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Assessing Built Environment Quality at Neighborhood Level in the Design, Construction and Operational Phase

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Abstract. The backbone of the research aims to facilitate the study, the implementation, test and validation of an indicator system based on 10 sustainability-driven challenges capable of assessing the quality of a built environment project: building, neighborhood, large urban regeneration of the city. The innovation, in addition to the systemic approach given by the challenges, lies in considering in the matrix of indicators 3 phases of the project life cycle of the built environment: design phase, construction phase and use (production) phase. The scope of the proposed model is the neighborhood, defining a new system specific for this scale within the management of Built Environment.

INTRODUCTION

This paper aims to define a strategy for monitoring a neighborhood, through an integrated strategy that can integrate the three principles of sustainability (economic, green and social sustainability), to be able to provide a guide to architects and in general. to the design teams when you want to develop a real estate development. The scale of the research, at a spatial level, is that of the neighborhood and the impact phases of the proposed model are defined on the three levels of the project cycle: design phase, construction phase and operational phase.

The prospects of the built environment cannot be separated from the transformations of society and the economy, at a global level (Bolshakov, Plyako, Celani, Azhimova, & Akimov, 2021) [1-11]; these transformations are increasingly rapid, frequent and are characterized by significant and unpredictable impacts. How can a development process make global trends its own and create products that can intercept stakeholder needs? From the post-war period until the beginning of the 2000s, market scenarios were sufficiently predictable, mainly characterized by trends and cycles, by well-defined industrial sectors in terms of demand, supply and competition and by consolidated technologies even if in continuous improvement and enhancement. In this market scenario, companies have developed and progressively refined business models and medium-long term strategies, pursuing growth, efficiency and productivity objectives over time. As a result of this "stability", the physical assets instrumental to the company's activities were designed and built to serve well-defined and time-invariable, specialized, "static" business models, with consolidated formats and mainly owned. The current market scenario, on the other hand, is characterized by sudden and difficult to predict evolutions, by the absence of well-defined trends and cycles, by competitive "arenas", rather than specific industrial sectors, within which mature and consolidated companies compete with emerging subjects that enter the market with innovative products and services, sometimes disruptive, also thanks to the use of new technologies. In this extremely dynamic scenario, companies adopt innovative business models, develop multiple strategies, create new demand and pursue objectives of agility and innovation in "open architecture". In this context, the physical assets instrumental to business activities must necessarily be designed and

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built to be multifunctional and "flexible", to serve strategies that vary over time to encourage multi-disciplinary collaborations between several subjects and support new formats. Real estate assets become part of an offer of integrated value-added services, i.e. productive infrastructure, rather than simple capital goods in property. This new context presents extraordinary challenges and opportunities for the developer and for the entire real estate sector that, in general terms, can be framed in three main areas of intervention: the regeneration of existing stock, the development of new products the creation of value-added services (Ciaramella & Dall'Orso, 2021) [5].

In summary, therefore, in a market phase characterized by a rapidly and unpredictable evolving demand, the developer must invest and work to mature adaptability and agility, his own and the products and services he offers, rather than try his hand at finding trends and cycles through the development of sophisticated forecasting modeling skills. "Marrying" principles of flexibility and managing change requires leadership skills, absolute focus on the product / service and the ability to understand market evolutions and scenarios. The reality of the facts has amply demonstrated that the predictive approach alone is no longer enough. To face an unknown future it will be necessary to develop a "progressive" approach, on the one hand able to understand the needs of stakeholders, on the other systematically experimenting with new products and services to create opportunities in every aspect of the real estate supply chain. In this way it is possible to transform real estate assets into a strategic resource and an integral component of a social and economic ecosystem capable of generating added value for all stakeholders. You can explore a new working model to address development and regeneration initiatives based on these general principles: New technologies offer operators the opportunity to transform their business models, to broaden research horizons and to efficiently and economically access innovative solutions, resources and collaborations. It is about applying the logic of crowdsourcing solutions, technologies and ideas. By adopting an "open architecture" logic based on decentralization, enhancement of information, collaborations and processes, the developer can acquire an increasingly in-depth and complete knowledge of the market and the ability to select the best solutions related to the various aspects of interest, and then expertly integrate them into an optimized system (Barykin, et al., 2021) [1]. The developer's focus is therefore on the creation of in-house skills related to "data science", digitization, collaborative processes and integration of innovative technologies rather than specialized technical know-how. Investments in research and development and great attention to content with the aim of creating new formats, services and real estate products perfectly aligned with demand expectations or even able to generate new market and new demand. Leveraging on new technologies, on the renewed skills of the supply chain and on collaborations with valuable partners, the challenge is to be able to create an innovative offer that on the one hand meets the actual needs of stakeholders and on the other guarantees adequate profitability. Give flexibility in the intended uses, formats, methods of use and operation of real estate products in order to ensure their sustainability and resilience over time. Recognize its importance and therefore develop a high quality architecture understood as the ability to create a durable, contemporary built environment, which meets demand, which guarantees full occupation of spaces, equipped with efficient systems and technologies at low running costs. The container then "serves" the contents, "dresses" them and enhances them. The quality architecture creates the identity of the place reinforces its vocation in perfect harmony with the natural environment and at the service of users and local communities. Supply/demand contract-phase: in order to reduce market risk, demand is preferably contracted and structured prior to the start of development, rather than estimated on the basis of hypothetical scenarios.

