

Accessed from the existing city center, dedicated tracks pedestrian streets and terraced waterfront promenades allow public walking, jogging, cycling, kiting and similar activities. Structures and open spaces with a wide-ranging program of activities are providing cultural, recreational and commercial attractions. Several plots are concert venues drawing international performers and musicians.

- *Beirut Exhibition Center*: The 1,200 sq m Beirut Exhibition Center (BEC) on blocks 147-01 and 147-08 has featured important art exhibitions since 2010. Developed by Solidere and designed by Makram El-Kadi and Ziad Jamaledine from L.E.FT., the prefabricated structure was reconfigured on the interior, and given a contemporary customized skin of corrugated anodized mirror aluminum. The mirror façades allow the BEC to act as a scale reflecting the continuously changing landscape in the Waterfront District.

- *The One*: A joint venture between Sky Management and Solidere, is a state-of-the-art winter sky bar to be inaugurated by end 2012 on the 3,200 sq.m block 151-01.

Designed by Sari El Khazen, it will stand out as a giant graffiti canvas. Lebanese and international artists will be invited to narrate Beirut's story on the building façade, set to become a work of art.

- Kidzmania: A joint venture between Solidere, Kaztel & Kazma Trading and Kzone Outdoor Advertising Group, the project, extending over 3,000 sq.m, is to offer a theme park for children, where they can play and learn about the world by role-playing in different jobs that make up the sectors of a real city. The project is expected to open by end 2012.

To reinforce this variety of architectural and urban identities and to replicate a natural city development process within a compressed timeframe the masterplan is subject to mixed use policies. They are defined in sector regulations allowing land-use to remain as flexible as possible to meet evolving developers and end-user needs.

Total surface area of the waterfront is of 191 hectares including a target floor space of 4.69 million sq.m. following is the functional repartition of the new under construction area:

- 49.8% residential
- 27.7% office
- 8.5% mixed use
- 6.3% hotel
- 3.8% cultural and governmental
- 3.2% retail
- 0.7% religious

5.1.4. Solidere's Corporate Social Responsibility

Solidere has been significantly involved in community engagement and

development since its inception as part of its mission to redevelop Beirut Central District as an urban anchor for the country. Solidere's Corporate Social Responsibility program today focuses on three core areas: the environment, the community, and local talent.

- *The Environment:*

As part of the efforts to execute on the master plan vision, Solidere was mandated to clean up the Normandy area, a dumping site for the city throughout the 15 years of civil war that accumulated over 5 million cubic meters of waste that almost caused an environmental disaster and seriously endangered marine life. Today, this area, better known as the waterfront, is a major leisure and sports destination for residents and visitors of the city.

The waterfront will also soon host an 80,000sqm public park - the largest in the country. Solidere also made an early and important investment to bring birds back to the city center. It conducted detailed assessments, looked into migratory patterns, and nesting requirements to bring back all the bird types that had historically inhabited the center of the city.

On energy saving standards Solidere at the Beirut souks for example utilizes eco-friendly lighting and decoration for the festive season, while at the waterfront it has been requiring that all new developments adopt a low-carbon strategy moving forward. Furthermore the company is significantly involved in supporting the various environmental and sustainability events and initiatives taking place throughout the year. This includes sponsorship of the National Environment Week and all its underlying initiatives, in partnership with the Ministry of Environment, Earth Day activities and it was one of the first companies to sign up for the Corporate Green Pledge that was based on the recommendations of the United Nations Environment Program for the private

sector in Lebanon.

Solidere was also one of the first companies to announce smoke free offices in 1998. In 2010 an internal recycling program was launched that collects approximately 10 tons of paper annually from all its offices. This program is in fact being extended today to all Beirut Central District tenants who have shown significant interest in this initiative.

- *The Community:*

As part of its restoration efforts in Beirut Central District, Solidere provided financial support to all religious authorities in order to redevelop and reconstruct all their properties without exception. And the city center continues to be a common place where all faiths are openly practiced and celebrated.

The company is also significantly involved around the year with a number of local NGOs and charitable organizations, for example these include Tamanna, Sesobel, Jouzourouna, Brave Heart, and the St Jude Children's Cancer Hospital in which it is a founding member that provides support through various funding programs. Earlier this year, it also supported the inmates in Baabda by providing space for them to perform their widely attended play, Sheherazad.

Souq Al Tayeb has also been a widely successful initiative since the early years. The Souk allows Lebanese farmers to market their products in Beirut and the rest of Lebanon. The Beirut Marathon, sponsored by Solidere has also become a widely anticipated event and meeting point for people from all over the world.

- *Local Talent Development:*

The company organizes every year the Fete De La Musique that aims at providing an outlet and showcase for our young artists and musicians. It also enables the exposure of these talents through street performances and events all year round.

Solidere provides additional support to artists and local talents through the Beirut Exhibition Center, a non-profit art space that hosts the finest works around the year. Also artistic expression is addressed through the display of public art and sponsorship opportunities at the “Venue” which has played host to many young talents that have showcased their work at the Beirut Souks. “Piece Unique” in Saifi Village has also been a platform with new artists being featured almost on a weekly basis.

Solidere also sponsors “Starch”, a fashion store in the Saifi area that allows young fashion students to sell and market their products all year round. More recently, the company has also started supporting the entrepreneurial ecosystem by partnering with important organizations like Arab Net for example.

In line with all these activities, the company is also connected to academia and educational institutions across the country. Solidere regularly sponsors academic events, and is a regular host for interns and student delegations that continuously seek to establish a stronger connection with Beirut Central District. Guests come from around the world, including students and alumni from international universities like Harvard, MIT, Stanford, University of Pennsylvania, Yale, and Duke. Solidere is in fact considering and currently working towards bringing a major Lebanese university to open an extension of its classrooms within Beirut Central District so that the area will be a vibrant space for classes, student interaction, and intellectual activities across the board.

5.2. Filling the Template Using the Data from the B.C.D.

Example of existing criteria qualification:

- *Construction activity pollution prevention:* given the different laws followed by Solidere especially concerning public safety on construction sites and workers safety

regulations (laws provided in appendix) it is clear that this criteria is addressed.

