

An exploration of the causal structure underlying crowdfunding: theoretical findings and practical implications

Exploring the causal structure underlying CF

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Abstract

Purpose – Crowdfunding (CF) is a digital-financial innovation that, bypassing credit crisis, bank system rigidities and constraints of the capital market, is allowing new ventures and established companies to get the needed funds to support innovations. After one decade of research, mainly focused on relations between variables and outcomes of the CF campaign, the literature shows methodological lacks about the study of its overall behavior. These reflect into a weak theoretical understanding and inconsistent managerial guidance, leading to a 27% success ratio of campaigns. To bridge this gap, this paper embraces a “complex system” perspective of the CF campaign, able to explore the system’s behavior of a campaign over time, in light of its causal loop structure.

Design/methodology/approach – By adopting and following the document model building (DMB) methodology, a set of 26 variables and mutual causal relations modeled the system “Crowdfunding campaign” and a data set based on them and crafted to model the “Crowdfunding campaign” with a causal loop diagram. Finally, system archetypes have been used to link the causal loop structure with qualitative trends of CF’s behavior (i.e. the raised capital over time).

Findings – The research brought to 26 variables making the system a “Crowdfunding campaign.” The variables influence each other, thus showing a set of feedback loops, whose structure determines the behavior of the CF campaign. The causal loop structure is traced back to three system archetypes, presiding the behavior in three stages of the campaign.

Originality/value – The value of this paper is both methodological and theoretical. First, the DMB methodology has been expanded and reinforced concerning previous applications; second, we carried out a causation analysis, unlike the common correlation analysis; further, we created a theoretical model of a “Crowdfunding Campaign” unlike the common empirical models built on CF platform’s data.

Keywords Crowdfunding campaign, System, Causal loop diagram, Crowdfunding dynamics, Document model building

Paper type Research paper

1. Introduction

The last decades have been characterized by growing entrepreneurial opportunities, availability of information, ease of networking and venturing, support of policymakers to entrepreneurship and economy. In contrast they have been characterized by financial crisis and bank fragility (Mamatzakis *et al.*, 2021; Casey and O’Tool, 2014).

The increased demand of capitals for new entrepreneurial initiatives and, on the opposite, the weakening of the capital market triggered a wave of financial innovations,



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leveraging on digital technologies, able to compensate the gaps of the traditional financial systems.

Based on the Internet and digital platforms a set of new systems tapping into management, finance and digital technologies started supporting a strategic yet unsatisfied demand for capitals and services.

This set of innovations like crowdfunding (CF), mobile payments, cryptocurrencies and blockchain became a challenging research area for management scholars, named Financial Technology (FinTech) (Elia *et al.*, 2022; Milian *et al.*, 2019; Thakor, 2019).

Among the many FinTech systems, CF has gained relevance both theoretically and practically. It is a process for both collecting capitals to finance business ventures and entrepreneurial initiatives and for personal microinvestments. It is free of physical intermediaries and bureaucratic constraints and enables the matching between many individual small funders (crowd) and entrepreneurial capital seekers. The matching and the funding are operated by a virtual intermediary, namely, a digital platform (Brokaw, 2014; Hagiū and Wright, 2015; Linzalone *et al.*, 2020).

CF is playing a relevant role in today's economy: supports ventures in the seed stage of entrepreneurial development (e.g. technology digital start-up) (Wonglimpiyarat, 2018), funds companies seeking to amplify or internationalize their business (Belleflamme *et al.*, 2014; Elia *et al.*, 2018; Giudici *et al.*, 2013; Troise *et al.*, 2022a) and offers a market for digital companies ("cybermediary") (Runfola *et al.*, 2013).

Although a consistent body of literature focus on actors (Beier and Wagner, 2016; Valančienė and Jegelevičiūtė, 2014), technologies (Koch and Siering, 2015), drivers (De Luca *et al.*, 2019; Mollick, 2014), projects (Jinwook and Lee, 2015; Xiao *et al.*, 2014) and outcomes (Chemla and Timm, 2019; De Luca *et al.*, 2019; Mollick and Robb, 2016), few studies focus the causes of CF behavior over time (e.g. the raised capital) considering the complex bundle of influences among the components. Such analysis addressable as *CF dynamics* (Haji Gholam Saryzadi *et al.*, 2020; Mollick, 2014; Rao *et al.*, 2014) is detectable through a study of CF as a complex and dynamic system.

After the foundational stage of the CF literature, aimed to identify and study the relations between components and critical outcomes of a campaign, a further theoretical advancement requires the study of the properties emerging from the system, to investigate the behavior, in particular, the trend of *raised capital* over time.

Understanding CF dynamics allows driving the *raised capital* toward the planned target, having cleared the causal mechanisms that preside over its behavior. Such an understanding is crucial to increase campaigns' success ratios, though requiring an underexplored perspective (Harris and Wonglimpiyarat, 2020; Mollick, 2014; Rao *et al.*, 2014; Shneor and Vik, 2020).

The few, previous attempts to explore the system's behavior of a CF campaign are mostly empirical, using data from CF platforms, thus hampering theoretical relevance (Shneor and Vik, 2020). Also, the previous literature considers CF raised capital in static conditions, namely at the campaign's end date, but very limited studies explore its dynamics (Shneor and Vik, 2020).

To fulfill this gap, this paper investigates the behavior of the CF campaign, namely, with regard to the *raised capital* linking it with the underpinning causal structure. To this aim, a causal loop diagram (CLD) model (Forrester, 1971; Kiani *et al.*, 2009; Lane, 2000; Sterman, 2000) of campaign is built, following a document model building (DMB) methodology (Haji Gholam Saryzadi *et al.*, 2020).

The remainder of the paper is organized as follows. Section 2 presents a literature review of the main conceptual elements and working mechanisms underpinning CF together with a review of existing literature about CF dynamics; Section 3 outlines the research methodology, while Section 4 presents analysis and findings emerging from the CLD model. Section 5

discusses the results and, finally, the concluding [Section 6](#) wraps up insights, implications and limitations of the study.

2. Theoretical background

2.1 Crowdfunding: theoretical elements and concepts

Funding is a vital input for entrepreneurship and business. It secures new ventures and existing companies the capitals required to transform new ideas into marketable products or services. Traditional funding systems like venture capital funds, banks and *business angels*, have been recently paired by new systems like CF.

CF was born during the global recession of 2008 ([Cai, 2018](#)) and increased during the following “worldwide credit crunch” ([Krebsz, 2011](#)), given the limited capacity of traditional funding systems to fund entrepreneurship ([Elia et al., 2018](#)).

Currently CF is just one of a large set of financial innovations leveraging on digital technologies, known as FinTech ([Cai, 2018](#); [Harris and Wonglimpiyarat, 2020](#); [Milian et al., 2019](#); [Thakor, 2019](#)).

FinTech includes, besides CF, systems like cryptocurrencies and blockchain, new digital advisory and trading systems, artificial intelligence and machine learning, peer-to-peer lending and mobile payment systems, robot advisory, big data, and cloud computing ([Cai, 2018](#); [Elia et al., 2022](#); [Thakor, 2019](#)).

FinTech systems, often used in combination, provide advanced financial products and services for insurance, regulations and legislative foundations, loans, payments and billing, personal finance and asset management, money transfer and remittance, cryptocurrency, capital markets, and CF ([Elia et al., 2022](#); [Milian et al., 2019](#); [Thakor, 2019](#)).

FinTech is not only a prosperous market but also an interesting and challenging research field, where CF has gained a prominent position.

CF rises at the intersection of three literature streams, that of digital platforms ([Brokaw, 2014](#); [Hagiu and Wright, 2015](#)), of microfinance ([Beaulieu et al., 2015](#)), digital business models ([Wirtz, 2019](#); [Zaheer et al., 2019](#)) and strategic outsourcing of organizations ([Haji Gholam Saryazdi et al., 2020](#)).

CF consists of “pooling small amounts of capital from a potentially large pool of interested funders” ([Short et al., 2017](#), p. 149) in contrast to the traditional pooling of large amounts from few professional investors and backers ([Belleflamme et al., 2014](#)).

From the *digital platform’s* perspective CF is the system of activities performed by a digital platform to match the demand of capitals coming from entrepreneurs, with the demand of investment projects coming from small investors. The CF platform is owned by a digital intermediary company, is accessible via the Internet and supported by a multisided digital platform ([Brokaw, 2014](#); [Hagiu and Wright, 2015](#)) (i.e. a web portal designed for matching demand and offer). The platform company keeps a share of the capital raised by successful campaigns ([Kimes and Wirtz, 2003](#); [Zott et al., 2011](#)).

The design, the operational settings and the management of the CF platform are critical elements of campaigns’ success ([Belleflamme et al., 2015](#); [Lacan and Desmet, 2017](#)) and antecedents of performance and sustainability ([Ammirato et al., 2021](#)).

CF is gaining theoretical relevance also from a strategic management perspective since the knowledge feedback going from investors to the entrepreneurs are strategic innovation inputs and sources of innovation and change ([Troise et al., 2021](#)).

Returns or compensations for funders can range from monetary to rewards, up to equity or to just moral satisfaction, depending on the CF model ([Haji Gholam Saryazdi et al., 2020](#); [Mollick, 2014](#)).

About CF projects, they can be of various capitals (*targets*) (Schwienbacher and Larralde, 2010) and various types (e.g., business and entrepreneurship, public administration, art, journalism, social, etc., all types) (Giudici *et al.*, 2013).

The CF campaign is limited in time and starts with the founders that post on the web platform (e.g. kickstarter.com, eppela.com, etc.) a set of information and digital contents about their entrepreneurial project to promote and showcase it. The platform's audience can browse, seek, compare and evaluate hundreds of projects, very easily and effectively, before they decide the project to fund. Key data are the capital required by founders (the target). However, "signals" are the strategic elements of a project caught by the audience and used to decide if to support it or not (Massa Saluzzo and Alegre, 2021; Shneor and Vik, 2020; Troise *et al.*, 2022b) among plenty of competing projects.

