

Fuzzy Inference System to Assess Entrepreneurial Self-Efficacy

Yesica Rodas-Cano, Eduardo Duque-Grisales, Leonardo Serna-Guarín, Miguel A. Becerra



Abstract: En este estudio se utiliza un sistema de inferencia difusa para medir la autoeficacia empresarial (ESE) basado en características emocionales. Se adquirió un conjunto de datos con varias características orientadas a la Teoría del Comportamiento Planificado de 741 sujetos. Se aplicaron las cuatro etapas siguientes: i) preprocesamiento de los datos, ii) correlaciones de variables para definir la influencia de las variables emocionales en la ESE, iii) sistemas de inferencia difusa (FIS): en esta etapa se establecieron las reglas basándose en los resultados del análisis estadístico y en los conocimientos de los expertos. iv) Se llevó a cabo la evaluación del FIS para medir su rendimiento. Los resultados demostraron la funcionalidad del modelo y se desvelaron sus ventajas, limitaciones y trabajos futuros. En este estudio se constató que, a medida que mejora la inteligencia emocional de las personas, éstas adquieren una mayor autoeficacia empresarial, lo que conduce a un mayor éxito como empresarios, que se modeló adecuadamente con el FIS desde múltiples variables de entrada.

Keywords: Emotional intelligence, Entrepreneurial Self-Efficacy, Entrepreneurial intention, Fuzzy inference system.

I. INTRODUCTION

The entrepreneurial attitude is highly desirable in a country's economy as it allows for economic growth of a country's GDP and a decrease in the unemployment rate [1][2]. However, the entrepreneurial attitude is closely linked to the culture and training of the individual. Thus, individuals with a high entrepreneurial attitude have extraordinary abilities to identify opportunities for new business ventures. Individuals constantly find opportunities, but not everyone can recognize them and transform them into successful enterprises. Identifying the right entrepreneurial opportunity is a deliberate behaviour. Entrepreneurial intention essentially predicts entrepreneurial behaviour. Therefore, investigating the motivation underlying entrepreneurial intention is considered an important activity that helps to understand and predict entrepreneurship [3]. Although intention is a powerful predictor of actual behaviour, it is essential to note that intention formation may be identified

long before the actual behaviour occurs, and the behaviour may never take place. Theory of Planned Behaviour, Entrepreneurial Self-Efficacy (ESE) is related to individuals' beliefs about their entrepreneurial skills [4][5] and influenced by socioeconomic variables, emotional intelligence, entrepreneurial intentions and behaviours among others, however, emotional intelligence and other intrapersonal traits are considered to be among the most relevant [6][7][8]. The literature reports some studies on emotional intelligence and entrepreneurship; however, there are few reports related to models to assess the entrepreneurial attitude in terms of emotional intelligence [9][10][11][12][13]. Considering the above, this study proposes a fuzzy inference system (FIS) [14] for the assessment of entrepreneurial attitude as a function of variables related to emotional intelligence. A statistical study was conducted using an analysis of 741 respondents to identify influential variables in valuing entrepreneurial attitude. The FIS was then constructed with expert support for the construction of the rules and functional validation of the proposed system. The results demonstrated the scope and limitations of the system, considering it a powerful tool for decision support in this field.

II. EXPERIMENTAL SETUP

A. Proposed Methodology

Figure 1 illustrates the addressed methodology. This describes the various stages of the method employed in developing the entrepreneurial attitude measurement system, which was conducted in five stages: (i) In the first stage, data collection was conducted using an instrument administered to a sample of 741 individuals. ii) In the second stage, the statistical analysis of the results from the applied instruments was carried out to identify the influential variables in assessing entrepreneurial attitude. iii) In the expert analysis stage, rules were established based on the relevant characteristic for the construction of the fuzzy inference system. iv) The fuzzy inference system is constructed based on the rules established in the previous point. v) Finally, the model's functionality is validated using surface diagrams.

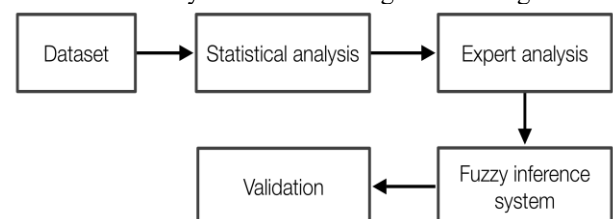


Fig. 1. Proposed Methodology

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III. RESULTS AND DISCUSSION

Correlation analysis, with a p-value of 0.05, showed that the variables presenting the highest degree of correlation concerning the ESE are: Autonomy (A), Risk-taking (Rt), Optimism (LOC), and Innovation (INN). On the other hand, the control variables, such as Age, gender, Student, Entrepreneur, and Employee, have a very low correlation and are therefore considered to make a little contribution to the measurement of entrepreneurial attitude.

Figure 2 illustrates the proposed and implemented fuzzy inference system, which has four inputs and one output corresponding to the ESE valuation.

