A Bibliometric Review of Sociocybernetics

[1]Manuel Ignacio Balaguera, [1]Jenny Paola Lis, [1]Mercedes Gaitan,
[1]Paula Viviana Robayo and [2]Amelec Viloria
[1]Fundacion Universitaria Konrad Lorenz, Bogota, Colombia
[2]Universidad de la Costa, Barranquilla, Colombia

Abstract: Sociocybernetics is an emerging field of research, innovation and development whose proposed goal is the construction of knowledge on social systems from the systems science and cybernetics perspectives. Sociocybernetics assumes that social systems belong to the superclass of complex systems and promotes the computational modeling and simulation approach to support decision-making processes when dealing with social systems problems. In the present work, the results and analysis of a bibliometric review on sociocybernetics is reported. The main conclusion of the present work is the fact that at the present, sociocybernetics is at its initial stage of development but widely extended both geographically and across scientific disciplines which justifies efforts directed towards a sustained work in its development and its consolidation.

Key words: Sociocybernetics, cybernetics perspectives, bibliometric, complex systems, consolidation

INTRODUCTION

At the present, Sociocybernetics is a transdisciplinary field of research, innovation and development dedicated to the construction of knowledge, methods and tools for the support of decision making when dealing with problems on social systems (Amozurrutia, 2012).

Sociology, the science of social systems as a science born in the 20th century, up to the present has been developed under the reductionist paradigm of science consisting in the belief that the behavior of a system may be explained by the linear superposition of a basic set of "laws", ideally reducible to a single law. However, the problems confronted by the world in the transition from the 20 century to the 21 century: global change has made evident the inadequacy of the reductionism paradigm to deal with all kind of complex phenomena including of course, social phenomena leading to the rise of a new scientific paradigm: the complexity theory (Castellani and Hafferty, 2009).

The essential change from reductionism to complexity lies in the idea that a system is much more than a simply connected set of objects, the connections may be diverse and dynamic such as in a living organism or in a society differing strongly from those occurring in the simple physical systems. This new perspective in complexity theory gives the possibility to explain the main features and behaviors of complex systems: non-linearity, emergence, contingency and chaos (Anderson, 1999).

In addition to the change in the basic ideas about the relation between components the global system behavior, there is a deep change in the use of quantitative tools used for predictions and prognostics that support decision making processes. Under the reductionist paradigm the "quantities production engine" is a mathematical model built in terms of a diversity of variables without any hierarchy or organization selected by intuition or by control needs and representing features of the global identity of the system without any consideration on its real internal organization and complexity (Forrester, 1971).

In the other hand computational modeling, thanks to the science of data structures and object oriented methods, allows a one to one correspondence between digital models and real systems in addition to an infinite spectrum of possibilities to represent the integrative connections between the components of a system, not just by simple addition as in linear or quasilinear mathematical models (Booch *et al.*, 2007; Nemiche, 2017).

Sociocybernetics pursue to connect the available knowledge on social systems structures their hierarchical organization and about the relations between agents and organizations composing these social systems with the concepts, methods and goals of cybernetics: the science of control and communication in the animal and the machine as was defined by Norbert Wiener.

As stated by Lancelot Law White, "The history of science is part of science we only fully understand an idea when we know enough about its history" (Law *et al.*, 1973).

Despite sociocybernetics is very young in the scale of evolution of science, the acceleration in the advancement of communications and all the subjects related to computing justifies a review in order to attain a snapshot of the state of the art of sociocybernetics and about its evolution. In the present work, the results of a bibliometric analysis on sociocybernetics are reported, reviewed and outlined.

MATERIALS AND METHODS

The study is based in search processes using the SCOPUS bibliographic database. In a first stage, given the high specificity of the term "sociocybernetics" and consequently the low quantity of papers found in a search for the word in the field "title", a new search for the word "sociocybernetics" in the extended field "title, abstract, keyword" was done in order to analyze the similarity between the time evolution patterns observed in both search results and be able or not to conclude that the second one is a good amplification of the first one.

In the second stage of the analysis, a systematic search-analysis of results is performed in order to capture all the papers that, despite the use of different expressions have a same scientific objective. A search for the expressions:

- Cybernetics AND "social system"
- Sociocybernetics OR (cybernetics AND "social system")

Was made by using the Boolean Algebra logic operators "AND": intersection between the operated sets of search results and "OR": union between the operated sets of search results.

