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URBIUS: A METHOD FOR ASSESSING THE SUSTAINABILITY OF URBAN RENEWAL STRATEGIES AT NEIGHBORHOOD SCALE.

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Figure 1 Existing urban fabric where URBIUS has been tested. Yverdon-les-Bains, Switzerland. © swisstopo

INCREASING DENSITY, TOOLS DEVELOPMENT (GUIDELINES, SOFTWARES, ETC.), URBAN REGENERATION

Research summary

One of the main challenges of European post-industrial cities is to prevent urban sprawl. Hence, increasing the density of inner cities instead of building new constructions in the peripheries has become a priority. However, city centres are already built and occupied by communities. Therefore, urban renewal projects aiming at increasing the density of the urban fabric should take into account existing buildings, as well as people living and working on the site (Dupagne, Teller, & Ruelle, 2004). In this perspective, interdisciplinary approaches including sociocultural, economic and environmental parameters are necessary to lead urban renewal projects (EU, 2010).

In addition, urban renewal projects cannot be completed within a single phase; a strategy needs to be established and implemented over a long period of time, depending on the number of owners and activities in the existing buildings. With this in mind, developing a series of urban renewal scenarios at neighbourhood scale seems to be the most appropriate solution. It provides both a holistic vision and a case-by-case vision (Roberts, Struthers, & Sacks, 1993).

This paper presents the URBIUS method, developed to assess the sustainability of urban renewal strategies at neighbourhood scale. The conceptual framework of URBIUS gathers the main issues of urban sustainability, including social, economic and environmental aspects. URBIUS is mainly used to compare different strategies for a single neighbourhood. Thus, the assessment thresholds are adapted to the specific potentials, and challenges. The aim is to support city planners in their prospective and proactive work of anticipating the sustainable urban transformation.

A case study assessing three different scenarios for the "Moulins neighbourhood" in Yverdon-les-Bains (Switzerland) is also presented to exemplify the method. Three strategies propose different ways to increase the built density: the first one (S1), allows a higher gross floor area per plot, the second one (S2) suggests some plot redistribution to optimize the urban form, and the third one (S3), suggests a land readjustment leading to a high quality dense neighbourhood. By providing sustainability profiles for each scenario, URBIUS gives stakeholders concrete and clear information for decision-making.

1. Introduction

The renovation of the building stock is a major challenge for post-industrial European cities (EU, 2010). Cities and urban areas function with a non-sustainable metabolism. The negative consequences are largely known: greenhouse gas emissions, pollution, fossil energy consumption, financial public debt, social segregation.

In order to be sustainable, the necessary urban renewal cannot be the result of a top-down planning but the result of an interdisciplinary work involving citizens, investors, professionals, associations and politicians. This interdisciplinary work is possible in the day to day work of the urban planning projects (Widmer Pham, 2014). To include this variety of stakeholders, the neighbourhood seems like the most adapted territorial level. At neighbourhood scale, urban renewal plans can be developed in order to create a common strategy guiding the developments on a long-term vision. A strategy is a vision, which fixes the objectives and the means to achieve them. Thus, its realisation can take several decades. The main reason is that a strategy is not a project. Hence, in legal terms, it binds the public administration but not the private owners.

Creating scenarios is a known and valid prospective method to create strategies for the future development of a neighbourhood (Courson, 1999). Nevertheless, the choice of the scenario intended to guide the development of the neighbourhood for the coming years is a complex task where a high number of parameters have to be considered.

Various sustainability assessment tools, guidelines, certifications methods, have been created to help decision makers orient their choices towards sustainability (Sharifi & Murayama, 2013). On the one hand, the main sustainability certifications methods, such as BREEM, LEAD or DGNB, are not adapted to neighbourhood renovation projects due to the specificities of the long-term process. On the other hand, some methods have been specifically created for urban renovation: HQE2R (Charlot-Valdieu & Outrequin, 2004) and "Acreditación de la Calidad y Sostenibilidad en el Medio Urbano" (Barcelona, 2012). However, none is entirely adapted to compare scenarios of urban renewal strategies at neighbourhood scale because they cannot be adapted to the specific existing situation and its potential (Riera Pérez & Rey, 2013).