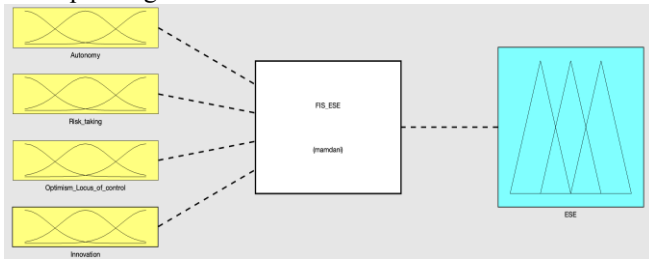


Fig. 2. Fuzzy Inference System – ESE Assessment System

Based on the influential variables affecting entrepreneurial attitude, the rules were constructed, considering three qualitative ratings for each variable (H: High, M: Medium, L: Low), as illustrated in Table 1.

Table I: Rules of FIS

A	Rt	OLC	INN	ESE
H	H	H	H	H
H	H	H	R	H
H	H	R	H	H
H	R	H	H	H
R	H	H	H	R
H	H	R	R	H
H	R	H	R	R
R	H	H	R	R
H	R	R	H	R
R	H	R	H	R
R	R	H	H	R
R	R	H	R	B
H	H	H	B	H
H	H	R	B	R
.
.
.
B	B	B	B	B

Figure 3 Shows the Structure of Fuzzy Sets (Low, Medium and High) with Their Scales [0, 1].

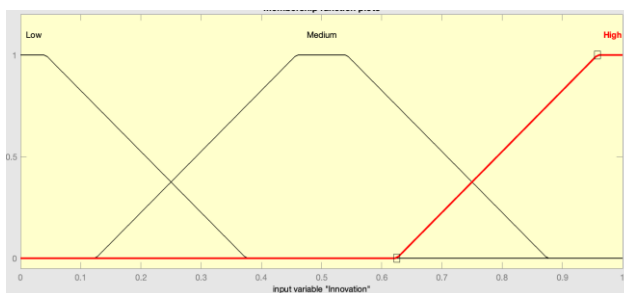


Fig. 3. Fuzzy Set For Innovation

Figure 4 shows surface diagrams which demonstrate the

functionality of the proposed system. They have shown that the most influential variables are autonomy and risk-taking, which are entirely consistent with the results, as these are the most significant variables. Additionally, the coherence of the measurement is evident.

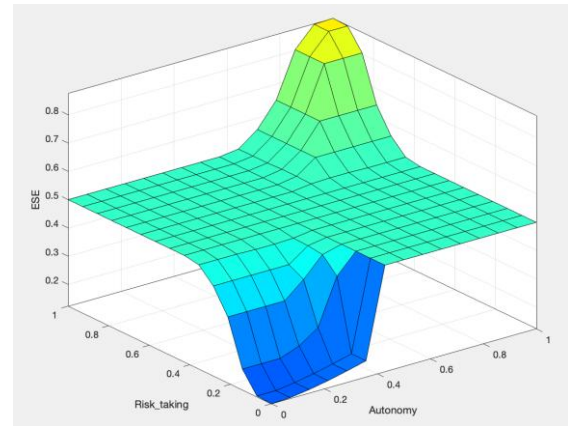
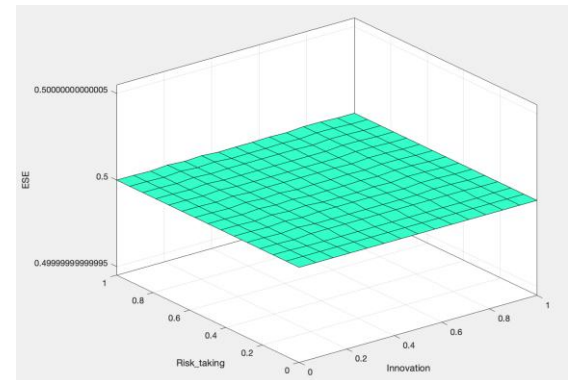


Fig. 4. ESE Assessment Risk-Taking Vs Autonomy



a) ESE Assessment Risk-Taking Vs Autonomy

IV. CONCLUSION

This study proposes a system for valuing the entrepreneurial attitude in Colombia, for which a set of weighted metrics was defined and integrated into four criteria, modelled in a Mamdani-type fuzzy inference system. The system demonstrated adequate performance, as evaluated by the experts based on the various metrics provided. Despite this, it is considered that an assessment and tuning of the system in terms of fuzzy sets and rules should be carried out to minimise the error. As future work, it is proposed to model the valuation system of the ESE sufficiently to train a learning machine and compare it, using performance metrics, with the fuzzy inference system and a hybrid system based on the FIS that allows for adequate tuning of the system. In addition, a framework based on JDL data fusion and information quality could provide a complete evaluation of the ESE in terms of risk, impact and situation, taking into account data quality [15][16].

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