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World constructal network of scientific publications, co-authorship and citations

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Abstract

This work presents a network analysis of the scientific publications, co-authorship and citations associated with the word "constructal" that appear in journals between the years 1996 to 12/2018 using a search engine recognized in the international academic community (Scopus). The constructed network considers the existing relationships between authors and the number of publications and citations in the studied range of years. In addition, an evolution over time of the construction network is presented. The results show that the constructal field has been growing and spreading. So far, papers have been published on all of the continents, and the data are presented according to the publications density for each country.

Keywords: constructal network, co-authorship, publications, citations.

1. Introduction

The Constructal law – "For a finite-size system to persist in time (to live), it must evolve in such a way that it provides easier access to the imposed (global) currents that flow through it" – was stated by Prof. Adrian Bejan in 1996 [1]. The growing

number of recent studies support Constructal law as valid for natural and engineered flow systems [2]–[5]. Constructal law shows how an idea flows [6], [7]. When there is a flow, also there should be connections with ideas the researchers who consider Constructal theory in their researches. The result of this connection is scientific collaboration [8]–[10]. The main objective of this work is to build and analyze the Constructal network based on the possible relationships between authors who published on Constructal realm in articles and conference papers and its evolution in time.

2. Methodology

The data were obtained in from the 3,410 published works on the constructal field from the years 1996 to December 2018. Four steps were established to investigate the constructal networks: Step 01: Establish the main digital search engines to be used. Scopus [11] was selected. Step 02: Determine the keywords to search for in digital search engines. "Constructal" was selected to determine the scientific works (articles and conference papers), and its corresponding authors were selected to be included in the Constructal network. Step 03: Establish criteria for excluding and including papers to be used for the construction of the Constructal network of international collaboration. The authors of the constructal network were selected if they had published at least three works for the collaborative network during the period from 01/1996 to 12/2002 and seven works for the collaborative network during the periods from 01/1996 to 12/2010 and 01/1996 to 12/2018. Step 04: The size of the authors circles is according to each one's degree, which represents the number of edges adjacent to the node. The edges' thickness symbolizes the weight of the connection between the authors. An edge with a greater thickness represents a greater amount of collaboration between the authors.

3. Constructal Network: Spreading and Growing

Fig. 1. a) Total number of publications and citations where the word "Constructal" appears in the text; b) Relationship between the number of publications of some actives authors.

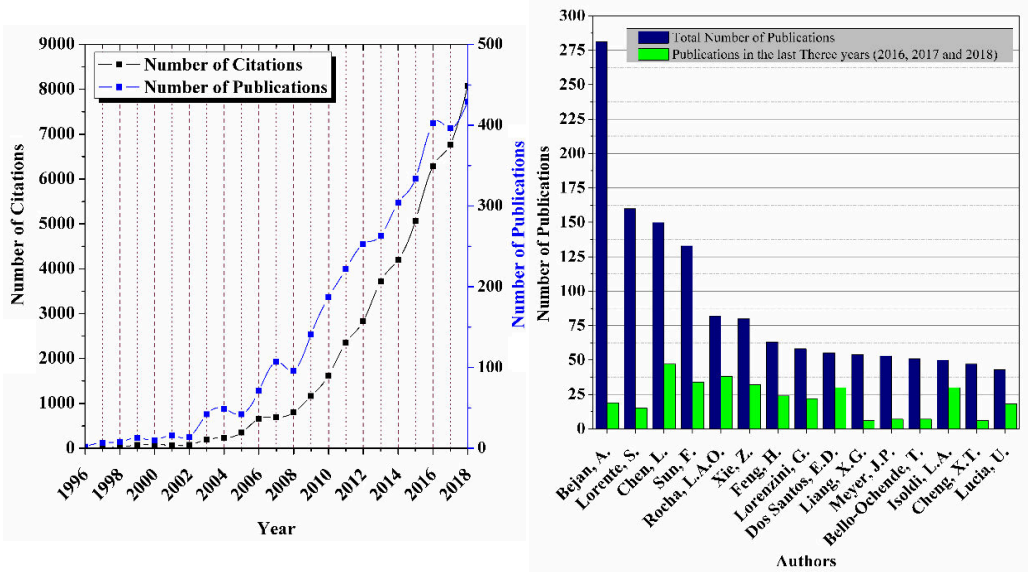
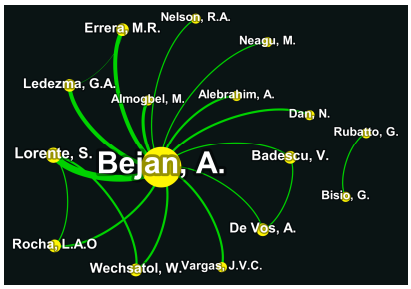
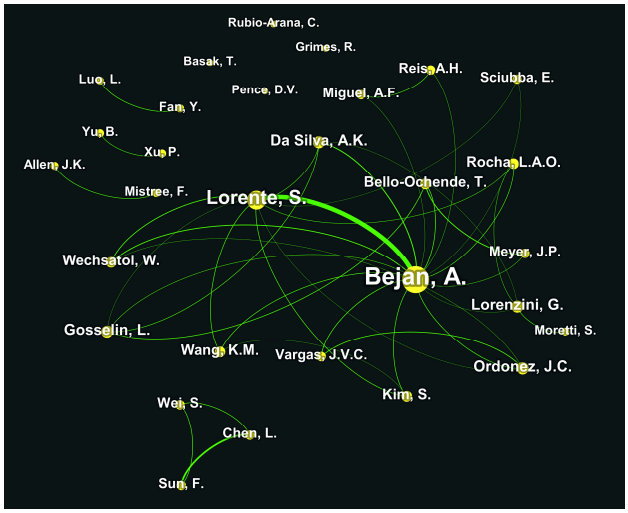


