A MULTICRITERIA MODEL BASED ON ANALYTIC NETWORK PROCESS (ANP) TO IMPROVE PEDESTRIAN ACCESSIBILITY IN THE CITY CENTER OF CARTAGENA DE INDIAS (COLOMBIA)

ABSTRACT

Improving pedestrian accessibility is a multifaceted problem. The design of accessible routes involves consideration of different stakeholders and factors. In this paper, a multicriteria decision analysis approach is presented based on Analytic Network Process (ANP) to help planning and design of pedestrian routes. A group of different stakeholders comprised of representatives of local administration, city transportation officials, commercials, associations, NGO's and city residents or users has been formed to select the criteria for designing pedestrian routes in the city center of Cartagena de Indias (Colombia). Some key stakeholders will be involved as experts to evaluate selected criteria trough ANP process. An index which measures the importance of each criterion in designing pedestrian routes will be obtained. Finally, starting from the results, some relevant streets will be selected and evaluated and redesigned. Starting from a literature review, , criteria related to connectivity, urban function, route attributes, convenience, and coexistence have been first selected as the more relevant ones.

Keywords: Multicriteria evaluation approach, Analytic Network Process ANP, stakeholder analysis, pedestrian route design, pedestrian mobility, pedestrian accessibility, urban walkability, Cartagena de Indias.

1. Introduction

Cartagena de Indias (Colombia) is a well-known international destination around the world. Nowadays the city has been working on being a sustainable destination especially in the Historical Center (Local Tourism Plan 2016-2019). This area has different scenarios that make it a vital point for the city. It combines different formal and informal activities as commercial, educational, tourist, etc. In terms of mobility, it is one of the most vulnerable areas. Pedestrians, vehicles, and formal and informal commerce interact in the same spaces daily.

As a part of an intervention of the city center, the local administration is proposing different plans and alternatives to improve the mobility and get more spaces available for the locals and tourists. Improving and promoting pedestrian mobility is one of the main proposals. It consists in designing different pedestrian paths through main historic and

tourist places around the city center, to better distribute traffic of vehicles and persons on the streets, reduce conflicts between users and improve traffic conditions, and therefore the mobility of citizens and tourists. Promoting the shift towards more sustainable transport modes (mainly walking and cycling) is one of the best ways for limiting the increase in motorization. Therefore, it should be a priority for local authorities (Caprì et al., 2016)However, these planning processes are under the pressure of stakeholders belonging to public and private sectors, but, mainly, of citizens, which demand actions that generate incomes and wellbeing for them. Including an active participation of citizens and stakeholders from the beginning of any transport decision-making process is widely recognized as a precondition to avoid the failure of a project as a consequence of a lack of consensus (Le Pira et al., 2018).

Walking can be considered the basis of a sustainable city, providing social, environmental and economic benefits (Moura, Cambra, & Gonçalves, 2017). Encouraging people to walk have mainly concentrated on making it easy and attractive (Jabbari, Fonseca, & Ramos, 2017). Thus, the design of pedestrian routes and areas involves consideration of different technical, economic, environmental, and social factors (Sayyadi & Awasthi, 2013). Understanding the factors that influence walkability and pedestrians' perceptions enables planners to build more walkable and liveable cities (Jabbari et al., 2017).

Built environment factors that would likely affect walking also differ according to other factors, such as pedestrian characteristics, walking purpose, urban context and other environmental and cultural aspects (Moura et al., 2017). Thus, location planning for pedestrian zones is a multifaceted problem (Sayyadi & Awasthi, 2013) that involve multiple stakeholders and multiple criteria. This is a multicriteria problem that we propose to face with a multicriteria approach provided by the Analytic Network Process (ANP).

This work aims to carry out a methodology to help the local administration to design pedestrian routes in the City Center of Cartagena with a participatory approach. We propose to use the ANP method in which designs criteria for pedestrian routes will be evaluated for different stakeholders.

2. Literature Review

The main theoretical concepts that are central to this work are (1) pedestrian mobility, (2) pedestrian route design and (3) the multicriteria evaluation approach (Analytic Network Process - ANP). Also, some additional concepts related to participatory approach and stakeholders' analysis have been considered.

