



Fuzzy systems in innovation and sustainability

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Abstract

Fuzzy systems in innovation and sustainability are important topics in literature nowadays. A lot of new formulations in fuzzy systems are being made including interesting applications in different topics. The aim of this special issue is to present different works made in this line of research that were presented in the IV International Congress of Innovation and Sustainability (ICONIS).

Keywords Fuzzy systems · Innovation · Sustainability

1 Evolution of fuzzy systems

Studies and research on fuzzy systems have been extensive since the proposals of (Zadeh 1965). Its main fields of development have been in computer science, artificial intelligence, engineering, automation, control and mathematics. Developments have focused on modelling fuzzy reasoning with multivariate systems that consider

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multidimensional reasoning methods (Takagi and Sugeno 1985). Among the methods that have been developed and have been extensively studied are adaptive-network-based fuzzy inference system (ANFIS), which is framework of adaptative networks that used a hybrid learning procedure based on human knowledge and stipulate input–output data pairs (Jang 1993). Another method is fuzzy logic controller (FLC), which provides a means of converting a linguistic control strategy thought-out fuzzification and defuzzification strategies, the derivation of the database and fuzzy control rules (Lee 1990). Likewise, fuzzy clustering consists in fuzzy validity criterion based on a validity function which identifies overall compact and separate fuzzy c-partitions without assumptions as to the number of substructures inherent in the data using to solve problems in pattern recognition and image processing (Xie and Beni 1991). Also, interval type-2 fuzzy logic systems is highlighted, which propose an efficient and simplified method to compute the input and antecedent operations and introduce the concept of upper and lower membership functions (Liang and Mendel 2000). On these approaches and others, developments have been made that are applied and used in different areas of research and practical settings.

These advances have permeated other fields of social and human sciences to help solve or provide answers to problems that have aspects related to people's reasoning (Blanco-Mesa et al. 2017). Of these fields are in the field of economics, business and management to aid to solve decision making problems. In these activities the direct action of people in decision-making processes makes it more complex to deal with aspects that include hard data and soft data (Blanco-Mesa 2020). Applications include logistics (Sheu 2007), stakeholder (Blanco-Mesa et al. 2018), investment and derivatives (Fonseca-Cifuentes et al. 2021; Anna M. Gil-Lafuente 2005a, b; León-Castro et al. 2017), transparency (Perez-Arellano et al. 2020), product development (Kim and Wilemon 2002), sustainability (Phillis and Andriantiatsaholainaina 2001), supply chain (Chan and Qi 2003), customer orientation (Frambach et al. 2016), innovation (Alfaro-García et al. 2017) entrepreneurship (Fabio Blanco-Mesa et al. 2021) and so on. These studies delve into solutions to problems specific to these areas. The following is a better description of progress in innovation and sustainability using fuzzy systems.

2 Applications in innovation and sustainability

Innovation research is nowadays receiving great attention because of its social, economic, and technological, implications for businesses and countries (Merigó et al. 2016). The wide-ranging scope that innovation research suppose, opens the path for scholars and academicians to address complex issues surrounding the topic (Cancino et al. 2017). Innovation, as the successful exploitation of ideas (Branson 1988) is a growingly studied field, that still in our days cannot be totally defined or modelled, however, fuzzy techniques have proven to be effective for its measurement (Alfaro-García et al. 2017).

Sustainability, understood as the development that satisfies present needs without compromising the ability of future humans to meet their own requirements (Simon 1987) is an urgently required field to be assessed (García-Orozco et al. 2020).

Human production and consumption systems are fully linked to the capacity and ecological limits of the planet (Meadows 1972) and the possible quality of life of the humankind responds to these planetary limits as well (Rockstrom et al. 2009). Even when sustainable protocols have been proposed, designed, and implemented by organizations and nations (Nations 2021), many challenges are still to be addressed. Here, innovation and technological change play a decisive role, for the assessment of big scope solutions (Smith et al. 2010).

Innovation and sustainability research are especially relevant for fuzzy systems (Alfaro-García et al. 2020; Kahraman et al. 2016), as their ability to analyze, measure and treat information in uncertainty (Alfaro-García, 2020) results vital for the correct understanding of the topic, moreover, recentring the attention in human based models (Gil-Lafuente 2005a, b). Some advancements in this regard are e.g. decision supports systems applied to agricultural technologies applying fuzzy techniques (Ciric et al. 2019), fuzzy models for the valuation of sustainable development and its social impact (Alfaro-Calderón et al. 2019), the assessment of green building indicators for sustainable manufacturing with fuzzy systems (Yadegaridehkordi et al. 2020) and measurement of innovation capabilities in regions applying fuzzy techniques (Alfaro-Calderón et al. 2020).

3 About the papers in this special issue

The special issue consists of 3 papers that have been presented in the IV International Congress in Innovation and Sustainability that was held in Leon, Guanajuato Mexico from 22 to 23 October 2020. The best papers were invited to be presented in this Special Issue. All the papers have been processes by a peer review process.

The first paper in the special issue is Innovation capabilities measurement using fuzzy methodologies: A Colombian SMEs Case, the aim of the paper is to stablish the hidden incidences that can improve specific aspects of the beekeeper innovation capabilities in Boyacá-Colombia. The findings suggest that there are two specifics actions that can improve the innovation culture that are: marketing strategies and product innovation. Also, it is possible to visualize how fuzzy methods help in contending with incomplete and subjective information, highlighting the meaning of the information rather than its measurements.

The second paper is A machine learning model of national competitiveness with regional statistics of public expenditure. This paper presents a model using a neural network to predict the behavior of competitive benchmarks using public expenditure variables. The theory of control, in which the neural network approach is based, offers some advantages such as solving the problem while considering the dynamic nature of the phenomenon and allowing control blocks to be implemented in a straightforward method. The present paper establishes a neural network model that links control, administration, and systems theories in a statistically sound approach that connects both sets of variables, opening the path for extensions that allow optimal allocation of resources.

The third paper is titled the effect of ICT and higher-order capabilities on the performance of Ibero-American SMEs. This paper uses second-order structural

equation models to test the research hypotheses with a sample of 130 Ibero-American SMEs. The results contribute to filling the gap in the SME-focused literature on empirical studies examining Information and communication technologies (ICT) enabled capabilities and firm performance. The results show an enabling effect of ICT on higher order capabilities, such as knowledge management capability (KM) and product innovation flexibility (PIF), which, by acting as mediating variables, create value and improve performance through innovation in firms.

As can be seen, the three papers present different methodologies, approaches, and information to analyze topics related to innovation and sustainability. This generates a new way of analyzing information, from different points of view, and generating better processes in organizations.

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