During the campaign, funders can pledge using the payment services made available by the platform (e.g. PayPal, credit card, wire transfer or autonomous agreements of payment between parts). Once the campaign is expired, if the target is achieved the campaign is successful and the funders are obliged to fulfil their promised funding (Etter *et al.*, 2014). If the target is not achieved, the raised capital is returned back to the backers (the "All-or-Nothing" (AoN) model), or alternatively is kept by the founders to carry out the project anyway (the "Keep-it-All" (KiA) model) (Beaulieu *et al.*, 2015; Belleflamme *et al.*, 2016; Mollick and Robb, 2016). This depends on the model adopted by the CF platform.

From an investment point of view there are four models of CF, depending on the type of return: donation-based, lending-based, reward-based and equity-based (Agrawal *et al.*, 2015; Aitamurto, 2015; Mollick, 2014) (see Table 1).

Despite the operational differences, all four CF models have a common mechanism of interests, motivations and transactions, that is, a causal structure; it underpins and determines the behavior of the CF campaign over time and then the raised capital.

The research gap on CF system's dynamics, acknowledged by some scholars (Haji Gholam Saryazdi *et al.*, 2020; Shneor and Vik, 2020), hampers the discovery of behavioral properties. These properties are not deductible by effects' overlay of the single components of CF, and a complex system perspective is suited to the analysis (Belleflamme *et al.*, 2015; Mollick, 2014; Poutanen *et al.*, 2016; Windsor, 2010). Also, dynamic system's properties are not observable in a static situation but with the system in motion, since the complex socio-economic processes of CF (a self-organized mass phenomenon typical of crowds) show in motion and develop in time according to mutual influences and adjustments between the components (i.e. in dynamic conditions).

We support that the study of CF campaign dynamics enables the transition from an initial and definitional stage of research, characterized by the static analysis of parts and effects, to a mature stage focused on systemic and dynamic analysis of CF. This objective provides a valuable base to design CF projects, to control campaign behavior and then to increase the success ratio of campaigns (Belleflamme *et al.*, 2014; Burtch *et al.*, 2013; Xiao *et al.*, 2014). This last is attested at 27% (Shepherd, 2020; Todorov, 2022), which imposes a reflection on the need to go beyond the extant knowledge and research.

2.2 Approaching crowdfunding campaign as a complex system

To study a CF campaign's behavior it is necessary to step forward the single relations between CF's parts (e.g. an actor, an actor's attribute, a platform feature or a setting, etc.) and their outcome (e.g. the raised capital). It is necessary to approach it as a system, whose behavior is produced by parts and variables in action, interacting and influencing each other over time (a complex system). The system's outcome over time, the behavior, is in fact a property emerging from the causal structure of the system (Poutanen *et al.*, 2016).

In general the behavior of the CF campaign is then the trend of a campaign's focal effect over time. Assuming a system's focal effect as the raised capital, the dynamic analysis relates CF behavior with the structure of causal influences.

A CF campaign can be modeled as several subsystems, made up of components that have complex influences (Jackson, 2009; Poutanen *et al.*, 2016); the isolated analysis of its components is neither suited to explain nor to predict the system's behavior. Its study requires a holistic and non-reductionist investigation approach, framed within the complexity theory (Jackson, 2009; Maani and Cavana, 2007; Poutanen *et al.*, 2016). It is a suitable and effective theoretical perspective to study complex systems, nonlinear relationships, systemic interaction and the emergence of system behavior (Cilliers, 2011). This theoretical lens enables research to look at the evolution of human-technology systems (Fleming, 2001), that would be not possible otherwise.

Approaching CF as a system enables the discovery of forms of regular interaction or interdependence (Mele *et al.*, 2010), thus providing generalizable and insightful knowledge about the system's behavior. A system can be defined as an entity, which is a coherent whole (Ng *et al.*, 2009) such that a boundary is perceived around it to distinguish internal and external elements and to identify input and output relating to and emerging from (Mele *et al.*, 2010).

CF, being a physical, dynamic and human system, is made up of (1) components (e.g. people, processes, products, capitals, etc.), (2) attributes (e.g. input, processes and output characteristics of each component) and (3) relationships between components and characteristics (Tien and Berg, 2003, pp. 23-24). Among this system's elements, some mutual cause-effect relationships are recognized (Haji Gholam Saryazdi *et al.*, 2020; Harris and Wonglimpiyarat, 2020; Wonglimpiyarat, 2018). The behavior of a complex system arises from its structure. Complex systems' structure consists of the feedback loops and nonlinearities created by the interaction of the physical and institutional structure of the system with the decision-making processes of the elements acting within it (Sterman, 2000).

2.3 Models to study crowdfunding campaign's dynamic behavior

The existing literature provides few studies of CF as a complex system. Elia *et al.* (2018) outline three main subsystems: project initiators (individuals or start-ups searching for funds), crowdfunders (people keen on providing money to finance business projects) and a CF platform company (an organization that allows interaction among project initiators and crowdfunders). However, CF has three other subsystems: the project, the platform and the platform's audience. Each of them is made up of components.

What gives birth to the (complex) system's behavior is the *feedback loop*. It is a circular chain of cause-effect relations among n elements (or components or variables) of the system. So, if a change in the state of one attribute of Component A determines a change in the state of one attribute of the element B and the change in B, in turn, influences newly a change in the attributes of A, a causal feedback loop governs the system's behavior.

Humans' systems are governed by many feedback loops, and the overall systems' behavior is the determined by the system's feedback loop structure.

Feedback loops determine "hard to predict" and counterintuitive behavioral effects of the system that struggle with the human mental models and capacity to detect them and analyze their consequences (Ammirato *et al.*, 2022; Groesser and Schaffernicht, 2012; Takahashi, 2005); thus specific and structured approaches of analysis are required.

The complex causal structure of CF is just nuanced in the study by Belleflamme *et al.* (2016) who highlight the key feedback loops among the three principal subsystems: fundraisers, funders and platforms (see Figure 1).

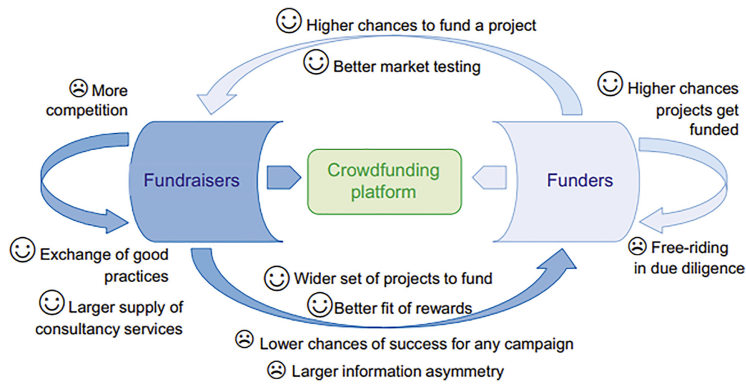


Figure 1.
Causal feedback loops
underpinning CF
system's behavior

Source(s): Belleflamme *et al.* (2016)

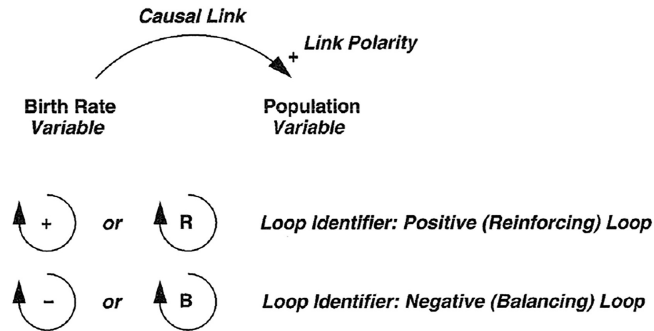


Figure 2.
Graphical elements
of CLD

Source(s): Sterman (2000)

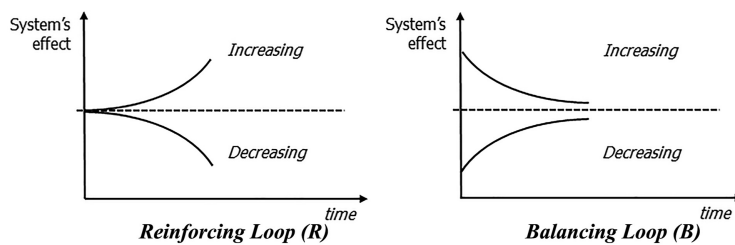


Figure 3.
System's behavior
for increasing and
decreasing external
stimuli

Exploring and theorizing the key mechanisms underpinning CF's behavior (at the global, platform and campaign levels) is a promising and viable way to increase the CF success ratio and indeed (Chen *et al.*, 2018; Lee *et al.*, 2016; Yang *et al.*, 2015) show diseconomies and failures' rates of CF platforms due to the lack of system studies. Strategic management of CF, thus, requires the analysis of the CF system's dynamics (Lee *et al.*, 2016). Analyzing CF as a complex system allows increasing learning and understanding (Chemla and Timm, 2019).

Despite the aforementioned studies, CF dynamics are far from being detected and understood; besides a complex and dynamic phenomenon like CF is elusive without a suited theoretical “lens” (Ammirato *et al.*, 2022).

2.4 Detecting and analyzing crowdfunding campaign’s causal structure: the causal loop diagrams

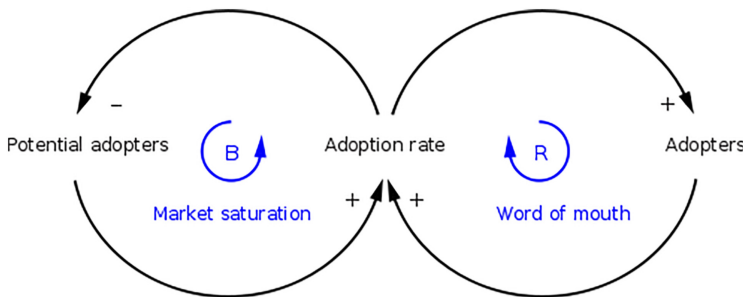
One of the most effective approaches to studying complex systems is system dynamics (Forrester, 1961; Moellers *et al.*, 2019; Sterman, 2000). It provides a set of conceptual elements, guidelines and tools to support the analysis of the *feedback loops* of complex systems.