Table 5.2. BCD Masterplan Sustainability Assessment

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
Environmental	Sustainable sites-- Building Exterior and Hardscape Management Plan	Key	x		taken care by both the municipality and Solidere services
	Sustainable sites-- Pest Management Plan	Key	x		Schedule of services implemented by BOECKER while using minimally invasive non toxic substances for all facilities and public spaces all over the BCD area
	Sustainable sites-- Heat Island Reduction	Key		x	not addressed by most building development as they do not use low reflecting roof materials and minimal presence of high-albedo and vegetated roof surfaces
	Energy and Atmosphere-- historic resource preservation and Adaptive Use	Key	x		study done before 1994 was done specifically to assess and make sure to save as many heritage as possible that were structurally sound and historically important.
	Smart location and linkage--Locations with reduced Automobile Dependence	Key		x	no zones specified for reduced automobile dependence. All zones are vehicle accessible
	Sustainable sites-- Alternative Commuting Transportation	Key	x		free service shuttles take stakeholders from parking lots in BIEL around at different shifts during the day. Initiative to be kept for future development.
	Smart location and linkage--bicycle Network and Storage	Key			x

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
	Smart location and linkage--housing and Jobs proximity	Key	x		being the BCD in the heart of Beirut location of the master plan is ideal as a midpoint location for jobs and houses
	neighborhood pattern and Design--Connected and open Community	Key		x	not connected neither internally nor to its neighboring areas. (refer to figure)
	neighborhood pattern and Design--Walkable Streets	Key	x		all streets are well maintained and suited for pedestrian sidewalks
	neighborhood pattern and Design----Compact Development	Key		x	no compact development initiated. Maximization of land development to generate profit.
	Sustainable sites--International Certified Design and Construction	Contributory		x	only a few buildings have applied so far: Beirut terraces, Audi plaza, Audi palladium, 3beirut, pinwheel project. Waterfront district aims to satisfy minimum requirement but with no intent to apply soon. BWD (yacht club) intends to apply for lead.
	Sustainable sites--Site Disturbance—Protect or Restore Open Habitat	Contributory	x		imitative to preserve bird species at place de l'etoile initiated during phase 1.
	Sustainable sites--Construction Activity pollution prevention	Contributory	x		site and safety regulation (yellow folder)
	Sustainable sites--Storm water Quantity Control	Contributory		x	no strategy to manage the criteria
	Sustainable sites--Solar orientation	Contributory		x	accounted for only in the NWD which is only about 45% of the total BCD area.
	Sustainable sites--Light Pollution Reduction	Contributory		x	no initiatives taken
	Water Efficiency--	Contributory		x	only in a few

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
	Minimum Plumbing Fixture and Fitting Efficiency				buildings were installed mixtures that reduce amount of water being consumed and combines air pressure with water to keep comfort of use. In offices 149-150..
	Water Efficiency--Water Performance Measurement	Contributory		x	no initiatives taken
	Water Efficiency--Water Efficient Landscaping	Contributory		x	no initiatives taken
	Water Efficiency--Wastewater management	Contributory		x	no initiatives taken
	Water Efficiency--Cooling Tower Water Management	Contributory		x	no initiatives taken
	Energy and Atmosphere--Energy Efficiency Best Management Practices—Planning, Documentation, and Opportunity Assessment	Contributory	x		a whole unit in charge of sustainability practices handles opportunity basements.
	Energy and Atmosphere--Minimum Energy Efficiency Performance	Contributory		x	no initiatives taken on a general policy level however some initiatives have been implemented like saving energy in the souks by minimizing use of lighting fixtures in parking lot
	Energy and Atmosphere--Infrastructure Energy Efficiency	Contributory		x	no initiatives taken
	Energy and Atmosphere--Fundamental Refrigerant Management	Contributory	x		no CFC based products used in the area
	Energy and Atmosphere--Existing Building Commissioning—	Contributory		x	initiative taken on behalf of solidere only on its owned buildings. Which is a

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
	Investigation and Analysis				small percentage of the area of the BCD. (as seeing in ownership diagram)
	Energy and Atmosphere--Existing Building Commissioning—Implementation	Contributory		x	
	Energy and Atmosphere--Existing Building Commissioning—Ongoing Commissioning	Contributory		x	
	Energy and Atmosphere--Performance Measurement—Building Automation System	Contributory	x		BMS equipment alarms available in most BCD buildings
	Energy and Atmosphere--Existing building reuse	Contributory	x		reuse of historic and heritage buildings is one of the major things solidere is proud of.
	Energy and Atmosphere--Performance Measurement—System Level Metering	Contributory	x		available in most BCD buildings
	Energy and Atmosphere--On-site and Off-site Renewable Energy	Contributory		x	no renewable energy source nor intuitive to be provided in the area
	Energy and Atmosphere--District heating and Cooling	Contributory		x	no initiatives taken
	Materials and Resources--Sustainable Purchasing Policy	Contributory		x	no initiatives taken
	Materials and Resources--Solid Waste Management Policy	Contributory		x	no initiatives taken
	Materials and Resources--recycled Content in infrastructure	Contributory	x		initiative to reuse existing building structure or building in concrete using recycled steel so it can

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
					be considered an addressed initiative
	Smart location and linkage--Wetland and Water body Conservation	Contributory	x		turning toxic landfill into usable site.
	Smart location and linkage--Agricultural Land Conservation	Contributory			N/A
	Smart location and linkage--Floodplain Avoidance	Contributory		x	no initiatives taken
	Smart location and linkage--Brownfield or Landfill redevelopment	Contributory	x		turning toxic landfill into usable site.
	neighborhood pattern and Design--reduced parking footprint	Contributory		x	problem is public awareness in Beirut is not yet mature enough not to use cars and depend on public or sustainable circulation so this factor has both sides: true parking facilities are available and at large BUT they will be underground this way serving the local community needs while reducing heat island effects.. which is in one way what sustainable development about. adapting to current needs as well as minimizing damages for the future.
	neighborhood pattern and Design--transportation Demand management	Contributory	x		existing initiative of encouraging people to use free service shuttle while parking in BIEL
	neighborhood pattern and Design--Local food production	Contributory	x		promotion of souk el tayeab among other temporary events to encourage consumption of local food
	neighborhood pattern and Design--tree-Lined and Shaded	Contributory	x		available all around the BCD

