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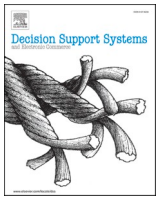

Research paper

Decision support systems in crowdfunding: A fuzzy cognitive maps (FCM) approach

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ABSTRACT

Crowdfunding as an alternative source of finance to banking is the subject of numerous research works. This research proposes the guidelines of a Decision Support System (DSS) in the area of crowdfunding based on a Fuzzy Cognitive Maps (FCM) approach. A framework consisting of three phases (ten steps) has been proposed to design the guidelines of a DSS in crowdfunding. The first phase focusses in the construction of the FCM. FCM-based scenarios have been built in the second phase. Finally, in the third phase the guidelines of the DSS in crowdfunding have been defined. Results show that DSS using FCM-based scenarios could be useful tools to promoters, funders and managers of crowdfunding projects.

1. Introduction

Crowdfunding is a source of financing projects through small contributions, thus mitigating the possible risk, made by public or private investors, who get in touch through virtual platforms. On these platforms, funders can choose the most attractive projects to them, based on their interests or expected results [1].

This source of project financing has raised almost 220 million euros in Spain in 2021, according to the Report on Crowdfunding in Spain prepared by the Universo Crowdfunding platform. This report reveals that the real estate crowdfunding platforms are the ones that have raised the most with 64 million euros; followed by the investment platforms with 62 million euros, the crowdlending platforms with 36 million euros, the donation and reward platforms with 32 and 25 million euros, respectively.

The potential of this alternative source of finance to banking is evident. Thus, for several years, studies on crowdfunding in all its forms (equity, lending, reward, donation, real estate) have increased.

The increasing importance of crowdfunding as a source of economic resources demands some kind of DSS to effectively manage all these services [2,3]. There are different actors in the crowdfunding field who need relevant information to support decision making processes. For example, project managers of crowdfunding platforms need support to select those projects with a higher potential as well as to provide assistance to promoters. Promoters demand support to design and develop crowdfunding campaigns successfully, among other issues. Finally, potential funders or investors need support to identify projects with a higher rate of potential success.

Stylios et al. [4] combined FCM and DSS, since they argue that the appropriate modelling technique for developing decision support systems are fuzzy cognitive maps. Following this approach, the aim of this paper is to propose the guidelines of a DSS in the area of crowdfunding based on a FCM approach.

Our study offers several contributions to the existing literature. First, this research identifies and analyses the relevant variables that have influence on the success of crowdfunding projects and finds the relationships between these variables in the crowdfunding field. Second, different models have studied crowdfunding but not thoroughly. Therefore, to understand the success of crowdfunding projects, we have used a fuzzy method. Our third contribution is the formulation of profiles regarding the type of promoter, the characteristics of the project or the promotional campaign based on groups of variables. These profiles allow a deeper analysis based on the type of promoter, the characteristics of the project or the promotional campaign. These findings provide support to decision making processes. Fourth, there is a lack of studies about crowdfunding using the point of view of experts as most studies

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have been carried out considering the information obtained from crowdfunding platforms [5,6]. According to Fang et al. [7] an expert is someone who is skilled in a particular topic. Expert opinion would provide evidence that is current and unbiased to the research [8]. Therefore, the expert approach to crowdfunding is becoming increasingly important.

The remainder of this paper is organized as follows. In the next section, we proceed to review the related literature on DSS and fuzzy methods in crowdfunding. We also analyse those variables that have been considered as critical success factors in crowdfunding. Next, methodology is explained and results are presented, including the analysis of the different profiles proposed to support decision making in crowdfunding. Finally, the discussion and practical implications are included, as well as limitations and further extensions of this research.

2. Literature review

2.1. Fuzzy cognitive maps (FCM)

Kosko [9] defined a fuzzy cognitive map (FCM) as "*a relation model map to express knowledge as a signed digraph and infer the cause-effect relationship between the concepts*". Zadeh [10] proposed fuzzy set theory, that is focussed to unpredictability, imprecision, or ambiguity to address the difficulty of expressing our opinions accurately. Thanks to this theory, we can represent vague data using fuzzy numbers. Additionally, fuzzy theory allows us to apply mathematics when fuzzy domains are analysed.

According to Özesmi and Özesmi [11], their main advantages, and how FCMs would be useful in creating decision support tools for crowdfunding, include: *(1) the ability to allow feedback processes* (e.g. promoters could analyse the expected success rate in different scenarios and improve their chances for success)*, (2) the ability to deal with many variables which may be not well-defined* (e.g. human capital or social capital in crowdfunding projects)*, (3) ability to model relationships between variables that are not known with certainty, but can be described in degrees such as a little or a lot* (e.g. relationships between experience or number of rewards in crowdfunding campaigns with success)*, (4) the ability to model systems where scientific information is limited but expert and/or local knowledge is available* (e.g. there is few scientific knowledge about DSS in crowdfunding but experts are available)*, (5) ease and speed with which cognitive maps may be obtained and reach similar results with lower sample sizes as compared to other techniques* (e.g. the number of crowdfunding experts in not very high)*, (6) ease and speed with which many different knowledge sources can be combined, including expert and local knowledge* (e.g. knowledge from different relevant experts in crowdfunding)*, (7) ease and speed of modelling the system and the effect of different policy options* (e.g. the simulation with vectors representing different crowdfunding scenarios).

Because of its benefits in the decision-making processes, the fuzzy set theory is being more and more used in academic research. There are some previous works in other domains but for similar purpose. For example, Rodríguez et al. [12] and Maftei and Gerogiannis [13] determined the most important success factors in IT projects and online music streaming services, respectively, using FCM.

There are also some contributions of fuzzy techniques used to analyse crowdfunding platforms. For example, Gupta et al. [14] carried out research to identify and prioritize the main factors that drive acceptance of crowdfunding as a funding method, either directly or indirectly. De Crescenzo et al. [15] examined how certain factors interplay and cause either success or failure in equity crowdfunding campaigns. However, in the context of crowdfunding, this application is still a rather restricted management tool and a further development is needed.

Furthermore, managers frequently examine the factors one by one or several at a time, but not all at the same time. As a result, computerized support is required to assess the worth of key concepts that influence the success of crowdfunding initiatives.

Most ideas are articulated using causal relationships with variables. Therefore, the opinion about a certain solution is sometimes not just ambiguous but also imprecise. In this situation FCMs allow to resolve conflicts between experts on a given topic.

2.2. DSS in crowdfunding: critical success factors

The success of crowdfunding projects is related with getting financial support using a diffusion campaign. However, there is a lack of research about the role of DSS in crowdfunding [16] and a significant amount of the specialized knowledge necessary for evaluating crowdfunding initiatives is held informally within the expertise of experts.

