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Buildings performance indicators to prioritise multi-family housing renovations

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ABSTRACT

Paying attention to the constructed city and renovating buildings are two objectives of current European policies. This article develops a system of physical performance indicators to detect multi-family housing estates that perform worse in energy efficiency, airborne sound insulation against outside noise and accessibility terms. Indicators were developed in close cooperation with the local Administration for residential estates and on a district scale, and allowed the buildings in worse conditions to be detected. The results are graphically represented on urban plans. Indicators are presented by a case study of social housing states in the city of Zaragoza for the 1939–1979 period.

1. Introduction

Paying attention to the constructed city is one of the objectives of current European initiatives; e.g., the 2007 Leipzig Charter on Sustainable European Cities, the 2010 Toledo Charter on Urban Development and the European 2020 initiative. They take Integrated Urban Regeneration as a strategic instrument to obtain a smarter, more sustainable and more socially inclusive urban model in already consolidated urban fabrics (UE, 2010), and the district scale has been identified as a suitable consideration (Bourdic, Salat, & Nowacki, 2012). In Europe the Commission urges Partners to mobilise investments in renovating the existing building stock (European Parliament, 2012). Moreover, some Member States, like Spain, urge the Administration to obtain and update maps and censuses of degraded zones or buildings that need to be restored which offer information for their policy making (Jefatura del Estado, 2013). Thus we can say that making information available about diagnosing the existing building park to the European Union and the Public Administrations is important.

Until 2010, in the city of Zaragoza in Spain, non-repayable subsidies for buildings renovation were granted only to families with low income living in previously identified quarters, whereas from 2010 on they are being granted to all kinds of families living in the whole city since the aim is not only supporting vulnerable population but also promoting the move to a low-carbon economy by means of encouraging the renovation of the existing building stock (López-Mesa, Rubio del Val, & J, 2015). The same is happening in the rest of Spain, where Zaragoza is considered one of the pioneer cities in renovation policies implementation. This may explain why in Spain vulnerability indicators have had a considerable development and a strong impact in political decision making, whereas buildings performance indicators are not being widely used yet. The Urban Vulnerability Atlas in Spain (Ministry of Public Works, 2012a, 2012b) constitutes an example of vulnerability indicators. It is included in the Observatory of Urban Vulnerability, a long-term project of the Spanish Ministry of Public Works that contains several studies about Urban Vulnerability. This graphical Atlas allows synthetic indices to be obtained for urban areas of the whole of Spain according to socio-demographic, socio-economic, residential and subjective criteria. They allow to measure the vulnerability of urban areas at the census section scale, as they are obtained from Population Census statistics, the only source of extensive and nationally homogeneous data, with sufficient disaggregation −the Census Section- (Ministry of Public Works, 1996).

The monetary budget of Public Administrations is generally limited and a prioritisation criterion is needed to optimise its allocation in multifamily housing renovations (Ferrante, Peri, Rizzo, Scaccianoce, & Vaccaro, 2017). The vulnerability criterion (which considers socio-economic aspects) cannot be the only one to be applied now that European cities aim to move to a low-carbon economy. The objective of this article is to develop a system of indicators, complementary to the vulnerability ones, to diagnose how needy residential estates are for renovation according to their degree of performance, which are to be graphically represented on maps. The indicators will allow users to intuitively and visually know and compare the level of renovation need of multi-family housing of cities, supporting administrations in the decision making regarding which buildings require more urgent renovations contributing to reduce the impact of the existing residential

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Table 1
Indicators systems to diagnose urban areas in Spain (in parentheses: P for pressure indicator, S for state indicator, and R for response indicator).

Indicators system, and Organisation	Starting basis	Short description of indicators	Indicators of building performance relating to energy efficiency, airborne sound insulation and accessibility
Atlas of Urban Vulnerability, by the Ministry of Public works of Spain (Ministry of Public Works, 2012a, 2012b)	A territory vulnerability has to do with two dimensions: a) the conditions of social and structural disadvantage to develop vital projects; and b) the perception that citizens have of the territory where they live and their social conditions, which can lead to processes of discomfort that do not correspond with objective vulnerability indicators	Organised in four main themes: - Demographic vulnerability (5 indicators relating to population ageing, households structure getting complex, foreign immigration from non-developed countries). - Socio-economic vulnerability (6 indicators relating to unemployment, job insecurity, low educational levels). - Residential vulnerability (5 indicators). - Subjective vulnerability (6 indicators). The Atlas allows the use of synthetic indices according to socio-demographic, socio-economic, residential and subjective criteria. Out of the 22 indicators, the following are considered Basic Indicators of Urban Vulnerability (IBVU): percentage of unemployed population, percentage of population without studies, and percentage of population in dwellings with no toilet. The Atlas also offers two large synthetic indices of Inequality, calculated combining the IBVU: IDS (Index of Socio-economic Inequality) and IDU (Index of Urban Inequality).	One of the residential indicators: - Percentage of households located in buildings built before 1951 (P). One of the subjective indicators: - Outside noise (S).
Diagnosis of the need for renovation of the Basque Country building stock (Tecnalia, 2011). Developed by TECNALIA, in collaboration with the Technical University of Madrid and the Polythecnic University of Valencia, for the Government of the Autonomous Community of the Basque Country	As recognised in the report, the choice of the initial indicators was conditioned by the availability of statistical data, and for this reason the stability and energy efficiency parameters had a smaller number of indicators compared to fitness for human habitation, accessibility and social vulnerability. This work was only applied to one Autonomous Community of Spain, the Basque Country.	The study analyses 65 different indicators (4 regarding stability, 16 fitness for human habitation, 13 accessibility, 29 social vulnerability and 3 energy efficiency), referred to the different parameters of physical and socio-economic vulnerability. The 61 indicators were later on reduced to 41 through a refinement process. From the 41 refined indicators, 10 factors were obtained using the method of main components factor analysis. These 10 factors explain 69% of the variance to identify and visualise the areas with greater or lesser physical and social vulnerability in 250 municipalities and 1.698 census tracts of the Autonomous Community of the Basque Country. These factors are, according to the factor analysis method, hypothetical variables that highlight several observable variables [15], i.e., indices that combine several simple indicators. The factors include: 1. Density. 2. Socio-economic vulnerability. 3. Vulnerability due to building state of conservation. 4. Vulnerability due to ageing. 5. Vulnerability due to poor communications and services. 6. Vulnerability due to distance to work. 7. Low occupation of dwellings. 8. Vulnerability due to immigration. 9. Vulnerability due to inefficient heating. 10. Vulnerability due to deteriorated urban environment. For the analysis of urban districts vulnerability, we can use these 10 factors or the indicators that appeared to be more relevant through the factor analysis method, which were up to 23 indicators.	Among the indicators: - Percentage of households without heating (P). - Percentage of buildings with no hallway accessibility and no lift (P). - Percentage of buildings built before 1980 (P). - Percentage of buildings without natural gas services (P). - Percentage of households with individual heating (P). Among the 10 factors: - Vulnerability due to inefficient heating (S).

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