

SUSTAINABLE URBAN DESIGN CRITERIA IN MEDIUM-SIZED, COLOMBIAN CITIES

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Abstract. Colombia is an urban country and its cities are facing three main challenges: climate change, population explosion and environmental impact. In addition, Colombian cities currently do not develop their urban environments holistically, instead wasting resources and damaging the environment in which they are located. An alternative to this situation is to build and develop Colombian cities using the concept of sustainable urban planning. Today, the Colombian government is implementing a national policy on urban planning and sustainable building which seeks to guide the design of medium-sized cities towards sustainability. Then, what exactly is the role of sustainable urban design in the development of Colombian Medium-sized cities? For this reason, it is necessary to propose design criteria for medium-sized Colombian cities which is based on three concepts: sustainable design, Smart cities and Form based codes. The objective of this paper is to propose an overview of what this type of design criteria for medium-sized cities, aimed at sustainability, in Colombia, might look like. The result of this research was a conceptualization analysis to identify the variables and criteria for sustainable urban design in medium-sized cities in Colombia.

Keywords: *sustainable urbanism, smart cities, form based code, medium-sized cities, design criteria.*

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1. Introduction

The phenomenon of urbanization in Colombia has gone from expanding cities to compact cities, which makes Colombia an urban country. It is expected that by 2050, there will be approximately 54 million people living in Colombia, of which 85% will be living in cities (DNP, 2012, 4). According to the National Planning Department, by this same date, Colombia will have about 69 medium-sized cities, spread over three mountain ranges and along both the Atlantic and Pacific coasts.

In recent years, Colombian cities have become poles of development and centers of attraction of the population. It has been identified that several of these cities reflect a high GDP growth. As a result, the Colombian government's policies are aimed towards the building of a system of cities within its territory (Barco, 2013). The aim is to generate a greater urban concentration with lower levels of poverty, i.e. to generate inclusive cities.

For these reasons, today such medium-sized cities are not without several problems because of their growth. These problems include: an increase in informality, uncertainty and administrative mismanagement, among others. It is therefore important to highlight the needs of these Colombian Medium-sized cities. These are:

- The need to create regional markets.
- The need for the diversification of activities within the city.
- The need to expand educational provision.
- The need to interact with the rural sector.
- The need for new infrastructure, and the development of public space and equipment.
- The need to connect efficiently mobility, the labor market and productivity.

Even though in Colombia today, the government is implementing a national policy for sustainable urban development, this policy does not define what these cities will be like once sustainable urban patterns are identified, making it necessary to propose such criteria for the suitable design of Colombian cities, grounded on the concept of sustainability.

In this context, Colombia must face the following three major challenges: climate change, population explosion and environmental impact. These three challenges urgently require the application of sustainable urban development principles in the country. As previously explained, the phenomenon of urbanization in Colombia has gone from expanding cities to compact cities, which makes Colombia an urban country.

Designing efficient cities is essential for the development of Colombia in the coming years (Samad, 2012). It will be the basis from which the country can generate an inclusive urbanization process driving an improved quality of life for its inhabitants, in these Medium-sized cities. Thus, it is important to ask, what exactly is the role of sustainable, urban design in the development of Colombian Medium-sized cities?

This scientific article is divided into four parts: in the first part, the methodology applied to the research is briefly described. The second part deals with the partial results that propose criteria for the design of intelligent, sustainable cities in Colombia. The third part develops an intelligent discussion on sustainable cities as a concept for efficiency, competitiveness and sustainability in Colombian Medium-sized cities. Finally, conclusions and references in the document are presented.

2. Methodology

The methodological framework of this research was built upon the study of the concepts of urbanism and sustainable thinking (United Nations, 1993; Fiksel, 2012). To determine the progress of the investigation, a conceptualization was proposed through an analysis of problem trees to identify the variables and criteria for sustainable urban design.

This technique was used to help identify sustainability issues present in Colombian cities, particularly in medium-sized cities, these being the cities that have greatest development process at present. This technique allowed us to identify and organize the information collected, resulting in the creation of a causal relationship model that explains the behavior of the growth of the Colombian medium-sized city.