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
	Streets				
Economical	CSR--Cultivate needed talent	Key	x		implemented by solidere
	CSR--Develop new markets	Key	x		implemented by solidere
	CSR--Protect labor welfare	Key	x		implemented by solidere
	Land use--functional compactness	Key		x	maximum exploitation of land to maximize real estate profit
Economical	role of A/E--using your influence as an expert	Contributory	x		solidere- hired engineers and experts from highest ranking companies and academic institutions
	role of A/E--partnership with all-an integrated process of work	Contributory		x	internally departments do not easily coordinate with each other making it a big entity with every department acting on its own making the work process not inclusive and not as efficient as it could be
	role of A/E--creating solutions, improve efficiency	Contributory	x		several departments are dedicated to operating and managing the different issues in the area
	role of A/E--changing the role from problem solver To problem formulator and proposing alternative solutions	Contributory	x		through its CSR solidere is aware of the main aim of enhancing the wellbeing of its stakeholders and thus does initiate redefine the problem as efficiently as possible to find the right solution
	role of A/E--defining all stakeholders affected	Contributory			x

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
					like creating recreational facilities for the serving staff...
	role of A/E--raising awareness and give early warnings to avoid future problems	Contributory	x		through its CSR solidere is aware of the main aim of enhancing the wellbeing of its stakeholders and thus does initiate redefine the problem as efficiently as possible to find the right solution
	CSR--Reduce environmental footprint	Contributory		x	not enough initiatives taken
	CSR--Involve stakeholders in the decision making	Contributory	x		through its CSR solidere is aware of the main aim of enhancing the wellbeing of its stakeholders and thus does initiate redefine the problem as efficiently as possible to find the right solution
	CSR--Green the supply chain	Contributory		x	not enough initiatives taken
	Land use--Demand and supply of property rights	Contributory	x		prime leader in the real estate market
	Land use--City's creditworthiness	Contributory	x		main reason why the BCD regained its international status
	Land use--Securing commitments and Leveraging	Contributory	x		prime leader in the real estate market
	Land use--clear framework for future expansion	Contributory	x		annual reports available yearly to expose all intentions and future projects as well as its financial earnings
	corporate policies--Centrality	Contributory	x		several departments are dedicated to
	corporate policies--Specificity	Contributory	x		operating and managing the different
	corporate policies--	Contributory	x		issues in the area

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
	Proactivity				
	corporate policies-- Voluntarism	Contributory	x		
	corporate policies-- Visibility	Contributory	x		annual reports available yearly to expose all intentions and future projects as well as its financial earnings
Social	pedestrian connectivity	Key		x	pedestrian areas are available but overall connectivity around the area does not exist
	accessibility to public spaces	Key	x		public spaces are accessible to everyone
	protection in public spaces	Key	x		operated and maintained by the municipality and solidere
	Water distribution	Key	x		available and serving the area
	social equity	Key		x	nonexistent since consumers as well as residents belong to the same social class. Creating social inequity with neighboring areas
	Air quality	Key	x		well maintained with minimum gas or motor emissions affecting residents and circulating pedestrians
Social	comfort using major facilities	Contributory	x		high standards applied in all buildings and major centers
	children friendly environment	Contributory		x	pedestrian circulation is not safe enough for children and no public space adequate to serve as a child friendly zone.
	commute distance	Contributory	x		given the BCD been in the heart of Beirut, commute distance for stakeholders is ideal
	comfort in transportation	Contributory	x		buses are well maintained by solidere

“Table 5.2 – Continued”

Template for sustainability thinking using the B.C.D. Master plan					
Pillar	Criteria	Classification	Applied	Not Applied	Qualifications
	facilities				to provide comfort
	availability of green spaces	Contributory	x		available around the BCD
	comfort in green spaces	Contributory		x	not much shaded spaces and lack of services does not provide comfort in the public spaces
	availability of services near public spaces	Contributory		x	no services provided for public spaces
	cleanliness of public spaces	Contributory	x		maintained by the municipality and solidere
	availability of transit facilities	Contributory		x	no transit facilities in the area
	Availability of restaurants, cafes, pubs, etc...	Contributory	x		available as needed in the area
	Availability of shopping malls, food markets, etc...	Contributory	x		available as needed in the area
	Availability of entertainment facilities	Contributory	x		available as needed in the area
	Availability of academic facilities	Contributory	x		Cervantes Spanish learning school as well as elementary school in wadi abu jmil.
	Mobile network coverage	Contributory	x		available and covers the whole area of BCD
	Public cleanliness	Contributory	x		maintained by the municipality and solidere
	City authority communication	Contributory	x		maintained by the municipality and solidere
	Parking facilities	Contributory	x		available as needed
	Road traffic situation/street system	Contributory	x		operated and maintained

The following maps, in Figures 5.6 and 5.7, stand as evidence to the different criteria that address how much of the operations being implemented by Solidere

actually affects the area of the BCD as a whole. As seen in figure 5.6 it is clear that even though Solidere assumes responsibility for the quality of environment in the area, it only implements its own strategies on what is colored in red which is relatively a small percentage. Figure 5.7 mainly illustrates the discontinuity of the pedestrian circulation from one area to another within the vicinity of the BCD. It also shows all of the “shared open spaces” of downtown that do not necessarily aim to include all the public but rather a certain social class to maintain the caliber and standard of living which matches that of whoever is currently residing in the area.