2. Research objectives

In response, the research presented in this paper aims at developing a novel method for the sustainability assessment of urban renewal projects at neighbourhood scale. This method, entitled URBIUS, intends to contribute to the decision making process when choosing which is the most appropriate urban renewal strategy. Hence, the main focus of the method is to compare different urban scenarios.

3. Methodology

The methodology implemented to develop URBIUS involves the following steps:

1. Identify global sustainability objectives for existing urban neighbourhoods
2. Chose the criteria needed to assess these objectives
3. Create thresholds adapted to the existing neighbourhood and its potential
4. Define ways to communicate the assessment results

The results of a case study will be presented in order to show a practical application.

4. URBIUS method

4.1 Objectives for a sustainable renewal of existing neighbourhoods

The objectives have been elaborated on the basis of the strategic principles for sustainable urban planning developed by Da Cunha (fig 2), and the main challenges of European cities (Cunha, 2005; Ecoplan, 2012; EU, 2010).

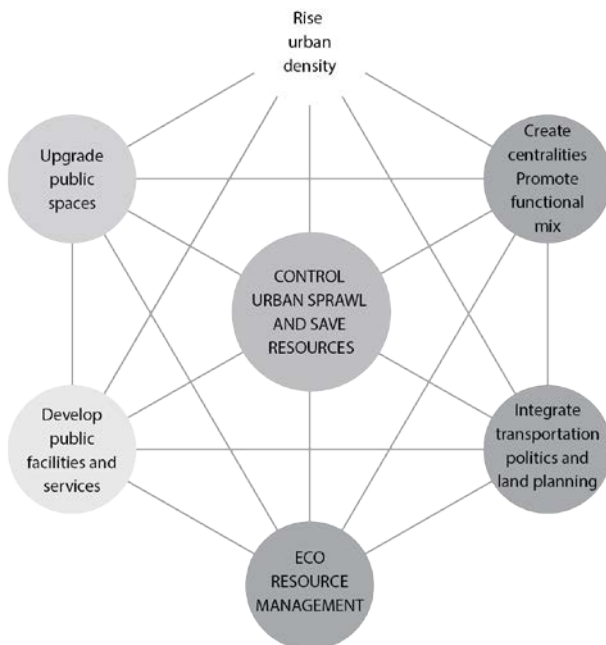The first objective is to elaborate an acceptable strategy both in economic and legal terms.

Figure 2 Strategic principles for sustainable urban planning **(Cunha, 2005)**

Second, synergies among objectives have been explored in order to avoid redundancies. Starting from the top-right (fig 2): "Create centralities" and "Integrate transportation" are gathered under "Offering housing to all citizens", which is one of the European urban challenges. This is possible because the method focuses on central neighbourhoods with high quality public transportation. "Promoting functional mix" and "Develop public facilities" are merged under "Balance housing and activity buildings". "Eco resource management" is separated into "Preserve the natural environment" and "Save energy sources". This last one is in itself an important European challenge. Finally, "Rise urban density" and "Upgrade public spaces" are synthetized on "Balance density and urban quality". Table 1 shows the six objectives.

The aim of the method is to measure the potential of the strategy: its capacity to reach these objectives.

4.2 Criteria

In order to assess the urban renewal strategy in regards to the defined objectives, the criteria in table 1 have been defined.

Table 1 URBIUS: Objectives & criteria

1. Ensure the viability of the strategy
1.1 Governance
1.2 Environmental impact
1.3 Economic viability
2. Offer housing to all citizens
2.1 Hosting capacity
2.2 Housing affordability
2.3 Neighbourhood's inhabitants
3. Balance housing and activity buildings
3.1 Functional mix
3.2 Proximity to services
3.3 Local economy
3.4 Attractiveness and visitation
4. Save energy resources
4.1 NRE (Non-Renewable Energy)
4.2 GWP (Global Warming Potential)
4.3 Local energy sources
5. Preserve the natural environment
5.1 Upgrading of the ecosystem
5.2 Groundwater preservation
5.3 Exploitation of in-situ materials
6. Balance density and urban quality
6.1 Density
6.2 Urban morphology
6.3 Quality of public space

Each of these criteria is measured by one or more indicator(s). Further publications will present the complete system.

