

Development and Sustainability of Residential Communities (Neighbourhoods) in Egypt, Recommended Criteria and Indicators Drawn from International Trials

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Abstract: This paper adopts an inductive research approach and is divided into two sections. The first section is a theoretical inductive overview of international urban trends aimed at ensuring urban community sustainability and discusses residential neighborhood sustainability assessment tools used by some of the leading countries in this field. The second section examines new urban communities in Egypt according to their expected future development and urban development prospects. It proposes criteria that could be applied to the planning and design of road networks, housing units and site coordination to the sustainability of urban residential neighborhoods (the smallest design units in the study of residential urban community trends from the perspective of sustainability). The research conclusion take the sustainable residential neighborhood design principles and of the connection between sustainability assessment tools and elements of design reveals the existence of criteria that could be used to appraise residential neighborhood sustainability in Egypt. This elements contains "Principal Site Layout, Designing Roads and Paths, Coordination of the Site's General Layout and Housing Units. finally A clear comprehension of the arrange objective, combined with a well-coordinated site facilitates getting clear directions to streets and buildings, promotes the conservation of native character and also the maintenance and maintenance of buildings associate degreed natural sites and creates an economical and comfy setting, all of that contribute to increased satisfaction among the neighborhood.

Keywords: Sustainable Residential Communities, Neighborhood Sustainability Assessment, Urban Development, Environmental Assessment of Residential Communities

1. Methods

The research method here is built upon objectives and hypothesis in order to explain the dissections stated bellow with a reading in the previous results of related subjects, first Research Objective: To explore the tools, experiences and appraisal methods applied internationally in the design of sustainable residential communities in order to develop appropriate tools for assessing residential community sustainability in Egypt, in light of the Egyptian State's present and future urban expansion. Second Research Hypothesis: The process of adapting tools used in other countries to existing conditions in Egypt needs to be carried out locally in accordance with contemporary local conditions.

2. Introduction

The provision and diversification of sustainable housing are the key components of the smart technology development program designed to support different housing configurations and to achieve environmental, social and economic benefits. The program is based on the application of certain principles: mixed-use buildings; compact constructions; extensive housing opportunities; creation of pedestrian areas; creation of distinctive, attractive residential districts that are appreciated; conservation of open spaces, agricultural and Eco-friendly land; reinforcing existing communities; a range of transportation options; anticipating environmental choices and encouraging shared decision-making between

community members and decision-makers concerning environmental issues [1].

The sustainable residential community concept hinges on the coherent use of advanced smart systems and modalities that apply, within a unified general framework, sustainability criteria to the planning and design of residential community elements (layout of the community – road and pathway design – overall perception – housing units – community zoning and partitioning) within a unified general framework.

3. Neighborhood Sustainability Assessment Tools

A number of Neighborhood Sustainability Assessment (NSA) tools are available. Sustainability is appraised by measuring a neighborhood's performance against the indicators of various sets of criteria. Assessment tools are divided into two categories; spin-offs of building assessment tools that assess the sustainability of built environments composed of more than a single building and plan-embedded tools that assess a neighborhood's sustainability based on its planning and sustainability initiatives [2].

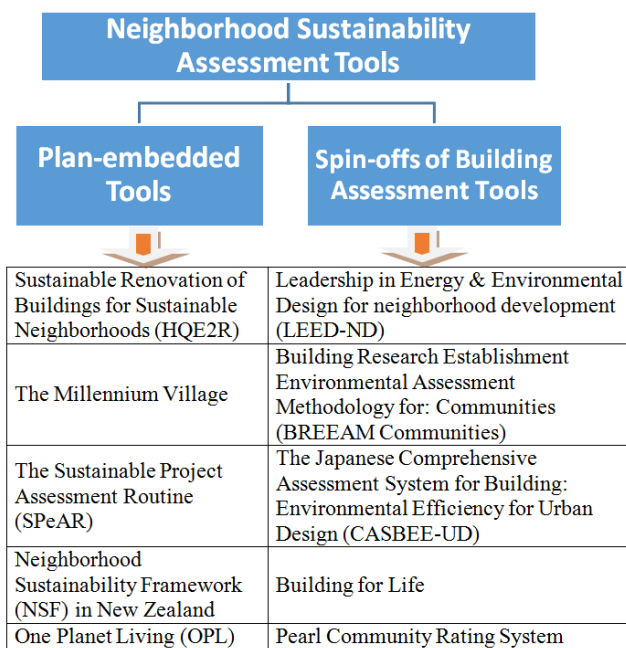


Figure 1. Neighborhood Sustainability Assessment Tools, Source: The Author.