“Real life” complex systems can be traced back to combinations of archetypes, whose behavior is known. “Common modes” (Sterman, 2000) or “system archetypes” (Senge, 1990) are causal structure *archetypes*, who give rise to emergent (standard) trends over time of a given effect of the system (behavior).

The main tool able to identify and model a complex system’s causal structure is the CLD (Forrester, 1961; Giordano *et al.*, 2007; Kiani *et al.*, 2009; Lane, 2008; Sterman, 2000). A further tool is the *stock and flow diagram* (Duggan, 2016; Sterman, 2000). The former is suited for wider scope qualitative analysis; the latter is needed in addition to the former for quantitative analysis.

A CLD is a standardized conceptual diagram (Lane, 2000, 2008) that represents a system’s *elements* (displayed by texts), connected by arrows representing *causal links* (Lane, 2000, 2008; Sterman, 2000). Graphically, arrows connect the texts, with incoming or outgoing direction depending on the cause–effect relation flow (incoming for effects and outgoing for causes).

Each causal link (*arrow*) is marked with a polarity, *positive* (+) or *negative* (–), to indicate how the effect variable changes with respect to the cause. A *positive link* is assigned when a



Source(s): Sterman (2000)

Figure 4. Example of a CLD: two interconnected feedback loops – The adoption rate of a new product

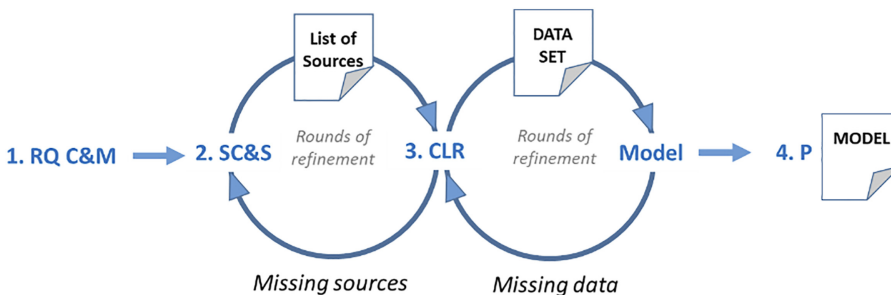


Figure 5. DMB research process

rise of the cause corresponds to a rise of the effect, or a decrease of the cause corresponds to a decrease of the effect. A *negative polarity* is assigned to the causal link if a rise of the *cause* generates a fall of the *effect*, or a fall of the cause makes the effect rise (Stermán, 2000) (see Figure 2).

Once drawn the CLD for the entire system model, the *feedback loops* show. They are the closed chains of arrows that start and end at the same element. The behavior of the system is determined by the structure of the feedback loops (i.e. the number, the type and interconnection). It is responsible for the behavior of the system and explains how and why it changes over time (Cronin and Gonzalez, 2007; Maani and Cavana, 2007; Stermán, 1989). The *feedback loop* type can be *reinforcing* (R) or *balancing* (B) and are marked by a *loop identifier* that shows whether the loop is *reinforcing* or *balancing* (Stermán, 2000).

The R loops tend to amplify any external stimuli since a rise (or a fall) in any of the loop's variables will increase (or absorb) the initial stimuli. Alternatively, in the case a system is in equilibrium, the stimuli that disturb this situation will be amplified and the dynamic behavior of the system will deviate exponentially from the initial equilibrium state (see Figure 3).

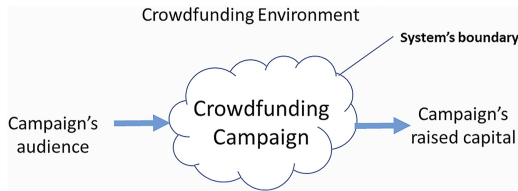


Figure 6.
CF campaign high-level model's elements

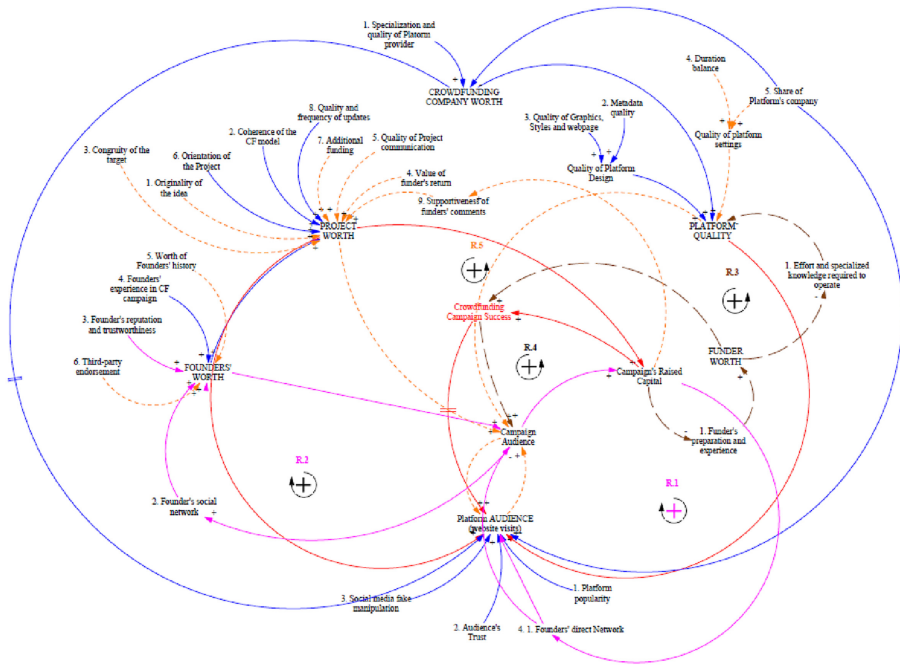


Figure 7.
CLP of the CF campaign's model

The reinforcing loop, therefore, gives rise to a self-reinforcement of a behavioral trend of the system (reinforcing loops are marked by the letter “R”). Negative feedback loops, on the other hand, tend to dampen any external stimulus. The balancing feedback loop, therefore, gives rise to a self-regulation or self-balancing process and is indicated by the letter “B” (balancing) (Sterman, 2000) (see Figure 4).

Reinforcing and *balancing* are the two basic feedback loop types that preside over the two basic behaviors of a system: amplification and dampening. Real systems embody much more complex causal structures than the two basics; however, Senge’s nine system archetypes (Senge, 1990) allow modeling any real system to a combination of archetypes, whose behaviors are known.

A CF campaign can be conveniently analyzed with a CLD to explore the causal structure and discover properties and mechanisms underlying the behavior. In this context, *causal links* connect tangible (e.g. rewards, capitals, web pages of the platform, etc.) and intangible (e.g. regulations, reputation, trust, satisfaction, etc.) system components (Meadows, 2008).

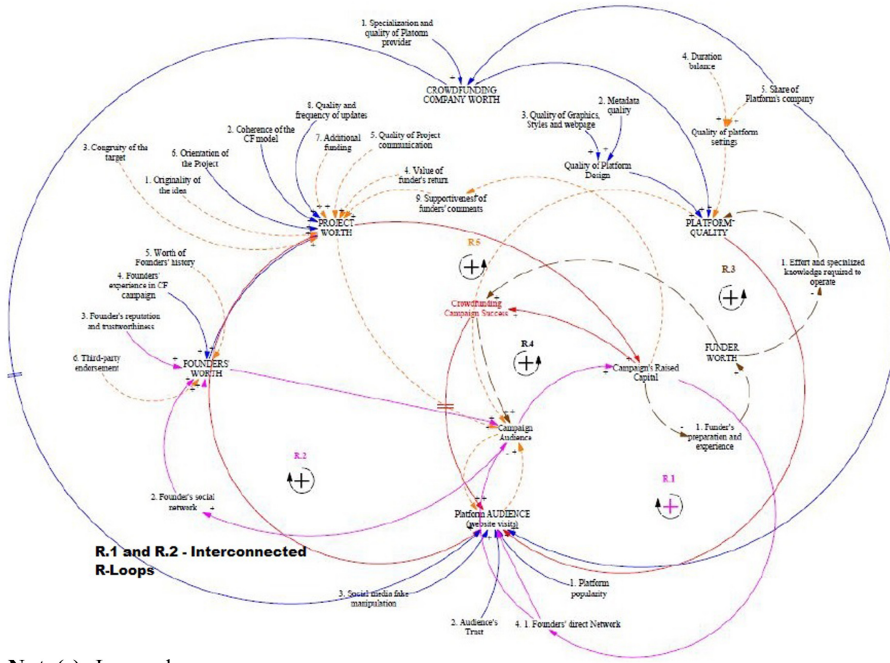


Figure 8. Causal structure of the start of the campaign

Note(s): In purple

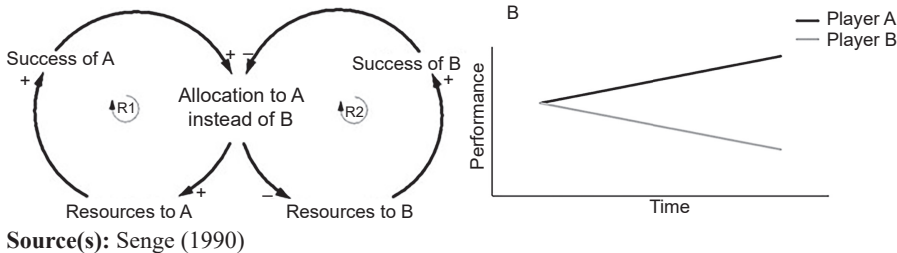


Figure 9. Structure and behavior of the system archetype ‘success to the successful’

Source(s): Senge (1990)