Fig. 2. Evolution of Constructal Network: a) 1996 to 01/2003 - Authors with more than three publications; b) 1996 to 01/2011 - Authors with more than seven publications; c)1996 to 12/2018 - Authors with more than seven publications.

a)



b)



c)

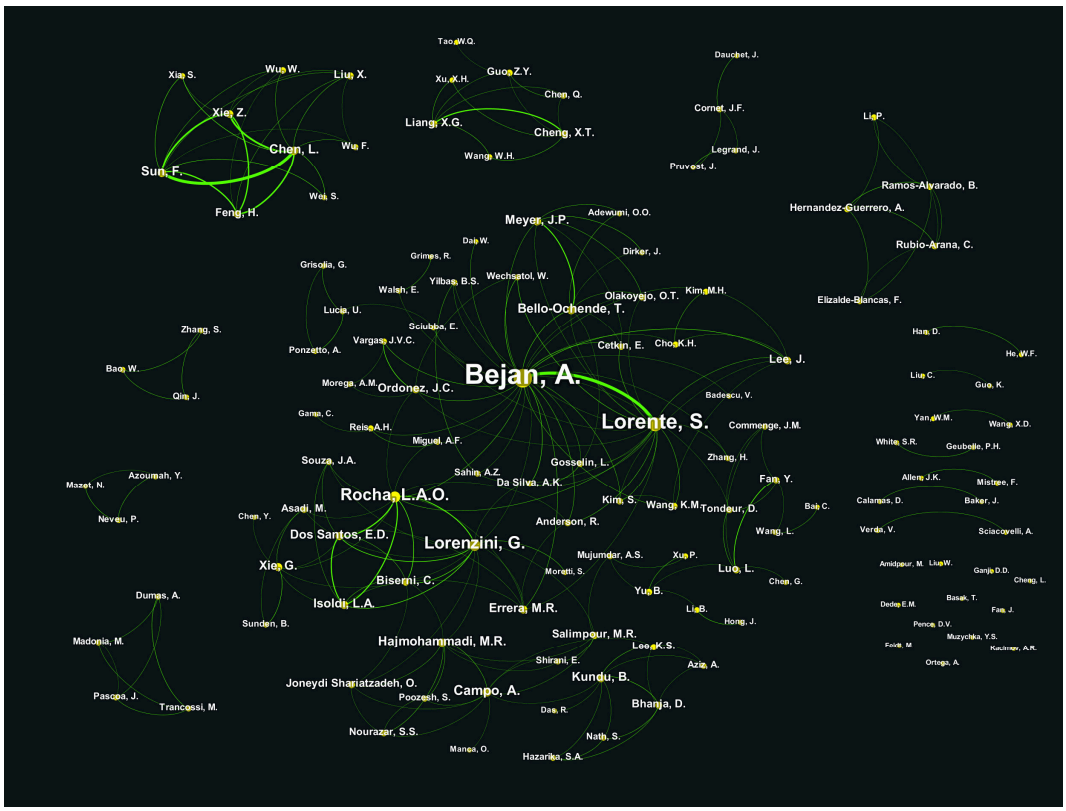
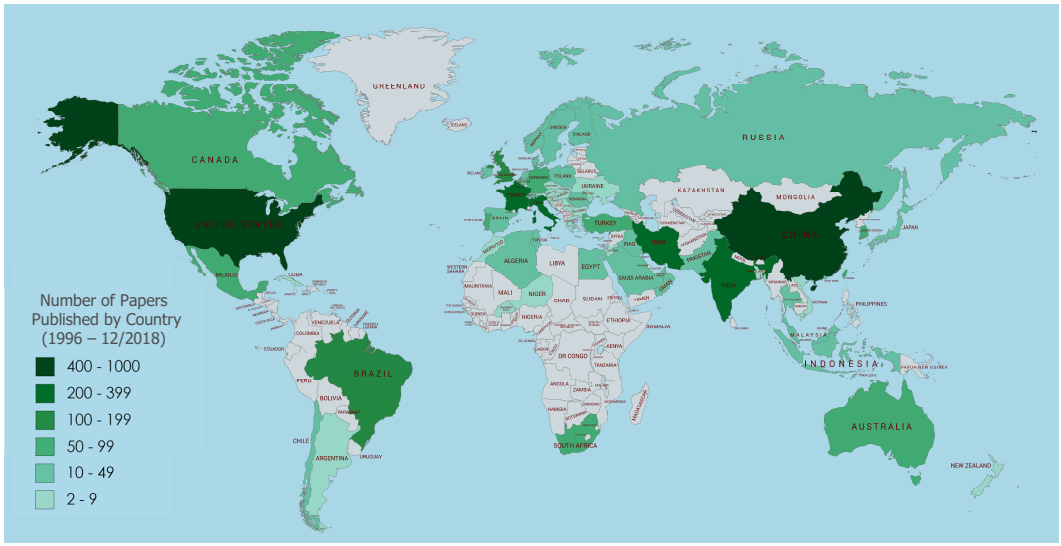


Fig. 3. Number of works published by countries in the Constructal theory scenario.



4. Conclusions

This paper shows the scientific collaborations that define the Constructal network that connect the researchers. Scopus was used as a digital search engine to get the publication number and the citation number. The results showed that this network is spreading and growing steadily. It also indicated that most of the author who publish in this field collaborate with each other. The result also shows the network's hierarchy: A few authors publish a large number of publications and receive more citations, and many authors publish a small number of publication and receive fewer citations.

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