In a third stage a continuous time plot for each expression is made by using the "moving average" interpolation model in EXCEL (©Microsoft Inc.) in order to compare these time dynamics and derive a first set of conclusions.

Once obtained the best representative expression, a complete bibliometric analysis is made for the selected expression in the selected search field.

RESULTS AND DISCUSSION

Figures 1 and 2 show the search results for the word "sociocybernetics" in the filed "title" and in the field "title, abstract, keywords", respectively. As observed in Fig. 3, although in Fig. 2 the data scale is approximately 3 times the scale in Fig. 1, in both plots there is a high similarity between the time distribution of the heights: starting from small peak in the first-class interval (1982, 1987) there is a steady decrease until a minimum in
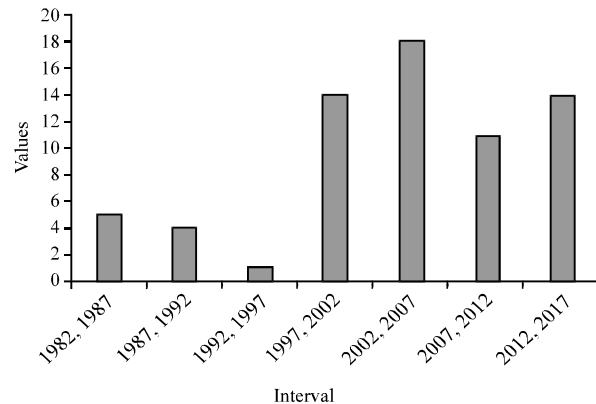

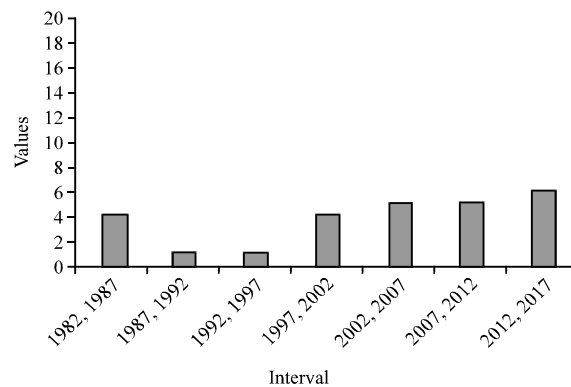Fig. 1: Sociocybernetics; title, abstract, keywords
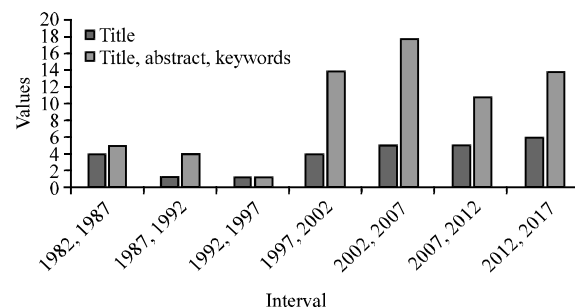

Fig. 2: Sociocybernetics; title

Fig. 3: Sociocybernetics; title vs title, abstract, keywords

the third-class interval (1992, 1997) followed by a jump in the fourth-class interval (1997, 2002) and a constant evolution up to the present. as a first result, it can be stated that the search results in the field "title, abstract, keywords" reflects appropriately the research interest in the concept of "sociocybernetics". Figure 4 and 5 shows the results corresponding for the search expressions {cybernetics and "social system"} and {sociocybernetics OR (cybernetics and "social system")} presenting almost identic time evolution patterns just differing by an
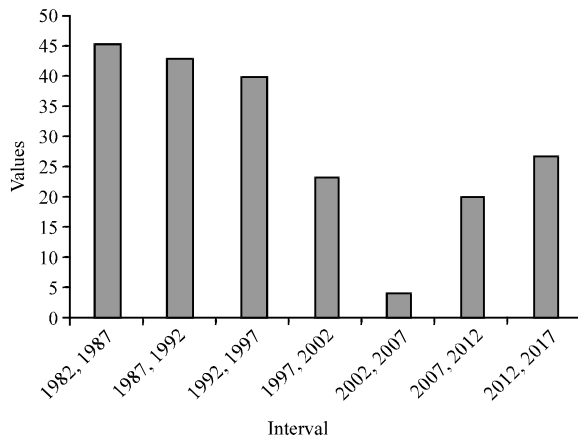
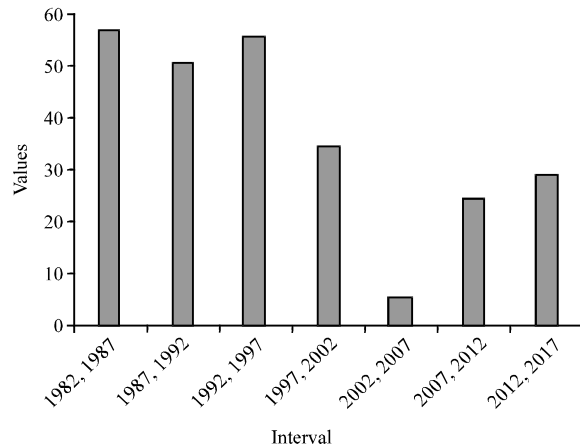Fig. 4: Cybernetics and "social systems" title, abstract, keywords