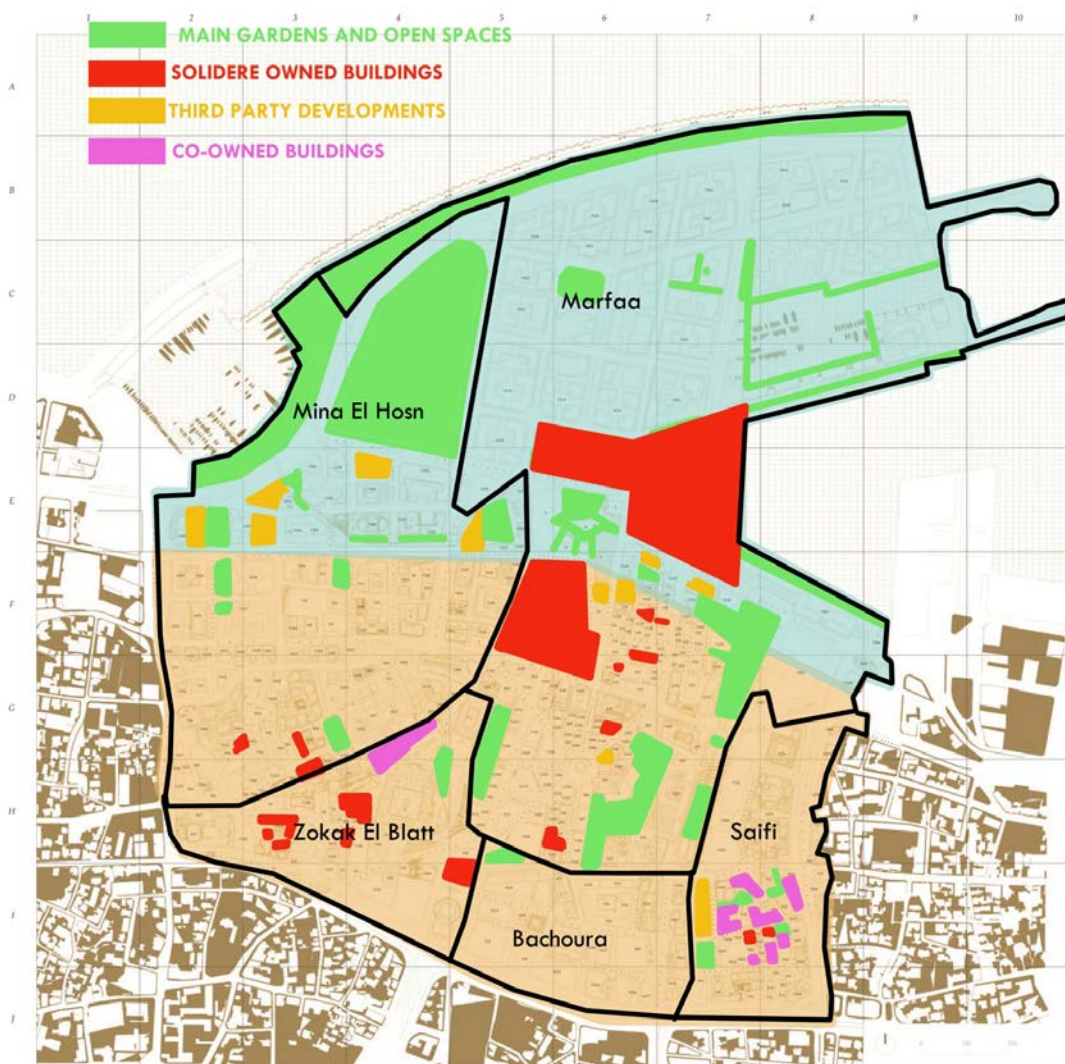


Fig.5.6. Land use Distribution and Ownership in the BCD

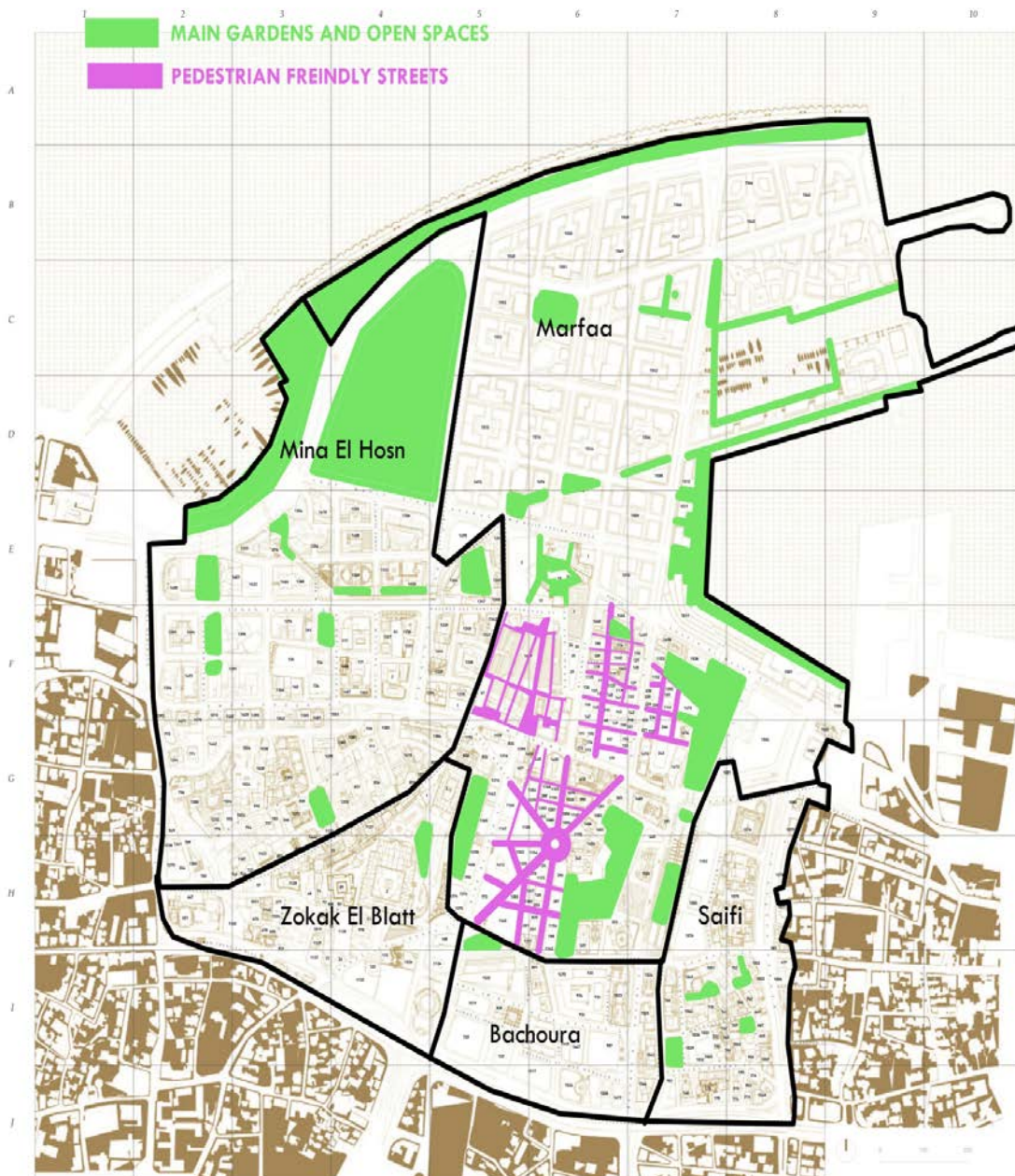


Fig.5.7. Distribution of Open spaces in the BCD

Other Qualifications to be noted are as follows:

- *LEED or any other sustainable standardized certificate designs* do exist in the BCD however they are few compared to the proportion of the area. So far only Beirut terraces, Audi plaza, Audi palladium, 3beirut, pinwheel project are working on

achieving LEED certificates. Waterfront district aims to satisfy minimum requirements but with no intent to apply soon.