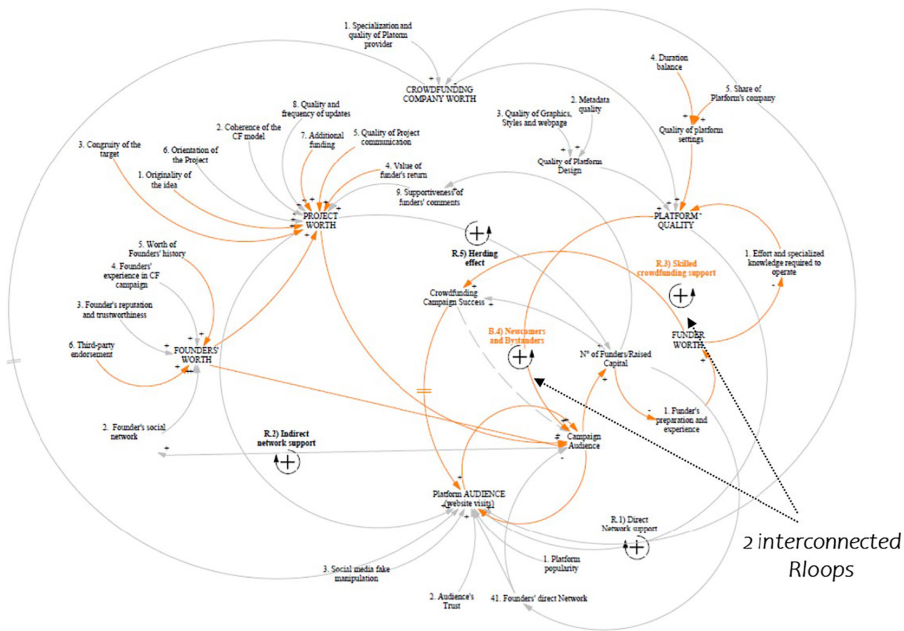


Figure 10. Causal structure of the scale-up stage of the campaign

Note(s): In orange

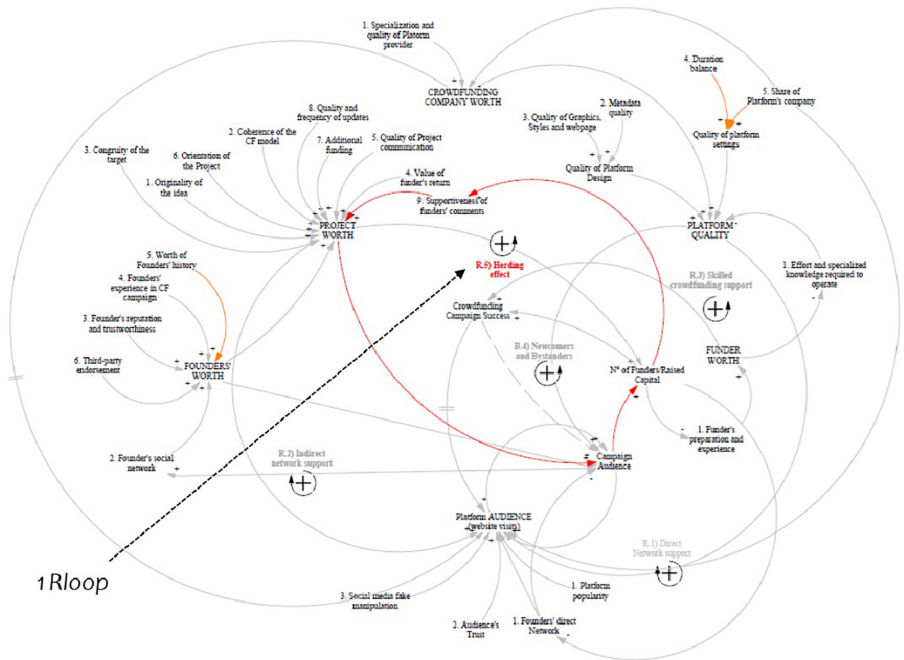


Figure 11. Causal structure of the maturity stage of the campaign

Note(s): In red

3. Research methods

DMB (Haji Gholam Saryazdi *et al.*, 2020) is a methodology that employs a literature review to create a data set for building a model. DMB is a data-driven research strategy (Bleijenbergh *et al.*, 2009), where sources of data and numerical databases are written (Forrester, 1980). Sources can include articles, reports, books and the like.

In line with the research protocol of Haji Gholam Saryazdi *et al.* (2020) the following phases were carried out (see Figure 5):

- (1) clarification and motivation (C and M) of the question to investigate,
- (2) sampling, collection and screening (S, C and S) of the literature sources,
- (3) critical literature review (CLR) of the sources and extraction of the relevant *model data* and
- (4) interpretation, composition and presentation of the *results* in a suitable form.

3.1 Clarification and motivation of the question to investigate

Approaching CF as a complex system, we can detect the feedback loop structure that determines its dynamics. We assume that CF has characteristics, behaviors and properties to discover with this approach. Approaching CF as a complex system has a high chance of coming to new and valuable findings. The research question we stated is the following: *What is the causal feedback structure underpinning a CF campaign's behavior?*

We found a few similar pieces of research addressing this question. Literature explored many single cause-effect relations occurring between the system's elements and a CF campaign's outcome.

Discovering and analyzing CF's causal structure give ground to study many aspects of its behavior and support business management and decision-making (e.g. entrepreneurs, small individual investors, platform managers, policymakers and regulators) about the system's settings, platform strategies and system's policies.

3.2 Sampling, collection and screening of the literature sources

The authors searched for relevant sources and inherent documents, reviewed the contents and analyzed them. Namely, a critical literature review was carried out (Snyder, 2019; Torraco, 2005). The sources were assessed for their relevance, and the key content was summarized. Hence, a model of evidence was created for the system under investigation (Khan *et al.*, 2003).

This approach reduces the bias of researchers, allows detailed information about the phenomenon, promotes the grounding with the literature and supports a coherent combination of various theoretical elements with a central theoretical subject.

3.2.1 Critical literature review. The *critical*, or *integrative*, review aims to assess, critique and synthesize the literature on a research topic (Torraco, 2005). In this case, the review was driven by the aim of detecting the comment and relations of the *CF system* model.

The review involved a "creative" collection of data as the purpose is to combine perspectives and insights from different fields of research and different types of sources (Snyder, 2019), to identify the main theoretical parts and then interconnect them.

Setting the model boundary was crucial at this point, to circumscribe the scope of the collection of the sources. For our aim, the unit of analysis was the *CF campaign*. It comprehends the whole system of activities, relations and actors, involved in a single, successful CF. By project, instead, we mean the entrepreneurial initiative behind the campaign.

Our boundary is defined by the input and the output of the system to analyze; input and output are, respectively, *CF platform audience* and *CF campaign's raised capital*. The main

components involved in the transformation of a platform's audience (i.e. web page visitors) in the campaign's raised capital are included in the system's boundary. Other relevant elements outside of the model boundary are parts of the outside environment. The focal variable of the analysis is *raised capital* (see Figure 6). This is a function of the time, whose initial value is zero at the kickoff of the campaign, and the final value is achieved at the expiration date. The campaign is successful if the capital raised at the expiration date is equal to or over the target.

Transparency and documentation of the process of review are required: how the integrative review was done and how articles were selected (Bryman and Bell, 2011; Snyder, 2019) are reported in the following sections.

3.2.2 Collection, screening and selection: creating the list of sample sources. In this phase, the scholarly relevant Internet search engine Google Scholar (<https://scholar.google.com/>) was used to search refereed papers published on recognized international journals or selected conference proceedings.

To collect and select the relevant and coherent papers to be included in the list L of theoretically significant sources, the search was conducted on December 7th, 2021. The aim was to identify and collect a significant number of sources, which brought any relevant element to the CF campaign model system, with respect to the model boundary. To this aim, no restrictions and filters were applied to the search whose entries were "crowdfunding" AND "dynamics" OR "system" OR "campaign". To secure a scientific reliability of the data, only *journal and conference proceeding* articles were accepted (see Table 1).

The sources that resulted from the search were reviewed by *abstracts* and then sorted in order of relevance and coherence. A full review of the sources was then performed, processing the items per batch. The sample list of sources was stopped when the authors considered *theoretically significant* the set of data against the CF campaign model (theoretical saturation). A list of 23 articles (see Table 2) was then agreed as exhaustive to cover the CF campaign's system elements (see Table 3).

3.2.3 Critical review and extraction of the model data. The key elements emerging from the sources were reported on a review form, and all the reviews were summarized and reported in a model boundary diagram (Haji Gholam Saryazdi *et al.*, 2020; Sterman, 2000). A model boundary diagram shows the elements to be included in the model (Sterman, 2000).

3.3 Interpretation, composition and presentation

Once agreed on the *model boundary diagram*, the data were combined according to CLD modeling notations and construction guidelines (Bala *et al.*, 2017; Lane, 2000; Schaffernicht, 2007; Sterman, 2000). Model building and analysis were supported with software for system dynamic modeling. Thus, *CLD* was used to both analyze the data and present the results. Visualizations were preferred to mitigate the difficulties of analyzing complex systems (Ammirato *et al.*, 2022).

4. Findings

4.1 "Crowdfunding campaign" system's structure

The findings show a set of 26 system components that, together with their mutual influence, determine the behavior (i.e. raised capital) of a CF campaign.

Literature addresses the effects of single components on CF campaign behavior, thus without consideration for "side-effects" among components. These are, instead, key determinants for the system's behavior according to the system dynamics perspective.

