STARTUP'S CRITICAL FAILURE FACTORS DYNAMIC MODELING USING FCM

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1. ABSTRACT

The emergence of startups and their influence on countries' economic growth has become a critical issue for governments. The failure of startups causes a vast loss of wealth and workforce efforts and damages a country's economic climate. Numerous factors might affect the startup's growth and cause failure in different stages of the startup's lifecycle. The success and a bit less the failure of startups was the main focus of many researchers and authors. Reviewing the literature of Critical Failure Factors (CFFs) of startups reveals the lack of research in studying all introduced failure factors and how they affect or amplify each other. This research extracts the literature's failure factors in different phases of a startup lifecycle and classified them to understand better how CFFs could affect each other using a questionnaire. The authors then build Fuzzy Cognitive Maps (FCMs) of startup's CFFs to examine these factors' effects in the four phases of a startup's growth, based on the expert's perceptions. The main research outlet is modeling a failing in a complex and uncertain atmosphere and revealing the hidden interactions amongst CFFs. The FCMs model enables entrepreneurs to predict potential failure in different scenarios based on their dynamic behavior. As a result, the proposed model provides entrepreneurs with a better understanding of the joint influence of various factors on failing a startup and effectively managing the problems that would arise in different stages in the risk of one or some CFFs.

Keywords- Startup, business failure, Critical Failure Factors, Fuzzy Cognitive Maps, entrepreneurship.

2. INTRODUCTION

Among many other factors, such as a nation's natural resources, education, and political system, countries' economic growth depends on their industries' ability to create innovative products. Remarkably, startups in this process have been increasing, and now it is a key factor to the success of countries' economies (Adelino et al., 2017; Fairlie et al., 2016; Carree & Thurik, 2010). Successful startups could create new occupations (Hyder & Lussier, 2016; Guzman & Stern, 2016), bring social mobility, encourage economic stability (Carree & Thurik, 2010), increase the rate of economic growth (Watson & Everett, 1993), reduce recessions in both developed and developing countries, improve the competitive environment and economic efficiency (Liao et al., 2008), and tackle the big social and environmental challenges facing humanity and create benefits for the common good (Dyllick & Muff, 2016).

Startups defined in many ways such as "A temporary organization in search of a scalable, repeatable, and profitable business model" (Blank & Dorf, 2012) or "A human institution designed to create a new product or service under conditions of extreme uncertainty" (Ries, 2011). Startups are newly registered firms (Isenberg, 2016) with limited experience (Crowne, 2002) and incorporated for three years or less, sometimes with just one employee who regularly is the founder (Isenberg, 2016). Startup angels may fund them, venture capitalists, a partnership or a temporary business organization, engages in the development, production, or distribution of new products, processes, or services and not formed through splitting or restructuring. They have little or no operating history, limited resources, multiple stakeholders, dynamic technologies, and markets (Paternoster et al., 2014).

Business failure is not a random, unpredictable haphazard occurrence; instead, it is a recognizable pattern of symptoms that can be tracked and identified in each business environment and industry (Walsh & Cunningham, 2016). Studying failure is an essential subject since it is an initial prerequisite for learning. Understanding why a startup failed or succeed is crucially critical to entrepreneurs, investors, and the governments' policymakers since its impact on the economic climate's stability and health (Liao et al., 2008). Failure has cost both the economy and society (Kibler et al., 2017). Therefore, it needs to be defined, studied, understood, and controlled with the same energy that successes are analyzed (Scaringella, 2017).

Recent research (Hyder & Lussier, 2016; Espinoza-Benavides & Díaz, 2019) reveals that startups' failure rate is exceptionally high among countries and industries. A study conducted by the European Commission across Europe entitled "Business Dynamics: Start-ups, Business Transfers, and Bankruptcy" (2011) revealed that 50% of the businesses that were newly established in European economies failed in the first 5 years (Atsan, 2016). In the Information Technology industry, only one firm out of three passes the crucial first three-year threshold in France (Koellinger et al., 2007; Lasch et al., 2007).

A startup presents a higher risk of a mature business since there are different unknown risks in various growth stages for entrepreneurs. They need to focus their efforts on the critical failure factors to avoid bankruptcy. However, startups are diversified and complex; these entities have their lifecycle. Staged models of startups are discussed in the literature (Bygrave, 1989; Bygrave & Zacharakis, 2014):

(1) Pre-startup or Ideation: The first stage concerns the development of an intention to start an enterprise (Shapero & Sokol, 1982; Krueger et al., 2000). In this very early stage, the entrepreneur initiates a set of activities to turn a potential idea into a profitable business and examine whether a market opportunity exists for the latent customers (Keating & McLoughlin, 2010). The uncertainty level is high since the entrepreneur needs innovation for a novel business model (Livi & Jeannerat, 2015).

(2) Business concept formation: The purpose of this stage is to transfer the idea to a business model. An entrepreneurial opportunity has been recognized at this phase, and a business concept has been developed (Passaro et al., 2016). The entrepreneur positions the venture for growth by demonstrating product feasibility, cash management capability, team building and management, and customer acceptance (Brush et al., 2006). The entrepreneur should get the technical and managerial resources by consulting and collaborating with incubators, Technology Transfer Offices (TTOs), and business centers.

(3) Organization creation: At the third stage, the resources are assembled, and the organization is created (Davidsson & Honig, 2003). The initial capital is used to build products or services (Manchanda & Muralidharan, 2014). This stage consists of technological and commercial development and business planning. Moreover, the founder seeks additional funding resources (Keating & Mcloughlin, 2010) such as accelerators, incubators, small business development centers, and hatcheries to accelerate the process.
(4) Expansion: This stage begins when the company enters into the market by selling its products and hiring first employees. The entrepreneur should develop new skills and abilities, such as handling a higher turnover, motivating and coordinating employees, relating with new customers and suppliers, looking for international markets and partners, and delegating growing tasks and activities. The entrepreneur should also exhibit multi-faced and complex competencies like leadership, strategic orientation, and coordination abilities (Ensley et al., 2000; Brannack & Carsrud, 2008; Zacharakis, Bygrave, & Corbett, 2017). The key activities are massive customer acquisition, back-end scalability improvements, internationalization, new personnel, and first executive hiring (Passaro et al., 2016).

Literature shows different perspectives on the startup's failure with both broad and narrow definitions of failure. There is no clear consensus on what constitutes a startup's failure in the literature (Scaringella, 2017, Watson & Everett, 1996). For example, in broad terms failure includes bankruptcy, failure of mergers, failure of acquisitions, inability to meet customers' needs, declines, retrenchments, downsizings, and generation of low profits (Scaringella, 2017; Miller, 1977). Alternatively, a business "fails to survive when it can no longer meet its financial obligations to debt holders, employees, or suppliers and resorts to or is forced into bankruptcy or liquidation" (Scaringella, 2017; Levinthal, 1991). An initiative can be said to have failed when it is terminated due to actual or anticipated performance below a critical threshold (Cooper et al., 1997). In other words, failure is the termination of an initiative that has fallen short of its goals. Besides the considerable literature of startups, it is not precisely determined that where to draw the line between failure and success and how to decide how long a venture must survive to be considered as a successful or failed one (Bruno et al., 1992)

Although startup failure is not a new research area in the literature, none of the previous studies have investigated the interrelationships among failure factors in a single study or model. Developing a more profound understanding with a focus on different business environments and startup ecosystem (Le Trinh, 2019) will help scholars and entrepreneurs to build and improve analytical models of entrepreneurial failures and learn from them (Nahata, 2019; Walsh & Cunningham, 2017; Lattacher & Wdowiak, 2020). Former research, because of the high degree of specialization, often assumed each of the success or failure factors to directly and independently influence startups' success and leads to a fragmentation of the field (Nogueira, 2019). Some models are based on a single approach, such as a motivational model (Naffziger et al., 1994), a cognitive model (Busenitz & Lau, 1996), or a network model (Larson & Starr, 1993). Therefore, the purpose of this research is twofold: (a) identify the most cited Critical Failure Factors (CFFs) in the literature and (b) analyze the hidden interrelationships among these factors.