3.1. Neighborhood Sustainability Assessment Tools That Are Spin-offs of Building Assessment

These include a large number of systems developed by various countries; they focus on different study areas, according to the interests, environmental, social and economic conditions of the countries that developed them. This paper reviews the most widespread of these tools.

3.2. Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND)

This American tool aims to establish an international assessment / rating system that incorporates standard criteria for neighborhood development (LEED-ND) within the framework of the LEED tool for green buildings. It can assess small sites (two buildings, for example) as well as entire new cities. The system is based on the principles of smart growth (one of the examples of a neighborhood where the project was applied), urbanization and green building.

The LEED-ND tool covers three major categories: smart location and linkage; neighborhood pattern and design; and green infrastructure and buildings. The focus is on construction (what is being built, and how, to develop the neighborhood). The tool covers two additional categories that are still incomplete: innovation and design process and labeling structural issues of sustainable design [2].

1. LEED-ND Objectives

LEED-ND addresses the three pillars of sustainability (environmental, social and economic). Its objectives are:

- Limiting the spread of urbanization.
- Protection of endangered species.
- Planning and developing new green neighborhoods.
- Creating a positive impression of the residential neighborhood and increasing occupancy rates.
- Reinforcing occupants' sense of place through the provision walkable streets inside the site, and the integration of historic buildings.
- Creating a positive impression of neighbors
- Reducing high rent levels
- Enabling every person working or living in a given community to reap the benefits of sustainable development by providing job opportunities and the curbing health problems.
- Providing a range of transportation options and reducing dependence on private vehicles.
- Promoting the re-development of industrial projects located in the neighborhoods by linking them to the neighborhood site [2].

2. Major Categories Covered by LEED-ND

- Smart location and linkage (location – protection of the natural environment –wetland and water conservation – conservation of agricultural land – avoidance of flooding).
- Neighborhood pattern and design (walkable streets – compact development –neighborhood centers – mixed income levels – reduced parking space – public transit facilities – transportation management – access to public spaces – access to entertainment and recreational facilities – awareness raising and community involvement – local food production – tree-lined streets – neighborhood schools).
- Green infrastructure and buildings (green building certification – buildings with at least minimal energy efficiency – buildings with at least minimal water quality – pollution prevention – natural

landscape areas – re-use of existing buildings – conservation and adaptation of historic resources – minimal disturbances of design and construction processes – reducing hot temperatures that affect delicate species – solar energy orientation – on-site renewable energy sources – cooling and heating area – infrastructure energy efficiency – wastewater management – recycling infrastructure content – management of infrastructure solid waste – reducing light pollution).

- d. Innovation and design process (innovation and optimal performance – LEED accredited specialists).
- e. Regional priority credit (regional priority – social justice and public health) [3].

3.3. Building Research Establishment Environmental Assessment Methodology for: Communities (BREEAM Communities)

BREEAM Communities is a British tool that was developed to assess sustainability of urban communities. A methodology used to assess sustainability and to design certifications using specific criteria that measure environmental development and the supervision of sustainable community development, it emphasizes the objectives of environmental, social and economic sustainability as well as the planning policies that affect project development within built environments. The methodology was extended in 2011 to include strengthening and supporting design during all phases of construction, including master plans of high developmental standards [4].

The BREEAM Communities tool covers five major categories: Social and economic well-being – Land and habitat use – Transport and movement – Resources and energy – Management.



Figure 2. Example of an LEED-ND 2 Project Neighborhood – Heart of Lake, Huixdand Islands, Xiamen, China, Source: <https://www.cnu.org/resources/projects/heart-lake-2015>.

BREEAM Communities Objectives:

The BREEAM Communities tool emphasizes the fact that by assessing development according to the benefits of sustainability and developmental requirements, measurement criteria provide economic and social benefits while minimizing the impact of built environments. Therefore, its objectives are the following:

- a. Sustainable urbanization.