Knowing how to innovate becomes a determining competitive factor. But how can good innovation be recognized? We can refer to the results of research conducted by the sociologist Everett Rogers1. Based on these studies, it emerges that the main and fundamental objective of any innovative idea is to be quickly adopted by the market. The faster an idea is adopted, the faster the payback of the investment and the dissemination of benefits to users. In addition, the speed of adoption of the idea puts the innovator ahead of the competitors who will follow. According to Rogers, an idea, in order to be adopted quickly, must possess the five characteristics briefly described below. Benefits offered compared to cost: the innovative idea must generate important tangible benefits for the user. These benefits must be well identified, explained and communicated in such a way as to make them visible and understandable. In the description of the benefits it is necessary to focus on the actual advantages and on the experience that users will experience in adopting the new idea; Simplicity of adoption: the simpler the new idea, the more likely and quickly it will be adopted by the market. Complex and difficult-to-explain ideas are less likely to be adopted, let alone adopted quickly; Compatibility with the life of users. A new idea to be adopted quickly does not have to require the user onerous procedures, changes and laborious adjustments to their tools and lifestyle habits. If the new idea requires too many changes for the user, all at the same time, it is more difficult for it to be quickly adopted; Testability by potential users: the possibility of trying the idea before adopting it and buying it allows you to overcome the barriers of initial distrust. New ideas must be made accessible, sometimes initially even for free, since if the user can try the idea and if the idea is liked it is likely that he will decide to adopt it; Observability by

potential users: for a rapid adoption of the idea it is essential that as many potential users as possible can view it and that therefore they can feel encouraged to test its use. To develop this approach it becomes essential to move from a prescriptive logic, which directs projects to consolidated types, to a performance logic, in which the product must correspond to performances that guide design choices and that can be adapted over time to a context that can be very changeable. With this approach, real estate assets become the tools with which the operator, based on its capacity and available technological solutions, meets people's expectations in terms of services, experiences and opportunities.

Considering the need to establish a standard to calculate the quality that is not only one-dimensional of a real estate development or relating to a single aspect of sustainability. A trend in the literature is observed that address single issues or the issues of quality at the building level and not at the level of neighborhood considering all aspects of sustainability (environmental, social and economic). Examples of district-level monitoring models that deal with particular aspects are observed in the literature, but there are no series of indicators that highlight guides for designers or for the Public Administration to assess the quality of projects. The indicators of the social condition of the neighborhood (Glassman, 2020) (Gadiaga, 2021) [8,9] are focused on the state of the social conditions of the neighborhoods in terms of quality of life, which is defined according to the principles contained in the theories of Urban Planning (Serag El Din, Shalaby, Hend Elsayed, & Elariane, 2012) [11] in which they are considered interdependent dimensions that contribute to a definition of quality in the neighborhoods.