Basically, DSS are computer systems designed to provide support during the decision-making processes [17]. DSS contain data and models intended to help decision makers with semi-structured or unstructured tasks [18].

Numerous studies analyse the success of crowdfunding projects and identify the variables that can influence it. Therefore, we discuss the theoretical background for the causal interrelations among location, gender, experience, human capital, social capital, social media, number of rewards and duration and their relationships with to the success of crowdfunding projects, which are the starting point to build a DSS based on a FCM in crowdfunding (Table 1).

"Location" plays an important role when deciding which project to fund. Thus, previous literature shows that funders feel more committed to closer projects [1,25,26], since sometimes these projects share a similar culture and values, thus enhancing social bonds [27]. Proximity also makes it possible to reduce information asymmetries that are particularly relevant in crowdfunding campaigns [28].

In the previous literature, there is evidence about how "gender" influences on the raising of funds in crowdfunding campaigns. According to several studies, projects launched by women have a greater success rate [29,30], since women generate greater trust in platforms [31].

"Experience" of promoters is a factor that can influence the success of crowdfunding projects [32,33]. Promoters acquire experience on crowdfunding platforms by initiating their own project (directly) or by supporting others´(indirectly). In both ways, they get feedback from the crowdfunding market (context), and both experience and context feedback would result into knowledge and will help them to develop subsequent initiatives [32]. Similarly, previous experience generates trust among the funders [5], thus influencing investment decisions [34].

Sometimes, the probability of achieving success in crowdfunding campaigns is related to the "human capital" of the promoters, since the funders analyse the ability of the human team to evaluate the return on investment in a certain project [25]. According to Ahlers et al. [20], business success is related to high human capital. Starting projects with

Table 1
Variables definition.

Variable: definition	Authors
Location: geographical proximity to the projects	[1]
Gender: sex of the project promoter	[19]
Experience: related to the promoter's success in previously carried out crowdfunding campaigns.	[5]
Human Capital: explains whether the high level of education and training of promoters has an influence on success	[20]
Social Capital: refers to the amount of real and potential resources incorporated, available and derived from the contacts that the promoters have	[21]
Social Media: is related to the use of new technologies in promotional campaigns. It specifically refers to the use of social media channels such as Facebook, LinkedIn, Twitter, etc., to publicise the project.	[22]
Number of rewards: are the amount, variety and customization of rewards offered by promoters to potential investors based on their contributions to the campaign.	[23,24]
Duration: is the number of days that elapse from the beginning to the end of the project.	[1]

people who doesn't know what they're doing can make it more difficult to keep going [25] and to make progress. Education level (e.g., share of executives with an MBA degree) has been shown to influence fundraising in a positive way in the crowdfunding context [20].

"Social capital" can be defined as the source of valuable information, especially at the start-up phase of a business [20], when the support from friends and family is crucial [35]. In this sense, previous studies have contrasted that personal networks are associated with the success of crowdfunding projects [1,36].

Likewise, it is also important to note that rewards, support for creators and projects, and strengthening relationships with people in their "social media" are all motives for funders to engage [22].

The use of social media also allows to increase the popularity of the campaign, depending, for example, on the number of "likes" that it receives on social media [22].

On the other hand, the use of social media also acts as an inducer of trust among funders as they allow validation of user profiles [35]. According to Koch and Siering [37], some founders connect their Facebook account with the presentation page of their project, revealing the number of friends they have on Facebook, in this way, potential investors can be impressed by a high number of friends. This may be an indication of high popularity and thus encourage trust in the founder.

An important obligation to be considered by the promoters is the design of adequate and attractive "rewards" for potential investors and the delivery of them on time [23]. The number of reward levels and their variety can influence the success of the campaign, as it can increase the number of funders who wish to participate [24]. Gerber et al. [38] stated that funders desire rewards, which are generally in the form of products and/or services, whereas promoters seek funding.

Regarding the "duration" of the campaign, it has been observed that a high capital raising in the first days is considered a predictor of its success [35]. In this sense, Mollick [1] considered that campaigns with long durations show a lack of confidence in the promoters of the project to raise funds successfully. In this sense, Kunz et al. [33] argued that at the beginning of a campaign, investments are normally high and, subsequently, interest and collection decrease.

3. Methodology and results

A FCM is represented as a matrix made up of nodes (C_i) (where $i = 1, \ldots, n$), which are referred to as concepts. The edges ($\omega_{i,j}$) describe the connections between nodes C_i and C_j. The influence of the causal variable on the effect variable can be modelled using an edge connecting two nodes [39]. Positive or negative connections can exist between edges [40]. Each edge's value is a function with values ranging from −1 to 1 inclusively [41].

$$A = \begin{pmatrix} \ldots & \ldots & \ldots \\ \ldots & w_{ij} & \ldots \\ \ldots & \ldots & \ldots \end{pmatrix}; w_{ij} \in [-1, +1] | \forall i, j$$

A positive edge value indicates a positive link between two nodes. It means that an increase or decrease in a causal variable causes the effect variable to change in the same direction. Negative values indicate that the change in the effect variable is in the opposite way. A '0' in the adjacency matrix denotes the absence of a causal relationship. Furthermore, because causality is not self-reflexive, the weight diagonal of the matrix always has '0' [42].

FCM not only allows for the conversion of qualitative knowledge into quantitative structuring –e.g., DSS in crowdfunding- [43], but it also allows for the testing of forecasting scenarios –e.g., to simulate what-if experiments with crowdfunding projects- [44]. One of the best features of FCM is the ability to create new situations or scenarios. As a result, we employ FCM to understand the potential impact of the promoter's profile, the characteristics of the projects or the promotional campaigns on the success of the project.

The overall framework of the proposed model to design the guidelines of a DSS in crowdfunding based on FCM is shown in Fig. 1.

3.1. Phase I. Creating the FCM

Step 1: Selecting the experts.

The experts were chosen based on their extensive knowledge and experience in the field of crowdfunding. All the experts in the survey had more than five years of crowdfunding experience. We assembled a diverse panel of experts to create an FCM that accurately represented the success of crowdfunding projects. A heterogeneous group is a collection of people who share a field of knowledge. This is a trait shared by the experts in our panel. Furthermore, these experts were chosen for their similar relevance, not simply because they were easily accessible.

In terms of the size of the panel of experts, determining a suitable number is difficult, and there are no studies in the literature that establish a specific number. The ideal group size is determined by the specific characteristics of the study. However, several experts acknowledged that a panel size of 10 to 20 seemed to be a fair compromise [45]. The panel of experts in our study consisted of 14 crowdfunding experts. (Table 2).