- b. Modification of planning policies that affect development projects in the built environment.
- c. Providing opportunities for projects to explain their environmental, social and economic benefits to local communities during the planning phase of the development project.
- d. Development projects in built environments must display complete credibility concerning the pillars of sustainability (environmental, economic and social).
- e. Use of efficiency criteria to determine sustainability and rating performance levels according to cost [4].
- f. Strive to achieve gains on the economic, social and environmental levels.
- g. Inasmuch as possible, industrial tools, practical applications and other measurement criteria should complement one another in support of political and technological development based on the available skills and at the lowest possible cost.
- h. Consultation with stakeholders to ensure continuous development in keeping with basic principles and modification of performance measurement criteria (due to politics, market regulations and capacity).
- i. Alleviating the negative impact of built environmental development projects.
- j. Adaptation of environmental development projects to local society, economic and social benefits.
- k. Emulation of sustainable development (and sustainable community) requests within the built environment.

BREEAM Communities Categories:

- a. Social and economic well-being: (economic impact – local demographic surveys – assessing flood risks – sound pollution – provision of housing – site layout – supply facilities and comfort amenities – public spaces – local climate – services – adapting to climate change – green infrastructure – local parking – flood risk management – local vernacular – comprehensive design – light pollution – qualifications and job opportunities).
- b. Land and habitat use: (environmental science strategy – land use – water pollution – improving environmental quality / value – natural landscapes – layout – rainwater collection).
- c. Transport and movement (transport assessment – safe, attractive streets – cycling route network – access to public transportation – cycling facilities – public transportation facilities).
- d. Resources and energy: (energy strategies – existing buildings and infrastructure – water strategies – building sustainability – low impact building materials – efficient resources – carbon emissions from transportation).
- e. Management: (program – plan – consultation – consultation and involvement – design revisions – community management of facilities) [5].



Figure 3. Example of a Neighborhood where the BREEAM Communities Project was Applied –Malthusian Project, Malmö, Sweden, Source: <http://www.breeam.org/page.jsp>.

3.4. The Japanese Comprehensive Assessment System for Building: Environmental Efficiency for Urban Design (CASBEE-UD)

CASBEE for Urban Design (CASBEE-UD) is a Japanese tool that measures urban development efficiency. It measures the balance between environmental load (use of resources and environmental impact) and performance and environmental quality (environmental quality and the use of facilities and utilities) to determine the efficiency of the building environment (degree of environmental quality and environmental load performance). This assessment tool can be applied to architectural design, from the pre-design stage all the way through the design and post design stages. It can be used for small groups of buildings (2 to 3 blocs in a neighborhood) as well as for hundreds or thousands of building sites, roads and parks – new cities, for instance [5].

CASBEE-UD covers three categories in the Q sector, which expresses environmental quality and three more categories in the L sector, which expresses environmental load as follows: environmental quality (natural environment, services, local community contribution) and environmental load (environmental impact on local climate, façade and natural landscape, social infrastructure, management of the local environment) [6].

Environmental design efficiency is calculated as follows:

$$\text{CASBEE-UD} = \frac{\text{Environmental quality in urban development (QUD)}}{\text{Environmental load in urban development (LUD)}}$$
 [7].

CASBEE-UD Objectives:

- To assess the environmental design of a group of buildings.
- To assess urban areas of built communities and outdoor spaces [8].

CASBEE-UD Categories:

- Environmental quality (natural environment): conservation of local climate in pedestrian walkways, local topography conservation, conservation of water environment, creating and conserving habitats, other environmental aspects within the designated space.
- Environmental quality (services): performance of supply and treatment systems, information system performance, transport system performance, crime and disaster prevention performance, comfortable day to

day living conditions, layout design considerations.

- Environmental quality (local community contribution): use of local resources, crime and disaster prevention performance, establishment of a sound community, townscape and landscape quality.
- Environmental load (environmental impact on local climate, façade and natural landscape): reducing thermal impact on the outdoor environment of the designated space in the summer, alleviating impact on geological characteristics of the surrounding environment, preventing the effects of air pollution in the surrounding environment, protection against noise, vibrations and odors in the surrounding environment, reducing wind and solar hazards, alleviating the effects of noise pollution in the surrounding environment.
- Environmental load (social infrastructure): minimizing the load on water supply lines, reducing the load on rainwater drainage, reducing the load on wastewater and grey water treatment, reducing the load on waste treatment and management, consideration of traffic movement, using efficient energy throughout the designated space.
- Environmental load (management of the local environment): heeding international warnings, management of environmentally responsible establishments, public transport planning, system monitoring and management [9].

3.5. Building for Life

Building for Life is a British home and neighborhood design assessment tool that uses 20 criteria for assessing the efficiency of design in new housing developments, which reflect the attractiveness and sustainability of home and neighborhood design [10].