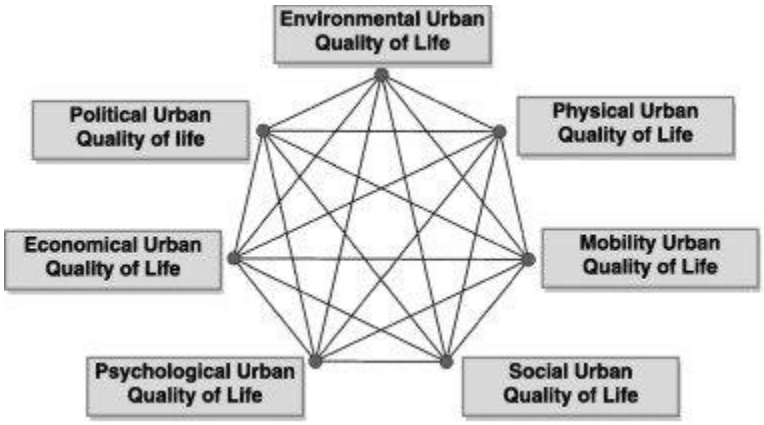

FIGURE 1. Urban Quality of Life dimensions **(Serag El Din, Shalaby, Hend Elsayed, & Elariane, 2012)** [11]

Here we distinguish the definition of seven dimensions that can better specify what was communicated at the beginning of this paper as three characteristics of sustainability (Economic, green and social) better addressing the issues within the scope of our study:

- Environmental Urban Quality of Life
- Physical Urban Quality of Life
- Mobility Urban Quality of Life
- Social Urban Quality of Life
- Psychological Urban Quality of Life
- Economical Urban Quality of Life
- Political Urban Quality of Life

Surely the definitions listed above help to address the themes within the research considering how these categories could be defined in a technical way. The question at this point may be: "How can we calculate and quantify the seven quality points already listed?".

METHOD

The research (Fomina & Lugovskoy, 2020) [7] analyses the category "quality of the living environment" understood as "the satisfaction of the population with their life in terms of various needs and interests", after analysing the following indicators:

TABLE 1. Indicators of urban quality according to (Fomina & Lugovskoy, 2020) [7]

INDICATOR	CARACTHERISTICS
General Index of Attractiveness of Cities (GIAC): based on 41 indicators	Information missing about the backbone of the model in literature
The Urban Environment Quality Index formed by the Ministry of Construction and Housing and Utilities of the Russian federation	Based on 6 spaces: residential and adjacent spaces, street networks, Green Spaces, Public and Business infrastructure and adjacent spaces, Social and leisure infrastructure and adjacent spaces, Citywide space Based on 6 criteria: safety, comfort, environmental friendliness and health, Identity and Variety, Contemporary relevance of the urban environment, Efficiency of government. The sum are 36 indicators with a maximum score of 360 points. A dedicated website with results published on a map for each city.

This article aims to compare these indicators and then integrate them with proposals that can lead to a proposal for a set of indicators at the neighborhood scale and potential additions will be considered with the set of indicators already seen in the review.
The study and assessment of the quality of the built environment at the level of the neighborhood scale passes through the definition of an evaluation strategy, even before a set of indicators. At the method level, we can hypothesize a system that by the Institutions that prescinds from a system of indicators understood as measurable KPIs imposed by those who must control and assess. The ideal starting point can be that of the table just set out, integrating with the challenges proposed by the international competition "Reinventing Cities", considering as the ideal the approach that had as a methodology the request to the teams participating in the competition to draw up a set of indicators for the following challenges (Celani, 2021) [4]:

1. Energy efficiency and low-carbon energy (mandatory);
2. Life cycle assessment and sustainable materials management (mandatory);
3. Low-carbon mobility;
4. Climate resilience and adaptation;
5. Ecological services for the neighborhood and green jobs;
6. Sustainable water management;
7. Sustainable waste management;
8. Biodiversity, urban re-vegetation and agriculture;
9. Inclusive actions, social benefits and community engagement;
10. Innovative architecture and urban design.

Also considering that each team participating in the competition must produce a set of indicators and indicate the calculation methods for each of the three phases of the project:
1. Design phase
2. Construction Phase
3. Phase of life of the neighborhood/activity

RESULTS

In this phase the 10 challenges proposed by Reinventing Cities (C40, 2019) [3], and already mentioned, for innovation objectives and proposals are analyzed putting in relationship the aim with possible innovation proposal. For each challenge the set of parameters in terms of innovation proposal has been analyzed. the choice fell on the analysis of the Reinventing cities indicators as they fell on the neighborhood scale and allow the determination of concrete innovation proposals that can be of help to architects and project teams.