- *Solar orientation of buildings* is only accounted for in the waterfront district which is approximately 45% of the BCD area: not enough to consider the criteria satisfied in the environmental pillar.

- *Minimum plumbing fixture and fitting efficiency* is also not addressed because only in a few buildings were installed mixtures that reduce amount of water being consumed and combines air pressure with water to keep comfort of use more specifically in offices 149-150.

- *Energy efficiency management* practices are addressed given the existence of a whole unit in Solidere in charge of sustainability practices on the environmental level.

- *Connected and open community*: clear disconnection between waterfront district and traditional city not making it easy for pedestrians to circulate comfortably from one area to another.

- *Reduced parking footprint*: problem is public awareness in Beirut is not yet mature enough not to use cars and depend on public or sustainable circulation so this factor has both sides: true parking facilities are available and at large BUT they will be underground this way serving the local community needs while reducing heat island effects, which is in one way what sustainable development is about: adapting to current needs as well as minimizing damages for the future. However in this context the criteria itself is still not satisfied and needs to be addressed.

- *Corporate Social Responsibility* is very well addressed especially with the planning and strategy department in Solidere taking care of all aspects to prove Solidere involvement in the community and its intention to be always working on enhancing its

stakeholder's wellbeing.

- *Comfort in green spaces*: although the spaces are quite available and form a fair percentage of the area of the BCD they are often vacant empty spaces due to lack of availability of public services to make the user comfortable and encourage the stakeholder to spend some time enjoying the space. Services like small mobile kiosks, shaded benches and accessible restrooms are not available and it seems to be on purpose for safety and marketing reasons. No matter what the motives are these spaces although existing and well maintained lose their functionality and therefore this is a crucial aspect to be addressed to help make the master plan sustainable.

Further to the application of the template, the below table 5.3 is concluded. It includes all the relevant numbers and percentages as per the template structure explained in Chapter 4.

Table 5.3. Summary of BCD Sustainability Assessment

ENVIRONMENTAL	KEY	6 of 11	54%	5 of 11
	CONTRIBUTORY	13 of 33	39%	20 of 33
	Total	20 of 44	46%	23 of 44
ECONOMICAL	KEY	3 of 4	75%	1 of 4
	CONTRIBUTORY	14 of 18	77%	4 of 18
	Total	17 of 22	77%	5 of 22
SOCIAL	KEY	4 of 6	66%	2 of 6
	CONTRIBUTORY	14 of 18	77%	4 of 18
	Total	18 of 24	75%	6 of 24

5.3. Mitigations

Noting from the above table that out of the key criteria 8 of 25 which approximately is 32% still to address. The following were not addressed in the BCD:

- Environmental key- Heat island reduction
- Environmental key- Bicycle network and storage
- Environmental key- Open and connected community
- Environmental key- Mixed income diverse communities
- Environmental key- Transit facilities
- Economic key- Functional compactness
- Social key - Pedestrian connectivity
- Social key- Social equity