The 26 components, according to a system perspective, are part of six subsystems. The existent literature does not focus and address explicitly this intermediate level, between the components and the system, theoretically linking operational variables with overall CF

The crowdfunding model type	Return to the funder	The reference type of the project
Donation-based (or patronage)	The funders act as philanthropists; there is no material return for their support to the campaign. They get moral, reputational, hedonic or social return (e.g. social recognition and moral satisfaction) (Aitamurto, 2015; Beier and Wagner, 2016; Lee et al., 2016; Mollick, 2014)	Art, science, health, social and humanitarian
Lending-based	Funds are provided by funders as a loan, with a rate of interest (Mollick, 2014) or without (Aitamurto, 2015). In this case the return is hedonic or social	Social and technology
Reward-based	Funders receive a reward for backing the project. The reward can range from a symbolic object (e.g. T-shirts and stickers) to the full product/service for which the finance has been given (Aitamurto, 2015; Beaulieu et al., 2015; von Selasinsky and Lutz, 2021)	Creative, artistic, hospitality, cultural heritage, technology or consumer product development
Equity-based	Funders act as investors, who receive equity stakes in return for their funding (Elia et al., 2018)	Technology start-up

Source(s): Own elaboration

Table 1. Crowdfunding models

Author	Title	Source (Journal/Conf. Proc.)
Belleflamme et al. (2014)	Crowdfunding: Tapping the right crowd	<i>Journal of Business Venturing</i>
Koch and Siering (2015)	Crowdfunding Success Factors: The Characteristics of Successfully Funded Projects on Crowdfunding Platforms	Proceedings of the 23rd European Conference on Information Systems (ECIS, 2015)
Mollick (2014)	The dynamics of crowdfunding: An exploratory study	<i>Journal of Business Venturing</i>
Mollick and Robb (2016)	Democratizing Innovation and Capital Access: The Role of Crowdfunding	<i>California Management Review</i>
Wonglimpiyarat (2018)	Challenges and dynamics of FinTech crowd funding: An innovation system approach	<i>Journal of High Technology Management Research</i>
Lacan and Desmet (2017)	Does the crowdfunding platform matter? Risks of negative attitudes in two-sided markets	<i>Journal of Consumer Marketing</i>
Muzellec et al. (2015)	Two-sided Internet platforms: A business model lifecycle perspective	<i>Industrial Marketing Management</i>
Bretschneider et al. (2014)	Motivations for crowdfunding: What drives the crowd to invest in start-ups?	22nd European Conference on Information Systems (ECIS)
Yang et al. (2015)	Winner Takes All? The “Blockbuster Effect” in Crowdfunding Platforms	Thirty Sixth International Conference on Information Systems
Kang et al. (2016)	Understanding the determinants of funders’ investment intentions on crowdfunding platforms: A trust-based perspective	<i>Industrial Management and Data Systems</i>

(continued)

Table 2. Sampled sources for critical (or integrative) literature review

Author	Title	Source (Journal/Conf. Proc.)
Massa Saluzzo and Alegre (2021)	Supporting entrepreneurs: The role of third-party endorsement in crowdfunding platforms	<i>Technological Forecasting and Social Change</i>
Belleflamme <i>et al.</i> (2015)	The economics of crowdfunding platforms	<i>Information Economics and Policy</i>
Rossi and Vismara (2018)	What do crowdfunding platforms do? A comparison between investment-based platforms in Europe	<i>Eurasian Business Review</i>
Haji Gholam Saryazdi <i>et al.</i> (2020)	Designing a qualitative system dynamics model of crowdfunding by document model building	<i>Qualitative Research in Financial Markets</i>
Shneor and Vik (2020)	Crowdfunding success: a systematic literature review 2010–2017	<i>Baltic Journal of Management</i>
Jinwook and Lee, 2015	A Long-Term Study of a Crowdfunding Platform: Predicting Project Success and Fundraising Amount	Proceedings of the 26th ACM Conference on Hypertext & Social Media
Troise and Tani (2021)	Exploring entrepreneurial characteristics, motivations and behaviours in equity crowdfunding: some evidence from Italy	<i>Management Decision</i>
Zvilichovsky <i>et al.</i> (2015)	Playing Both Sides of the Market: Success and Reciprocity on Crowdfunding Platforms	Eighth bi-annual conference on The Economics of Intellectual Property, Software and the Internet
Lee <i>et al.</i> (2016)	Improving Donational Distribution for Crowdfunding: An Agent-Based Model	International conference on social computing, behavioral-cultural modeling and prediction and behavior representation in modeling and simulation
Beier and Wagner (2016)	User Behavior in Crowdfunding Platforms - Exploratory Evidence from Switzerland	49th Hawaii International Conference on System Sciences (HICSS)
Hörisch (2015)	Crowdfunding for environmental ventures: an empirical analysis of the influence of environmental orientation on the success of crowdfunding initiatives	<i>Journal of Cleaner Production</i>
Hörisch and Tenner (2020)	How environmental and social orientations influence the funding success of investment-based crowdfunding: The mediating role of the number of funders and the average funding amount	<i>Technological Forecasting and Social Change</i>
von Selasinsky and Lutz (2021)	The Effects of Pro-Social and Pro-Environmental Orientation on Crowdfunding Performance	<i>Sustainability</i>

Table 2.

outcomes. The six intermediate subsystems that we observe are founders, funders, projects, platforms, campaign audience and platform companies. The following attributes are found to be linked with the campaign's success: founders' worth, funders' worth, project worth, platform quality, campaign audience and platform company worth.

4.2 Components and causal relations

The CF campaign components and inherent cause-effects relations are presented in this section per subsystems.

Model component	Theoretical foundation	Literature description
1. The founder's direct network	Mollick (2014)	It is the group of family, friends and colleagues. It is the backbone of the campaign in the early stage (Mollick, 2014). This variable is crucial to bring the campaign to a wider audience on the web
2. The founder's social network	Koch and Siering (2015)	It is the amount of the social network (e.g. LinkedIn and Facebook) contacts of the founders (i.e. the number of contacts)
3. Founder's experience in CF campaign	Jinwook and Lee (2015), Koch and Siering (2015)	Previous experience of founders in crowdfunding projects, both as a funder and founder is positively related to CF project's success
4. Founder's reputation and trustworthiness	Belleflamme <i>et al.</i> (2015), Koch and Siering (2015), Mollick (2014), Mollick and Robb (2016)	Personal and professional reputation of founders are positively related to project's success; thus if it rises then project's success rises
5. Third-party endorsement	Massa Saluzzo and Alegre (2021)	Third-party endorsement about founders, in crowdfunding platforms, is linked to project's success. If endorsement rises (in quantity and quality) then project's success rises
6. Founder's history	Koch and Siering (2015), Zvilichovsky <i>et al.</i> (2015)	Previously backed and/or created other (successful) projects on the platform (funding reciprocity)
7. Funder's preparation and experience	Jinwook and Lee (2015)	As funder's preparation rises, the success of CF campaign rises. This is a mix of, basically, knowledge and previous experience in crowdfunding attitude
8. Effort and specialized knowledge required to users	Koch and Siering (2015), Rossi and Vismara (2018)	The level of effort and/or the specific knowledge required to the users (backers and founders) to operate or just navigate the crowdfunding platform
9. Metadata quality	Shneor and Vik (2020)	Quality-designed metadata reduces users' effort and increases matching ratios between funders and fundraisers. These enhance the experience of using the platform, i.e. users' engagement
10. Quality of graphics, styles and the web page	Beier and Wagner (2016)	Graphics, styles and web pages' structure design influence the experience and the engagement of users, thus influencing the quality of platform design
11. Duration of the campaign	Beier and Wagner (2016)	Duration balance of the campaign (Koch and Siering, 2015) is the maximum duration of the open call, over which the project expires

(continued)

Table 3.
Model boundary diagram

Model component	Theoretical foundation	Literature description
12. Revenue share of the crowdfunding platform	Aitamurto (2015) , Muzellec <i>et al.</i> (2015)	It is “the price” applied by the crowdfunding platform provider, thus for the intermediation services. It has the form of a share on the capital raised by the crowdfunding campaigns (if successful)
13. Quality project communication (i.e. information, contents and use of media)	Koch and Siering (2015) , Xiao <i>et al.</i> (2014) Mitra and Gilbert (2014) Etter <i>et al.</i> (2014)	Quality of project communication is a key cause of campaign’s success; it is made up of <ul style="list-style-type: none"> a) quality of descriptions, (Koch and Siering, 2015), b) depth of description (Koch and Siering, 2015; Xiao <i>et al.</i>, 2014), c) language used (Mitra and Gilbert, 2014), d) Characteristics specified (Etter <i>et al.</i>, 2014) and e) effective use and combination of media (Koch and Siering, 2015)
14. Orientation of the project toward common goods and interests	Hörisch (2015) , Hörisch and Tenner, 2020 ; von Selasinsky and Lutz, 2021)	The higher orientation of the project (i.e. the impact) on saving and preserving common goods and interests (e.g. environmental, social, etc.) the higher is the success ratio of the project
15. Funds other than Funders’	Mollick and Robb (2016)	The presence of additional capitals, other than funders’, increases the project’s success
16. Idea originality and creativity	Burtch <i>et al.</i> (2011) , Shneor and Vik (2020)	Originality and creativity of the project idea is searched by non-professional investors (i.e. people) who are looking for a return and for an engagement, a form of participation to a campaign
17. Coherence of the crowdfunding model	Bretschneider <i>et al.</i> (2014)	The model of crowdfunding (donation, reward, lending, equity and ll-or-nothing vs. keep-it-all) applied to the crowdfunding campaign influences the quality of the project, perceived by the audience of a campaign
18. Congruity of the target	Mollick (2014) , Yang <i>et al.</i> (2015)	Targeting the campaign over the target perceived as “congruous” by the audience causes the fall of trust and confidence to the success of the campaign
19. Quality and frequency of project updates	Lee <i>et al.</i> (2016)	Quality and frequency of project updates are crucial to capture funders during the open campaign timeframe
20. Supportiveness of the comments posted by backers	Shneor and Vik (2020) , Yang <i>et al.</i> (2015)	The supportiveness of the comments posted on the project page by those who backed the campaign, influences the level of audience and orients the decisions of investing (or not) in the given project

Table 3.

(continued)

Model component	Theoretical foundation	Literature description
21. Value of return to the funder	Belleflamme et al. (2015)	The value the funder recognizes to the returns (financial or not). This return depends on the crowdfunding model chosen by the founders, (the type of return) and by the amount of reward/return. The rise of return is linked to the rise of project's success
22. Platform popularity	Branzov and Maneva (2014) , Jinwook and Lee (2015)	Platform popularity is the level of acknowledgment of a crowdfunding platform, in the crowdfunding environment (potential crowdfunders)
23. Social media fake manipulation	Shneor and Vik (2020)	Manipulation of fake comments with social media reduces audience of the platform and in turn of the campaign
24. The financial gap	Wonglimpiyarat (2018)	The lower the gap of the extant capital raised against the target, the lower the risk of failure. As much as the gap falls, the funding (both in pledges and in speed) rises
25. Confidence or trust	Kang et al. (2016)	It is the trust, reputation and confidence, a certain platform has gained in the crowdfunding environment. This influences the choice of the project to fund. Trust can be cognitive and affective (Kang et al., 2016)
26. Specialization and quality of platform service provider	Rossi and Vismara (2018)	The specialization and the quality of service offered to users by platforms' companies are causes of engagement and reuse of the platform

Table 3.