FCMs can represent a complex system's behavior and reveal all possible connections based on the combination of fuzzy logic and neural network concepts. FCMs can mean many situations, including uncertain descriptions, linguistic descriptions, vague rules, or quantifiers. These expressions enable us to represent the experts' belief that cannot readily be quantified in numerical terms. Therefore, human perception is reflected in the model more precisely (Lopez & Salmeron, 2014). Accordingly, we will apply FCMs to discover the interrelationships of the most cited CFFs of startups.

3. Research Methodology

3.1. Modeling tool selection

This study is aimed to model the failure factors of startups extracted from the previous research and studied in different phases of a startup lifecycle. The relationships of failure factors are unstructured and not readily quantifiable based on the literature section. Through FCMs, the authors represent all possible connections (Buyukozkan et al., 2010) in the condition of uncertainty (Costa et al., 2007; Wu et al., 2008).

Indeed, FCMs can describe Cognitive Maps (CMs) with two characteristics. First, the causal relationships between a set of concepts (nodes) with fuzzy numbers (a quantity whose value is uncertain). This could be thought of as a function whose domain is usually the interval between 0 and 1. Each numerical value in the gap represents the grade of membership to a fuzzy set, where 0 is the non-membership and one the full membership. The second characteristic is where the system is dynamic, and the effect of change in a concept may affect the other ones, which can affect the node initiating the change.

Therefore, FCMs can simulate their evolution through a given time after determining model nodes' initial values. Thus, this technique can forecast the future behavior of the specific domain represented. Indeed, this excellent forecasting of FCMs results in developing a what-if analysis to understand a variable's vulnerability in different layers of the FCMs model. Managers and decision-makers can identify and rectify problems and the determine the components of a given situation by use what-if scenario, even when they have no technical background (Kosko, 1986). For these reasons, we think that FCMS is the most suitable technique to help us understand the connection of extracted Failure Factors of Startups and different types of failing and support the entrepreneurs to forecast their startup’s dying by detecting the failure factors in the atmosphere.

3.2. Fuzzy Cognitive Maps (FCMs)

Cognitive maps (CMs) were first introduced by Axelrod (1976) in the 1970s. The method developed and studied social scientific knowledge in decision-making in activities related to international politics. Fuzzy cognitive maps (FCMs) extend the idea of mental maps by allowing the concepts to be represented linguistically, where the main system components are fundamentally vague rather than precise. A concept could be an entity, a state, a variable, or a system characteristic (Kosko, 1986; Papageorgiou & Salmeron, 2013, 2014; Salmeron & Gutierrez, 2012). In a complex system, the existing knowledge of concepts is stored in the structure of nodes. FCMs is a modeling tool that enables an intelligent design with uncertain descriptions (Stula et al., 2017). The method can be used for capturing multi-type knowledge with a unified solidification in the same model. Also, it can simulate the dynamics of the system (Salmeron et al., 2017).

Indeed, the main goal of building a cognitive map around a problem is to enable the decision-makers to predict how the concepts of a system interact with one another (Vidal et al., 2015). These predictions can be used for discovering whether a decision made by someone is consistent with the entire collection of stated causal assertions (Bueno & Salmeron, 2008; Jetter & Schweinfort, 2010; Salmeron et al., 2012). This method has been applied in various fields such as medicine (Papageorgiou et al., 2006), computer science (Osei-Bryson, 2004), simulation (Fu, 1991), and some other domains (Lee & Han, 2000; Kang, Lee, & Choi, 2004).

FCM is a digraph that modeled a system according to its nodes (C_i) = {C_1, C_2, . . ., C_n}. Arcs (C_j,C_i) represent causal links between concepts; that is how C_j causes C_i. Weights and associated with a value matrix mean the relationship among concepts where i is the presynaptic (causal) node and j the postsynaptic (effect) node. The relationship between the two concepts have three possible types (Dkerson & Kosko, 1994):

1. $w_{ij} > 0$. This indicates positive causality between nodes x_i and x_j.

2. $w_{ij} < 0$. This indicates negative causality between nodes x_i and x_j.

3. $w_{ij} = 0$. This indicates no causal relationship exists between x_i and x_j.

3.3. FCMs Causal Algebra

Kosko has developed a fuzzy causal algebra that describes the causal propagation and combination of concepts in FCMs. The algebra depends only on the partial ordering P; the range set of the fuzzy causal edge function, and general fuzzy-graph properties (e.g., path connectivity). A causal path from some concept node C_i to concept node C_j, say C_i--~C_{k1}, C_{k1}--~... C_{kn}, C_{kn} --~C_j, can be indicated by the sequence *(i, k, ...* k_{nj}). Then the indirect effect of C_i on C_j is the causality C~l imparts to C_j via the path (i, k_l . . . . . k_{nj}). The total impact of C_i on C_j is the composite of all the indirect-effect casualties. The FCM technique specifically describes a cognitive map model with two significant characteristics. First, causal relationships between nodes have different intensities, represented by fuzzy numbers. The second characteristic is that the system is dynamic— it evolves with time. The method involves feedback, and a change in a concept node may affect other concept nodes, which can impact the node initiating the change. Feedback plays a prominent role in FCMs by propagating causal influences along complicated pathways (Salmeron & Lopez, 2012).

A simple fuzzy causal algebra is created by interpreting the indirect effect operator *I* as the minimum operator (or t-norm) and the total effect operator *T* as the maximum operator (or s-norm) on the partially ordered set *P* of causal values (Pelaez & Bowles, 1996). Formally let ~ be a causal concept space, and let e: ~ x ~ P be a fuzzy causal edge function, and assume that there are many causal paths from C_i to C_j: (i, k~….k~, j) for 1 ~< r ~< m. Then let Ir (C_i, C_j) denote the indirect effect of concept C_i on concept C_j via the r^{th} causal path, and let T (i, C_j) represent the total effect of C_i on C_j overall m causal path. Then:

$$I\sim(C_i,C_j)=\min\,(w(C_p,C_{p+1}): (p,p+1) \sim (i, k\sim.....k,\sim j)) \quad (1)$$

$$T(C_i,C_j)=max\,(Ir(C_i, C_j)), \text{ where } l<\sim r<\sim m \quad (2)$$

Where p and p+1 are contiguous left to right path indices (Papageorgiou, 2010).

The FCMs concepts can be updated through iteration with the other concepts and their value. This is given by a graph with the causal relations weights and is represented by the sum's weight. The concepts values evolve after several iterations, as shown in Equation (3) until they stabilize at a fixed point or limit cycle.

$$A_i^t = f\left(\sum_{j=1\ j\neq i}^{n} A_j^{t-1}\, W_{ji} + A_i^{t-1}\right) \quad (3)$$

where A_i^t is the value of concept C_i at time t, A_i^{t-1} the value of concept C_i at time t-1, A_j^{t-1} the value of concept C_j at time t-1; w_{ji} represents the degree of causality from concept C_j to concept C_i; f is a threshold function and to squash the result in the interval [0, 1].