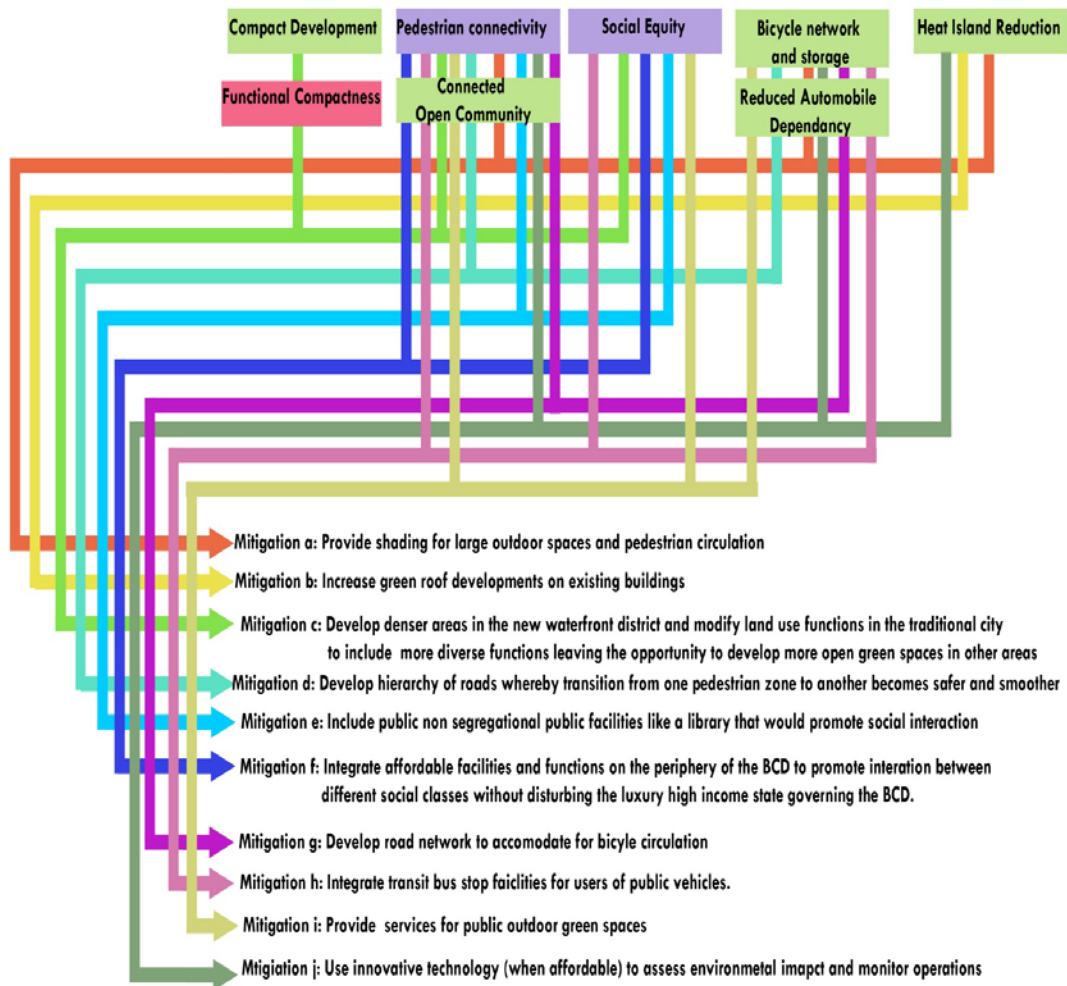


Fig.5.8. Key Mitigations Proposed

Given that the masterplan phase is still half way through and we still have 17 years to reach its target date it would be relevant to start addressing the heat islands existing all around the area more specifically the large temporary parking lots that will later on be moved underground to make way for new development. Currently the parking lots are uncovered, large pieces of land that emit a large quantity of heat. This is harmful not only on an environmental level but also on the social level for all end-users using these parking lots in times of rain or intense heat they have to travel big distances to reach their destinations. Even if Solidere has provided shuttles at the exit points of these parking lots it does not provide the choice for them to walk comfortably and chose to continue a walking journey to their destination because the pedestrian connectivity between the different areas of the BCD is still very weak. It is true that some areas are made exclusively pedestrian but it's the commute between them that is still not safe, pedestrians still have to cross high speed vehicular veins to reach from one district to another. In this context making the transitions more pedestrian friendly concentrating on their safety and comfort is essential. Locating pedestrian crossing zones with traffic lights controlling regularly their movements would help achieve this goal along with off course providing as many shading devices as possible especially concerning the currently big empty vacant lands used for parking.

Solidere has been heavily criticized ever since the beginning of its "elitist" orientation and its very segregating strategies. However one has to not that given the reality of things now. The area of the BCD does include residents that are of a certain caliber and that entails certain needs of security and safety along with a minimum amount of "social filtering" to be able to guarantee a pleasant environment for all its stakeholders. Unfortunately we do not live in a perfect world and we cannot cater for all the need of all Lebanese specially given their own stigma and fear from one another.

However in this context there are still initiatives to be implemented to at least try and merge different Lebanese social classes together. More specially on the peripheries on the BCD where Manara cornice meets Zaitunay Bay, the integration of services where stakeholders can interact and coexist in the same space would be a milestone in social equity.

Enhancing the public green available spaces to become more users friendly is also a very important aspect to address. Adding needed public services as explained in the qualifications above is essential to make these spaces functional and serving the actual needs of its stakeholders.

Sequence of actions:

It is clear that further to the proposed mitigations a plan of action needs to take place. This plan of action will prioritize tasks according to their impact on the masterplan, how complex their implementation is and how costly it will be to be able to apply them.

Many other mitigations can be proposed depending on how qualified the person or entity's expertise, background and creativity. In the case of the mitigations proposed it is noticeable that for instance mitigation d is the most needed mitigation to be addressed as it can solve the main problem of the area: pedestrian connectivity. This easy and comfortable public network once addressed can reduce automobile use, enhance social equity reduce heat island effects among others. However changing an existing masterplan's road hierarchy is very complex and takes time that's why mitigation d is crucial to be planned for but given the circumstances would take more time and finances in fact to be implemented. Given the latter providing shading for the existing pedestrian roads and outdoor spaces (mitigation a) can be addressed directly because it involve considerably less financial support and will impact directly

stakeholders experience in the area. In this manner or way of thinking one can proceed with the rest of the mitigations to be able to produce a proposed schedule for the mitigations to be implemented. Following in figure 5.9 is a timeline illustrating a proposed scenario of action.

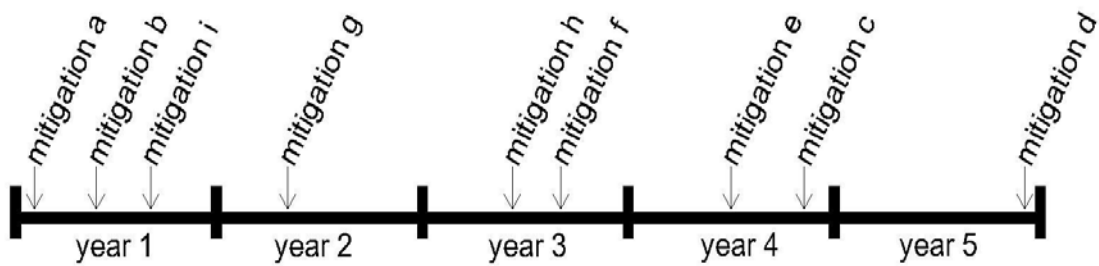


Fig.5.9. Proposed Key Mitigations Timeline

It is concluded that for instance integrating affordable facilities (mitigation f) will take less time than including and providing space for non segregational facilities (mitigation e). In fact mitigation “f” will impact existing rented facilities like shops and converging them to a more middle to low income social class orientation however mitigation “e” will involve a major landmark appropriation and a significant time of work, effort and finances to designate what that function will be and how it will be operated to include the diverse classes of the community.

Concerning the Contributory criteria we realize that their mitigation and solution are quite self-explanatory since they are pillar specific be and addressing them mainly inquires applying the different methods to be able to have a more sustainable outcome. Following in Table 5.4 is a more elaborate explanation of each contributory mitigation.