Building for Life objectives

- To apply the best alternative for housing units and residential neighborhoods.
- To understand the needs and aspirations of home buyers.
- To identify and eliminate obstacles to good design [11].

Building for Life Categories

- Environment and community (development of community services and utilities such as schools, parks, playgrounds, commercial outlets and cafeterias – promoting accommodation that reflects the needs and aspirations of the local community – easy access to public transportation – development that has a low environmental impact).
- Characteristics (a design that is specific to the scheme / plan – incorporation of existing building plans and natural topography – distinctive plan – easy to find one's way around the site – efficient street plans).
- Streets, parking and pedestrians (building plans accorded priority over streets and parking spaces to reduce domination of highways – parking space design contributes to the street scene – streets that are pedestrian, cycling and car friendly – planned

integration between existing streets and paths and surrounding development – safety of public spaces and pedestrian paths).

- d. Design and construction (well-designed and coordinated public spaces – architecturally sound buildings – internal spaces and planning allow for adaptability, transformation and extension – construction makes use of advanced technologies that maximize the scheme's performance, quality and attractiveness – integration of existing streets into the plan) [11].

3.6. Pearl Community Rating System

A UAE initiative, the Pearl Community Rating System is an assessment tool that aims to promote sustainable development and improve the quality of life. The tool is suitable for development projects that support at least 1000 persons within a permanent residential community [12].



Figure 4. Milton Keynes, Buckinghamshire, England Project, Source: <http://www.builtforlifehomes.org/schemes/go>.

Pearl Community Rating System Objectives

To establish many sustainable communities, cities and international businesses through creating a balance among the four pillars of sustainability (environmental, economic, social and cultural), improving the quality of life and encouraging the reduction of water and energy consumption, waste production, the use of local materials and by improving sustainable and recycled products and resources [12].

Pearl Community Rating System Categories

- a. An integrated development process (collective work – environmental management).
- b. Natural systems (protection of the natural environment).
- c. Livable communities (internal spaces – outdoor

spaces).

- d. Water (efficient distribution of alternative water sources – reducing demand for water).
- e. Energy (energy conservation – renewable energy sources).
- f. Stewarding materials (efficient selection of materials) [12].

4. Plan-embedded Residential Neighborhood Sustainability Assessment Tools, Including Environmental, Economic and Social Aspects

Just like tools that are spin-offs of building assessment, plan-embedded sustainability assessment tools include many systems developed by different countries according to these countries' specific interests, environmental, economic and social conditions. An overview of the most widespread systems is presented below [13].

Sustainable Renovation of Buildings for Sustainable Neighborhoods (HQE2R)

Sustainable Renovation of Buildings for Sustainable Neighborhoods (HQE2R) is a European research and developmental project for renovating urban neighborhoods. The project was developed over a 30-month period (2001 – 2004) in coordination with the Scientific and Technical Center for Building (CSTB) in France, assesses various scenarios and supports decision-making using three subsidiary tools [14].

HQE2R Objectives

To provide opportunities for local authorities to implement work plans and renovate urban neighborhoods and neighborhood buildings within the framework of sustainable development [14].

HQE2R Categories

- a. Conservation of resources (reducing energy consumption and improving energy management – improving management and quality of water resources – avoiding land depletion, improving land management – reducing materials consumption, improving materials management – preservation and enhancement of buildings and natural heritage).
- b. Local environment quality (preservation of the environment, site and visual comfort enhancement – improved housing quality – enhanced cleanliness and health – enhanced safety and risk management – improved air quality – reduced sound pollution – waste minimization).
- c. Reinforce diversity (ensure diversity of the resident population – ensure functional diversity – ensure diversity of housing and supply).
- d. Enhanced integration (raise education levels and enhance job qualifications – improve all residents' access to all city services and facilities by providing

affordable and easy transportation options – enhance the neighborhood's integration in the city by creating meeting places for social interaction among all city inhabitants – avoiding unwanted mobility and improving environmentally friendly mobility infrastructure).

- e. Enhancement of social life [14].

5. The Millennium Village Program for Establishing Sustainable Urban Communities

The Millennium Village Program was developed in the year 2000 and includes seven sustainability categories.

Millennium Village Categories related to Sustainable Development.

