

BIBLIOMETRIC STUDY ON AHP AND URBAN MOBILITY

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ABSTRACT

This work presents a bibliometric study on the Analytic Hierarchy Process (AHP) and urban mobility. We identified important elements, as keywords, with documents indexed in the Scopus database and we mapped relations with VOSviewer. Urban mobility was selected due to its relevance for the economic development. The survey was carried out at the middle of 2020, resulting in 104 documents published from 2015. One major finding is the absence of scientific production relating both AHP and urban mobility.

Keywords: Analytic Hierarchy Process; Bibliometrics; Urban Mobility; Public Management.

1. Introduction

Economic, social, cultural and political processes, such as globalization, added to the population increase, especially in developing countries, have caused the growth and consolidation of cities. However, its rapid growth contrasted with the slowness with which states and municipalities tried to respond to the new realities. In Brazil, due to the scarce resources of most cities, the demand for technological advances reveals great differences between them at the time of hiring and implementing technological systems to support local Governments management, even though being part of the same Metropolitan Region or neighboring cities with similar development index. Decision makers often come up with complex problems involving intangible and conflicting criteria (SAATY; ERGU, 2015).

In this sense, the possibility of evaluating cities from some specific method or technique can contribute to the resolution of common demands among municipalities, "in view of the scarcity of studies focused on the analysis of Brazilian scientific production in the area of technology applied to Urban Mobility in a regionalized way" (WEISS, 2019). Thus, the selection of the AHP methodology, due to its flexibility to determine, classify and compare the different criteria, enables the aid for the acceptability and prioritization of the projects to be implemented, acting as an integration tool.

2. Literature Review

Bibliometrics has been used as a quantitative analysis method for scientific research (SU; LEE, 2010) and taking as reference, the bibliometric studies, trends and/or gaps can be identified to conduct new research. Of the different research methods in the areas of Science & Engineering, a multi-criteria decision analysis AHP is a methodology that gains strength when talking about its applicability in public administration and in different urban mobility systems, especially its efficiency and sustainability.

Using the AHP method, we can evaluate results together with the proposed model, calculating the degree of contribution and benefits that each project will bring to each municipality. First, the decision makers of a local government evaluate the results of the model and, second, those responsible for the projects that make up the model evaluate for their own projects. (IIDA; KOIZUMI, 2018).

3. Objectives

The objective of this research is to identify how bibliometric analysis helped in the construction of a map that contemplates and relates the main scientific productions that comprise the AHP Multicriteria Decision Method and the Urban Mobility area, and can serve as a basis for researchers in the development of a model and its subsequent application. On the other hand, the AHP method can be improved in the search for application in new fields of activity.

4. Methodology

The work was systematized in four phases. **Initially**, the main search terms and their occurrences were selected in the Scopus database: "AHP" (11,318), "Analytic Hierarchy Process" (9,150), "Governance" (65,342), "Public Management" (2,632) and "Urban Mobility" (1,855). We used scientific production data based on the analysis of scientific articles published in journals, congress annals and conference papers indexed in the Scopus database of the areas of knowledge: "computer science", "mathematics", "decision sciences", "social sciences", "business management", "environmental", "economics" and "engineering".

As selection criterion, the relationship between the keywords and their interdependence was used, considering the standard search terminology of the database itself. In the **second phase**, with the articles presented in the research, it was carried out verification, article by article, confirming the actual approximation of these with the related theme. At the conclusion of this phase, 107 articles were selected. After the "manual" selection of the articles, the 10 databases created, one for each search term, were compiled on a single basis, thus nullifying the possible duplication of articles and inconsistency of the information.

In total, 104 scientific articles were selected, 73 (70.20%) articles published in academic journals, 29 (27.88%) published in the fields of scientific events indexed in the database, and 2 (1.92%) review articles published in both of them.

Table 1. Number of selected documents by search terms.

| Search Term | Articles | Search Term | Articles |
|-------------|----------|-------------------|----------|
| AHP | 15 | Public Management | 11 |

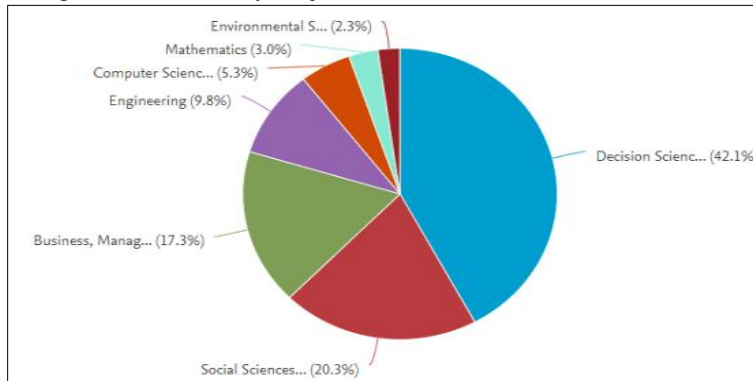
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|------------------------------|----|--|----|
| Analytic Hierarchy Process | 17 | Smart Cities | 10 |
| Governance | 14 | Sustainable Urban Mobility Plan (SUMP) | 6 |
| Local Productive Arrangement | 4 | Urban Mobility | 18 |
| Public Administration AHP | 4 | Urban Mobility Technology | 8 |

Source: Scopus database.