Another modified update rule was proposed in Equation (4) to avoid the conflicts emerging in inactive concepts. Indeed, the rescaled inference depicted in Equation (4) allows dealing with the scenarios where there is no information about an initial concept state and helps prevent the saturation problem (i.e., the activation values of processing entities careen toward their minimal/maximal values as a result of a dense information flow described by similar causal signs) (Papageorgiou, 2011).

$$A_i^t = \left(\sum_{j=1\ j\neq i}^{n} (2A_j^{t-1} - 1)\, W_{ji} + 2A_i^{t-1} - 1\right) \qquad (4)$$

A_i^{t-1} are the concept value C_i in the actual iteration (previous), and f function (equation 5) is a sigmoid:

$$f(x) = \frac{1}{1+ e^{-\omega(x)}} \qquad (5)$$

Finally, this process keeps repeating till converging to a steady-state point in which almost all concepts plateau. Equation 6 checks the stopping condition of this process. in this Equation, the second norm between old and new state vector is examined according to a fractional threshold:

$$||A^t - A^{t-1}||^2 \leq \varepsilon \qquad (6)$$

The main goal of building an FCMs around a problem is to predict the outcome by letting the relevant issues interacts.

3.4. Building Augmented FCMs

In the real world, experts of a specific area might have different attitudes toward a problem. Building FCMs based on the experts' opinion is a three-step model. First, experts should identify the fundamental concepts of a specific area. Second, they estimate the concepts' causal relationship based on their knowledge using linguistic variables or real numbers. Third, they assess the strength of causal relationships (Papageorgiou, 2010). The Augmented FCMs is an approach that each expert draws his adjacency matrix based on his opinion. This method makes an opportunity to reach a consensus without changing the prior views of experts (Dikerson & Kosko, 1994, Salmeron, 2009). The elements in the Augmented matrix (w^{Aug}_{ij}) are computed according to the following Equation:

$$W^{Aug}_{ij} = \frac{\sum_{i=1}^{m} W_{ij}k}{m} \quad (7)$$

Where m is the number of FCMs added, one per expert, k is the identifier for each FCM, and i and j are identifiers of the connections. We computed the elements for the AAUG using Eq. (7) because the experts' FCM had common nodes.

3.5. Construction Method

This research aims to define the startup's critical failure factors and determine the available interrelationship between them and estimate the degree that they affect each other to increase the probability of startup failure, using FCM modeling techniques. The research structure used for this purpose is a six-step approach, as illustrated in Fig.1.

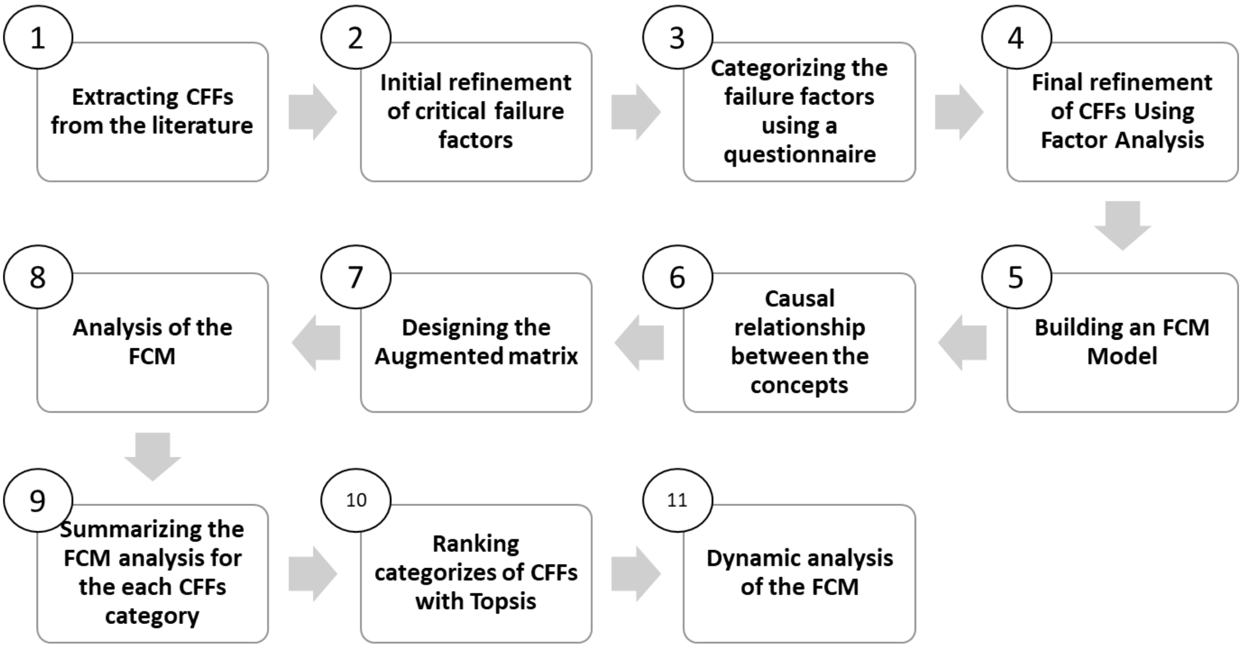


Figure 1- A construction method

3.5.1. Critical Failure Factors (CFFs) background

In recent decades, numerous authors investigate the main reasons for startups' failing. The previous researcher examined whether a specific factor or group of factors would affect a startup's failure by some models such as statistical models (Keasey and Watson, 1991). Some others investigate the intensity of two or more independent variables that can affect a startup's failure in a single structured model (such as logistic regression analysis) (Marom & Lussier, 2014, Everett & Watson, 1998, Lussier, 1995). Although numerous researches identify various failure factors, there is no generally accepted list of these factors. We tried to gather numerous critical failure factors from prior research to build the known CFFs' list and prepare them for further analysis. For this purpose, we reviewed 78 papers and listed failure factors from different authors to develop our integrated list.

Table 1. Startup failure factors

#	Failure Factors [Measure]	Description	Author
1.	A power-hoarding executive	A business which is under the full control of a power-hoarding and figurehead chief executive.	(Duchesneau & Gartner, 1990; Miller, 1977)
2.	Management incompetency	Entrepreneur's lack of management experience, capability and knowledge abilities	(Castrogiovanni, 1996; Duchesneau & Gartner, 1990; Halabí & Lussier, 2014; Hyder & Lussier, 2016; Lasch, Le Roy, & Yami, 2007; Lussier, 1995; Miller, 1977; Peña, 2002; Rahet al., 1994; Stuart & Abetti, 1987; Thornhill & Amit, 2003; Zaridis & Mousiolis, 2014)
3.	Insufficient Entrepreneur's experience	No or lack of prior entrepreneur's business and startup experience.	(Cope, 2011; Duchesneau & Gartner, 1990; Ucbasaranet al., 2010)
4.	Lack of entrepreneur's marketing skills	The knowledge and background of entrepreneur's marketing skills and experiences.	(Hyder & Lussier, 2016)
5.	Inappropriate innovation	Too much or too little emphasis on product-market innovation (Innovation trap).	(Lasch et al., 2007; Miller, 1977) (Hyytinen et al.2015)
6.	Inefficient control capability	Too much emphasis on control or too few controls	(Duchesneau & Gartner, 1990; Miller, 1977)
7.	Poor Entrepreneur's team working skill	Importance of the entrepreneur team, capabilities and skills (Human failure/Incompetence risk)	(Bruno et al.1992; Kakati, 2003; Macmillan et al., 1985; Stuart & Abetti, 1987)
8.	Entrepreneur's [and the team] industry experience	Lack of Entrepreneur's and the team experience in the industry	(Hyder & Lussier, 2016; Lussier, 1995; Peña, 2002; Zaridis & Mousiolis, 2014)
9.	Irrelevant Entrepreneur's education	University level education of the entrepreneur.	(Cooper et al., 1991; Hyder & Lussier, 2016; Lussier, 1995; Peña, 2002; Zaridis & Mousiolis, 2014)
10.	Poor entrepreneur's HR skills	The ability to attract and retain qualified staff.	(Hyder & Lussier, 2016; Lussier, 1995; Unger et al., 2011; Zaridis & Mousiolis, 2014) (Benzing et al., 2009)
11.	Partners	A businesses established by two or more people are more likely to succeed than those by one.	(Hyder & Lussier, 2016; Lussier, 1995; Zaridis & Mousiolis, 2014)
12.	Entrepreneur's age	The age of entrepreneur.	(Hyder & Lussier, 2016; Lussier, 1995; Zaridis & Mousiolis, 2014; Corner et al., 2017)
13.	Entrepreneur's gender	The gender of enrapture.	(Cooper et al., 1991; Javadian & Singh, 2012)
14.	Entrepreneur compatibility	The congruence of the new venture with the company's image, culture, product experience, and general approach to the marketplace	(Stuart & Abetti, 1987)
15.	Market factors	Small and slow-growing market rate.	(Stuart & Abetti, 1987)
16.	Financial Management	The efficient and effective management of money in such a manner as to accomplish the objectives of the organization.	(Bruno et al., 1992; Halabí & Lussier, 2014; Honjo, 2000; Hyder & Lussier, 2016; Lasch et al., 2007; Lussier, 1995; Thornhill & Amit, 2003; Zaridis & Mousiolis, 2014)
17.	Capital/Investment difficulties	The amount of capital invested by the founder (as a proportion of the minimum startup capital needed for the venture).	(Castrogiovanni, 1996; Cooper et al., 1991; E. Halabí & N. Lussier, 2014; Honjo, 2000; Hyder & Lussier, 2016; Lasch et al., 2007; Lussier, 1995; Peña, 2002; Zaridis & Mousiolis, 2014)