(1) Founders' worth: *Founders' worth* is a first subsystem that influences with a positive link polarity the CF campaign: if the founders' worth rises, the success ratio of campaigns rises. Founders' worth is made up of the following:

- the founders' direct network
- the founders' social network
- founders' reputation and trustworthiness
- founders' experience in CF campaigns
- founders' history
- third-party endorsement

The founders' direct network of people (i.e. family and friends) affects the founders' worth; in practice, it is the group of backers who generally support the campaign in the early stage ([Mollick, 2014](#)). This variable is crucial for bringing the campaign to a wider audience on the web CF platform. The rise of this variable in the number will correspond, according to CLD building guidelines, to a rise in the founders' worth (positive link polarity).

The founders' social network (i.e. followers of Facebook, LinkedIn and personal web pages) is the amount of the social network contacts of the founders (i.e. the number of contacts). This variable is fundamental to scaling up the audience, just after the opening of the call.

This variable is a cause (positive link polarity) of *founders' worth* (Belleflamme *et al.*, 2014; Mollick, 2014).

Founders' reputation and trustworthiness are acknowledged key elements of founders' worth (Belleflamme *et al.*, 2015; Koch and Siering, 2015; Mollick, 2014) linked to this latter with a positive link polarity.

Founders' experience in CF campaigns is recognized as a cause of founders' worth establishing – according to CLD notation – a positive link polarity (Jinwook and Lee, 2015; Koch and Siering, 2015). The campaigns in which founders have backed other projects before show a positive relation with CF campaign success (Koch and Siering, 2015). In terms of the causal link, if the *founders' experience* in CF campaigns rises, either as a backer or founder, the *founders' worth* rises, and the success of the campaign rises too (positive polarity).

A branch of studies has focused on the influence of *the founders' history* on the success of the CF campaign (Koch and Siering, 2015; Zvilichovsky *et al.*, 2015). Koch and Siering (2015) show that *the worth of founders' history* is a cause influencing the success of CF campaigns thus linked with positive polarity. The rise of *the worth of the founder's history*, both personal and professional, implies the rise of the *founders' worth*.

Third-party endorsement is acknowledged by literature as another concurring cause of CF campaign success since the rise of it is positively linked with crowd-funded campaigns (Massa Saluzzo and Alegre, 2021).

- (2) CF platform quality: The CF *platform emerges as another* critical subsystem of a CF campaign, whose key attribute is *quality*. The literature highlights its importance to engage the users. Platform quality comprises effective and efficient operations, hosting and processing of all project information, data and transactions, from and to both sides of users. The *platform quality* is linked with a positive *polarity* to the raised capital (i.e. the *success ratio of the CF campaign*) since an increase in the platform's quality results in an increase in success of the CF campaign.

Quality of the CF platform (*platform quality*) is caused by

- (1) effort and specialized knowledge required to users
- (2) metadata quality
- (3) quality of graphics, styles and web page structure
- (4) duration balance
- (5) *revenue share* of the platform company.

Effort and specialized knowledge required by users have a negative polarity with platform quality (Koch and Siering, 2015).

The *quality of platform design* is a polar cause of *platform quality* (Lacan and Desmet, 2017). It is made up of the quality of metadata, quality of graphics, styles and web page. They influence the experience of the users, both founders and backers.

The quality of metadata is a cause of the quality of platform design. Well-designed metadata reduces users' effort and increases matching ratios between funders and fundraisers. Metadata allows the audience to browse the posted campaigns, by filtering them per category (e.g. film, dance, arts, design and technology) and get effective and clear information to ponder the decision to invest. This increases the quality of the funders' experience. *Metadata quality* and *quality of platform design* are linked with a positive *link polarity*.

The quality of platform settings emerges from literature as another cause of platform quality. In turn, it is caused by a set of key settings (i.e. parametrizations of the CF platform): duration and share.

The duration of the campaign is the maximum duration a campaign can have, over which the project expires. The platform company sets this constraint. If the duration rises then the fundraised increases, but a longer duration implies both obsolescence of the idea and a longer return period for funders (Beier and Wagner, 2016). The balance is a key cause of the quality of the platform setting.

Share of the Platform is the price for the intermediation, the share the company keeps on the capital raised by the crowdfunded campaigns. If the share falls, the audience rises, while the Platform's quality falls.

(3) The project worth: The third subsystem of a CF campaign is the *project*, whose attribute linked to the system's behavior is *worth*. Project worth is a fundamental cause of a campaign's success ratio, as pointed out by Koch and Siering (2015). The following components concur with the "Project worth":

- originality of the idea
- coherence of the CF model
- congruity of the target
- value of return to the funder
- quality of communication
- *orientation of the project*
- additional funding
- quality and frequency of project updates
- funders' public comments' positivity.

These components' attributes are acknowledged for effects on the project's worth.

The originality and creativity of the project idea are searched by nonprofessional investors (i.e. people) in the projects they screen when deciding to support a CF campaign. These kinds of investors seek and choose often for engagement and fulfillment of originality (Kang et al., 2016).

Quality and frequency of project updates are acknowledged as crucial for capturing funders during the campaign timeframe. Lee et al. (2016) show the influence of *project updates* on CF campaign success. An increase in quality and/or frequency causes an increase in *CF campaign success*.

Congruity of the target is a cause that has effects on the *project's worth*. As (Mollick, 2014) argues the requested amount of money influences the project's funding success. The project's goal, or target, is set by founders depending on the planned required capital and the (eventual) availability of other funding sources from the third party. The target then can be very different, ranging from small amounts (e.g. < 1\$) for a single initiative like an exhibit, to a proper seed capital provision for the start-up of a new venture. Mollick (2014) supports that the rise of the target over the perceived "congruous" target causes the fall of trust and confidence in the success of the campaign. In turn, the rise of the congruity of the target (that corresponds to the cut of the gap between the "perceived congruous" target and the actual target) is linked with a positive polarity to the *project worth*.

The *quality of communication of the project* is another cause linked to CF campaign success that links to project worth. Namely, if the first rises the second rises too (positive polarity). The quality of communication, in turn, is given by the combination of the quality of descriptions (Koch and Siering, 2015), depth of descriptions (Koch and Siering, 2015; Xiao et al., 2014), language used (Mitra and Gilbert, 2014) and characteristics specified

(Etter *et al.*, 2014), all regarding the way the founders present and communicate the project, through the platform. *Effective use of media*, meant as the effective combination of various media (video, images and texts), is another cause of the quality of communication. Each medium has its influence on the funding success of projects (Koch and Siering, 2015).

The orientation of the project is acknowledged by the literature as a positive causality with the project's worth. In other words, the orientation (level) of the project toward a collective interest or good (environment, social discrimination, etc.) is causally linked with the worth of the project. In the eyes of the crowdfunders, if the orientation of the CF project rises, the project worth rises too, thus revealing a positive link polarity from the first to the second. The literature shows, in fact, the link between the environmental and/or social responsibility of the project to the success of the CF campaign (Hörisch, 2015; Hörisch and Tenner, 2020; von Selasinsky and Lutz, 2021). Thus, a positive link polarity exists from *the orientation of the project to the project's worth*.

Additional funding, other than crowdfunders, is another variable linked to project worth. The optional, possible coverage of a share of capital with other financial sources (e.g. of the founders themselves or of third parties) to fill a certain gap, is linked with positive polarity to *project worth*.

Funders' comments positivity is another cause influencing the level of audience since it orients the decisions of the platform audience to invest or not in a given CF campaign. The supportiveness of the comments posted on the project page by those who backed the campaign influences the level of the audience and orients the decisions toward investing (or not) in the given project. It is assumed that an increase in positive comments (in the amount and content) causes a rise in the CF campaign's audience.

- (4) Funder worth: *Funder's preparation and experience* is a variable with a positive causal link with success of CF campaign as reported by Jinwook and Lee (2015).
- (5) Audience: *Audience* of CF campaign is the group of Internet users looking for CF campaigns to back. Of course, the audience has a positive link polarity to the *number of funders*, and this in turn has a positive link polarity with the success of a CF Campaign. Causes of audience are detected in
 - platform popularity,
 - audience's trust,
 - social media fake manipulation and
 - financial gap.

Platform popularity is the level of acknowledgment of a CF platform, in the CF environment (potential crowd funders). Platform popularity has a positive link polarity with the audience since the rise of popularity determines the rise of the audience. For this reason, the platform companies invest strategically in platform branding (Branzov and Maneva, 2014). Social media shares create the so-called tam-tam, thus raising the audience on a CF platform. This raises the number of funders.

The audience's trust is the confidence about the likelihood of success of a given posted project. It influences the choice of the project to fund (Kang *et al.*, 2016). Trust can be cognitive and affective (Kang *et al.*, 2016). If the audience's trust rises then the number of funders and capital raise.

Social media fake manipulation is a cause of mistrust toward a CF platform. As the manipulation of fake comments rises, the audience of the CF platform falls.

The financial gap is the difference between the target and the actual capital raised. (Wonglimpiyarat (2018) points out that this gap is a cause of an increase or decrease in the

audience of the campaign and finally in the funders. As much as the gap falls, the audience's confidence in the success of the campaign rises, and the risk of failure reduces. These signals boost backers in funding the campaign (both in pledges and in speed). As much as the gap falls, the funding (both in pledges and in speed) rises.