Step 2: Identifying preliminary nodes.

This step began with a literature review of crowdfunding research to figure out what elements influence the success of crowdfunding campaigns. Then, we removed duplicates and any factors that were not relevant for this study. Finally, we chose nine factors described in the literature, which are the preliminary nodes of the study. This is not an exhaustive list since experts could propose new factors.

Experts were asked by email and face-to-face meetings to design suitable FCMs. Individually, each expert designed an FCM. To accomplish this, we first presented them the preliminary list of factors. The expert's assessment was not influenced by this list because they were able to add additional nodes not included in the preliminary lists or to discard those factors considered as not relevant. As result, the experts added four new nodes to the study and the final FCM is made up of thirteen nodes. Table 3 summarizes the nodes and shows its origin.

Step 3: Building the FCMs.

Experts typically design an FCM since they have appropriate knowledge and experience in the field. Following to Jetter and Schweinfort [46], experts create causal cognitive maps representing their mental model. First, the preliminary list consisting of nine nodes were presented to the respondents as stimuli. Each expert can add additional nodes not included in the preliminary lists or discard those nodes considered as not relevant. In a second step, each expert reflected the causal relationships between the concepts and the causal links were added showing the sign of the relationships. Finally, a 7-point Likert-type scale was used to assign causal weights to each relationship. Values ranged from 1, signifying a very weak causal link, to 7, signifying a very strong causal link. After the procedure was complete, the interviewer requested the expert to clarify each concept and causal connection to make sure they were accurately recorded. As result, 14 cause maps where obtained and they were easily translated into 14 adjacency matrices which contain all the information that is captured in a cross-impact matrix [47]. The values in the adjacency matrixes were transformed into values between −1 and 1.

After gathering the viewpoints of the experts, it was required to reach a consensus among them. To reach an agreement, a variety of strategies could be used. In a multi-criteria decision procedure, experts' consensus is commonly calculated using an arithmetic mean [48]. As a result, FCM with mean is used in this study to reflect expert consensus. The mean may be used to avoid the influence of extreme results and can also be used to calculate negative values, which is important in this study. To determine the mean, we assume that each expert is of equal importance. As a result, we believe that the weight of their points of view is equal for the purposes of constructing the matrix.

The Augmented FCM approach is an additive method that involves adding the FCMs produced by each expert. By combining the FCMs,

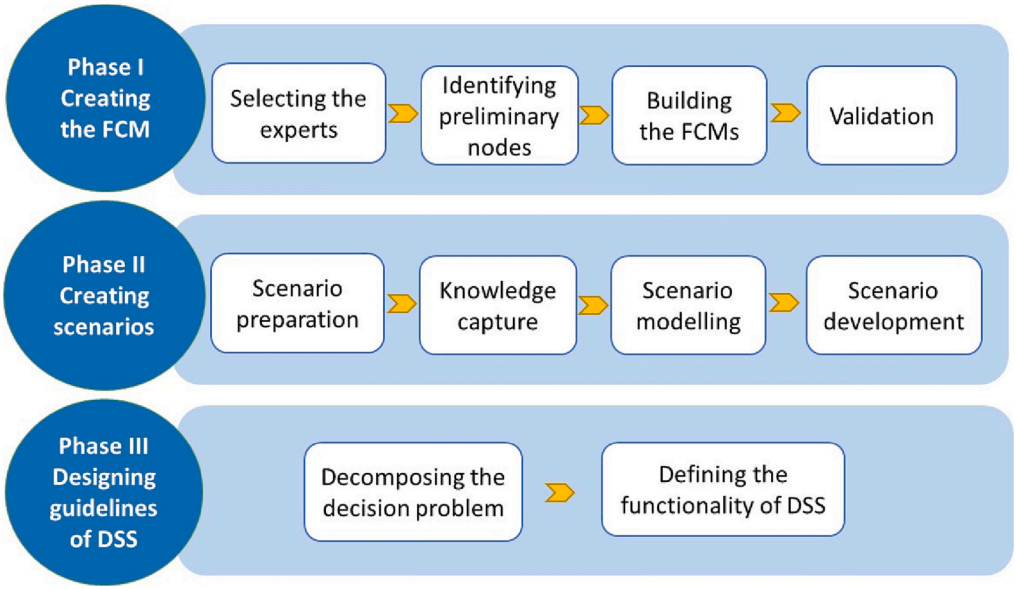

Fig. 1. Framework of the DSS in crowdfunding based on FCM.

Table 2
Experts profile.

Position		Experience in crowdfunding	
Chief executive officer	7	5–6 years	2
Chief operations officer	4	6–7 years	7
Chief financial officer	3	8 years and over	5

Gender		Academic background	
Female	6	Ph.D.	3
Male	8	Master Degree	11

Table 3
FCM nodes.

PRELIMINARY NODES	LOC	Location	LR
	SUCCESS	Success of the crowdfunding project	LR
	GEN	Gender	LR
	EXP	Experience	LR
	HUMCAP	Human Capital	LR
	SOCCAP	Social Capital	LR
	SOCMED	Social Media	LR
	NUM	Number of Rewards	LR
	DUR	Duration	LR
NODES ADDED BY EXPERTS	EST_PR	Pre-campaign content development strategy and phases of actions to be carried out	P
	TRANS	Transparency and simplicity	P
	INNOV	The innovation and value of the project	P
	ENTERP	Entrepreneurial spirit of the driving team: adaptability, creativity, recovering from mistakes to keep moving forward.	P

LR: Literature review P: Panel experts.

conflicting relationships are either cancelled out or reduced, while agreement strengthens causal connections [49].

The adjacency matrix of each expert is added to create the augmented adjacency matrix. The resulting augmented matrix includes the union of the causal nodes for all of the experts and when an expert's FCM does not include a specific concept, then those rows and columns in the adjacency matrix are all zero [49]. It is computed using the average values of the edges ($\omega_{i,j}$) from the adjacency matrixes.

$$\omega_{i,j}^{Aug} = \frac{\sum_{K=1}^{n} \omega_{i,j}^{k}}{n}$$

The adjacency augmented matrix represents the final FCM, which has 23 edges (Table 4). This matrix represents the relationships between all nodes. It was created by combining each expert's adjacency matrix because consensus does not necessitate experts changing their minds [50].