4.3 Adaptable Thresholds

Each criterion is evaluated through the Hermione aggregation of the indicators chosen to measure it (Flourentzou, 2001, 2003). The indicators are classified into three different categories: Green (best practice), Yellow (acceptable), Red (inacceptable, i.e. no compliance with legal requirements). Therefore, target values (TV) and limit values (LV) are necessary to define these categories. An indicator is green when its value is better than the TV, yellow when the indicator is in between the TV and the LV, and red when the indicator value is below than the LV.

Figure 3 Evaluation of the indicators based on the Hermione method. LV: Limit Value, TV: Target Value (Flourentzou, 2001, 2003)

As the existing built environment may vary significantly from one neighbourhood to the other, the assessment should be based on adaptable thresholds likely to reveal the specific assets of a neighbourhood. Thresholds (LV, TV) must adapt to the two main peculiar features of an urban renewal project:

1. State: The strategy should take into account the current state of the neighbourhood.
2. Evolution: The strategy should guide the neighbourhood towards increased sustainability. Therefore, the aim is to assess the improvements achieved thanks to the strategy. Hence, the latter should not be compared to the existing neighbourhood, but rather to the neighbourhood after evolution, as if no strategy had been planned. This situation is referred as "trend development of the

neighbourhood" and it will be estimated on a long-term horizon, around 30 years from now.

If the existing neighbourhood is defined by t_0 (for time = 0), the "trend development of the neighbourhood" is defined by t_{30} (for time = 30). The specific threshold will be based on the assessment of the existing neighbourhood t_0 to consider State and on t_{30} to consider Evolution. Based on these two assessments, the SWOT method (Strengths Weaknesses Opportunities Threats) (Garrette, Dussauge, & Durand, 2009; Martinet, 1988) is applied to the neighbourhood indicators as follows (fig 4):

Figure 4 SWOT method adapted to neighbourhood assessment

Based on the SWOT method, several rules can be defined to determine the new thresholds: TV_{30} and LV_{30}:

1. **Conserve strengths and value opportunities**
   If the best case between t_0 and t_{30} is better than TV → TV_{30} = best (t_0, t_{30})
2. **Face problems and prepare for challenges**
   Even if t_0 and t_{30} are worse than LV → LV_{30} = LV
   Problems and challenges should appear.
3. **Never go worse**
   If the worst value between t_0 and t_{30} is better than LV and worse than TV → LV_{30} = worse (t_0, t_{30})
4. **Limited deviation**
   The aim is to avoid having very different values in the same category of assessment. To do so, the deviation between LV and TV should not be increased. If TV_{30} = worse (t_0, t_{30}), it means that there is a potential or a strength, then the LV must also be

adapted to the quality of the neighbourhood: LV_{30} = TV. This rule is applied in 2nd priority in regards to the others.

Figure 5 shows the possible cases of thresholds adaptation to t_0 and t_{30}. No difference is done between t_0 and t_{30} since there is no weight difference between them in the assessment.