18.	Macro-Economic issues	The lack of commercial land, resulting in congestion as well as a higher cost of doing business than other countries, making business difficult	(Hyder & Lussier, 2016; Khelil, 2016)
19.	R&D intensity	Investing a higher portion on R&D than marketing.	(Kakati, 2003; Lussier, 1995; Stuart & Abetti, 1987; Zaridis & Mousiolis, 2014)
20.	Entrepreneur's family background	Having no or limited family background in entrepreneurship	(Bird & Wennberg, 2016; Cooper et al., 1991; Duchesneau & Gartner, 1990; Edelman et al., 2016; Hyder & Lussier, 2016; Lussier, 1995; Zaridis & Mousiolis, 2014)
21.	Long hours working	Lead entrepreneurs in successful firms were more likely to have worked long hours.	(Duchesneau & Gartner, 1990; Peña, 2002)
22.	No personal investment	Lead entrepreneur with no personal investment in the firm	(Duchesneau & Gartner, 1990)
23.	Having two jobs	Entrepreneur do not abandon previous job to startup a new company	(Peña, 2002)
24.	Do not have a clear broad business idea	lead entrepreneurs has a clear, broad business idea that provided organizational will to overcome adversity, confrontation, and often a troubled financial condition.	(Duchesneau & Gartner, 1990)
25.	Inadequate planning	Spending more time on planning.	(Duchesneau & Gartner, 1990; Halabí & Lussier, 2014; Lussier, 1995; Rah et al., 1994; Zaridis & Mousiolis, 2014)
26.	Lack of familiarity with target market	poor and inadequate information about competitors and marketplace opportunities;	(Carayannis et al., 2006; Duchesneau & Gartner, 1990)
27.	Purchased firms	A firm purchased by another entrepreneur.	(Duchesneau & Gartner, 1990)
28.	Lack of professional advisors	The use of outside professionals and advisors for help in solving specific problems during startup was necessary for success	(Duchesneau & Gartner, 1990; Halabí & Lussier, 2014; Hyder & Lussier, 2016; Lussier, 1995; Zaridis & Mousiolis, 2014)
29.	Failure to control the fix cost	Incapability to minimize fixed costs, especially during the downturns	(Willis, 1992)
30.	Lack of good relationship with the venture capitalist	a good relationship is defined as one in which both the entrepreneur and the venture capitalist share the same objectives and agree on the means to achieve them.	(Brunoet al., 1992)
31.	Founders definition of success and his/her feeling of satisfaction	Had the founder not enjoyed what he was doing or had his ambitions been different, the companies might not have survived in their independent	(Bruno et al., 1992)
32.	Time to market	The length of time it takes from a product being conceived until its being available for sale	(Hyder & Lussier, 2016; Lussier, 1995; Lussier & Pfeifer, 2001; Zaridis & Mousiolis, 2014)
33.	Attributions matter	Lack of attitude, motivation, intention, and cognition of entrepreneur.	(Gatewoodet al., 1995; Eggers & Song, 2015; Walsh & Cunningham, 2017; Yamakawa et al., 2015)
34.	The superiority of product and technology	Superiority of product performance, price, uniqueness and competitiveness, Degree of core technology capability	(Rah et al., 1994)
35.	Unavailability of raw materials	Stable supply of raw materials	(Rah et al., 1994)
36.	Growth rate	High entry rate of industry/market	(Honjo, 2000)
37.	Bad economic circumstance	Entering the market during economic crisis and recession.	(Honjo, 2000; Zaridis & Mousiolis, 2014)
38.	Firm age	The age of firm	(Honjo, 2000)
39.	Weak incubator support	Incubator weak involvement in startup gestation period	(Peña, 2002)
40.	Founders overconfidence	Overconfidence as arising when founders overestimate the personal abilities and achievements.	(Hayward et al., 2006) (Koellinger et al., 2007; Ucbasaran et al., 2010)

41.	Fear of failure	Not encourage risk-taking so that suppressing the creativity and innovation which undermines competitiveness.	(Carayannisa et al., 2006)
42.	Differentiation	Insufficient uniqueness of product/service relative to competitors	(Carayannisa et al., 2006)
43.	Negative stereotypes and culture	The economy is dominated by the traditional merchant economy which has a male dominated culture	(Javadian & Singh, 2012)
44.	Low emotional intelligence	The capacity to be aware of, control, express one's emotions, and handle interpersonal relationships judiciously and empathetically.	(Hyytinen et al., 2015; Dias & Teixeira, 2017; Liu et al., 2019)
45.	The stigma of entrepreneurial failure	The defemination of executives due to their association with a fail company.	(Singh et al., 2015)
46.	lack of professional social network	Entrepreneur's lack of professional social network	(Spiegel et al., 2016)
47.	Weak business model	a plan for the successful operation of a business, identifying revenue sources, the intended customer base, products, and financing details.	(Spiegel et al., 2016)
48.	Entrepreneurs' disappointment	psychological state depends on the perceived gap between actual rewards or performance and the entrepreneur's goals or expectations	(Khelil, 2016)
49.	Exit to avoid failure	Describes a situation in which an entrepreneur, to avoid accumulating additional loses, searched for a planned exit strategy.	(Khelil, 2016)
50.	Weak business plan	a standardized proper formal business plan to get government support	(Hyder & Lussier, 2016)
51.	Lack of interpersonal trust	Unfavorable interpersonal relationships which can be linked to lack of trust as a contextual factor	(Atsan, 2016)
52.	Ostensible customers	Ostensible customers may appear to offer benefits (motivation to solve problems, experience sharing, improvement suggestions). Still, their value may be misleading owing to lack of knowledge, vaguely defined wants, and no real intent to purchase.	(Scaringella, 2017)

3.5.2. Initial refinement of critical failure factors

To build up an integrated list for further analysis, we asked a panel of experts to participate. The optimal number of participants depends on the study's characteristics (Rodriguez-Repiso et al., 2007). However, a heterogeneous team with fewer participants would have better results (Lopez & Salmeron, 2014). A heterogeneous panel is a group of people with the same knowledge but on a different professional scale, which took place in our study. Our expert panel comprises five professionals with high expertise in information technology entrepreneurship with over ten years of field experience. This group does the first refinement of CFFs (extracted from the literature) and makes the first list (see table. 1).