References related to pedestrian activities, design networks and pedestrian accessibility had allowed to identify different factors, dimensions and criteria to improve pedestrian mobility. The main and more relevant ones are related to connectivity, urban function of the routes, route attributes, convenience, and the coexistence between pedestrian and other modes of transport (Blečić, Cecchini, Congiu, Fancello, & Trunfio, 2015; Jabbari et al., 2017; Moura et al., 2017).

Some recent works involve stakeholders and decision-makers in the planning process of pedestrian mobility. Moura et al. (2017) propose a participatory walkability assessment framework for distinct pedestrian groups and trip purposes; Taleai and Amiri (2017)

develop a participation process in which 'experts' and 'non-experts' (residents) were asked to rate criteria based on their importance in terms of encouraging people to walk and; The EU in Pedestrian Quality Needs Project (2010) encourages cooperation and dialogue with stakeholders outside government/administration.

Furthermore, applications related to pedestrian mobility using AHP have been developed. These include a research related to locating pedestrian zones (Sayyadi & Awasthi, 2013); understanding of environmental attributes, which encourage pedestrians to walk (or not)\, examining the pedestrian decision making process through AHP (Mateo-Babiano, 2016); developing a GIS-based integrated approach to assess a pedestrian network by combining multi-criteria and network analysis based on space syntax (Jabbari et al., 2017) and, developing a methodology based on the integration of geospatial information science, remote sensing and group multi-criteria analysis to assess the walkability of pathways in a city (Taleai & Taheri Amiri, 2017). So far, no ANP application has been found in literature.

Some authors also recognized the importance of tools which not only evaluate but also assist urban design processes, beyond the problems of standard road network, since this involves "thicker" and multidimensional description of the urban environment and its actors (Blecic, Cecchini, & Trunfio, 2015).

3. Hypotheses/Objectives

This work intends to prove that a multicriteria technique (MCDM) such as ANP is an appropriate tool to elicit stakeholder preferences and reach a consensus among them on the issues of designing pedestrian routes in the city center of Cartagena de Indias. The aim is to support the local administration of the city in the design of walkable streets to improve pedestrian accessibility in the city center.

4. Research Design/Methodology

The proposed methodology has been applied with the overall aim to improve pedestrian accessibility in the city center of Cartagena. The application of this methodology is arranged in three main stages: (i) understanding the context of the problem, (ii) involving stakeholders (Bryson, 2004), and (iii) developing the Analytic Network Process (ANP) (Saaty, 2001).
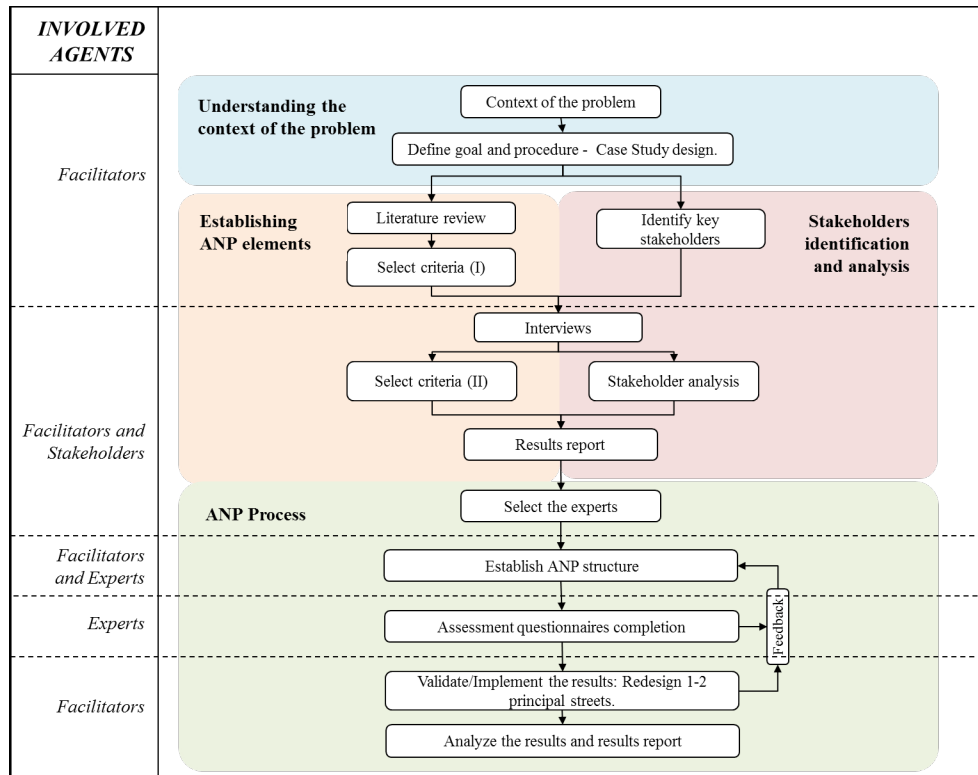
The main goal is to evaluate design criteria for designing pedestrian routes to improve pedestrian accessibility in the city center.