The cause-and-effect nodes make up the first column and row of this adjacency enhanced matrix, respectively. Each cell depicts the impact of one variable on the others. The relationships between variables can be positive, negative, or have no relationship at all. The range of standardised effects is −0.20 to 0.95. On the path from DUR to SUCCESS and from SOCMED to SUCCESS, the lowest and largest causal effects are discovered. Graphical representation of the FCM is shown in Fig. 2.

Step 4: Validation.

Validation is required in developing a complex system. A model should be validated at two points, according to Cobelli and Carson [51]. First, the validation procedure should be carried out within the model construction process, which requires the active participation of experts. Also, once we have built the model, designers must check it.

However, no method has been selected to validate the model building as the most suitable by the scientific community. The property of the method depends on the availability of data [52]. Considering that FCMs are qualitative models, the validation of the FCMs is usually impossible [11]. Finally, we asked experts in crowdfunding and in general, they describe the FCM created as a practical and helpful instrument.

Findings show the most influential priorities, the most important sequences of dimensions and criteria, and the links between the antecedents of successful crowdfunding campaigns. SOCMED (0.95), SOCCAP (0.81) and EXP (0.80) have a direct influence on the success of crowdfunding projects. Experts think that these factors are the main ones directly affecting the success of crowdfunding projects (Table 4).

According to experts, it can be found that EXP (0.16) is the main factor affecting SOCCAP. Furthermore, SOCCAP (0.21) can improve the SOCMED. Also, EST_PR (0.50), TRANS (0.46) and NUM (0.45) could affect success crowdfunding projects positively. DUR (−0.20) affects success crowdfunding projects negatively.

A FCM is not a static representation. It enables the study of the system's dynamics and the creation of projections for various potential

Table 4
Adjacency augmented matrix.

	HUMCAP	SOCCAP	DUR	ENTERP	EST_PR	SUCCESS	EXP	GEN	INNOV	LOC	NUM	SOCMED	TRANS
HUMCAP	0.00	**0.08**	0.00	0.00	0.00	**0.41**	0.00	0.00	0.00	**0.06**	0.00	**0.06**	0.00
SOCCAP	0.00	0.00	0.00	0.00	0.00	**0.81**	0.00	0.00	0.00	0.00	**0.06**	**0.21**	0.00
DUR	0.00	0.00	0.00	0.00	0.00	**−0.20**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENTERP	0.00	0.00	0.00	0.00	0.00	**0.08**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EST_PR	0.00	0.00	0.00	0.00	0.00	**0.50**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUCCESS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EXP	0.00	**0.16**	0.00	0.00	0.00	**0.80**	0.00	0.00	0.00	0.00	0.00	**0.06**	0.00
GEN	0.00	0.00	0.00	0.00	0.00	**0.06**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INNOV	0.00	0.00	0.00	0.00	0.00	**0.14**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LOC	0.00	0.00	0.00	0.00	0.00	**0.45**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NUM	0.00	0.00	0.00	0.00	0.00	**0.45**	0.00	0.00	0.00	0.00	0.00	**0.05**	0.00
SOCMED	0.00	**0.07**	0.00	0.00	0.00	**0.95**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRANS	0.00	**0.08**	0.00	0.00	0.00	**0.46**	0.00	0.00	0.00	0.00	0.00	**0.08**	0.00

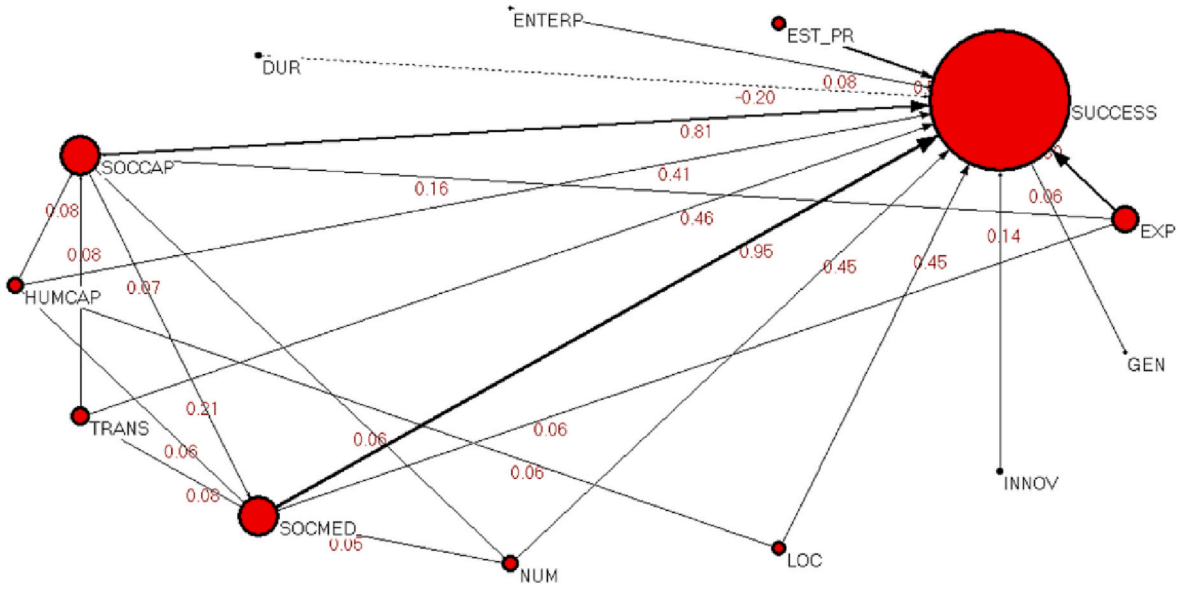

Fig. 2. Graphical representation of the FCM.

scenarios. By inputting an initial stimulus vector state into the fuzzy cognitive map, it can simulate how a scenario changes over time by allowing concepts to interact. Next state values can be calculated by multiplying the weight matrix by the preceding state.

The vector state C_j^{t+1} at the instant t + 1 would be computed as follows, where $f(x)$ is the transformation function.

$$C_j^{t+1} = f\left(\sum_{i=1}^{n} C_i^t . \omega_{i,j}\right)$$

$$f(x) = \frac{1}{1 + e^{-\lambda x}}$$

When stability is reached, the FCM inference procedure is complete. The final vector state shows the effect of the change in the value of each node on the FCM [49].

The final vector reaches its equilibrium after 20 iterations according to the results in Table 5.

3.2. Phase II. Creating scenarios

Scenarios describe situations that could happen in the future and that need to be faced. The aim of scenario planning is to simulate what-if experiments to build possible states of the uncertain aspects of the future and to analyse how other factors could evolve under certain conditions [44,53].

Table 5
Results – final vector.