3.5.3. Categorizing the failure factors using a questionnaire

Based on the literature, the environment of a startup has influential aspects known as its ecosystem. These aspects are defined differently from the perspective of different authors. Cukier & Kon (2018) described them as knowledge spread, human resource availability, capital availability, and investors. These elements are some characteristics of the startup ecosystem of a region or country. A startup ecosystem is formed by startups, entrepreneurs, investors (angels and venture capital firms), universities, and government (Motoyam & Knowlton, 2016). Tripathi and others (2018) defined eight crucial elements in a startup ecosystem: entrepreneurs, technology, market, support factors, finance, human capital, education, and demography.

Based on these aspects and the similarities of factors, our panel expert decided that they could be refined and categorized. Therefore, we decided to publish an online questionnaire consisting of 52 questions (52 failure components), sent to 2500 entrepreneurs and professionals focusing on information technology entrepreneurship.

The 52 questions were presented in the questionnaire with no categorization or division because of two reasons. First, we did not want the respondent to be directed to any pre-judged direction regarding defined labels and categories. Second, we tried to use the factor analysis technique to bring related failure factors based on the questionnaire responses. The CFFs could categorize into 5 groups of elements: Personal, Strategic, Managerial, Environmental, and Financial.

3.5.4. Final refinement of CFFs Using Factor Analysis

Factor analysis helps to deal with a data set with large numbers of observed variables that are thought to reflect a smaller number of underlying/latent variables. This is the most commonly used inter-dependency technique used when the relevant set of variables shows a systematic inter-dependence. The objective is to find out the latent factors that create a commonality.

Accordingly, we used factor analysis to discover the underlying variables failure factors among the 52 CFFs based on the survey result. In return, the 52 failure factors were integrated into 25 macro failure concepts (Table 2).

Table 2- The validity of factor analysis

KMO and Bartlett's Test

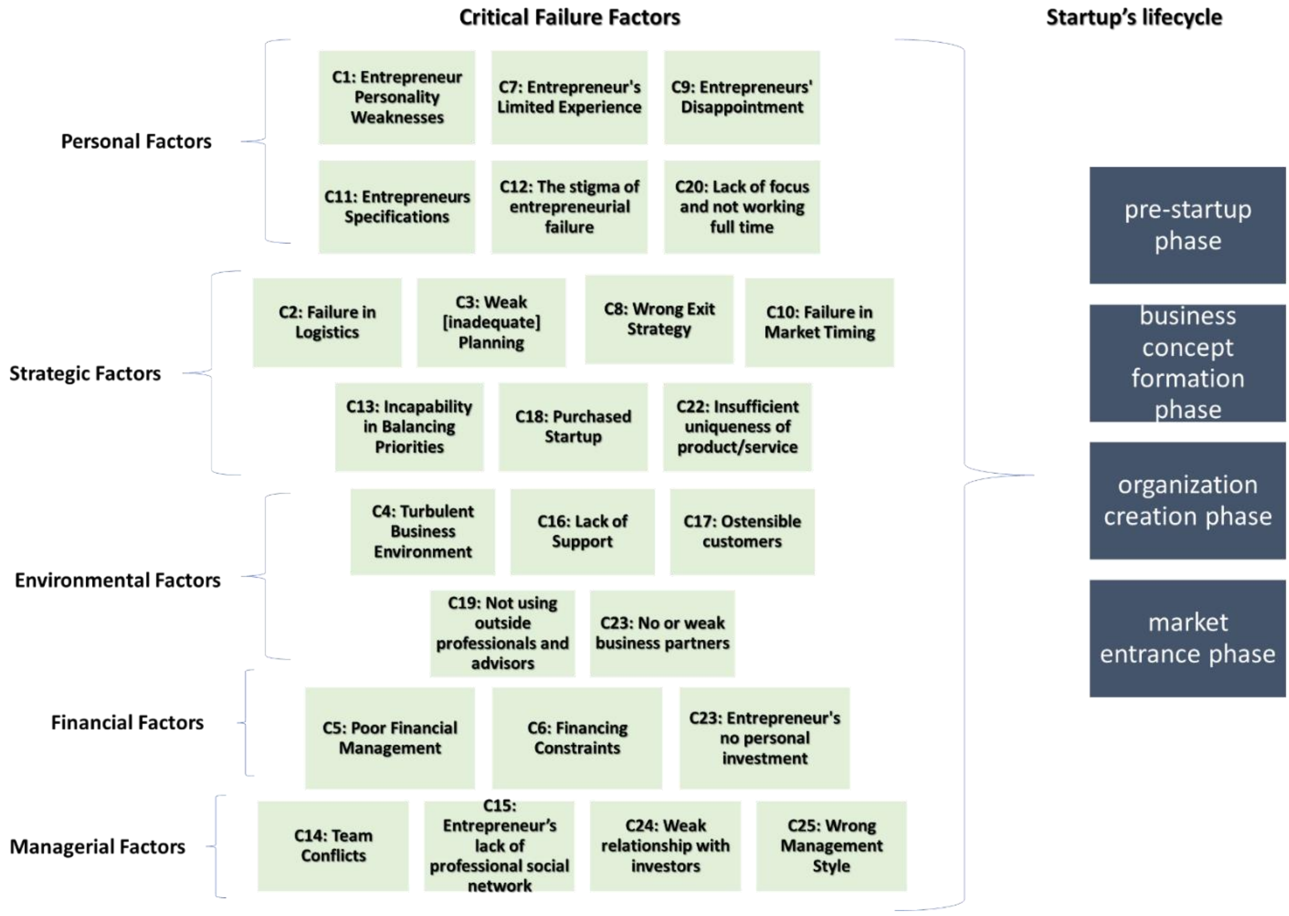
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.770
Bartlett's Test of Sphericity	Approx. Chi-Square	3394.129
	Df	1326
	Sif.	0.000

The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy is a measure of the proportion of variance in a set of variables that might be caused by underlying factors. The above table shows two tests that indicate the suitability of our data for structure detection. High values (close to 1.0) generally suggest that factor analysis may be useful with the data. If the value is less than 0.50, the factor analysis results probably will not be beneficial. Based on the factor analysis of the 2 CFFs, the amount of KMO is 0.77, and as it is higher than 0.5, the results are valid and useful for further the consequences.

3.5.5. Building an FCM Model

Fig.2 exhibits a partial representation of this research's FCM model and shows the 25 failure concepts in the startup's lifecycle's four phases. In the next sections, we determine the interactions and their weight.

Figure 2. FCMs model of Startup failure factors in different phases of a startup



4.3.5.1. Causal relationship between the concepts

In FCM, defining the system's variables and identifying each connection's relationships and weight can be obtained from experts' knowledge (Stach et al., 2005; Salmeron, 2009). Indeed, using humans' experience and expertise has been recommended in FCM to valid results and improve the model's reliability and consistency (Yaman & Polat, 2009).

However, data analysis complexity would be increased by adding the number of experts (Rodriguez-Repiso et al., 2007). Therefore, the number of experts can be limited according to a recommended range (Salmeron & Lopez 2012; Clayton, 1997; Okoli & Pawlowski; 2004).

The relationships between the concepts are identified in the next step. Experts (attendants of the same focus group mentioned above) filled an FCM weight matrix separately to create the model. They assigned a weight to each concept's relationship with the other concepts. The relationships were represented with weights as 1 (strong positive relation), -1 (strong negative relation), and different connections positioned between these two scales.