- (6) CF company worth: CF platforms are owned and managed by companies that, according to multisided platforms' business model (Brokaw, 2014; Rossi and Vismara, 2018; Wirtz, 2019), keep a share of the capital raised by successful campaigns (Aitamurto, 2015). If the revenue share falls, then the founders rise, and since the share is kept away from the raised capital the project's success rises too.

The specialization and the service offered to users by platforms' companies, being able to reach a large audience, causes engagement and reuse of the platform (Aitamurto, 2015; Rossi and Vismara, 2018).

Combining and summarizing the most relevant findings coming from the literature review, the data set for the CLD model comes out, by pointing to the correspondent (short) name for CLD and the effect (i.e. the link polarity of each link) (see Tables 4 and 5).

4.3 Modeling crowdfunding with causal loop diagrams

The data confirm a set of 26 components (variables) belonging to six subsystems: founder worth, funder worth, platform quality, project worth, platform audience and platform company.

Assuming as the focal effect of the study the *CF campaign's capital* (i.e. behavior of the campaign) and connecting them according to the data set a CLD model of a CF campaign is carried out (see Figure 7).

The model shows the existence of 19 feedback loops (see Appendix), five of which are "engines" (Haji Gholam Saryazdi et al., 2020) of the CF campaign (see Table 5).

5. Discussion

CF campaign behavior (i.e. the *raised capital over time*) is critical to address the low CF success ratio (Mollick, 2014). To this aim, we advance the following discussion based on the CLD model's evidence.

5.1 Causal structure of a crowdfunding campaign

Despite the spread and growth of CF platforms and projects, the success ratio of CF campaigns is steady and moderate. A high rate of unsuccessful campaigns produces disengagement of the audience from CF platforms, thus hampering its growth.

Our research returned a set of 26 components of the CF campaign, grouped in six subsystems, unlike Shneor and Vik (2020) who identified 106 labels of variables, grouped into five broad categories (Shneor and Vik, 2020).

The key feedback loops ("engines of growth") of the behavior work in specific stages of the campaign that we identify in: (1) kickoff, (2) scale-up and (3) maturity.

The interpretation of the results is supported and informed by the concept of *system archetypes* (Senge, 1990) or *common modes* (Sterman, 2010). They are paradigms, mental models and frames of reference to interpret the dynamic phenomena that emerge from the observation of reality. They provide the rationale for a given system's behavior, linking the trend of a focal variable (behavior) to the system's causal structure. This way it is possible to analyze or predict a system's behavior over time.

5.2 Stage 1 – start

The start of the campaign is characterized by two reinforcing and interconnected feedback loops: R1: *direct network support* and R2: *indirect network support*.

The CF subsystem	Component	CLD name (cause)	Effect (polarity)
1. Founders' worth	1. The founder's direct network	1. The direct network	Project promotion (+) N° of funders (+)
	2. The founder's Social Network	2. The social network	Project success (+)
	4. Founder's experience in CF campaign	3. Experience in CF campaign	Projects success (+)
	3. Founder's reputation and trustworthiness	4. Reputation and trustworthiness	Project's success (+)
	6. Third-party endorsement	5. Third-party endorsement	Project success (+)
	5. Founder's history	6. Worth of founders' history	Project success (+)
2. Funder	1. Funder's preparation and experience	1. Funder's preparation and experience	Funder worth (+)
3. Platform quality	1. Effort and specialized knowledge required to users	1. Effort and specialized knowledge required to operate	Platform quality (-)
	2. Metadata quality	2. Metadata quality	Users' engagement (+) Users' matching (+)
	3. Quality of graphics, styles and the web page	3. Quality of graphics, styles and the web page	Quality of Platform design (+)
	4. Duration of the campaign	4. Duration balance	Quality of platform settings (+)
	5. Revenue share of the crowdfunding platform	5. Share of platform's company	Quality of platform settings (+)
4. Project worth	1. Quality project communication (i.e. information, contents and use of media)	1. Quality of project communication	Project worth (+)
	2. Orientation of the project toward common goods and interests	2. Orientation of the project	Project success (+)
	3. Funds other than funders'	3. Additional funding	Funders engagement (+) Project trustworthiness (+)
	4. Idea originality and creativity	4. Originality of the idea	Project success (+)
	5. Coherence of the crowdfunding model	5. Coherence of the CF model	Project worth (+)
	6. Congruity of the target	6. Congruity of the target	Project worth (+)
	7. Quality and frequency of project updates	7. Quality and frequency of project updates	Project worth (+)
	8. Supportiveness of the comments posted by backers	8. Supportiveness of funders' comments	Project worth (+)
	9. Value of return to the funder	9. Value of funder's return	Project success (+)
5. Audience	1. Platform popularity	1. Platform popularity	Audience of the campaign (+)
	2. Social media fake manipulation	2. Social media fake manipulation	Audience of the campaign (-)
	3. The financial gap	3. The financial gap	Audience of the campaign (-)
	4. Confidence or trust	4. Audience's trust	Audience of the campaign (+)
6. Platform provider	1. Specialization and quality of platform service provider	1. Specialization and quality of the platform provider	Campaign audience (+)

Table 4.
Data set for the
CLD model

5.2.1 R1: *direct network support*. The “Start” is the early stage of the CF campaign, characterized by the support of the founders’ direct network (i.e. *family and friends*) (Agrawal *et al.*, 2015), which is also the main audience of the campaign’s web page. The driver for supporting the campaign is the direct and personal relationship between founders and funders, rather than the return of the investment, or the platform’s audience.

Family and friends, by the mean of *word of mouth* and social media networks, extend the campaign’s audience to the founders’ indirect network (i.e. the *friends of friends*). They start backing the campaign and increasing the capital, driven by the worth of the founders (Troise and Tani, 2021), namely reputation and trustworthiness.

5.2.2 R2: *indirect network support*. As soon as the direct network mobilizes to back the campaign, the indirect network starts being involved. Founders’ indirect contacts (social network contacts, friends of friends and indirect relatives) are informed of the campaign by the *direct network* and avail social and geographic proximity (Agrawal *et al.*, 2013, 2015) to assess project and founders’ worth and finally decide to back the campaign (see Figure 7).

R1 and R2, according to the CLD (Figure 8), are two interlocked reinforcing loops. These two interlocked, reinforcing loops, amplify or dampen in time. Two interconnected reinforcing feedback loops lead back to the system archetype “Success to the successful” (Senge, 1990). This archetype concerns the situation in which two actors compete for common and finite resources. The one who first prevails in acquiring more resource than the other acquires, reinforces his/her success over the other, who is weakened over time until it disappears (see Figure 9).

In light of the aforementioned archetype, *direct* and *indirect* networks compete to acquire a share of the capital, which is (theoretically) limited by the target. Since both networks are functional and need to support the capital raising it should be avoided an overcapitalization from one of them. Since a share of the *target capital* is always pledged by founders’ direct and indirect backers, the acquisition from “direct” and “indirect” backers must be appropriately balanced to avoid the success of one over the other and to preserve the investment capacity for both.

This finding fits with an established behavior in the nascent CF literature, in that CF projects are subject to critical mass phenomena (Agrawal *et al.*, 2013; Giudici *et al.*, 2013). Projects that succeed in raising a sizable amount of capital in the early days of a CF campaign (i.e. the *start* stage) are fated to succeed, while those that fail to attract contributions in the early days are fated to fail.

5.3 Stage 2 – scale-up

In this stage, R1, direct network support and R2, indirect network support have run out of supportive power. This stage of the CF campaign’s behavior, shifts the audience (and the backers) from the founders’ network, to the worldwide Internet audience of the CF platform. The driving force of the campaign’s behavior is the quality of the investment project. This is given by the return’s (i.e. compensation for the funding) value and by the worth of the project. The worth of the project comprehends a set of dimensions (orientation, quality, originality and congruity), assumed by the campaign’s audience.

#	Type	Chained with (#)
1	Reinforcing (+)	2
2	Reinforcing (+)	1
3	Reinforcing (+)	4
4	Reinforcing (+)	3
5	Reinforcing (+)	4

Table 5.
Growth engines’ loops
underpinning a CF
campaign

This aforementioned shift is much more evident with the project size of the CF campaign: small projects' capital is little affected by quality, while the capital of large projects is influenced by project quality (Burtch *et al.*, 2011).

In this stage, then, the behavior of CF is driven by the worth of the investment and of the project. The ability to scale up from the founders' network to a *crowd* of funders comes from the quality of the project. This mechanism is critical for the following behavior of the campaign, in order to make it a "crowd" phenomenon. Quality of the project, indeed, captures a key group of backers, which provide a valuable contribution to the campaign capitals and to the campaign's credibility for the following wave of backers.

Even in CF settings driven by altruism and moral return (i.e. social CF projects or donation-based models) success of CF rises for higher-quality projects (Burtch *et al.*, 2013). Thus, the relevance of project quality on campaign's behavior is stably positive (i.e. if project quality rises, then *raised capital* rises) across types of projects.

According to the CLD model (see Figure 10) two reinforcing feedback loops operate and influence the campaign's behavior: R3: skilled crowdfunders and R4: newcomers and bystanders.

5.3.1 R3: skilled crowdfunders support. Crowdfunding campaign's behavior is driven by a share of the platform's audience, with investor attitude, that seeks, compares and ponders the possible alternate campaigns, before to decide. This group of backers is driven by rational analysis of the campaign's likelihood of success (the financial gap and coherence of the target), the project quality (value of the return on funding, idea originality, congruity of the target and quality of project communication), and the founders' worth (namely founders' history and third-party endorsement). The likelihood of success is the main driver of decision for these potential backers, who ponder the platform's value too (i.e. share of the platform's company).

This R3 reinforcing loop is in line with the well-known *Matthew effect*. High-quality projects attract more (skilled) investors/funders, whose investments attract other more funders (Macht and Weatherston, 2014; Xu *et al.*, 2016; Vasileiadou *et al.*, 2016). This reinforcing feedback loop is known as *Matthew effect* (Mollick, 2014).

5.3.2 R4 newcomers and bystanders' support. R4 is a reinforcing feedback loop interconnected with the R3, caused by newcomers and opportunistic lenders (*bystanders*); they cover a part of the capital, when the investment risk is low, while evaluate the return and the financial gap (they take advantage of the financial coverage of the precedents and the reasonable certainty that there will be a last group of lenders who will not miss the opportunity to successfully reach the target).