		Iterations				
		(1)	(2)	(…)	(19)	(20)
INNOV	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
DUR	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
LOC	1.0000	0.5150	0.5075	……	0.5075	***0.5075***
GEN	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
ENTERP	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
HUMCAP	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
EXP	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
SOCCAP	1.0000	0.5968	0.5509	……	0.5499	***0.5499***
EST_PR	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
NUM	1.0000	0.5150	0.5090	……	0.5082	***0.5082***
TRANS	1.0000	0.5000	0.5000	……	0.5000	***0.5000***
SOCMED	1.0000	0.6142	0.5631	……	0.5606	***0.5606***
SUCCESS	1.0000	0.9927	0.9346	……	0.9285	***0.9285***

According to Jetter and Schweinfort [46], we have used the following steps to build FCM-based scenarios: (1) scenario preparation, clarifies the goal and limits of the scenario project; (2) knowledge capture, finds potential scenario drivers; (3) scenario modelling, signs and weights are assigned to scenario drivers; and (4) scenario development, creates the FCM model for various input vectors that reflect plausible combinations of concept states.

Step 1: Scenario preparation and knowledge capture.

DSS utilize existent knowledge and human expertise and they are often based on pattern classification [54]. The identification of these patterns can raise the accuracy of identifying crowdfunding projects with a higher potential success. In this way, results from FCMs have been widely applied to pattern recognitions [55] because they represent the knowledge of experts in a specific area of interest.

Hoegen et al. [2] provided a decision-making framework based on sets of factors and their cause-and-effect interactions for crowdfunding projects. Following this approach, we asked to experts to classify the variables included in the FCM into categories (project/promoter/promotional campaign) in order to later identify guidelines to patterns classification of successful crowdfunding projects using FCM simulations. All variables were classified depending on they are related to the characteristics of the crowdfunding project, to the characteristics of the promoters or to the characteristics of the promotional campaign. All experts do agree with the classification included in Table 6. It also includes the outdegree (sum of absolute values of out going arrows), indegree (sum of absolute values of in going arrows), and total centrality (sum of absolute values of in and out going arrows) of all variables to show how important they are in the system.

Step 2: knowledge capture.

As shown in Table 6, variables composing the FCM have been classified into three groups:

- Variables related to the characteristics of the project: INNOV, DUR, LOC.
- Variables related to the characteristics of the promoter: GEN, ENTERP, HUMCAP, EXP, SOCCAP.
- Variables related to the characteristics of the promotional campaign: EST_PR, NUM, TRANS, SOCMED.

Therefore, three kind of scenarios were prepared:

- Scenarios #1: Project Characteristics: This kind of scenarios analyses whether projects located geographically closer, with a lower number of days from the beginning to the end of the campaign and with higher innovation and value directly influence the success compared to other projects located further afield, with a longer duration and without innovation or value.
- Scenarios #2: Characteristics of the promoter: In this kind of scenarios, projects promoted by women with experience, with a high level of studies and training and a number of real and potential resources, available and derived from the network of relationships have been compared to those promoted by men, without experience and with low levels of human capital, social capital and entrepreneurial spirit.
- Scenarios #3: Characteristics of the promotional campaign: The third kind of scenarios considers that an intensive use of social media, a greater number of personalized and varied rewards, a good campaign strategy and transparency affects the success of the project.

Table 6
Groups of variables and FCM indices.

	Variables		Outdegree	Indegree	Centrality
Projects	Node #1	INNOV	0.14	0.00	0.14
	Node #2	DUR	0.20	0.00	0.20
	Node #3	LOC	0.45	0.06	0.51
Promoter	Node #4	GEN	0.06	0.00	0.06
	Node #5	ENTERP	0.08	0.00	0.08
	Node #6	HUMCAP	0.61	0.00	0.61
	Node #7	EXP	1.01	0.00	1.01
	Node #8	SOCCAP	1.08	0.39	1.48
Promotional campaing	Node #9	EST_PR	0.50	0.00	0.50
	Node #10	NUM	0.50	0.06	0.56
	Node #11	TRANS	0.63	0.00	0.63
	Node #12	SOCMED	1.02	0.47	1.49
	Node #13	SUCCESS	0.00	5.32	5.32

Step 3: Scenario modelling.

The FCM proposed by experts considers 13 nodes organized into three categories (Table 6). The vector state allows us to model the proposed scenarios. It has 13 nodes with values between 0 and 1, indicating the absence or presence of each node from the scenario [13]. Therefore, each proposed scenario can be represented by a vector according to the following structure:

$$\text{Vector Scenario}_a = (v1_a, v2_a, v3_a, v4_a, v5_a, v6_a, v7_a, v8_a, v9_a, v10_a, v11_a, v12_a, v13_a).$$

where vn_a represents the value of the node "n" in the scenario "a".

Using this representation method, the following scenarios can be modelled.

In the first simulation, we want to know how the characteristics of the project (INNOV, DUR, LOC) influence the success of crowdfunding projects. To do that, we compute LOC, DUR and INNOV with a value of 1 for "projects type *v1=v2=v3=1*" and with a value of 0 for "projects type *v1=v2=v3=0*". A value of 1 signifies maximum presence in the simulation while a value of 0 means that a node is not active for this simulation.

$$\text{Vector "Project Type v1=v2=v3=1"} = (1,1,1,v4_1,v5_1,v6_1,v7_1,v8_1,v9_1,v10_1,v11_1,v12_1,v13_1).$$

$$\text{Vector "Project Type v1=v2=v3=0"} = (0,0,0,v4_2,v5_2,v6_2,v7_2,v8_2,v9_2,v10_2,v11_2,v12_2,v13_2).$$

In the second simulation, we analyse how the characteristics of the promoter (GEN, ENTERP, HUMCAP, EXP, SOCCAP) affect to the success of crowdfunding projects. To do that, we compute all these variables with a value of 1 for "promoters type *v4=v5=v6=v7=v8=1*" and with a value of 0 for "promoters type *v4=v5=v6=v7=v8=0*".

$$\text{Vector "Promoter Type v4=v5=v6=v7=v8=1"} = (v1_1,v2_1,v3_1,1,1,1,1,1,v9_1,v10_1,v11_1,v12_1,v13_1).$$

$$\text{Vector "Promoter Type v4=v5=v6=v7=v8=0"} = (v1_2,v2_2,v3_2,0,0,0,0,0,v9_2,v10_2,v11_2,v12_2,v13_2).$$

With the third simulation we want to know how the characteristics of the promotional campaign (EST_PR, NUM, TRANS, SOCMED) affect to the success of crowdfunding projects. To do that, we compute these variables with a value of 1 for "campaigns type *v9=v10=v11=v12=1,*" and with a value of 0 for "campaigns type *v9=v10=v11=v12=0*".