Table 3- Augmented FCM concepts weight matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	p1	p2	p3	p4
C1	0	0	0	0	0	0	0	0	0.036	0	0	0	0.004	0.018	0.004	0.004	0	0	0	0.004	0	0	0	0.007	0	0.036	0.004	0.109	0.036
C2	0	0	0.036	0	0.036	0	0	0	0.033	0.087	0	0	0.066	0.036	0	0	0	0	0	0	0	0	0	0.036	0.033	0	0.033	0.069	0.174
C3	0	0.116	0.007	0	0.116	0	0	0.116	0.040	0.119	0	0	0.109	0.073	0	0.043	0	0	0	0.006	0	0.116	0.007	0.004	0.080	0.109	0.080	0.145	0.094
C4	0	0.123	0.152	0	0.080	0.116	0	0.006	0.073	0.109	0	0	0.080	0.040	0	0.043	0.010	0	0	0.040	0	0.001	0	0	0.036	0.043	0.109	0.145	0.181
C5	0	0.123	0.010	0	0	0.145	0	0.043	0	0.040	0	0	0.109	0.036	0	0	0	0	0	0	0	0	0.004	0.145	0.040	0.145	0.109	0.218	0.130
C6	0	0.123	0.014	0	0.080	0	0	0	0.050	0.014	0	0	0.017	0.043	0	0	0	0	0	0	0.014	0.036	0.007	0.109	0.004	0.036	0.036	0.145	0.163
C7	0	0.001	0.014	0	0.017	0	0	0.017	0.073	0.007	0	0	0.073	0.073	0	0	0	0	0.009	0.033	0	0	0	0	0.040	0.116	0.043	0.080	0.094
C8	0	0	0.003	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.033	0.054	0.063	0.102
C9	0	0	0	0	0.029	0	0	0.080	0	0	0	0	0.036	0.066	0	0	0	0	0.001	0.073	0.036	0	0	0.043	0.054	0.007	0.007	0.080	0.109
C10	0	0.036	0.036	0	0.066	0.066	0	0.050	0	0	0	0	0.036	0	0	0	0	0	0	0	0	0.095	0.036	0	0	0.109	0.080	0.050	0.040
C11	0	0	0.007	0	0	0	0.036	0	0.073	0	0	0	0.043	0.109	0	0	0	0	0.007	0.043	0	0	0.007	0.036	0.014	0.043	0.073	0.058	0.043
C12	0	0.007	0.007	0	0.007	0.029	0	0.050	0.094	0.087	0	0	0.021	0.066	0.007	0	0	0	0.066	0.047	0.102	0	0.066	0.036	0.073	0.069	0.069	0.098	0.036
C13	0	0.087	0.108	0	0.116	0.007	0	0.043	0.007	0.021	0	0	0	0.050	0	0.014	0	0	0.021	0.043	0.011	0.028	0.014	0.014	0.087	0.116	0.094	0.083	0.109
C14	0	0.021	0.021	0	0.014	0	0	0.021	0.064	0.021	0	0	0.050	0	0	0.087	0	0	0.028	0.021	0.021	0.021	0.028	0.032	0.028	0.007	0.043	0.073	0.153
C15	0	0.080	0.021	0	0.007	0.059	0	0.021	0.018	0.018	0	0	0.014	0	0	0.130	0	0	0.130	0	0.007	0.021	0.094	0.035	0.021	0	0.003	0.033	0.073
C16	0	0.087	0.014	0	0.014	0.130	0	0.014	0.095	0.036	0	0	0.007	0	0.035	0	0	0	0.007	0.007	0.021	0.021	0.064	0.094	0.007	0.094	0.080	0.094	0.098
C17	0	0.057	0.028	0	0.036	0.029	0	0.029	0.054	0.050	0	0	0.080	0	0	0	0	0	0	0.029	0	0	0	0	0	0	0.036	0.029	0.050
C18	0	0.057	0.066	0	0.029	0.073	0	0.057	0	0	0	0	0.014	0.021	0	0	0	0	0.029	0.043	0	0.05	0	0	0	0	0	0	0.073
C19	0	0.035	0.108	0	0.035	0.007	0	0.070	0.062	0.071	0	0	0.077	0.042	0.035	0.042	0	0	0	0.007	0.014	0.064	0.028	0.064	0.035	0.109	0.094	0.073	0.050
C20	0	0.021	0.130	0	0.064	0.058	0	0.007	0.007	0.021	0	0	0.123	0.059	0.007	0.043	0	0	0.007	0	0.035	0.057	0.057	0.071	0.021	0.058	0.061	0.077	0.080
C21	0	0	0.014	0	0.065	0.088	0	0.029	0	0.014	0	0	0.007	0.014	0	0.029	0	0	0	0.094	0	0	0.029	0.059	0	0.040	0.069	0.069	0.040
C22	0	0	0.021	0	0	0	0	0.021	0.051	0.021	0	0	0.021	0.014	0	0.057	0	0	0.021	0	0	0	0.021	0.014	0.014	0.095	0.095	0.095	0.095
C23	0	0.035	0.014	0	0.050	0.080	0.028	0.021	0.028	0.021	0	0	0.014	0	0.042	0.101	0	0	0.028	0	0	0.021	0	0.035	0.014	0.116	0.102	0.109	0.106
C24	0	0.021	0.021	0	0.105	0.095	0.021	0.021	0.068	0.028	0	0	0.028	0.047	0.021	0.101	0	0	0.021	0	0	0	0	0	0.007	0.033	0.047	0.066	0.096
C25	0	0.071	0.071	0	0.064	0.065	0.014	0.089	0.028	0.042	0	0	0.101	0.130	0.028	0.036	0	0	0.042	0.021	0.007	0.021	0.021	0.021	0	0.066	0.089	0.125	0.135

4.3.5.1. Designing the Augmented matrix

The final matrix was created as the average matrix of all expert responses according to equation (7). This average matrix is the last model of startup failure factors that we used for further analysis and judgments (Table 3). Indeed, this table depicts the relationship between numbers and linguistic variables.

4.3.6. Analysis of the FCM

In the real world, when one factor arises, this may exert an influence on another factor. Therefore, our model can predict the results of CFFs' effects on failure in different phases with great accuracy since FCM can reflect direct and indirect effects in a model. Table 3 shows the impact of CFFs on each other, which are all positive. This means that changes in the level of a factor provoke changes in the other factor's effect in the same direction, and the amount shows the intensity of this effect. Moreover, an increase in the level of a CFF increases the possibility of failure in all phases.

Table 4 reveals the results of dynamic FCM used to discover these relationships more accurately. Based on table 4, the first state columns indicate the direct effects of concepts, and min/max columns show the indirect impacts of concepts.

Table 4- FCM model

		Max of mins				Direct			
		p1	p2	p3	p4	p1	p2	p3	p4
Personal	C1	0.0363	0.0363	0.1088	0.0363	0.0363	0.0036	0.1088	0.0363
Strategy	C2	0.0866	0.0866	0.0866	0.1744	0.0000	0.0328	0.0691	0.1744
Strategy	C3	0.1158	0.1088	0.1451	0.1193	0.1088	0.0796	0.1451	0.0936
Environment	C4	0.1158	0.1088	0.1451	0.1814	0.0433	0.1088	0.1451	0.1814
Financial	C5	0.1451	0.1088	0.2177	0.1451	0.1451	0.1088	0.2177	0.1298
Financial	C6	0.1053	0.1088	0.1451	0.1633	0.0363	0.0363	0.1451	0.1633
Personal	C7	0.1158	0.0726	0.0796	0.0942	0.1158	0.0433	0.0796	0.0942
Strategy	C8	0.0328	0.0544	0.0632	0.1018	0.0328	0.0544	0.0632	0.1018
Personal	C9	0.0726	0.0726	0.0796	0.1088	0.0070	0.0070	0.0796	0.1088
Strategy	C10	0.1088	0.0948	0.0948	0.0948	0.1088	0.0796	0.0503	0.0398
Personal	C11	0.0726	0.0936	0.0866	0.1088	0.0433	0.0726	0.0579	0.0433
Personal	C12	0.0656	0.0936	0.0983	0.1018	0.0691	0.0691	0.0983	0.0363
Strategy	C13	0.1165	0.1088	0.1158	0.1158	0.1165	0.0942	0.0831	0.1088
Managerial	C14	0.0866	0.0936	0.0866	0.1528	0.0070	0.0433	0.0726	0.1528
Managerial	C15	0.1082	0.1088	0.1298	0.1298	0.0000	0.0029	0.0328	0.0726
Environment	C16	0.1053	0.1088	0.1298	0.1298	0.0942	0.0796	0.0942	0.0977
Environment	C17	0.0796	0.0796	0.0796	0.0796	0.0000	0.0363	0.0293	0.0503
Strategy	C18	0.0726	0.0726	0.0726	0.0726	0.0000	0.0000	0.0000	0.0726
Environment	C19	0.1088	0.1082	0.1082	0.1082	0.1088	0.0942	0.0726	0.0503
Personal	C20	0.1158	0.1088	0.1298	0.1193	0.0579	0.0608	0.0766	0.0796
Financial	C21	0.0878	0.0936	0.0936	0.0936	0.0398	0.0691	0.0691	0.0398
Strategy	C22	0.0948	0.0948	0.0948	0.0948	0.0948	0.0948	0.0948	0.0948