So far, we have finished the first stage. Some key stakeholders have already been selected. We are working with them on defining designed criteria to be evaluated, and assessing the relationships among them.

Once the model will be agreed upon, the ANP questionnaire with the required judgements based on pairwise comparisons will be designed and sent to the experts. The results will be obtained with the help of Superdecision© v.2.0.8. Software.

We will obtain prioritization results for each individual expert according to his/her judgments. In order to obtain a global judgement, individual judgements' aggregation AIJ (Saaty & Peniwati, 2008) will be performed using the geometric mean for all the experts.

According to final results, some streets in the city center will be evaluated and redesigned. Finally, the results obtained will be presented to the local administration and to the stakeholders.

5. Data/Model Analysis

The AHP network designed for this case is presented in the following figure:
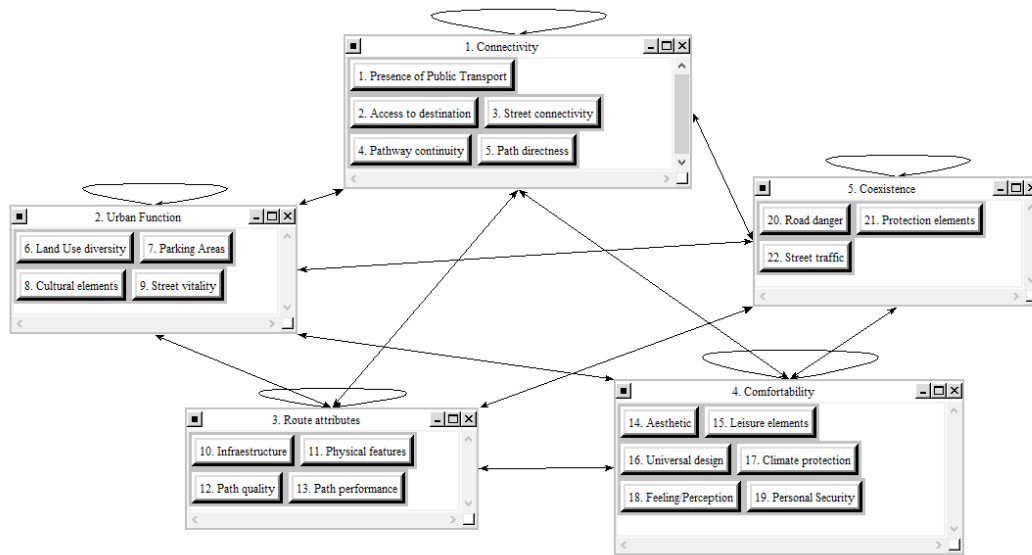
6. Limitations

Given the scope and characteristics of this case, we have not developed the model so far. To better involve stakeholders in the case is necessary to capture information in situ in order to guarantee more reliable results.

7. Conclusions

The proposed methodology has been applied to improve pedestrian accessibility in the city center of Cartagena. We have not developed the model so far, so we do not have any conclusions yet. At the moment, given the number of selected criteria (22) divided into five clusters, we can say the model is not complex and the questionnaire will be simple. Results will be allowed to evaluate different routes and define pedestrian routes in the city center.

8. Key References

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