Table 5.4. Contributory Mitigations Proposed

Template for sustainability thinking using the B.C.D. Master plan			
Pillar	Criteria	Classification	Mitigations
Environmental	Sustainable sites-- International Certified Design and Construction	Contributory	encourage and promote certification of designs for new and operating buildings
Environmental	Sustainable sites--Storm water Quantity Control	Contributory	implement as per international sustainable standards
Environmental	Sustainable sites--Solar orientation	Contributory	can only be addressed in the new waterfront district
Environmental	Sustainable sites--Light Pollution Reduction	Contributory	reduce night time light pollution
Environmental	Water Efficiency--Minimum Plumbing Fixture and Fitting Efficiency	Contributory	implement as per international sustainable standards
Environmental	Water Efficiency--Water Performance Measurement	Contributory	implement as per international sustainable standards
Environmental	Water Efficiency--Water Efficient Landscaping	Contributory	implement as per international sustainable standards
Environmental	Water Efficiency--Wastewater management	Contributory	implement as per international sustainable standards
Environmental	Water Efficiency--Cooling Tower Water Management	Contributory	implement as per international sustainable standards
Environmental	Energy and Atmosphere-- Minimum Energy Efficiency Performance	Contributory	implement as per international sustainable standards
Environmental	Energy and Atmosphere-- Infrastructure Energy Efficiency	Contributory	implement as per international sustainable standards
Environmental	Energy and Atmosphere-- Existing Building Commissioning— Investigation and Analysis	Contributory	develop policies on behalf of municipality to commission the rest of the buildings of the BCD and use SMART technology when affordable to assess and test operations
Environmental	Energy and Atmosphere-- Existing Building Commissioning— Implementation	Contributory	
Environmental	Energy and Atmosphere-- Existing Building Commissioning—Ongoing Commissioning	Contributory	
Environmental	Energy and Atmosphere--On- site and Off-site Renewable Energy	Contributory	investigate if possible and implement whichever method can be applied
Environmental	Energy and Atmosphere-- District heating and Cooling	Contributory	implement as per international sustainable standards

“Table 5.4 – *Continued*”

Template for sustainability thinking using the B.C.D. Master plan			
Pillar	Criteria	Classification	Mitigations
Environmental	Materials and Resources-- Sustainable Purchasing Policy	Contributory	implement as per international sustainable standards
Environmental	Materials and Resources-- Solid Waste Management Policy	Contributory	implement as per international sustainable standards and initiate new innovative ways as per existing world strategies
Environmental	Smart location and linkage-- Agricultural Land Conservation	Contributory	N/A
Environmental	Smart location and linkage-- Floodplain Avoidance	Contributory	implement as per international sustainable standards
Environmental	neighborhood pattern and Design--reduced parking footprint	Contributory	problem is public awareness in Beirut is not yet mature enough not to use cars and depend on public or sustainable circulation so this factor has both sides: true parking facilities are available and at large BUT they will be underground this way serving the local community needs while reducing heat island effects.. which is in one way what sustainable development about. adapting to current needs as well as minimizing damages for the future.
Economical	role of A/E--partnership with all- an integrated process of work	Contributory	develop a more inclusive strategy between departments to make the work more holistic and integrated and thus more efficient and sustainable
Economical	role of A/E--defining all stakeholders affected	Contributory	increase awareness with regards to defining the different stakeholders including all social classes
Economical	CSR--Reduce environmental footprint	Contributory	implement as per international sustainable standards
Economical	CSR--Green the supply chain	Contributory	implement sustainable strategies relating to supply chain management of goods and construction materials

“Table 5.4 – *Continued*”

Template for sustainability thinking using the B.C.D. Master plan			
Pillar	Criteria	Classification	Mitigations
Social	children friendly environment	Contributory	allocated areas that are public and child friendly with the needed services
Social	comfort in green spaces	Contributory	provide services around green spaces as well as shading devices for comfortable seating
Social	availability of services near public spaces	Contributory	provide services around green spaces
Social	availability of transit facilities	Contributory	provide comfortable transit facilities for users of public circulation

One of the major contributory environmental criteria to address is the solid waste management which in the case of Solidere is only addressed in the traditional sense but rather “luxurious” traditional sense. The garbage trucks not only circulate all the residential quarters but actually pass by each privately owned building to collect the waste. This of course might be very efficient and comfortable to the residents but it certainly isn’t economical nor environmental, due to the transportation routes taken by the garbage trucks which entail gas emission and consumption of oil as well as more labor force and labor hours needed. Several options in this case can be applied depending on the availability of financial resources as previously discussed in chapters 2 and 3 like the use of pneumatic tubes. The issue lies here with the immediate action on the patterns of consumption of fuel and also on the process of the solid waste collection.

CHAPTER 6

CONCLUSION

6.1. Summary of Research

Master plans have always been integral into the formation of our cities given their scale complexity and amount of aspects of our daily lives they address. It is the trend now to address sustainable development only at its environmental level and worst yet usually the trend for marketing purposes only disregarding the real aim to enhance the wellbeing of human being and whoever is affected by the facility be it a building, a megaproject, a masterplan , a city or a continent. This research tackled this problem and after a thorough literature review developed the different pillars to be addressed and more specifically the different criteria that must be part of any sustainable masterplan. The methodology resulted in the creation of a template categorized by 3 pillars, each with their relative criteria (key and contributory).

6.2. Conclusion

It is concluded after this production that evidently addressing sustainability entails much more than certifying for standards that clearly address only the environment. It is clear that the social and economic pillars of sustainable development are as important because they address the wellbeing of the people occupying the spaces in question. In fact and further to this thesis, it is noticeable that these realms should be more addressed and perhaps should be equally prioritized when it comes to setting the different sustainable aims and goals of a project.

6.3. Recommendations

It is necessary here to clarify that this topic requires certain qualifications for an entity or even a person to take on such a complex challenge. Handling masterplans or mega urban development naturally will entail the involvement of knowledgeable and academically accredited urban designers and architects as well as experts with background in infrastructure and environmental engineers. Having entities with an enhanced CSR vision and plan of action would also be beneficial to the implementation and application of such a template (be it a governmental entity or a private company/ organization). Making the plan of action in a more inclusive and holistic manner where all involved experts would practice an integrated process of communication to be able to get the job done as efficiently as possible.

6.4. Significance of the Findings

The outcome of the research helps make way to reassessing all existing master plans. It's a mean of evaluating its progress and catching up on any unthought-of of aspects that at the time of its creation were not relevant to address. This research, through the data collected, has highlighted the different aspects and their importance more specifically in clarifying which criteria are key and which are to be considered contributory. In this context, mitigations can take place according to what is needed the most and proportionate to how complex addressing the criteria is. Many aspects play a role in prioritizing this address among which are time, resources available, financial feasibility, etc...

The outcome of this work is an eye-opener regarding pre planning for master plans and anticipating the modifications one design goes through to be able to reach optimum sustainability. As such, this research work will pave the road for a better

understanding of sustainable development as a whole. It will target long term master plans and so that theory and practice become complementary and lead to the most efficient and realistic results that help us create better lives for our societies and the future generations to come.