Environment	C23	0.1165	0.1018	0.1088	0.1065	0.1165	0.1018	0.1088	0.1065
Managerial	C24	0.1053	0.1053	0.1053	0.1053	0.0328	0.0474	0.0656	0.0960
Managerial	C25	0.1006	0.1006	0.1253	0.1346	0.0656	0.0890	0.1253	0.1346

Concepts with high outdegrees are influencers or deriving variables. Concepts with high indegrees are influenced strongly by other concepts and are so-called receiving variables. Indegree is a count of the number of ties directed to the node, and outdegree is the number of relations that the node refers to others. Based on table 5, the highest outdegree nodes are Entrepreneur's Limited Experience, wrong management style, and weak planning. The first three nodes with the highest in-degree are Poor Financial Management, Entrepreneurs' Disappointment, and Incapability in Balancing Priorities.

The degree centrality of a node, one of the graph theory measures (Harary et al., 1965), reflects the node's importance, i.e., how much an important role a node plays or contributes FCM (Kosko, 1986). The degree centrality measure has been used to analyze the structure of social FCMs by characterizing their most essential nodes (Strickert, 2009). Altay and Kayakutlu (2011) utilized the degree centrality measure of a node in FCMs to prioritize and rank the factors (criteria) for decision making in complex applications and used this rank to reduce the excess number of measures to make it a realistic and robust decision-making process. To calculate the degree centrality of a node, the unlimited incoming (indegree) and outgoing (outdegree) connection weights should be summed (see equation 8). Concerning FCM, the degree centrality is a measure of how strong direct connections of a node is with other nodes in the FCM (Alvin Chin, 2007; Del Pozo et al., 2011; Freeman, 1978):

$$C_D (V)= \sum (id (v) + od (v) \qquad (8)$$

where the indegree id(v) is the summation of connection weights entering node v, and the outdegree od(v) is the summation of connection weights exiting node v.

Centrality indices are answers to the question "What characterizes an important vertex?" The answer is given in terms of a real-valued function on a graph's vertices, where the values produced are expected to provide a ranking that identifies the most critical nodes. The effect of Poor Financial Management (C5) is high in all phases. Moreover, Weak Planning (C3) and Turbulent Business Environment (C4) Incapability in Balancing Priorities (C13), Not Using Outside Professionals and Advisors (C19) and No or Weak Business Partners (C23) should be controlled in different phases since their high centrality degrees.

4.3.7. Summarizing the FCM analysis for each CFFs category

Table No. 5 shows the sum and average effects of CFFs' in each category,

Table 5- the analysis of 5 CFFs' categories

	Direct								Max of mins							
	Sum				Average				Sum				Average			
	p1	p2	p3	p4	p1	p2	p3	p4	p1	p2	p3	p4	p1	p2	p3	p4
Personal	0.3294	0.2564	0.5009	0.3984	0.0549	0.0427	0.0835	0.0664	0.4786	0.4774	0.5827	0.5693	0.0798	0.0796	0.0971	0.0949
Strategy	0.4618	0.4354	0.5056	0.6858	0.0660	0.0622	0.0722	0.0980	0.6279	0.6209	0.6730	0.7737	0.0897	0.0887	0.0961	0.1105
Environment	0.3628	0.4207	0.4500	0.4861	0.0726	0.0841	0.0900	0.0972	0.5260	0.5073	0.5716	0.6055	0.1052	0.1015	0.1143	0.1211
Financial	0.2212	0.2142	0.4319	0.3329	0.0737	0.0714	0.1440	0.1110	0.3382	0.3112	0.4564	0.4019	0.1127	0.1037	0.1521	0.1340
Managerial	0.1053	0.1826	0.2962	0.4559	0.0263	0.0457	0.0740	0.1140	0.4006	0.4082	0.4469	0.5225	0.1001	0.1021	0.1117	0.1306

Table 6- the overall analysis of different phases

	max of mins		direct	
	sum	average	Sum	average
p1	2.3714	0.0949	1.4805	0.0592
p2	2.3250	0.0930	1.5092	0.0604
p3	2.7305	0.1092	2.1844	0.0874
p4	2.8729	0.1149	2.3592	0.0944

Based on the result of FCM (See Table No. 5), the role of Strategic factors is significant in different phases of startup lifecycle in both sum max of mins and sum indirect situation. On the other hand, the average effects of financial factors are the most effective factors that cause a startup's bankruptcy. An entrepreneur should focus on the strategic factors throughout the lifecycle and support his company with financial investments. At the other hand, the organization creation and market entrance are the critical phases of the startup lifecycle since numerous factors would cause bankruptcy.

Overly phase 4 seems the most critical step in a startup's lifecycle based on table 6, and this phase needs first strategic and then financial solutions. The third phase is also crucial and requires more effort to prevent failure.

4.3.8. Ranking categorizes of CFFs with TOPSIS

The technique for order performance by similarity to ideal solution (TOPSIS) is a multicriteria method developed by Hwang & Yoon, to detect the best alternative from a finite set of ones (Hwang & Yoon, 1981). TOPSIS was developed based on the idea that the chosen option has the shortest geographic distance from the positive ideal solution and the farthest distance from the perfect negative solution (Wang & Elhag, 2006). The categories of both direct and a max of min are ranked with this method. Accordingly, the closer category to the positive-ideal category has the most influential factors of failing (Table 7).

Table 7- TOPSIS ranking

Category	Rank in direct	Rank in the max of min
Managerial	5	3
Personal	4	5
Strategic	3	4
Environmental	2	2
Financial	1	1

4.3.9. Dynamic analysis of the FCM

Figures 3 and 4 presents a graphical comparison of the results of the FCM simulations. This provides entrepreneurs with valuable information for effectively setting up their startups. Specifically, the visual representation shows which factors practitioners should focus their efforts on.

Dynamic analysis of FCM requires an initial scenario definition, which represents a proposed initial situation to assess. In this research, we created a whole of 11 scenarios. Scenarios are defined as a set of hypothetical events in the future constructed to clarify a possible chain of causal events and their decision points (Kahn and Wiener, 1967). As the consideration of scenarios can significantly enhance the ability to deal with uncertainty and the usefulness of the overall decision-making process, scenario planning has been adopted technology planning or strategic analysis

Multiple scenarios have been built to test the different types of concepts and their effects on the two types of failures. Based on the above figure 3. we planned nine scenarios based on the following. The rate of effect is categorized according to this range: Very high: 0.8-1, high: 0.65-0.8, middle 0.5-0.65, Low: 0.2-0.5and very low: 0-0.2.