Furthermore, state of the art study was conducted along different lines of contemporary thought, dealing with the issue of sustainable urban design. Representative cases including the theories of the architect Jan Gehl (1987; 2013) were studied to understand the relationship between man and the city. Design processes of contemporary cities (O'Hare, 2009; Marshall, 2013) was also studied. Finally, theories of design forms based on codes were analyzed, as a tool in the design process and the

planning of cities (Parolek, 2008), as were the proposals and principles of Smart Growth, developed by Andres Duany (2010).

3. Results

Results of the research present a proposed set of criteria to be applied to the design of Medium-sized cities oriented towards sustainability. The proposal states that the design and management of Colombian Medium-sized cities requires the implementation of different tools for their development and proper implementation within the natural environment.

From a strategic urban vision, (Fernández, 1997) this proposal seeks to define a systematic way to address climate change and create the best possible future for Colombian Medium-sized cities. In the meanwhile, this general idea is being exposed. This view is composed of three fundamental concepts that function as tools for the design of an efficient intermediate city. These are: the concept of sustainability, the concept of a smart city and the concept of form-based codes.

- The concept of sustainability: sustainability is understood as the ability of a system to remain throughout time. Regarding the case of Colombian Medium-sized cities, it is hoped that they can establish a balance between social, economic and environmental dimension, so that can be effective in managing their resources.
- The concept of SmartCity: A smart city is defined as one that bases its development on sustainability and is thus able to respond efficiently to the needs of its population, it can minimize environmental impacts and can use innovation oriented technology to solve the two previous requirements. This type of city is also known as an intelligent sustainable city.
- The concept of form-based codes is the process of design and planning of the city in which it seeks to control the configuration, features and functions of the buildings that define and shape public space (FBCI, 2014).

The interrelationship between these three concepts embodies the vision of what is understood of as an intelligent sustainable city (see Graphic No. 1). For a Colombian medium sized city, it can be oriented towards efficiency and then to become an intelligent sustainable city it must meet the following steps (see graphic No. 2):

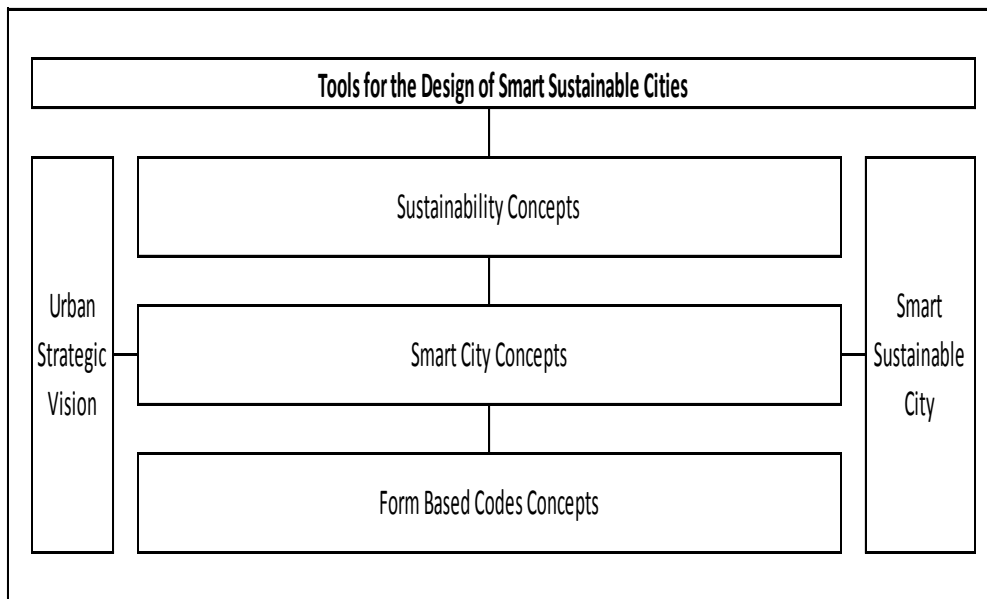
- 1) Analyze the City: the analysis of the city cannot be conducted from conventional methods. It requires an understanding of the social and urban patterns of each city and of the relationships between its inhabitants and the environment. From this understanding, the analysis should be performed by studying the architectural and urban forms of cities. It is also important to understand the public space relationship of built forms to be able to determine sustainability criteria and indicators that can predict balanced scenarios within the various Medium-sized cities.
- 2) Propose strategies: The strategies arise from an analysis of features such as long-term vision, a consideration of the surroundings, the identification of the competitive advantages of the city, the integrated vision of urban reality, the flexibility in urban standards and the identification of critical issues in the city (Fernández, 1997).