6.5. Research Challenges/Limitations

Although the template is generic and can be used for all existing master plans, some aspects remain always case sensitive where by some scenarios entail more region specific needs and concerns. And this also applies to the mitigation process where by means of solving unaddressed criteria can also be different from one region to another.

6.6. Future Work

Future Work in regards to this production would be to attempt to propose a way of scoring that would clarify more a masterplan's sustainability status. With further scientific development, and in addition to the current environmental standards helping in c quantifying how sustainable a project is, further research in quantifying the economic and social realms would be quite beneficial to help make the template repeatable and more easily applicable in different circumstances.

REFERENCES

- Azapagic, A., Perdan, S. and Clift, R. 2004 *Sustainable Development in Practice: Case Studies for Engineers and Scientists*. New York: John Wiley & Sons Ltd.
- Blengini, Gian Andrea, Fantoni, Moris, Busto, Mirko, Genon, Giuseppe and Zanetti, Maria Chiara. (2012). "Participatory approach, acceptability and transparency of waste management LCAs: Case studies of Torino and Cuneo". *Waste Management* 32: 1712–1721.
- Bovea, M.D., Ibanez-Forés, V., Gallardo, A. and Colomer-Mendoza, F.J. (2010). "Environmental assessment of alternative municipal solid waste management strategies: A Spanish Case Study". *Waste Management* 30: 2383–2395.
- Brandon, Peter. (2012). "Sustainable development: ignorance is fatal - what don't we know?" *Smart and Sustainable Built Environment* 1(1): 14 – 28.
- Broitman, Dani, Ayalon, Ofira and Kan, Iddo. (2012). "One size fits all? An assessment tool for solid waste management at local and national levels." *Waste Management* 32: 1979–1988.
- Brundtland Commission. 1987. "Towards Sustainable Development." *Our Common Future*. Oslo: United Nations World Commission on Environment and Development; available from <http://worldinbalance.net/intagreements/1987-brundtland.php/>; Internet; accessed 11 June 2012.
- Carew, A.L. and Mitchell, C.A. (2002). "Characterizing undergraduate engineering students' understanding of sustainability." *European Journal of Engineering education*.
- Dryzek, J. (1999). "Transantional democracy". *The Journal of Political Philosophy* 7(1): 30-51.
- Fawcett, A. and Roberts, P. 2002. The institution of engineers. Transactions of a Multidisciplinary Engineering, Australia.
- Futowicz, S.O., Ravetz, J.R. 1999. "Information tools for environmental policy under conditions of complexity". Environmental issues Series No.9, European Environment Agency, Copenhagen.
- Green, M. 2002. "Educating the new engineer." Transactions of a Multidisciplinary Engineering.
- Hosseini, Hossein Mirshojaeian and Shinji Kaneko. (2012). "Causality between pillars of sustainable development: Global stylized facts or regional phenomena?" *Ecological indicators* 14:197-201.

- Joos, W., Carabias, V. Winistoerfer, H. and Stuecheli, A. (1999). "Social aspects of public waste management in Switzerland". *Waste Management* 19: 417-425.
- Joseph, Amita V. (2009). "Successful Examples of Corporate social responsibility. *Indian Journal of Industrial Relations* 44(3): 402-409.
- Kamenetz. 2007. "The green standard? available from <http://www.fastcompany.com/60675/green-standard/>; Internet; accessed 24 August 2012.
- Mezher, Toufic, Tabbara, Samer and Al-Hosany, Nawal. (2010). "An overview of CSR in the renewable energy sector. Examples from the Masdar Initiative in Abu Dhabi" *Management of Environmental Quality: An International Journal* 21(6): 744-760.
- Nkyonya, E., Karsenty, A., Msangi, S., Souza, C., Shah, M., Braun, J. Galford, G. Park, S. (2012). "Sustainable land use for the 21st century". United Nations Department of Economic and Social Affairs- Division for Sustainable Development.
- Omer, Abdeen Mustafa. (2012). "Clean energies development in built environment." *World Journal of Science, Technology and Sustainable Development* 9(1): 45–63.
- Peattie, Ken and Crane, Andrew. (2005). "Green marketing: legend, myth, farce or prophesy?" *Qualitative Market Research: An International Journal* 8(4): 357 – 370.
- Plachciak, Adam. (2010). "Sustainable development in postmodern society". *Economics and Sociology* 3(2): 86-91.
- Powell, Fred. 2012. "'Think globally, act locally': sustainable communities, modernity and development". Springer Science and Business Media B.V.
- Rae, Callum and Bradley, Fiona. (2012). "Energy autonomy in sustainable communities-a review of key issues". *Renewable and Sustainable Energy Reviews* 16(2012): 6497-6506; available from <http://www.ibm.com/ibm/green/>; Internet; accessed 20 August 2012.
- Sembiring, Emenda and Nitivattananon, Vilas. (2010). "Sustainable solid waste management toward an inclusive society: Integration of the informal sector Resources". *Conservation and Recycling* 54: 802–809.
- Sihlongonyane, Mfaniseni Fana. (2009). "Community Development' as a Buzz-Word". *Development in Practice* 19(2)(April): 136-147.
- Sneddon, Chris, Howarth, Richard B. and Norgaard, Richard B. (2006). "Sustainable development in a post-Brundtland world". *Ecological Economics* 57: 253–268.
- Solidere. 2010. "City in Layers." Solidere Annual Report.

- Taylor, E. (1995). "Professional values and attitudes." *Australian Journal of Engineering Education*.
- Turner, Megan M. 2010. "Is LEED a True Leader? Studying the Effectiveness of LEED Certification in Encouraging Green Building." Pomona Senior Theses, Paper 1.
- Udall and Schendler. 2005. "LEED is Broken"; available from http://www.igreenbuild.com/cd_1706.aspx; Internet; accessed 20 August 2012.
- Udall, Randy and Schendler, Auden. 2005. "Leed is Broken – Let's Fix It." *iGreenBuild.com*, August 9; available from http://www.igreenbuild.com/cd_1706.aspx; Internet; accessed on September 2012.
- Williamson, Ian, Enermak, Stig, Jude Wallace and Rajabifard, Abbas. 2010. *Land administration for sustainable development*. ESRI Press Academic.