Fig. 5: Sociocybernetics OR (cybernetics and "social systems") title, abstract, keywords

Fig. 6: Comparative continuous time plot

Fig. 7: Consolidated results for cybernetics of social systems

approximately 20% in columns height. Figure 6 shows the continuous time plot for the three explored expressions. Here, it is clearly observed an opposite concavity between the plots corresponding to "sociocybernetics" alone and the other two extended expression having an approximate convergence from the 2002-2007 period continued up to the present. In addition, a continuous decrease is observed in the use of the isolated expressions "cybernetics" and "social systems" while is observed an increase in the use of the combined expression "sociocybernetics". Figure 7 shows the consolidated results for the field of control of social systems under the names of "cybernetics of social systems" and "sociocybernetics". Searches using expressions not including explicitly the word "cybernetics" were not included in the analysis because there is not guarantee that these papers were written under the perspectives of systems science and complexity
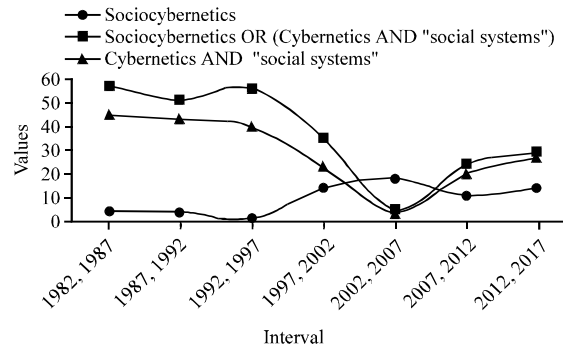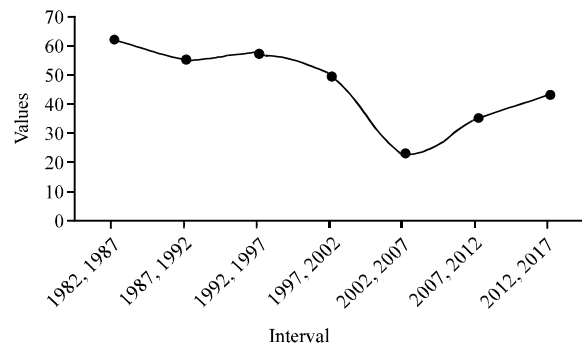
theory which are the specific focus of sociocybernetics community. Figure 7 shows that from the beginning of the use of the concept "sociocybernetics" in 1982 there was a period of steady production in the field followed by a deep decrease during the last decade of the 20th century and the first decade of the 21st century possibly due to the evidence in the inadequacy of the reductionist-determinist approach of science brought about by the global change phenomena.