Vector "Campaigns Type v9=v10=v11=v12=1" = ($v1_1$, $v2_1$, $v3_1$, $v4_1$, $v5_1$, $v6_1$, $v7_1$, $v8_1$, 1, 1, 1, 1, $v13_1$).

Vector "Campaigns Type v9=v10=v11=v12=0" = ($v1_2$, $v2_2$, $v3_2$, $v4_2$, $v5_2$, $v6_2$, $v7_2$, $v8_2$, 0, 0, 0, 0, $v13_2$).

Step 4: Scenario development.

Using FCM as a simulation tool in scenario planning can help visualize and evaluate possible scenarios in crowdfunding. The main aim of this simulation process is to know how the type of project/promoter/campaign can affect the success of the crowdfunding project (v13). However, we can also analyse whether it also affects to the rest of nodes and the sign of these relationships. The process starts with a set of conditions of the scenario by including values in the vector and it finishes after several iterations with the FCM until the vector is stable (final vector). This final vector includes the values of each node in the scenario under study.

Table 7 shows how the success of crowdfunding projects and its determinants are affected by the characteristics of the projects (variables 1 to 3). Although most of the nodes do not change, we found that projects type $v1 = v2 = v3 = 1$ are more successful (v13) than projects type $v1 = v2 = v3 = 0$.

In order to better infer the interrelatedness of the factors and their impacts, we have created simulations for all possible combinations of *v1, v2 and v3*. Although variables can take continuous values from 0 to 1, for computational reasons we only consider 0 and 1 as possible values. Table 8 includes these eight (2^3) types of projects. We can see that all success values (v13) are between 0.9140 (project type $v1 = v2 = v3 = 0$) and 0.9403 (project type $v1 = v2 = v3 = 1$).

Table 9 shows how the success of crowdfunding projects and its determinants are affected by the characteristics of the promoters (from v4 to v8). Although some variables present minor changes, the highest difference between promoter type $v4 = v5 = v6 = v7 = v8 = 1$ and promoter type $v4 = v5 = v6 = v7 = v8 = 0$ is the success of crowdfunding projects (v13). Furthemore, the promoter's profile also affects to other variables in the model (LOC, NUM, SOCMED).

We have simulated all potential combinations of variables related to promoter characteristics (from v4 to v8) in order to more accurately determine how these elements are interrelated and what effects they have. For computational purposes we only consider the values 0 and 1, even though variables can take continuous values ranging from 0 to 1. These 32 (2^5) different types of promoters have been simulated (Table 10). All success values (v13) fall between 0.8016 and 0.9745, which corresponds to the range of promoter types.

Table 11 shows how the success of crowdfunding projects, and its determinants are affected by the characteristics of the promotional campaigns. Although some nodes have minor changes, we found the highest difference between campaigns type $v9 = v10 = v11 = v12 = 1$ and campaigns type $v9 = v10 = v11 = v12 = 0$ in the success of crowdfunding projects (v13).

As above, we ran simulations for all possible combinations of variables affecting the characteristics of the promotional campaigns (from v9 to 12) to better understand their interdependence and effects. Although variables can take continuous values ranging from 0 to 1, we only consider 0 and 1 as possible values for computational reasons. Table 12 lists these 16 (2^4) types of promotional campaigns. All success values (v13) are found to be between 0.7862 (campaign type v9 = v10 = v11 = v12 = 0) and 0.9403 (campaign type v9 = v10 = v11 = v12 = 1).

3.3. Phase III: designing the guidelines of the DSS

The design and development of a DSS in crowdfunding is a complex process and a number of issues should be faced including programming, testing, implementation, and use and evaluation. However, a deep knowledge of relevant variables in crowdfunding decision making, their interactions and their effects on the success of crowdfunding projects can be considered the baseline of all this process.

A DSS involves the collection of data on current decision-making using techniques such as interviews or questionnaires and historical records; the identification of relevant variables to be considered in the decision process and their relationships; and the specification of norms to support the decision making process. In this research, all these steps have been performed as we have collected data from experts in crowdfunding decision making, relevant variables from the literature and from the panel of experts have been identified as well as their relationships and, lastly, the need of considering the characteristics of the crowdfunding project, promoters or promotional campaigns in decision making processes as well as the relative effects of all them in the success of the project. This is the core of phase III to propose the DSS guidelines, which come from results obtained in previous phases (I and II).

FCM and scenarios simulation could be helpful when designing DSS in the crowdfunding area. Based on the results of the previous phases, two steps have been followed to design the guidelines of the DSS in crowdfunding [56]: (1) Decomposing the decision problem, the crowdfunding problem must be analysed to identify the factors that are limiting or otherwise constraining the unaided decision maker; and (2) Defining the functionality of DSS, define the functions that the DSS should provide to support crowdfunding decision making.

Step 1: Decomposing the decision problem.

In the phase I, experts in our panel confirm that the success of crowdfunding projects directly depends on several factors and that the main ones are SOCMED (0.95), SOCCAP (0.81) and EXP (0.80). More concretely, the results show that the main antecedent of the success of crowdfunding projects is the use of recent technologies in promotional campaigns. Regarding social capital, it is also an especially important antecedent of the success of crowdfunding projects. It means that the more contacts the promoters have, the more success they will have in raising funds through crowdfunding.

The main antecedents of SOCMED, in order of importance, are SOCCAP and HUMCAP, according to the findings. The lack of social and human capital, on the other hand, has a negative influence on the use of social media as a promotional tool and hence has a negative impact on the project's success.

In the case of SOCCAP, the findings show that EXP is the most

Table 7
Project characteristics: simulation project 1 vs. project 0.

Variables		Conditions Vector Project 1	Conditions Vector Project 0	Final Vector Project 1	Final Vector Project 0	Differences
Node #1	INNOV	1.00	0.00	1.0000	0.0000	1.0000
Node #2	DUR	1.00	0.00	1.0000	0.0000	1.0000
Node #3	LOC	1.00	0.00	1.0000	0.0000	1.0000
Node #4	GEN	–	–	0.5000	0.5000	0.0000
Node #5	ENTERP	–	–	0.5000	0.5000	0.0000
Node #6	HUMCAP	–	–	0.5000	0.5000	0.0000
Node #7	EXP	–	–	0.5000	0.5000	0.0000
Node #8	SOCCAP	–	–	0.5499	0.5499	0.0000
Node #9	EST_PR	–	–	0.5000	0.5000	0.0000
Node #10	NUM	–	–	0.5082	0.5082	0.0000
Node #11	TRANS	–	–	0.5000	0.5000	0.0000
Node #12	SOCMED	–	–	0.5606	0.5606	0.0000
Node #13	SUCCESS	–	–	0.9403	0.9140	***0.0263***

Table 8
Projects types (all combinations for 0 and 1 values).