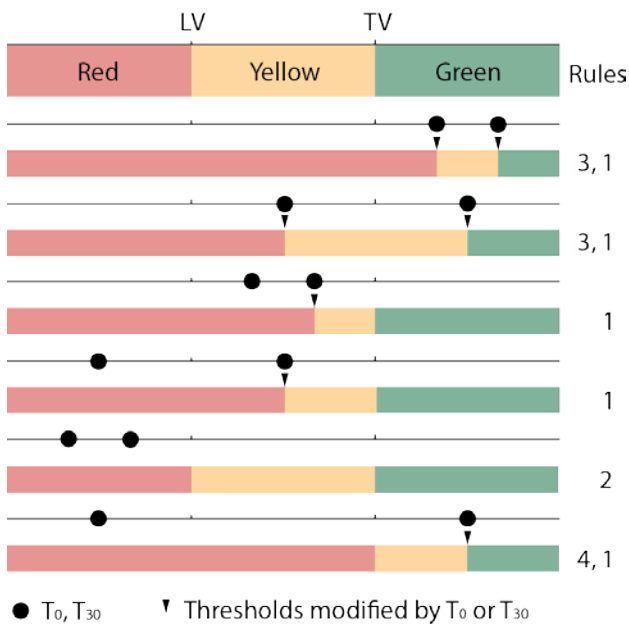● T_0, T_{30} ▼ Thresholds modified by T_0 or T_{30}

Figure 5 Thresholds adaptation following the new rules

4.4 Communicating the results

In order to communicate the ability of a strategy to achieve the objectives, the red, yellow and green evaluation are translated into low, medium and high potential, respectively.

A major challenge for MCDM (Multi Criteria Decision Making) tools is to be scientifically relevant and usable at the same time (Bartke & Schwarze, 2015; Brown & Thérivel, 2000). Hence, URBIUS shows the assessment objectives in graphic form. In addition, the user can access exhaustive results of criteria and indicators. This translation of the assessment objectives into graphics consists in representing the results (high, medium and low potential) in circles of different sizes: the

bigger, the better. For instance, if a strategy has a high potential for an objective, the circle will be bigger than the circle of another strategy with a lower potential for the same objective.

5. Case study

5.1 Neighbourhood in Yverdon-les-Bains

The results of a case study are now presented to illustrate the URBIUS method. It is an existing neighbourhood in Yverdon-les-Bains, a representative medium-size urban centre in the Swiss midlands. The neighbourhood "Les Moulins" (fig 6) has been chosen because of its potential to contribute to the poly-centric city. Its low density and its proximity to the main train station makes it the ideal location to densify the city of Yverdon-les-Bains.

Figure 6 Neighbourhood "Les Moulins", Yverdon-les-Bains, T_0

5.2 Scenarios

Three strategies propose different ways to increase the built density: the first one (S1),

allows a higher gross floor area per plot, the second one (S2) suggests some plot redistribution to optimize the urban form, and the third one (S3) suggests a land readjustment leading to a high quality dense neighbourhood.
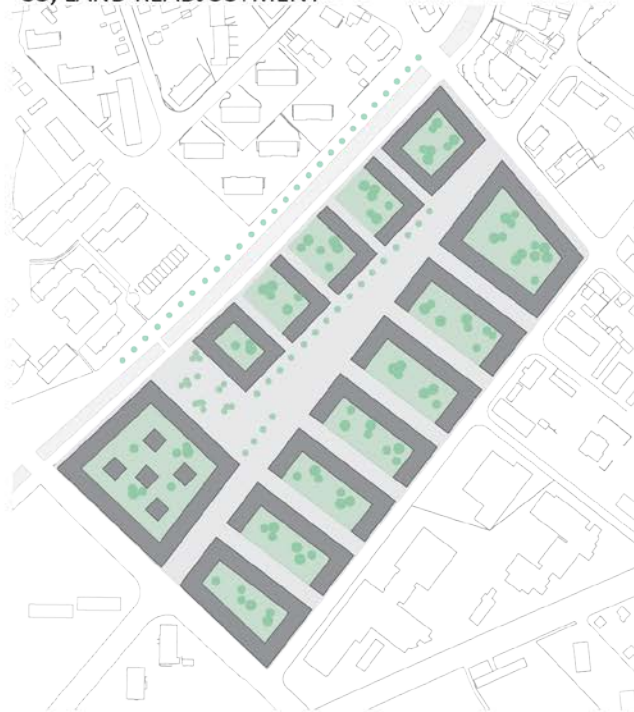
Figure 7 Yverdon, Switzerland. Scenarios S1, S2 and S3 and T30 ("trend development of the neighbourhood")