Reducing consumption of resources

- a. Protecting and enhancing environmental capital.
- b. Urban design quality and efficiency (creating an efficient environment – cohesive street pattern – quality, high-value buildings – respect for privacy and ensuring safety and security).
- c. Quality living (comprehensive public services, local comfort amenities and public transport – urban management – development of local employment and jobs).
- d. Increased social integration (income levels – social and environmental conditions of homes – diverse housing styles).
- e. Broad participation in governance.
- f. Commercial viability [15].

6. The Sustainable Project Assessment Routine (SPeAR)

In the year 2000, Ove Arup and Partners Ltd developed the SPeAR assessment tool, a methodology for appraising urban projects and assessing their sustainability. It identifies the strengths and weaknesses of urban spaces, provides an assessment of the project site and presents indicators specific to new projects [12].

SPeAR Objective

To review and enhance sustainability opportunities; the methodology has the ability to address the various aspects of sustainability and usually applies performance measurement criteria to 22 points of relevance [13].

SPeAR Categories and Realizing Sustainable Development

- a. Protecting the environment (air quality – land and site uses – water drainage – natural and cultural heritage – building design, construction and operation – transportation infrastructure and affordability).
- b. Exploitation of natural resources (use of materials – water use – energy use – minimization of waste).
- c. Social well-being (health and well-being – overall

configuration and empty space – accessibility – comfort).

- d. Economic viability (transport – workforce availability – effects of competition – financial soundness) [13].

7. Neighborhood Sustainability Framework (NSF) in New Zealand

NSF was developed by Beacon Pathway specifically for New Zealand, which represents a unique built environment. The system or framework addresses built environments, including buildings, infrastructure, open areas such as green spaces and space management [16].

NSF Objectives

To ensure that a neighborhood's built environment is designed, constructed and managed in a way that allows residents to create rich and rewarding living conditions while taking into account natural environment parameters.

NSF Categories within the Framework of Sustainability Pillars

- a. Infrastructure (functional flexibility – use of appropriate resources and climate protection – maximizing bio-physical health).
- b. Buildings and spaces (neighborhood satisfaction – effective governance and civic life).
- c. Neighborhood's urban configuration (minimizing costs) [17].

8. One Planet Living (OPL)

OPL emerged as the developer of the largest zero fossil community, Beddington Zero (fossil) Energy Development (BedZED), in the UK. It was developed by Peabody Trust in cooperation with Bio Regional and ZED factory and implemented in 2002 [18].

OPL Objectives

To promote sustainable environmental, economic and social development.

OPL Assessment Tool Categories

OPL covers ten categories: zero carbon energy, zero waste, sustainable travel and transport, sustainable local materials, sustainable local food, sustainable water use, natural habitats and wildlife, culture and heritage, equity and trade, health and happiness [19].

9. Results & Discussions

The above overview of sustainable residential neighborhood design principles and of the connection between sustainability assessment tools and elements of design reveals the existence of criteria that could be used to appraise residential neighborhood sustainability in Egypt, as follows:

9.1. Principal Site Layout

Protection of the natural environment and wildlife, flood risk assessment and conservation of natural topography.

Wise land management that avoids overexploitation, minimization of thermal effects on external environments and making use of the plans of existing buildings or of the site's topography, planning land use to create functional flexibility and protection against noise pollution.

Minimizing unexploited spaces (average space use is 40% to 50% for housing – 30% to 40% green spaces and services – 15% to 20% roads).

Reducing the number of accesses to and exits from the compound for security and privacy purposes: a single main entrance and a single main exit, from one of the main roads surrounding the compound and a secondary entrance and exit from one of the side streets.

Provision of semi-private gardens for groups of housing units in such a way that the front façade of each unit overlooks the street and its rear façade overlooks a garden.

Allowing for the wind factor in the compound's design; the orientation of roads and housing units should be the same as the prevailing wind direction and natural ventilation should be used in homes and open spaces [20].

Encouraging contact with neighboring compounds and reinforcing it through services and means of transportation while at the same time safeguarding the privacy factor.

Land sub-division and design should be compatible with the general layout design and the needs of housing units and should be in keeping with the size of the units and the category of users.

Appropriate timing of services delivery according to need (daily, weekly, monthly, yearly), beginning at the neighborhood's main central services center and ending at its outskirts.

Using both solar energy and renewable energy for lighting, insulation, cooling and heating.

Waste storage, recycling grey water, providing water control systems from the closest possible water source, water conservation technology and equipment.

Orientation and shaping of building openings to provide optimum natural thermal, ventilation and lighting comfort.