TABLE 2. Reinventing cities Challenge 1

AIM	INNOVATION PROPOSAL
Reduction of greenhouse gas emissions and the environmental impact of energy production and consumption	Energy strategy based on: • Passive design and efficiency in the shape and fabric of the building; • Energy efficient devices / equipment; • Occupant control, monitoring and evaluation of energy consumption; • Production and consumption of renewable energy in situ and externally; • Energy storage;

The reduction of carbon emissions inherent in the project is the scope of this challenge which is characterized by the design and management choices of the construction site. The production process of the building asset is considered in the phases of construction, transport of building materials. The construction and disposal operations of the building asset in its end-of-cycle phase are subject to the required assessments.

TABLE 3. Reinventing cities challenge 2

AIM	INNOVATION PROPOSAL
Reduction of carbon emissions inherent in the project throughout the life cycle of the building or public spaces	Participating teams are asked to develop an energy strategy by developing the following aspects: the. i. Passive design and efficiency in the shape and fabric of the building ii. Energy efficient devices / equipment iii. Occupant control, monitoring and evaluation of energy consumption iv. Production and consumption of renewable energy in situ and externally v. Energy storage vi. Benefits for society related to sustainable energy

The aspects of sustainable mobility are considered in challenge 3 with a strong focus on low emissions mobility.

TABLE 4. Reinventing cities challenge 3

AIM	INNOVATION PROPOSAL
Promotion of sustainable mobility and definition of innovative ways to promote mobility with low environmental impact	Participating teams are asked to develop incentives for sustainable mobility within the projects: the. Ì. Walking ii. By bike iii. Public transport iv. Electric or low-emission shared vehicles The discouragement of the use of means of transport powered by fossil fuels is promoted (disincentivizing/ decarbonization line) The integration of choices relating to sustainable mobility with the needs of the modern city is promoted: prosperous and safe for climatic aspects.

Climate-Related risks are considered in challenge 4 in order to stress the idea of resilience into the project.

TABLE 5. Reinventing cities challenge 4

AIM	INNOVATION PROPOSAL
Development of a resilient project with respect to current and future climate risks	Participating teams are required to integrate climate resilience measures within the projects, in particular the project must be resilient to risks: the. i. Raising the temperature ii. Increase in the intensity and frequency of winds and storms ii. Floods iii. Raising of the level of the tide and phenomena of drought A climate change assessment is requested which defines the climatic risks to which the specific site is exposed according to the two coordinates: • Possible scenarios of climate change • Specific time horizons Resilience must involve two aspects: • Resilience of the occupants (planting, creation of shaded areas) • Building resilience (action on foundations, consideration of the potential impacts of drought on the stability of building materials, implementation of a modular design The installation of mechanisms for the evacuation of water, basins or the creation of permeable surfaces should also be considered.

The area of services is considered in challenge 5. The focus is on services, in terms of support to community and facility management-related innovations.

TABLE 6. Reinventing cities challenge 5

AIM	INNOVATION PROPOSAL
Exploitation of the site for the development of new ecological services for the area, functional to the promotion of a more sustainable lifestyle and consumption habits, to reduce the environmental impact of the city and to encourage new forms of green work. The site must be a catalyst that allows the development of innovative green services.	The innovation proposal must be based on innovative proposals that take into account: • Supply and export of clean energy; • Sustainable waste management services; • Shared economy services; • New or improved public spaces; • Green transport; • Urban agriculture; • Education for sustainability (Orozco-Messana, de la Poza-Plaza, & Calabuig-Moreno, 2020) (De la Poza, Merello, Barbera, & Celani, 2021) [6,10]; ecosystem services; • Services and activities that encourage sustainable consumption habits The formulation of the proposals must also integrate aspects that are not simply directly correlated with ecological sustainability but with the encouragement of green habits. The project must also integrate the possibility of creating: • Professions that work responsibly by exploiting experiences that the site can generate • Creative Fab Labs in the green field • Shared spaces for craftsmen • Production and sale of neighborhood products

The topic of water is considered in two ways: water consumption and resilience to atmospheric events.

