2º SIMPÓSIO
ENGENHARIA CIVIL
03 05 2023

LIVRO DE ATAS

TÉCNICO LISBOA

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TÉCNICO LISBOA

Aviso Legal

Ficha Técnica

Título: 2º Simpósio de Engenharia Civil (2SEC 2023): Livro de Atas

Publicação: Instituto Superior Técnico (IST)

Editores: José Neves, Ana Galvão, António Gago, Isabel Ramos, José Bogas, Luís Guerreiro, Rita Bento, Teresa Freitas

ISBN: 978-989-35262-0-0

DOI: 10.5281/zenodo.8150018

Lisboa, julho de 2023

A GIS-BASED MULTI-CRITERIA METHOD TO EVALUATE THE LEVEL OF WALKABILITY IN THE CITY CENTRE OF GUIMARÃES

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Keywords: pedestrians, active mobility, multi-criteria analysis, urban planning.

Thematic area code: 15 **Video presentation**

1. INTRODUCTION

Walking is the greenest, cheapest, and easiest mode of transport and is often the first and last mode of transport used in a trip. Walking is also a form of doing physical activity that helps to prevent various physiological and mental diseases associated with sedentary lifestyles. Due to these benefits, the promotion of more walkable cities has received increasing attention over the last years. The extent to which the built environment is pedestrian-friendly and enables walking is broadly defined as walkability. The research on walkability has resulted in increased precision in measuring the influence of built environment variables on walking, namely due to the availability of spatial data along with the use of GIS tools. Many different methods, variables and measures have been used to describe walkability, which usually rely on a composite measure (index) of various built environment criteria [1]. This presentation summarizes a MSc dissertation on Civil Engineering carried out at the University of Minho [2], which was focus on applying a GIS-based multi-criteria analysis to evaluate the level of walkability in the city centre of Guimarães.

2. METHODOLOGY

The GIS-based multi-criteria method was inspired in the Smart Pedestrian Net (SPN) research project, which was firstly implemented in Bologna and Porto. The two main steps were evaluating and weighting the attributes. As adopted in SPN, a total of 19 built environment and streetscape attributes grouped in six criteria were used to evaluate the level of walkability in Guimarães (Figure 1). The evaluation consisted in a binary classification, where each street segment was scored with 1 and 0 according to the respective performance in each item. For example, street segments within 400 m to a bus stop scored 1, otherwise scored 0; sidewalks wider than or equal to 1.5 m scored 1, otherwise 0. All the details about these evaluation, which involved GIS operations and street audit work, can be found in [3]. Inversely to SPN, where the scores were based on a survey to 1438 individuals, in this study the weighting process was support on the evaluation of 28 experts (mainly engineers, architects and geographers) of the University of Minho using the analytic hierarchy method (AHP). As detailed described in [3], first a pairwise comparison was performed to assess the relative value of each decision criterion, then the results were normalized so that the sum of the weightage of each criterion was equal to 1, and finally the consistency of the comparison matrix was checked. The obtained scores are shown in Figure 1. Through GIS operations, the binary evaluation of each criterion was then combined with the AHP scores and the values normalized again. The result was a walkability map ranging from 0 to 1, showing the final classification of all street paths according to the various criteria. A sector of 1.6 km^2 at the centre of Guimarães was selected as the case study (Figure 2). This compact urban area includes 90 streets divided into 118 paths, squares, and footpaths, which sum a length of 28 km.

3. RESULTS

In terms of average evaluation, the performance of the six main criteria in the study area was as follows: accessibility (0.88), street connectivity (0.74), sidewalk facilities (0.69), traffic safety and security (0.66), land use (0.51), and streetscape design (0.46). The level of accessibility and street connectivity were very favourable due to the compact urban structure of the city centre and to the

diversity of urban functions. To obtain the walkability scores, the normalized values from the evaluation were combined with the weights derived from the multi-criteria analysis. The final walkability evaluation combining the six criteria is shown in Figure 2.

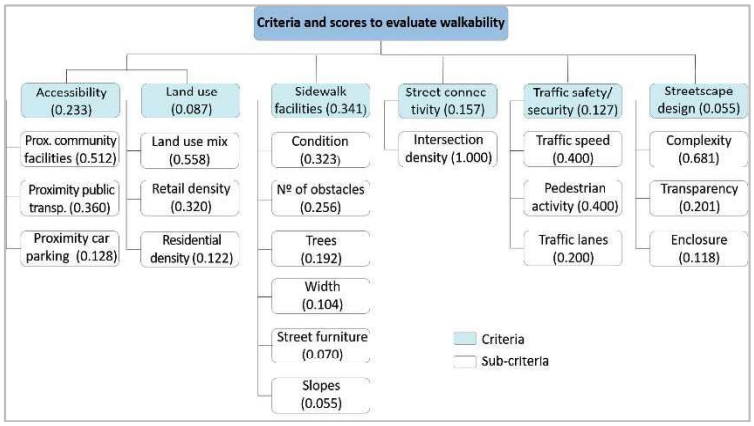

Figure 42. Criteria, sub-criteria and scores to evaluate walkability

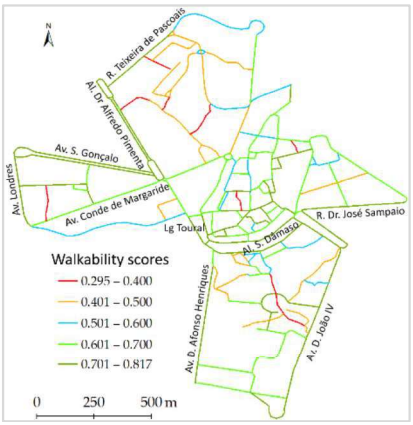

Figure 2. Walkability evaluation

The analysis showed that the overall walkable conditions in this area are favourable. As shown in Table 1, 29% of the street paths are within the best-scored class (>0.701), while around 65% of the streets' path lengths scored above 0.60. There were no street paths ranked below 0.29. The best-ranked street paths can be mostly found in the city centre. Besides the overall favourable conditions, the study area does not have a pedestrian network of high walkable streets. Although the city centre has a network of streets providing good levels of walkability, the study area has several discontinuities and interruptions, which could make walking less comfortable and attractive and encourage the use of other modes of transport for short urban trips.

Table 14. Summary of the walkability assessment in Guimarães

Walkability score classes	Street paths		Street length	
	By class	Accumulated	By class	Accumulated
<0.400	7.73%	7.73%	4.48%	4.48%
0.401–0.500	13.53%	21.26%	15.46%	19.94%
0.501–0.600	14.49%	35.75%	14.77%	34.71%
0.601–0.700	35.75%	71.50%	30.14%	64.85%
>0.701	28.50%	100.00%	35.15%	100.00%

4. CONCLUSION

The centre of Guimarães can be classified as pedestrian-friendly area. Around 64% of the street length scored above 0.60, which is a threshold value used to classify high walkable areas [3]. In part, these results reflect the good performance of the three criteria, which were highly scored by the experts: sidewalk facilities, accessibility, and street connectivity. The application of the SPN method proved to be efficient in mapping the different levels of walkability in Guimarães and the discontinuities of the pedestrian network. The method also proved to be adjustable in terms of weighting the attributes according to local specificities. Thus, this method could be replicated in order to evaluate and support policies to create more sustainable cities.

5. REFERENCES

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