3) Propose operations in the city: an action taken regarding the city should be directed to development, revitalization, comprehensive neighborhood improvement, risk mitigation and urban renewal. Although in conventional planning these operations are frequent, they are not geared, for the most part, for comprehensive and strategic vision which guarantees sustainable urban environment quickly and safely.

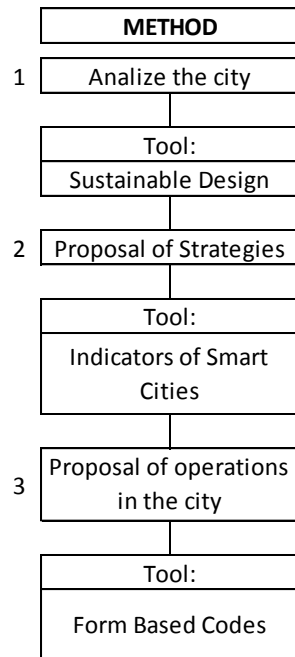
Once the problems present in a city are identified, a set of criteria is to be proposed, based on principles of sustainability that establish an ideal city that we want to create. To do this, three tools are applied including sustainable design. The analysis of sustainability indicators applied to the city and the study the formal language of each medium-sized city's urban patterns.

Then, it must be decided which would be the most appropriate action in the city. To do this, it must first be determined that in practice it is better to act in a certain urban setting of each intermediate city, as these can operate as trigger projects that guide the urban planning for the interconnections of the city easily (See graphic No 3).

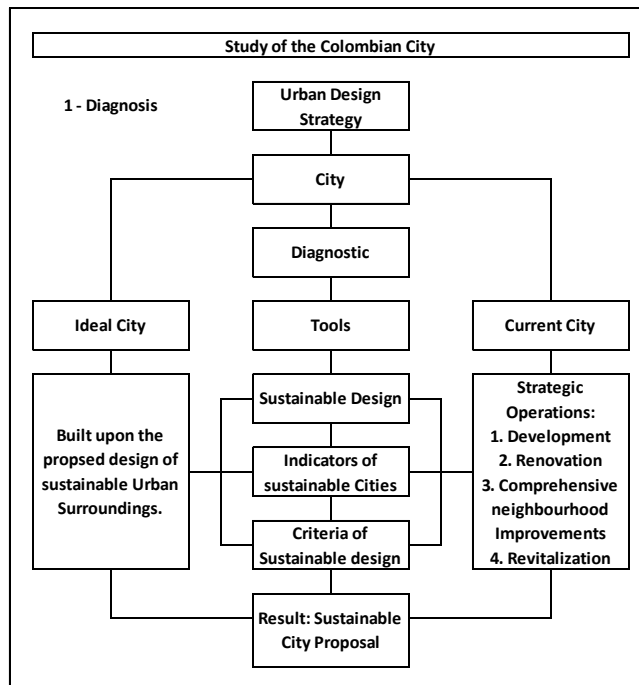
Finally, Graphic No. 4 presents a summary of the key idea expressed in this document, which seeks to systemize the design process of the Colombian medium-sized city. It is important to note that this proposal is still under development and requires further thought on the subject.



