



A multi-criteria approach to compare urban renewal scenarios for an existing neighborhood. Case study in Lausanne (Switzerland)



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ABSTRACT

The post-industrial European city is characterized by dispersed urbanization, resulting in increased travel, substantial use of land, social disparities and costs that are unsustainable in the long term. Consequently, most European countries have set the goal of limiting urban sprawl by prioritizing increased density in already built-up areas. To achieve this goal, it is not enough to build new buildings in the urban lots that are still available. Efforts to increase the density of existing neighborhoods are also needed. These actions represent an important opportunity for ensuring sustainability through the simultaneous integration of socio-cultural, economic, and environmental criteria in our cities. This paper presents the evaluative approach applied to a case study carried out in the Fleurettes neighborhood, located near the train station in Lausanne, Switzerland. It demonstrates how carrying out a structured sustainability assessment of an existing neighborhood as well as a multi-criteria comparison of three possible scenarios using a tool recently developed known as SmÉO may truly help the decision-making process when choosing an operational strategy.

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1. Challenging the approaches to regional sprawl

Urban sprawl, with its juxtaposition of poorly defined outskirts, often characterized by the compartmentalization of activities, is not consistent with sustainable development and its underlying long-term goal of balance [1–3]. In fact, urban sprawl represents an inefficient use of land, resulting in the waste of these land resources and a potentially harmful pressure on the landscape [4–6].

Multiple studies have confirmed that the low density of suburban buildings and the typical distances between activities also lead to the significant energy consumption associated with using private motorized vehicles for transport [7,8]. Urban extension also results in increased environmental impacts and costs for the construction and operation of infrastructure networks [9].

From a socio-cultural standpoint, a dispersed city is characterized by a significant increase in socio-economic disparities. Imbalances may arise in core cities, which then have to deal with costs that are higher than their tax revenue potential, or in suburban communities, which are sometimes caught in a slow spiral of decline [10].

Faced with these issues, many stakeholders of the built environment are now seeking to increase territorial consistency [11,12]. In this context, urban densification strategies are a central issue. This shift in urban development towards sustainability also involves an increased coordination between urbanization and mobility [13,14]. In particular, this requires the use of greater densities in the most strategic areas near public transport stops [15]. The regeneration of derelict urban areas is a priority for creating these types of urban hubs, both mixed and dense [1,16]. Given the scope of the necessary reorientation of the post-industrial European city's development towards sustainability, it is not enough to simply regenerate derelict urban areas or to build new operations in the remaining empty urban lots. Operations to renew existing neighborhoods are also needed.

2. The neighborhood scale

Sustainability of the built environment is by no means restricted to questions regarding the location of buildings and urban densification. In other words, if density is to be considered as a necessary condition for sustainability, it is however far from being sufficient [17]. With a view to the overall quality of living conditions, the promotion of the return to the city raises multi-dimensional questions that must be incorporated into the processes of urban transformation.

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In this context, the neighborhood level, which sits between the city and the building levels, appears to be particularly interesting in operational terms. It is indeed well suited to experimenting with the specific practices aimed at improving the sustainability of the urban environment. This allows to look at the urban reality at a scale that is large enough to address themes that clearly exceed the scale of a single building, while remaining small enough to examine concrete actions. By addressing targeted issues, this type of approach can result in innovative solutions through the application of certain technological developments as well as through the redefinition of the processes of governance and participation [18]. The eco-neighborhood is situated exactly at the crossroads between the art of constructing sustainable buildings and the art of managing a sustainable city, two areas of action in which the various stakeholders are proceeding independently from each other [19]. While the neighborhood does not necessarily exist on a legal level, it is still an important operational meeting point between the public and private sectors.

There are many fields to be taken into consideration when developing urban projects – not only in relation to the inhabitants' quality of life, but also to the environment and the economy. The integration of sustainability goals into the dynamics of the project is not spontaneous. It involves setting up a specific, proactive process supported by the majority of the project stakeholders, incorporating holistic, interdisciplinary participative and evaluative approaches [2].

3. Sustainability assessment

These processes of optimization and monitoring of urban projects require a defined framework and methodology. The decision-making process must be transparent, discussed, and debated with the participation of the public. This is why it is necessary to develop decision-making tools and monitoring, and assessment indicators to support the decisions made [20]. Furthermore, the person in charge of managing an urban renewal project has the key role of bringing together different interests [21].