V1	*0.0000*	*0.0000*	*1.0000*	*1.0000*	*0.0000*	*0.0000*	*1.0000*	*1.0000*
V2	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V3	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***
V4	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V5	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V6	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V7	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V8	0.5499	0.5499	0.5499	0.5499	0.5499	0.5499	0.5499	0.5499
V9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V10	0.5082	0.5082	0.5082	0.5082	0.5082	0.5082	0.5082	0.5082
V11	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V12	0.5606	0.5606	0.5606	0.5606	0.5606	0.5606	0.5606	0.5606
V13	**0.9140**	**0.9335**	**0.9246**	**0.9387**	**0.9168**	**0.9347**	**0.9293**	**0.9403**

Table 9
Promoter characteristics: simulation promoter 1 vs. promoter 0.

Variables		Conditions Vector Promoter 1	Conditions Vector Promoter 0	Final Vector Promoter 1	Final Vector Promoter 0	Differences
Node #1	INNOV	–	–	0.5000	0.5000	0.0000
Node #2	DUR	–	–	0.5000	0.5000	0.0000
Node #3	LOC	–	–	0.5145	0.5000	***0.0150***
Node #4	GEN	1.0000	0.0000	1.0000	0.0000	1.0000
Node #5	ENTERP	1.0000	0.0000	1.0000	0.0000	1.0000
Node #6	HUMCAP	1.0000	0.0000	1.0000	0.0000	1.0000
Node #7	EXP	1.0000	0.0000	1.0000	0.0000	1.0000
Node #8	SOCCAP	1.0000	0.0000	1.0000	0.0000	1.0000
Node #9	EST_PR	–	–	0.5000	0.5000	0.0000
Node #10	NUM	–	–	0.5145	0.5000	***0.0150***
Node #11	TRANS	–	–	0.5000	0.5000	0.0000
Node #12	SOCMED	–	–	0.5987	0.5164	***0.0824***
Node #13	SUCCESS	–	–	0.9745	0.8016	***0.1730***

important antecedent. In other words, the promoters' interactions are greatly influenced by their previous experience. Human capital is also an antecedent of social capital, which is consistent with past research findings. It means that the more human capital, the higher the social capital of the project, even though the weight of this ratio is judged to be only 0.08 by experts.

Other variables that have a beneficial impact on the performance of crowdfunding initiatives are EST PR (0.50), TRANS (0.46), and NUM (0.45). Projects with longer duration, on the other hand, have a reduced chance of receiving funding.

Step 2. Defining the functionality of the DSS in crowdfunding.

The functionality of the DSS involves patterns classification of successful crowdfunding projects according to the results obtained in phase II.

The creation of profiles has allowed us to analyse the effect of variables at a collective level on success. Previous works that have studied the determinants that influence the success of campaigns have analysed the variables individually; this being the first work that exposes a group of variables that allows forming profiles to define the type of project, campaign, or promoter with the highest probability of success.

The results achieved show that both the characteristics of the project, promoter, and campaign affect the success. However, it is the profile related to the dissemination and promotion of the campaign that has the greatest influence on the success of crowdfunding. Thus, the dissemination of the campaign through social media, a greater number of personalized and varied rewards, a pre-campaign strategy and transparency in its dissemination affects the success compared to those other projects that do not manage the promotion campaign in this way (Tables 11 and 12).

After the profile related to the dissemination of the campaign, it is the profile related to the promoter that has the greatest impact on success. Thus, the projects promoted by women, where the promoters have experience in carrying out successful campaigns, have a high level of studies and training and several real and potential resources incorporated, available and derived from the network of relationships influences the success of crowdfunding (Tables 9 and 10).

Finally, the profile related to the characteristics of the project also affects to the success. Those projects located geographically closer, with a lower number of days from the beginning to the end of the campaign and with a higher innovation and value are more successful than those located further afield, with a longer duration and without innovation (Tables 7 and 8).

Fig. 3 summarizes the guidelines of a DSS in the area of crowdfunding based on the results obtained using a FCM approach. First, all variables should be organized according to their relationship with projects, promoters and promotional campaigns. Then, attending to their values and relationships, patters classification could show its type according to the vector of this specific scenario. Then, an estimated value of the success rate could be obtained by using the simulation function in our FCM. Moreover, additional information about its strengths and weaknesses could be obtained according to the values of the variables composing the scenario vector.

4. Final conclusions

This paper presents a relevant contribution to the body of knowledge about DSS in crowdfunding. Relevant factors to understand the success of crowdfunding projects as well as their connections have been analysed using a FCM approach. The creation of profiles based on the type of promoter, the attributes of the project, or the promotional campaigns contributes to scenario simulations and to better understand the impact of these profiles to support decision-making processes.

Therefore, this study offers various theoretical implications. First, although previous research has identified factors that could influence the success of crowdfunding projects, few has used the expert's points of view to clarify the effects of the characteristics of the crowdfunding project, promoters or promotional campaigns in the project success rate. In particular, this study identifies different scenarios and reinforces the

Table 10
Promoters types (all combinations for 0 and 1 values).

V1	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V2	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V3	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V4	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***
V5	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V6	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
V7	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***
V8	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
V9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V10	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V11	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V12	0.5164	0.5164	0.5313	0.5313	0.5164	0.5164	0.5313	0.5313
V13	**0.8016**	**0.8109**	**0.9010**	**0.9062**	**0.8144**	**0.8233**	**0.9082**	**0.9130**
V1	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V2	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V3	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V4	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***
V5	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V6	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
V7	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***
V8	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V10	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150
V11	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V12	0.5696	0.5696	0.5842	0.5842	0.5696	0.5696	0.5842	0.5842
V13	**0.9058**	**0.9108**	**0.9559**	**0.9583**	**0.9127**	**0.9173**	**0.9592**	**0.9615**
V1	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V2	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V3	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150
V4	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***
V5	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V6	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V7	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***
V8	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
V9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V10	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V11	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V12	0.5313	0.5313	0.5462	0.5462	0.5313	0.5313	0.5462	0.5462
V13	**0.8608**	**0.8679**	**0.9330**	**0.9367**	**0.8705**	**0.8771**	**0.9380**	**0.9414**
V1	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V2	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V3	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150
V4	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***
V5	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V6	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V7	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***
V8	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V10	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150	0.5150
V11	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V12	0.5842	0.5842	0.5987	0.5987	0.5842	0.5842	0.5987	0.5987
V13	**0.9364**	**0.9399**	**0.9707**	**0.9724**	**0.9412**	**0.9444**	**0.9730**	**0.9745**

findings that a greater value of a set of variables leads to a higher success rate.