Establishing a main services center that encompasses all public services (commercial, health ...).

Providing public service strips along principal roads; building a neighborhood mosque.

Provision of a complete range of public services, including public transportation and local amenities; developing communal facilities such as schools, parks, recreation spaces, commercial malls and cafes; provision of delivery services and other facilities.

Community involvement: Raising awareness, engagement and dialogue on the local level, local demographic surveys, and community participation in the review and judging of designs and plans [20].

9.2. Designing Roads and Paths

Streamlined, flexible road designs that take into account road network scales within the compound and how they connect to the main entrances.

Vehicles: Should not use more than 10% to 15% of the total surface area of the compound – use of speed detectors –

spots in the compound for providing directions – minimizing monotonous views – road designs that help to reduce driving speed – minimal parking spaces in residential and service areas to encourage walking to these destinations – planting trees on roadsides for shade and aesthetic value – sequential road pattern (main roads and side roads).

Pedestrians: Shaded walkways and paths – a network of pedestrian paths that enables easy and fast access to services – pedestrian walkways that are suitable for special needs persons in the compound).

Create a central public transport hub, as well as stops for public and electric transport in locations that can be reached on foot within 10 to 15 minutes at most.

Street plans that are coherent – planning for public transport – merging plans for new road network with existing roads in the neighborhood – avoid undesirable traffic and upgrade the infrastructure of environmentally friendly transportation.

Facilitate road traffic and minimize parking space – safe, attractive streets – provide protection against crime and traffic accidents – facilitate access to public transport [17].

9.3. Coordination of the Site's General Layout

A clear comprehension of the overall plan objective, combined with a well-coordinated site facilitates obtaining clear directions to streets and buildings, promotes the conservation of local character and the maintenance and upkeep of buildings and natural sites and creates an efficient and comfortable environment, all of which contribute to increased satisfaction within the neighborhood.

Easy access to public open spaces that are designed to promote relaxation –reinforcing security and safety and danger management – provision of services and efficient management.

Historic buildings: Natural and cultural heritage – reuse of existing buildings – conserving historic resources and managing their use.

Conserving local climate in pedestrian spaces in the summertime by minimizing the nefarious effects of wind and sunshine – green open spaces.

Unified architectural style and making use of a variety of design solutions for open spaces and internal roads.

Create view stops by adding parks and public service areas on the main routes of internal road networks.

Create a network of greenery, trees and plant varieties and urban parks or gardens.

Distribute green spaces within the residential compound by creating a green band between two rows of housing units overlooking the green area in addition to a centrally located main green space for the entire residential compound [19].

9.4. Housing Units

Ratio between the size of buildings and land area – housing units should be built at the front of the land lot to do away with outer fences, which helps to identify sections of the general layout more efficiently and constitutes a better use of land that promotes future expansion.

Specifying the number of parking slots for each housing unit.
Grouping housing units according to height.

Using cost-effective materials and technologies (flexible, multi-use spaces, using external open spaces, simplicity of design and execution, optimum exploitation of construction materials, minimizing the length of water and wastewater pipelines and electricity extensions, ensuring that housing units are adapted to environmental conditions, planting rooftops ...) [16].

Optimal performance: Buildings to be awarded Green Building Certification (for highest rate of energy and water efficiency and sustainability).

Building orientation: Promote health and comfort by correct positioning of buildings in relation to the sun's path.

Optimizing housing efficiency: Variety of housing categories, providing appropriate housing for different income and social levels – providing protection against noise, air pollution and earth tremors coming from outside of the location.

Architectural features that give buildings a pleasing aspect.

Facade design and placement of openings in facades: protect privacy and ensure safety and security.

Interior design of architectural units: Interior spaces that are adapted to present day uses and that can be altered to satisfy future needs [20].

10. Conclusion

One of the main conclusions of this study is that the government plays a critical role in overall quality and performance levels of Sustainable development in neighborhood design in Cairo, and in all other governorates in Egypt, since they are managed under the same authority. This does not mean that the government should continue to play the role of a single actor. The influential role of public authorities and the civil society should be emphasized since they are not profit providing spaces and also because urban sustainable development not purposefully designed for yield production. The role of the state should be developing an effective institutional framework, providing awareness to change the user behaviors against damaging the spaces, communicating different views and perceptions, and collaboratively controlling the implementation, planning, and management of the sustainable urban development for the neighborhood design lying in the midst of the compact city of Cairo.

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