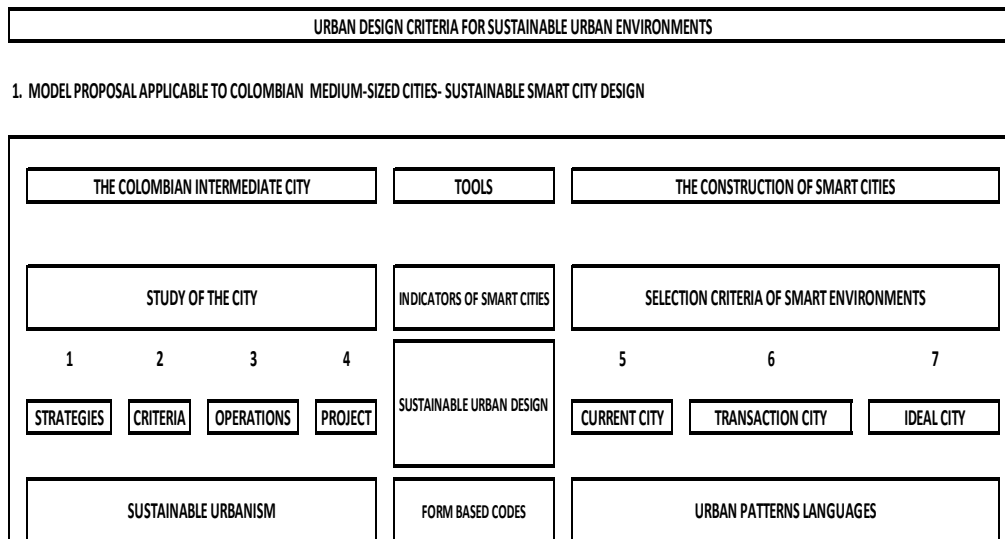
Graphic 1. Tools for designing sustainable cities
Source: Rolando Cubillos



Graphic 2. Steps to design an intelligent sustainable city
Source: Rolando Cubillos



Graphic 3. Process design of intelligent sustainable cities.
Source: Rolando Cubillos



Graphic 4. Proposal for the design of intelligent sustainable cities
Source: Rolando Cubillos

Given the Graphics above, below is presented a primary, broad outline of strategies for the sustainable urban design of Colombian Medium-sized cities, from a study looking at the relations of the three pillars of sustainability:

Urban Design Strategies for the Environmental dimension.

- Propose the development of low-CO2 urbanization.
- Find a balance between the impact and the use of the environment in the city.
- Develop passive and active design strategies for the construction, renovation and recycling of buildings in the city.

Urban Design Strategies for the Social dimension.

- propose responses to the needs of citizens from sustainable urban patterns.
- Sustainable management of land use.
- Balancing urban work activities, health, culture and education to ensure superior quality of life indicators.
- Strive for a harmonious development between the old and the modern.

Urban Design Strategies for the Economic dimension.

- Integration of the public and private sector green economic models.
- Saving Strategies and responsible consumption of urban resources.
- Orientation of industry to responsible environmental intervention.
- Minimize waste generation processes.

Finally, the following Urban Design criteria are proposed from the strategies proposed above:

1) The street, the block, the square, the park and the building are the fundamental elements that make up Colombian medium-sized city. Therefore, these must be designed to define the relationships of its inhabitants considering the three dimensions of sustainability, i.e. to attain a balanced blend of the social, environmental and economic dimensions in a public space.

2) The street in Colombia, particularly in Colombian cities, is one of the urban patterns that have the potential to promote equity and social equality, through good infrastructure. It may provide spaces within the city to improve the environmental dimension, productivity and quality of life.

3) It is essential to give priority to public space in the Colombian medium sized city, because these are the places of excellence of city life. In public areas, the role of buildings cannot be isolated, because the design of the buildings and their relationship with the public space plays a key role in designing and renovating the city (Gehl, 2014). This is particularly true in Colombian Medium-sized cities.

4) The planning and design of the Colombian medium-sized city should be aimed at building a sustainable habitat. That is, it should be directed to meet the needs of the people living within these cities and ensure that these solutions enable people to maintain an excellent quality of life in the city over time.

5) It is necessary to return to the concept of the Low-High Density (Samper, 2002, p.41). This concept has already been applied successfully in the past in some Colombian cities. It is necessary to revise and update this concept considering the principles of sustainable urbanism today, with which they have some overlap. Low-High density allows it to be more consistent with the construction of the compact city, generating densities with lower environmental impact and lower CO₂ emissions, compared to the densification of high density areas which have a very high environmental impact.

4. Discussion

4.1. The need for the implementation of sustainable urban development in Colombia

Colombia is an urban country par excellence. For this reason, a change of view is required regarding how to build the Colombian cities. In this context, the country must address the development of their cities facing three key challenges: climate change, population explosion and environmental impact. Because of its location in the tropics, Colombia is a country extremely vulnerable to climate change, given that it has several ecosystems that are in danger because of this phenomenon, including: coasts, moors, glaciers and dry areas (MAVDT, 2009, pp.10-12).