Allocation of the project's capital must be balanced between the two interconnected R loops, which trace back to the system archetype *success to the successful*. The overallocation of capital to one of these types would produce pathological negative effects. It is necessary to break the link between the two feedback loops, detaching the allocation of capital from the lender's experience.

5.4 Stage 3 – maturity

This stage is characterized by the funding of followers, who put in place a *herding effect* (Beier and Wagner, 2016). A crowd of funders, who rely on the pioneering investments of the skilled funders, crowd the campaign according to the "herding effect" (Beier and Wagner, 2016).

5.4.1 R5 – "herding" effect. This stage's behavior is characterized by a reinforcing feedback loop (*R loop*) (see Figure 11). It exponentially amplifies the initial stimulus *supportiveness of funders' comments* and *raised capital*.

The *capital raised* and the *supportive comments* posted by previous funders on the campaign's web page become new drivers of CF behavior. The campaign's audience, at

this stage, is driven and supported by previous backers' comments. Key signals are then the amount and positivity of comments posted on the campaign's web page and the capital gap. Depending on these two elements, new backers fund the project according to the *herding* effect (Beier and Wagner, 2016), that is they are motivated to participate in a community, to avoid staying aside from a campaign or rather to support an original idea or a certain orientation of the project (e.g. environmental, social, humanitarian and scientific).

This study provided valuable, although preliminary and early, evidence of the theoretical importance of the dynamics of a CF campaign. This study comes to identify the causal foundation of CF campaigns, which makes the underpinning mechanisms of CF behavior. They have been supported and argued by Kuppuswamy and Bayus (2013) who show the existence of dynamics among groups of backers, where *herding* effects take place between early funders and bystanders.

5.5 Managerial implications and limitations of the study

CF campaign causal structure is a theoretical antecedent of CF dynamics, in particular of the trend of *raised capital* over time.

The audience, the funders and ultimately the capital of the campaign, naturally increase or dampen in time, depending on the causal structure. Ignoring the rationale and mechanisms underpinning CF behavior makes it hard to manage it and increase the success ratio of campaigns.

Implications from this study suggest that the allocation of capital among the various stages and types of backers must be balanced; this allows switching smoothly across the stages and the groups of backers, from those starting the capital funding to those closing the campaign. It is also suggested to control the allocations of the capital available for funding, between the groups concurring in the same stage (*start* and *scale-up*) since they interact according to the archetype "*success to the successful*." These system archetypes suggest that the excessive relative allocation of capital to one of the two groups would produce pathological negative effects (i.e. the disappearance of the unsuccessful group). Both groups in both stages, however, are needed to pass all the developmental stages of the campaign, so the existence of a theoretical balance of the funding between the group of backers and a theoretical ratio among the capital raised emerges across the stages.

Alternatively, it is suggested to break the interconnection between the feedback loops, to detach the allocation of capital between groups of funders.

The aforementioned implications are useful for the managers of CF platforms, seeking to increase the performance of the platform; the rise of the overall platform success ratio goes through a higher campaign success ratio. Hence, they should translate the highlighted implications into proper settings and adjustments of platform structures and operational parameters.

Policymakers as well, seeking to foster effective policies in support of CF as an economic flywheel (Harris and Wonglimpiyarat, 2020), can take useful knowledge to bypass the system's resistances, to consider counterintuitive behaviors (Forrester, 1971; Sterman, 2000) and exploit systems' leverage points (Chen *et al.*, 2018).

Despite the perspective and the scope of this study on CF, not circumscribed to just the project and enclosed into a specific model of CF, it is not free of limitations. All the literature sources grounding the model are useful for a preliminary exploration, but a wider and systematic review may provide further elements on the CF structure. Future development of this study line would involve quantitative modeling.

6. Conclusions

This paper, by keeping a holistic, system approach to the CF campaign, contributed to discovering and analyzing the causal structure underpinning the behavior of CF campaigns.

Linking the causal structure with the focal variable *raised capital* over time, we identified and reported the mechanisms by which groups of backers interact and influence each other during the development of the campaign. Motivated by a common goal (fulfilling the target capital) different groups of backers (the direct network, the indirect network, skilled funders, newcomers and bystanders), according to a *system archetypes*' interpretation, compete in the acquisition of shares of the target capital. Both in the *start* and the *scale-up* stages of the campaign overallocation to one of the groups would weaken the other, thus compromising the stage's capital share. This view also suggests the existence of pondered shares of capital across the three stages, whose balanced achievement brings to the concluding *herding effect* reinforcing loop.

The Extant literature mainly focuses on CF projects, with empirical data of single projects and in the boundary of one specific CF model (donation, landing, reward and equity) following that theories and implications for management remain within the descriptive and operational level.

This paper approached a system-level exploration, to provide an understanding of the relationship between causal structure and behavior of CF campaigns; this investigation is useful to prevent unbalances or dampening trends in the capital rising, rather than make funding from backers a self-reinforced cycle. These objectives are keys to addressing agreed diseconomies of CF campaigns (e.g. many CF projects fail, while many others overfund) (Shneor and Vik, 2020; Yang *et al.*, 2015).

On this premise, by the means of a DMB methodology, we come to the causal structure of the CF campaign. It revealed 26 campaign system components and attributes, belonging to six subcomponents with attributes: founder worth, funder worth, project worth, platform quality, platform audience and platform company.

Building a CLD we provided evidence of the complex structure of a CF system. Interactions of feedback loops show the mechanisms underpinning the dynamics of CF. The extant literature is, in contrast, mainly focused on a suboptimal-level analysis.

As stated by Mollick (2014) "*there is substantial value in further studying the dynamics of crowdfunding, since it sheds light on a variety of subjects of interest to academics and policymakers, with implications for entrepreneurial financing, the role of individual quality and networks in venture success, and the importance of geography in new ventures*" (p. 2).

Despite a relatively consistent corpus of literature, the CF theory is in its infancy (Shneor and Vik, 2020): a quantitative orientation of the existent studies and a recursive empirical analysis of data from a few dominant CF platforms reveal that current knowledge is a far from being mature for markets, players, concepts and behavioral patterns (Shneor and Vik, 2020). This paper synthesized and connected results from existing studies, employing qualitative-oriented studies aiming toward theory development and conceptual fine-tuning thus forwarding research according to research directions addressed by Shneor and Vik (2020).

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Appendix

<i>Loop Number 1 of length 2</i>	<i>Loop Number 13 of length 6</i>
The no. of funders/raised capital	The no of Funders/Raised Capital
4. The financial gap	Crowdfunding campaign success
Campaign audience	Platform audience (website visits)
<i>Loop Number 2 of length 2</i>	Campaign audience
The no. of funders/raised capital	2. The founder's social network
9. Supportiveness of funders' comments	Founders' worth
PROJECT WORTH	Project worth
<i>Loop Number 3 of length 2</i>	<i>Loop Number 14 of length 6</i>
The no. of funders/raised capital	The no. of funders/raised capital
Crowdfunding campaign success	1. Funder's preparation and experience
Campaign audience	Funder worth
<i>Loop Number 4 of length 3</i>	1. Effort and specialized knowledge required to operate
The no. of funders/raised capital	Platform quality
4. The financial gap	Platform audience (website visits)
Platform audience (website visits)	Campaign audience
Campaign Audience	<i>Loop Number 15 of length 6</i>
<i>Loop Number 5 of length 3</i>	The no. of funders/raised capital
The no. of funders/raised capital	4. The financial gap
9. Supportiveness of funders' comments	Platform audience (website visits)
Project worth	Campaign audience
Campaign audience	2. The founder's social network
<i>Loop Number 6 of length 3</i>	Founders' worth
The no. of funders/raised capital	Project worth
Crowdfunding campaign success	<i>Loop Number 16 of length 7</i>
Platform audience (website visits)	The no. of funders/raised capital
Campaign audience	1. Funder's preparation and experience
<i>Loop Number 7 of length 4</i>	Funder worth
The no. of funders/raised capital	Crowdfunding campaign success
9. Supportiveness of funders' comments	Campaign audience
Project worth	2. The founder's social network
Platform audience (website visits)	Founders' worth
Campaign audience	Project worth
<i>Loop Number 8 of length 4</i>	<i>Loop Number 17 of length 8</i>
The no. of funders/raised capital	The no. of funders/raised capital
1. Funder's preparation and experience	1. Funder's preparation and experience
Funder worth	Funder worth
Crowdfunding campaign success	Crowdfunding campaign success
Campaign Audience	Platform audience (website visits)
<i>Loop Number 9 of length 5</i>	Campaign audience
The no. of funders/raised capital	2. The founder's social network
1. Funder's preparation and experience	Founders' worth
Funder worth	Project worth

Table A1.
List of 19 feedback loops detected for the CF campaign's CLD model

(continued)

1. Effort and specialized knowledge required to operate	<i>Loop Number 18 of length 8</i>
Platform quality	The no. of funders/raised capital
Campaign audience	1. Funder's preparation and experience
<i>Loop Number 10 of length 5</i>	Funder worth
The no. of funders/raised capital	1. Effort and specialized knowledge required to operate
Campaign audience	Platform quality
2. Founder's social network	Campaign audience
FOUNDERS' WORTH	2. The founder's social network
Project worth	Founders' worth
<i>Loop Number 11 of length 5</i>	Project worth
The no. of funders/raised capital	<i>Loop Number 19 of length 9</i>
1. Funder's preparation and experience	The no. of funders/raised capital
Funder worth	1. Funder's preparation and experience
Crowdfunding campaign success	Funder worth
Platform audience (website visits)	1. Effort and specialized knowledge required to operate
Campaign audience	Platform quality
<i>Loop Number 12 of length 5</i>	Platform audience (website visits)
The no. of funders/raised capital	Campaign audience
4. The financial gap	2. The founder's social network
Campaign audience	Founders' worth
2. The founder's social network	Project worth
Founders' worth	
Project worth	

Table A1.

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