1. Personal Type Scenario: All personal concepts ultimately affect the startup (=1). The probability of failing in pre-startup and business concept formation is very low when only personal factors are out of control. Through the organization phase, personal factors would cause failure with the medium possibility. Therefore entrepreneurs should focus on the personal factors; however, this effort could be decreased in the market entrance phase.
2. Strategic type scenario: All the strategic concepts ultimately affect the startup (=1). Strategic factors should be focused remarkably in the market entrance phase, and a medium

focus on P1, 3. On the contrary, in the organization phase, strategic factors (while other factors are under control) would below.

3. Environmental type scenario: When the environmental concepts are entirely out of control or ultimately affect the startup (=1), no phases are at a high or very high risk of failure. The environmental factors have low influence at the P1, P2, and medium impact at P3, P4.
4. Financial type scenario: If the financial concepts completely affect the startup (=1), the possibility of failure at all phases is low, which means that when all factors are under control, the financial affairs could not cause a startup's failure solely.
5. Managerial scenario type: The managerial concepts have a medium influence in the market entrance phase when other factors are fully controlled. In the different phases, managerial concepts could not cause the bankruptcy of a startup.
6. Normal random type scenario: This scenario refers to the circumstance that all factors randomly are influential. In this chaotic circumstance, the rate of failure in all phases is very high.
7. Low random type scenario: This circumstance shows that all factors' effect is soft and somehow under control. The model reveals that the possibility of failure in all phases is very low in this state.
8. Medium random type scenario: In this state, all factors have a medium effect, and about half percent are out of control. In this circumstance, the market entrance phase is crucial for entrepreneurs, while failure rates in other phases are low.
9. High random type scenario: All factors are out of control in this state. In this circumstance, the failure rate is high at phase 1and two and very high at phase 3 and 4.

Figure 3 - scenario analysis of the FCM

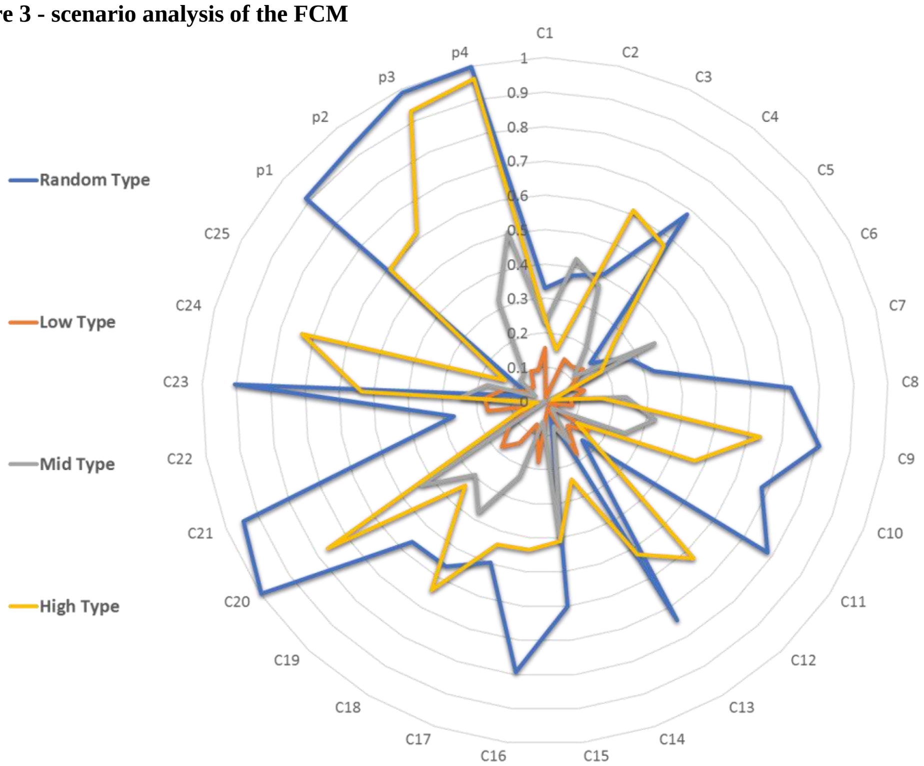


Figure 4 - Dynamic FCM results of different groups of CFFs

4. CONCLUSIONS

Entrepreneurs to design and run a startup would face numerous issues that cause bankruptcy and failure of their business model. To avoid undesired outcomes, entrepreneurs should be aware of potential risks in different stages of startup's lifecycle. In the literature of startups, many studies have been done to underline the factors that might cause failure. However, we have not identified a comprehensive model that assesses all potential factors of failure of startups in a single model. Therefore, a model that could analyze factors and measure their effects seems quite necessary for entrepreneurs. This paper tried to assess the risks and determine their intensity based on the literature review and building an FCM model. The methodology brings the following results for entrepreneurs, managers, and researchers:

(1) In this paper, the critical factors of startups' failure are brought together and integrated into a single list. The list contains 25 factors that cover all the potential risks that threaten a startup. The entrepreneurs should be aware of them and specify strategies to control them.

(2) The growth phases of a startup are defined, and the features of each stage are explained. However, previous studies define the startup's lifecycle. We integrate into four levels and introduce the development phase of startups as Pre-startup (ideation), Business concept formation, organization creation, and expansion phase.

(3) Our study determined five categories for failure factors based on the opinion of the questioner's participants: Personal, strategic, financial, environmental, and managerial to examine the effects of similar factors in the same group and understand how they will amplify each other to the outcomes.

(4) The number of strategic factors is the biggest among the five groups (with seven factors), and the financial factors are the smallest (with three factors).

(5) The FCM analysis provides information about causal relationships between CFFs of startups and their direct and indirect roles in different phases of a startup's lifecycle. This could help entrepreneurs to get a better perception of potential problems in running a startup.

(6) The given FCM model reveals that the Strategic Issues have the highest contribution in sum on a different phase of a startup lifecycle (see table. 6). The 7 strategic factors could amplify their disruptive effect and increase the probability of failure. This group has the most effective, particularly in the phase organization formation (3) and expansion (4).

(7) Organization formation and expansion phases seem the crucially essential phases in a startup's lifecycle, and entrepreneurs should bring about first some strategic and then some financial solutions, while some other viable alternatives should be determined in different remaining categories.

(8) Managerial factors ranked as the most influential factors of failure in direct status. At the other hand, the personal factors are the most critical factors of failing in max of min status. Financial and Environmental factors have the lowest effect on failure.

(9) We developed a what-if analysis to analyze the dynamic behavior of CFFs and quantify their effect on the failure. 9 scenarios are defined, and the results are visualized.

(10) In a chaotic atmosphere (which has the most similarity to the real world), the normal level of factors has a considerable effect on the lifecycle. It might cause a high rate of bankruptcy in different phases. Indeed, the factors boost each other's destructive effect, leading us to conclude that the quality of failure of a startup is high in developing countries.

The research could help entrepreneurs to grow their startups and avoid undesired outcomes. These results have benefits for both academics and business owners in the complex process of running a startup.

5. Limitations and Future Research

One future research avenue is to analyze our proposed startup CFF model in different startup sectors and different startup environments (countries) with the consumption that not every startup sector has the same behavior. There are differences regarding the startup sector and environment.

Another potential future research is to analyze the effect of startup failure on the economy. While the first judgment that it is a negative effect, there is a debate that startup failure may not be as harmful as is assumed and, even in the most mature environments, is not avoidable.

A fertile area of future research is the role of main stakeholders on startup failure. It is essential to know each stakeholder's contribution to controlling and reducing the adverse effects. By stakeholders, we are pointing to the entrepreneur itself, government, business regulators, education system, families, incubators, science and technology parks, economy regulators, and other stakeholders with different levels of effect on startup failure.

6. References

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