This phenomenon can have profound consequences for the growth and development of cities. Moreover, it is the low-income population that will suffer its effects in larger proportion. These are the sections of the population who have settled in high risk areas on the outskirts of Colombian cities (MAVDT, 2009, pp.14-16). Colombia faces three risk factors: first, the temperature rises in cities. Second, the change in hydrological dynamics in the country increasing the risk of flooding. Third, the increased health risk due to the high pollution in cities and inadequate management of waste produced by cities.

On the other hand, the population explosion in the country has been increasing over the past 60 years. Indeed, in Colombia 75% of its population live in cities (Samad, 2013). In this respect, both population growth and migration in the country have caused

the concentration of population in cities. The country has 29 cities of over 200,000 inhabitants and 31 cities with over 100,000 inhabitants (DANE, 2014).

According to the National Planning Department (NPD, 2014) Bogota is the largest city in Colombia, with approximately 8.5 million inhabitants (DANE, 2014); followed by three cities with between 1 million to 5 million inhabitants. These cities are: Barranquilla, Cali and Medellin.

Finally, Colombian cities reflect a high environmental impact, because they develop their urban environments holistically, causing a need for change in the patterns of production and consumption of the city: These kinds of patterns do not guarantee that these cities can stand the test of time, due to the wasting of resources and damaging the environment in which they are located.

In this regard, these kinds of cities should implement an efficient urban infrastructure and direct their policies towards optimal quality of urban living. That is, they should guide the construction of urban environments towards generating autonomous and competitive cities at local, regional and global levels. It is important to analyze the life cycle of the city. To orient urban policies towards the efficient management of resources and energy consumption of the city.

An alternative to this is to build and develop Colombian cities from the concept of sustainable urban planning. Sustainable Urbanism is defined as the study and application of the principles of sustainability and resilience in the design and management of the city (Farr, 2007). Eliminating the environmental impact of urban development. Seeking a balance between the built environment and nature.

Likewise, it is important to generate the ability of cities to be resilient in response to climate change. Design and building ought to be focused on resilience principles, which must be applied to the infrastructure, the supply chain and the management of city resources. Such principles are: density, Biophilia, Brokers and sustainable high-performance buildings (Farr, 2007; p.20, pp.112-122).

Indeed, today Colombia is implementing a national policy of planning and sustainable building which seeks to guide the design of the Colombian cities towards sustainability, thus, it seeks to balance the number of issues discussed above (Rodríguez, 2013). However, this search cannot define these cities from the perspective of urban design, rather it focuses on planning. It is necessary to propose criteria for the proper design of cities from the concept of sustainability.

4.2. The importance of the medium-sized city in the development of Colombia

Colombian cities are the engine of growth in the country, given that, $\frac{3}{4}$ of the Colombian population live in cities which generate 85% of GDP of the country (Samad, 2013, p.9-10). As a result, Colombian cities have provided an improvement to the overall quality of life of Colombians and they have become centers of attraction of the population.

Therefore, the development of the entire country represents a challenge for Colombian cities, as it requires the solution of various issues previously discussed, such as: land management, environmental management and protection of the environment. It is also necessary to consider the resettlement of many of its cities due to their current location in areas of elevated risk. These considerations mean that it is important to correct many needs of Colombian cities, such as:

- The need to guide the city towards environmentally responsible production and align the means of production towards innovation.
- The need to develop the city towards virtual and real connectivity.
- The need to solve problems surrounding transport and mobility in Colombian cities.
- The need to think of Colombian cities as a network of cities and the city itself as an open system.
- The need to propose an efficient Colombian city that has the ability to minimize its environmental impact.

Therefore, it is necessary for Colombian cities to be connected at a local, regional, national and international level. To allow these to be competitive, the overall quality of life of the population must be increased and the three challenges facing today Colombian cities responded to.

The World Bank and the National Planning Department state that the three dimensions of cities must be addressed: the social, economic and environmental, covering the three pillars of sustainability and guiding the planning of cities towards this concept. According to these institutions, regarding the social dimension, cities must be designed with the goal of obtaining a balance between the informality and formality of the city. Studies conducted by these two institutions claim that:

"The demographic and economic dynamism of households has had no correspondence with the availability of land and formal housing, where public and private stakeholders concur. As a result, about half of our cities have their origin in the informal sector"(Samad, 2013, p.13).