Second, our research bridges the gap of using DSS in the crowdfunding area using a FCM approach. There is few literature about the contribution of DSS in this area and how the key success factor can be structured to support decision making processes. Our findings also help to better understand issues related to how the characteristics of project, promoters or promotional campaigns can influence the success of crowdfunding projects.

In addition to the above insights, the current study also has important managerial implications. The most notable contribution of this study lies in the identification of some guidelines for DSS on crowdfunding based on project profiles that are most likely to be successful, and these findings are important for both the promoter and the funders. These antecedents are quite valuable to people who plan crowdfunding campaigns. As a result, promoters should carefully analyse these aspects to improve their chances of success.

The findings suggest promoters invest time and resources to improve the variables composing the "vectors" of their projects because it influences its success rate of crowdfunding campaigns.

They will be able to evaluate those typologies that are considered relevant to success, which will allow them to configure their crowdfunding campaigns accordingly. On the part of the funders, they will be able to choose to invest funds in those projects that are most suitable and

Table 11
Characteristics of the promotional campaign: Simulation Campaign 1 vs. Campaign 0.

Variables		Conditions Vector Campaign 1	Conditions Vector Campaign 0	Final Vector Campaign 1	Final Vector Campaign 0	Differences
Node #1	INNOV	–	–	0.5000	0.5000	0.0000
Node #2	DUR	–	–	0.5000	0.5000	0.0000
Node #3	LOC	–	–	0.5075	0.5075	0.0000
Node #4	GEN	–	–	0.5000	0.5000	0.0000
Node #5	ENTERP	–	–	0.5000	0.5000	0.0000
Node #6	HUMCAP	–	–	0.5000	0.5000	0.0000
Node #7	EXP	–	–	0.5000	0.5000	0.0000
Node #8	SOCCAP	–	–	0.5678	0.5297	***0.0381***
Node #9	EST_PR	1.0000	0.0000	1.0000	0.0000	1.0000
Node #10	NUM	1.0000	0.0000	1.0000	0.0000	1.0000
Node #11	TRANS	1.0000	0.0000	1.0000	0.0000	1.0000
Node #12	SOCMED	1.0000	0.0000	1.0000	0.0000	1.0000
Node #13	SUCCESS	–	–	0.9759	0.7862	***0.1897***

Table 12
Campaigns types (all combinations for 0 and 1 values).

V1	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V2	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V3	0.5075	0.5075	0.5075	0.5075	0.5075	0.5075	0.5075	0.5075
V4	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V5	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V6	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V7	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V8	0.5297	0.5503	0.5474	0.5678	0.5297	0.5503	0.5474	0.5678
V9	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***0.0000***
V10	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V11	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***
V12	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***
V13	**0.7862**	**0.8560**	**0.9062**	**0.9398**	**0.8525**	**0.9033**	**0.9382**	**0.9609**

V1	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V2	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V3	0.5075	0.5075	0.5075	0.5075	0.5075	0.5075	0.5075	0.5075
V4	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V5	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V6	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V7	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
V8	0.5297	0.5503	0.5474	0.5678	0.5297	0.5503	0.5474	0.5678
V9	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V10	***0.0000***	***0.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***1.0000***	***1.0000***
V11	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***	***0.0000***	***1.0000***
V12	***0.0000***	***0.0000***	***1.0000***	***1.0000***	***0.0000***	***0.0000***	***1.0000***	***1.0000***
V13	**0.8584**	**0.9074**	**0.9409**	**0.9626**	**0.9050**	**0.9390**	**0.9616**	**0.9759**

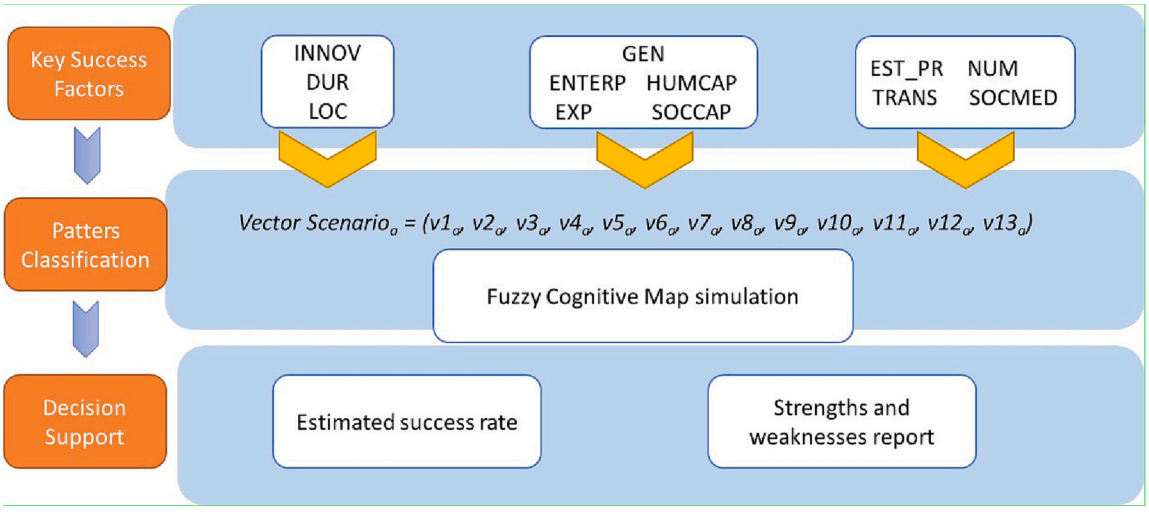

Fig. 3. Guidelines to design a DSS in the crowdfunding area.

have the best chances of success.

The research has some limitations that may impact the universal applicability of the results. First, even though the sample size was considered representative, it was made up entirely of Spanish experts. The sample size could be expanded to include specialists from diverse scenarios and cultures. Second, the only criterion for measurements and calculations was professional judgment. As a result, the subjectivity of the weight and impact assigned to one factor's influence over others must be considered. Future research could be focussed on the improvement of this guidelines by analysing the performance of the proposed model as well as extend the research to the simulations of other scenarios in the crowdfunding area.

Credit authors statement

All authors who meet authorship criteria are listed in the paper, and all authors certify that they have participated sufficiently in the work to take public responsibility for the Conceptualization, Formal analysis, Methodology, Writing - review & editing of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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