5.3 Scenarios assessment

Figure 8 shows the preliminary results of the comparative assessment of the different scenarios. If we consider all objectives as equally important, S3 would be the most performing scenario. The reason is that S3 has two high potentials and only one low. S2 is more balanced, but it doesn't value the opportunities as much as S3. Finally, S1 is clearly the least performing one. Nevertheless, if the viability of the strategy is considered as a priority objective (it measures the facility to apply the strategy), the choice would be different. Decision makers should therefore define precisely their capacities and objectives, and choose the most appropriate strategy based on these considerations.
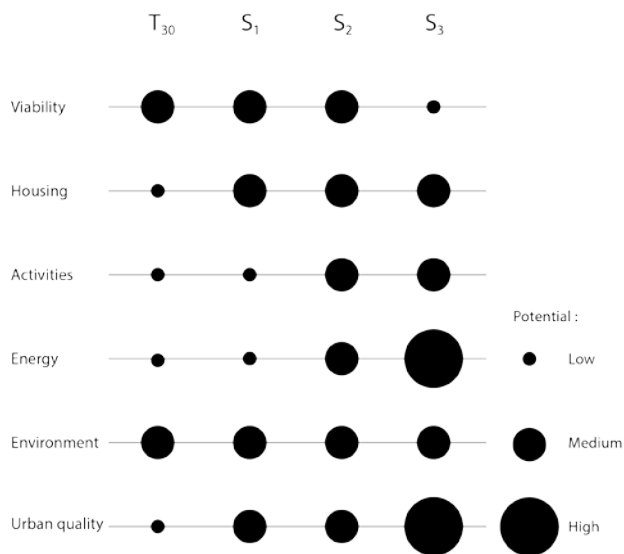

Figure 8 Sustainability assessment of the scenarios

The main difference among the scenarios is the plot management options. This has an important impact on their assessment because it permits or limits the different types of interventions. For example, on the energy objective assessment, a refurbished building is less efficient than a new one. Hence, T_{30} and S_1 are less energy efficient because 63 and 46 buildings are respectively preserved, from 124 existing. On S_2 only 10 buildings are preserved.

And finally, in S_3 all buildings are new. Therefore, S3 has the highest potential to achieve the energy objective.

5.4 Discussion

As seen in the example of the neighbourhood "Les Moulins", URBIUS doesn't indicate which scenario is the most performing. It shows the assessment of each strategy in regards to the different objectives. The final decision relies on the stakeholders and their priorities.

The final results are simple, they show the final aggregation. Moreover, if the user wants to further develop his understanding of the scenarios, two additional steps are proposed: the criteria of assessment and the value of the indicators. URBIUS therefore ensures both the traceability of all results and the transparency of the entire method for all actors. Having said that, three levels of assessment for the final results seem not enough to transmit the richness of all the information gathered. Further improvements should include a higher range of potential values.

6. Conclusions

The URBIUS method does not say how to renovate an existing neighbourhoods, but which scenario is the most appropriate in regards to sustainability. Hence, the first step before using URBIUS is to develop different scenarios. URBIUS can then help to define which are the most performing scenarios and understand why. Without a multidisciplinary work it wouldn't be possible to collect all data to do the prospective work and to understand the results. URBIUS can also contribute to the participative process with citizens and owners. Participative processes are essential to accept the strategy and prevent barriers in the application stages (Feddersen et al., 2014).

Strategically, these are the two main contributions of URBIUS: helping in the multidisciplinary working and applying it to a prospective project.

7. Future implementation

URBIUS is a new born tool which will grow, develop and become more precise in the near future. It is currently being developed within the framework of a PhD thesis, and the method will be communicated to different public authorities at the end of the PhD. Four neighbourhoods in four different cities are analysed. These cities are interested in the method and a broader use of URBIUS seems possible.

8. Acknowledgments

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