Therefore, Colombian cities must propose a set of criteria that can solve the problem of informality that is present in the Colombian cities. This requires the recourse to a series of "urban character operations" to ensure proper insertion of the informal sector in cities.

As for the economic dimension, it must be coordinated with government public spending policies so that the city can generate through its urban design balance required in the social dimension. In this context, the studies assert:

"Regional spending has increased in those sectors in which money is assigned for a specific destination, but in others it has become stagnant." (Samad, 2013, p.30).

In this regard the design of the city should be designed to identify a series of indicators of competitiveness, efficiency and quality of life, which ensure that the city can be maintained over time, i.e. they would be sustainable cities.

Finally, the environmental dimension must be accompanied by a series of strategies to enable sustainable urban design which emphasize the balance between Colombian cities with the environment. Thus, the cities will become more efficient in managing their resources. These cities should be a series of interconnected and coordinated sustainable cities, or rather a network of sustainable cities to ensure that their impact is a positive one. Studies about this proposed:

"The implementation of an appropriate coordination strategy is vital to ensure that the development will have a positive impact and will mitigate the impact of events such as

floods and landslides, which can lead to natural disasters in areas of high threat" (Samad, 2013, p.112).

In summary, Colombia has 60 cities, four of which have over 1 million inhabitants, which means that 56 of them can be classified as Medium-sized cities. That is, Colombia is constituted by a series of Medium-sized cities that need to be interconnected and oriented towards efficiency.

We can say that the medium-sized city plays a key role in the development of the country. In this context it would be worth introducing a new concept in the design and development of cities: the smart sustainable city. Next, this concept will be defined.

4.2. Smart sustainable cities as a concept for efficiency, competitiveness and sustainability in Colombian Medium-sized cities

Smart sustainable cities are understood as urban design that seeks to identify differences in the cities in order to develop strategies for their own development and positioning. It is intended that the urban quality, quality of housing and industry are directed to innovation. To do so requires understanding the urban patterns aimed at sustainability, and, identifying the language of construction and development of cities. It also seeks to understand how the shape of the city in terms of its design and planning is coded.

For building Smart cities, human capital, environmental capital and technology must be combined to make the city an efficient and sustainable system. The concept of a smart sustainable city is a tool for identifying the strengths and weaknesses of the cities in the light of globalization processes in search of a competitive equilibrium.

5. Conclusion

The first part of this research sought to enhance the strengths and qualities of Colombian Medium-sized cities, and to generate interest to propose criteria for sustainable urban design by highlighting the values of these cities. Colombian Medium-sized cities are characterized by their diversity, in which significant importance should be given to public space in different dimensions, economic, social, cultural and environmental. It allows for the resolution in Medium-sized cities of many sustainability issues and will enable its residents to enjoy an excellent quality of life.

When the Colombian government intends to build a system of cities, it aims to consolidate the country's development, but also seeks to connect principles of sustainability into its economy. That is why the proposed criteria become important because it provides a direct answer of how management and planning policies could be developed in a concrete way.

On the other hand, today the urban design in Colombia is oriented towards the generation of a compact city, pretending to be consistent with some of the principles of sustainable urbanism. However, this concept has been misunderstood, rather, it has been geared towards high densities without measuring nor gauging neither the environmental impact nor the sustainability impact that urbanization generates.

What is sought with the proposal of these criteria is that the Colombian intermediate city is developed properly, intervening sectors and specific urban pieces that serve as triggers for the development of such cities and allow to positively qualify the transformation processes of these type of cities.

Thus, in the future a second stage of development will be proposed, which will consist in the carrying out of pilot workshops that will be able to validate the initial theoretic plans. In these workshops, the proposed criteria will be revised, new criteria will be proposed along with the analysis and identification of urban dynamics present in Intermediate Colombian cities.

A first area of study will be the medium-sized cities of Girardot, Honda and La Dorada due to their strategic importance. These cities have been chosen to be included in the national government's plans to be, in the future, a strategic region for the economic development of the involved departments. These are: Cundinamarca, Tolima and Caldas.

Moreover, the interest of the national government is the revitalization of the Magdalena River as a navigable corridor and development center (Compes, 2013; Cormagdalena, 2011). Finally, these three Medium-sized cities are in a development process that evaluates the concepts proposed in light of the search for proposing a better urban design for these cities.

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