The research was conducted between September and November 2020, addressing the period between 2015 and 2019.

In the **third phase**, a characterization of the archives was made, electing only those that related between different cities and their integration, written in English. In this phase, the different statistics were also evaluated for analysis of bibliometric results and it was generating the file in "CSV" format for network graph generation with VOSviewer tool.

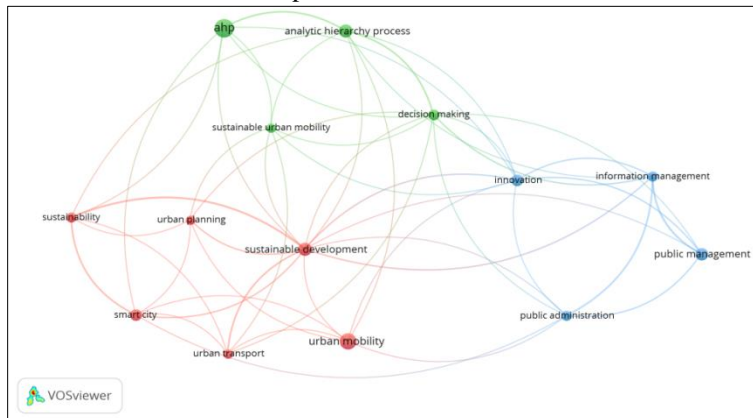
Figure 1. Percentage of documents by subject area.



Source: Scopus database.

In the **fourth and final phase**, the data were mapped with the VOSviewer bibliometric networks construction and visualization tool, using the graph creation feature based on bibliographic data with co-occurrences analysis between all keywords. It was detected 614 key words with a minimum requirement of 5 occurrences to integrate the analysis, resulting in 14 connected cores. Graph creation considered the method "full counting".

Figure 2. Network of co-occurrences of productions from 2015 to 2019.



Source: VOSviewer software.

The network graph shows 3 Clusters (6-4-4 items), distributed as follows: **Cluster 1** - focusing on physical space and its planning, having as axes urban mobility and sustainability ("*smart cities*", "*sustainability*", "*sustainable development*", "*urban mobility*", "*urban planning*" and "*urban transport*"); **Cluster 2** - focusing on AHP Multicriteria Decision Methodology ("*AHP*", "*analytic hierarchy process*", "*decision making*" and "*sustainable urban mobility*") and **Cluster 3** - focusing on public administration and innovation ("*information management*", "*innovation*", "*public administration*" and "*public management*").

Cluster analysis allowed the identification of a direct relationship between sustainable development, urban mobility, public administration and decision methods, being the main items of each cluster: "*AHP*"; "*urban mobility*" and "*public management*". The item identified with the highest weight was "*AHP*".

The analysis also showed the consolidation of different terms, repeated in network map, such as: "*urban*", "*mobility*", "*public*", "*analytic hierarchy process*" and its acronym "*AHP*". The three clusters interrelate through 2 items: "*sustainable development*" and "*innovation*".

5. Limitations

Generally speaking, the Scopus database guided the identification of different subjects that have special relevance in studies conducted in isolated areas. In the case of Public Management, most studies are based on the efficiency of the management itself, the applications of AHP in production systems and management of independent areas, and, in Urban Mobility, the studies are aimed at the public passenger transport integration systems and sustainable development.

Despite the abundance of publications, it is difficult to obtain bibliographic data sufficiently organized for the bibliometric processing necessary in the construction of indicators (OKUBO, 1997).

In the search for a new bibliometry, the path to be traced will be the identification of integration models already successfully implemented, taking as reference the different types of integrated technology and the management model at the regional level, thus adding the real experiences with its implementation, risks assumed and improvements to be made in the model.

6. Conclusions

Future studies may be based on the development of an integration model with collaboration between government - private initiative - academy for the implementation of management technologies for cities, through planning tools that help in the decision-making of local administrations, acting in a joint and regionalized manner and bringing economic and development benefits to the different regions.

7. Key References

IIDA, Y; KOIZUMI, R. (2018) A framework using the Analytic Hierarchy Process for local Governments in Japan to evaluate projects based on outcomes. **International Journal of the Analytic Hierarchy Process**. 10(3).

OKUBO, Y. (1997) Bibliometric indicators and analysis of research systems: methods and examples. **STI Working Papers**. Paris: OECD, 69.

SAATY, T. L.; ERGU, D. (2015) When is a decision-making method trustworthy? Criteria for evaluating multi-criteria decision-making methods. **International Journal of Information Technology & Decision Making**, 14(6), 1171-1187.

SU, H.; LEE, P. (2010) Mapping Knowledge Structure by Keyword Co-Occurrence: a first look at journal papers in technology foresight. **Scientometrics**, 85(1), 65-79.

WEISS, M. C. (2019) Posicionamento da indústria de TIC para a construção das cidades inteligentes no Brasil: resultados de um levantamento com sete gigantes do setor. **Revista Tecnologia e Sociedade**. Curitiba. 15(36), 165-189.