In the last decade, 2007-2017, it is observed a low pace but steady increase in production which may be explained by the onset and slow but progressive consolidation of the complexity paradigm in the contemporary science. Figure 8 shows that almost the half of the production has been published in one journal, "Kybernetes" and the other half was published by journals from a diversity of research fields which together with the in Fig. 9, corroborates the transdisciplinary nature of sociocybernetics in addition to the recognition observed of "Kybernetes" not just as the most representative journal in the field but as its paradigm. Operations Research and System's Science stand out in the spectrum of the other sciences. Finally, Fig. 10 and 11 show that the interest for sociocybernetics
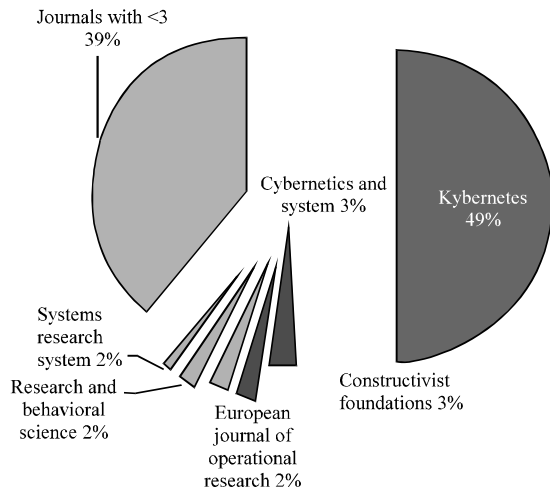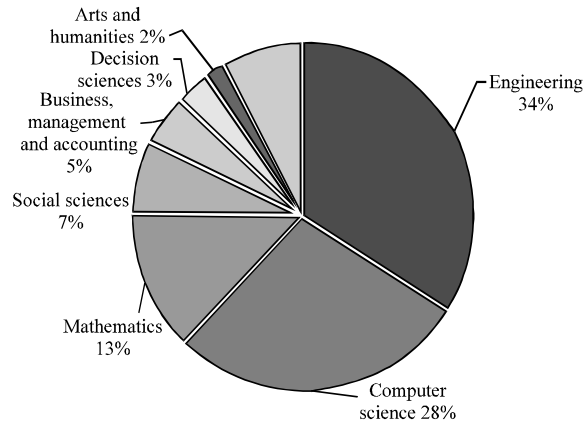
Fig. 8: Papers by journal
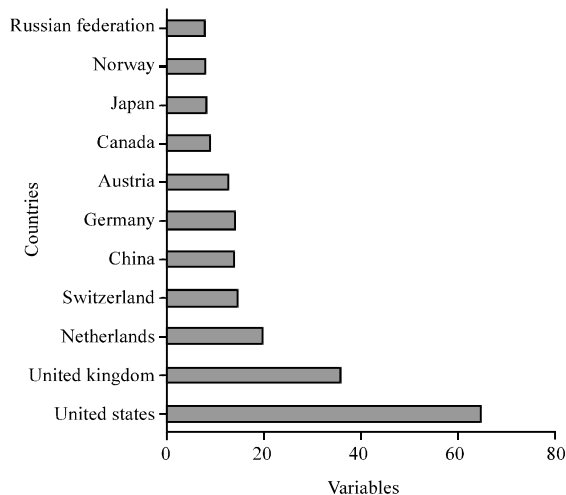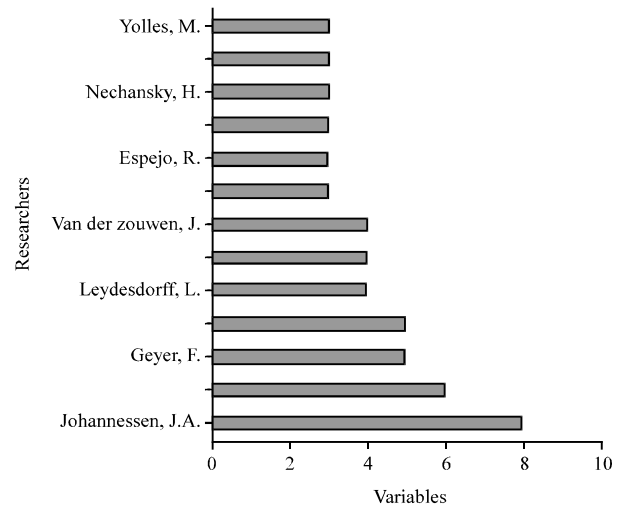

Fig. 9: Papers by subject

Fig. 10: Papers by country

Fig. 11: Papers by researcher

is extended across the world which suggests that sociocybernetics is becoming a consolidated research community.

CONCLUSION

Despite its low volume of articles at the present, Sociocybernetics has a growing dynamic extended both geographically and across disciplines which suggests its potential as an alternative strong focus in the study of social systems and a source of effective strategies in the treatment of complex social problems. Although, data supports sociocybernetics as a transdisciplinary research field, it is observed a low involvement of the social sciences in its development which is strongly leaded by the quantitative sciences and engineering. The time evolution of production in sociocybernetics as measured by the number of published papers in the field is coherent with the dynamics of science leaded by perspectives of the systems science and the complexity theory.

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