TABLE 7. Reinventing cities challenge 6

AIM	INNOVATION PROPOSAL
Reduction of water consumption and management of water resources in a sustainable way. Understanding and forecasting of climate change in the next 30 years and relationship with the impact on the chosen site.	The innovation proposal must consider: • Supply materials • Water consumption control systems • effective systems for water evacuation • Increase in permeable surfaces to avoid flooding of the areas • Management of the effects arising from atmospheric phenomena that produce an excess of water • Management and prevention of possible flooding of the city network • Adaptability of the project to the increasing probability of flooding You are asked to identify the major sources of water consumption of your project. For each of these sources, it is requested to indicate which water resources management measures have been put in place to conserve the resource.

The topic of waste management is included in challenge 7 and it is related to strategies at design level and operational innovations.

TABLE 8. Reinventing cities challenge 7

AIM	INNOVATION PROPOSAL
Accelerating the transition to a zero-waste city, developing a sustainable waste management system for the operational phase of the project. Reduction of greenhouse gas emissions, reduction of the extraction of limited resources and consumption of fossil fuels.	• Promotion of behaviors in the operational phase that include activities that favor waste management: • Process innovation (innovative waste cycle management systems) • Product innovation (ICT tools, IoT etc ...) • Composting plants, in situ anaerobic management, gardens and vegetable gardens for local consumption • Circular economy approaches (reparability and recyclability) • Integration with local FabLabs

Biodiversity in terms of management of operations in terms of vegetation and agriculture in the neighborhood is the topic of challenge 8. It is connected also to the design phase but it has important connections to the education and use of the facilities during the phase of life of the neighborhood.

TABLE 9. Reinventing cities challenge 8

AIM	INNOVATION PROPOSAL
Protection of biodiversity and development of urban vegetation and agriculture to mitigate climate risks and promote environmental sustainability	• Promotion and recovery of local plant species • Promotion and recovery of local ecological habitats • Citizen education programs • Integration with municipal and regional education programs • Public accessibility of green surfaces • Models for the promotion of local green production • Encouragement of applied scientific research

Inclusion is the topic of challenge 9, in terms of accessibility of spaces and initiative by all the citizens.

TABLE 10. Reinventing cities challenge 9

AIM	INNOVATION PROPOSAL
Development of inclusive services and interventions that meet the needs of the local population and involve the local community itself and its actors in the implementation of the project	• Projects in favor of the health and well-being of citizens • Mixed use of spaces • Involvement of the local community in the decision making process • Development of an involvement strategy in the three phases of the project (project-construction site-operational) • Implementation of alternative solutions to promote virtuous lifestyles and social inclusion • Inclusive integration of all users in the decision-making process and in the possibility of using the spaces • Use of technology to fulfill the needs of citizens' involvement in decisions

Challenge 10 is the more classical challenge, related to the idea of Architecture as discipline for innovating quality of spaces, in terms of use of materials also and integration with infrastructures.

TABLE 11. Reinventing cities challenge 10

AIM	INNOVATION PROPOSAL
Combination of environmental performance with high quality architecture and urban design	• Use of innovative materials • Use of integrated technology in innovative design • Good use of available spaces through design • Use of recyclable materials • Integration with existing networks and systems (eg cycle paths or parks)

CONCLUSION

The definition of a kit of indicators for monitoring the built environment in the neighborhood differs from the other monitoring methods for larger areas or buildings. The scale of the intervention makes a big difference and an organized methodological structure is required that first of all includes the three life stages of real estate development: project phase, construction phase and neighborhood life phase. The integration between different aspects of sustainability can be defined through a scheme that accompanies any real estate development that includes the scale of the neighborhood. The model proposed by this article gives the opportunity to integrate the interest of stakeholders with those of the municipality and with those of the developer and service providers in a virtuous way. Thus, challenge 1 and 2 also consider the aspect of the building and not just the neighborhood, providing, in the focus provided by this paper, a complete view of everything that insists on the development area. In this way, a real estate development model is proposed and opens up to the city and actively considers all the life phases of the project, also including the life phase that potentially goes from the delivery of the building objects to the future.

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