A certain number of approaches for assessing the sustainability at the neighborhood scale have been developed in institutional and academic worlds [22]. These can be grouped into five main categories: (i) certifications, which are based on an evaluation of the results, regardless of the process; (ii) modeling, which provides concepts that incorporate all of the parameters on a quantitative basis; (iii) targeted assessment tools, which make it possible to evaluate a specific phase of the project; (iv) reference models, which provide a list of indicators and principles to be followed; and finally, (v) decision-making tools, which highlight the strengths and weaknesses of a project as a whole [23]. However, the analysis of these various methods reveals that they are not fully adapted to the problems associated with the sustainable urban renewal of an existing neighborhood. The main reasons are that they do not take into account the specific situation of the existing neighborhood, they are too complex to allow for a truly effective decision-making support process [22], or they are restricted to only a few aspects of sustainability. In addition, as Charlot-Valdieu points out, most of the tools used to assess neighborhoods continue to focus on the building level and do not involve the three pillars of sustainable development: economic, socio-cultural and environmental, in an equivalent and cross-cutting manner [24,25].

4. Methodology

In order to better understand the multi-dimensional dynamism of the sustainability of a neighborhood undergoing densification, the aim was to analyze different issues regarding sustainability of an

existing urban neighborhood, suggest various scenarios for its urban renewal and compare them with a multi-criteria methodology.

The analysis of the existing evaluative approaches concluded that the decision-making tool SméO, while designed more specifically for the assessment of new neighborhood projects, could provide an initial platform for the present work, with some tailored adaptations (defined below).

The SméO tool provides a structured database for the decision-making process and incorporates all of the topics related to sustainable development over the life cycle of buildings and neighborhoods. Its indicators system is adapted to accommodate the specificities of the project's phases, scale and type of action [26]. The main criteria are defined following a bottom-up method; sustainability is defined according to the different aspects that need to be considered when planning a project. These include: water and soil resources, site and architecture, comfort and health, land and landscape, infrastructures, building concept, community, viability, safety, energy, domestic water and wastewater and operating costs. The tool gives two thresholds; the first one defines the limit between acceptable and unacceptable (laws or common practice), and a second limit sets the best practice. These two thresholds can either be qualitative or quantitative. Depending on the project's characteristics, a class (green, yellow, red or black (veto)) is assigned to each criterion. The evaluation results are aggregated according to the Hermione methodology [27], which allows several levels of aggregation. The method aggregates the criteria and assigns a class to the newly aggregated criterion following democratic rules [28]. Sustainability is then achieved if the evaluation is "Green": best practices have been applied. Nevertheless, SméO is a decision support tool and not a sustainability certification, because it considers that by offering a holistic vision of the project, synergies and trade-offs can be made in a more sustainable way. Finally, sustainability is not determined by the tool itself, but by the users of the tool.

Sharifi and Murayama compared the main Neighborhood Sustainability Assessment (NSA) tools and identified their main strengths and weaknesses [23]. SméO outperforms it in some of these issues. Firstly, it avoids indicator's scoring and weighting thanks to the Hermione methodology. The transparency of the criteria hierarchy supports a better comprehension of the results. Secondly, SméO includes economic, social and ecological issues. Thirdly, a web platform is available for stakeholders to introduce their project characteristics, share their project with multiple stakeholders and print results throughout the project process to communicate results. It is also possible to make copies of your project in order to introduce variants and compare them in an optimization process.

In order to comply with the specificities of an existing neighborhood, some indicators were selected among those proposed by the tool and the structure was adapted in order to apply the Hermione method.

The case study was performed according to the following steps. First, the research consisted of choosing a neighborhood that truly represented the topic of urban renewal. In particular, the choice of the case study was made in order to correspond to the following characteristics:

- The neighborhood is urban, in order to examine it through the lens of urban densification. There is now a consensus among experts, practitioners, and public policy researchers that this principle is one of the required conditions for improving sustainability [12,29].
- It is a low-density neighborhood, i.e. there is a true potential for densification.
- The neighborhood is located near public transportation. This proximity goes hand in hand with the increased coordination between urbanization and mobility, which tends to foster a

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