

# A System Dynamics Approach to Designing a Crowdfunding Model in Technological Entrepreneurship Ecosystem with a Focus on Technology Incubator Centers

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## Abstract

Crowdfunding, a new financing method for funding ideas or ventures through a large number of relatively small contributions from many individuals has witnessed the phenomenal development over the past decade. It involves bypassing traditional financial intermediaries and using online web-based platforms to connect users of funds with retail funders. This research first explores in greater detail the crowdfunding phenomenon, discussing its main aspects, as well as the role of the involved Stakeholders, and then introduce the A system dynamics approach to designing a crowdfunding model in technological entrepreneurship ecosystem with a focus on technology incubator centers. The present study is based on the system dynamics method and this research, in terms of the purpose is applied and in terms of the survey method. So for analysis of data, Vensim software has been used. The simulation results show that technological entrepreneurship ecosystem policy combinations can effectively promote crowdfunding, which attracts more entrepreneurs to provide their ideas. So crowdfunding could promote entrepreneurial to give a greater impact on economics, and contribute to building a more sustainable society.

**Keywords:** Crowdfunder; Entrepreneurial Culture; Economic value; Social value; Emergence of new markets

## 1. Introduction

In less than a decade, the way of financial innovation and entrepreneurial initiatives has been dramatically shaped by the emergence of crowdfunding platforms, namely online platforms through which individuals and companies aim at funding their projects by means of open calls, in exchange for rewards, equity, other monetary benefits, or simply an acknowledgment (Belleflamme et al., 2014; Mollick, 2014). The crowdfunding phenomenon has surged so prominently that, according to the World Bank, crowdfunding investments are going to surpass traditional forms of new venture financing, such as venture capital (VC) investments, reaching \$90 billion by 2020 (Barnett, 2015; Greenhalgh, 2016; Scott-Briggs, 2017).

These figures come along with the flourishing of a plethora of platforms, over 2000 globally (Drake, 2016), adopting a variety of different crowdfunding mechanisms across many product/service categories. The rapid growth characterizing this phenomenon and its impressive impact on the economy has been generating an overwhelming interest also in academia. A quick article search on Google Scholar shows that researchers from different fields have started investigating the multi-faceted nature of this phenomenon. As a matter of fact, before 2009, when Kickstarter (one of the major crowdfunding

platforms worldwide) was launched, the term crowdfunding resulted in 425 occurrences on Google Scholar, whereas after nine years it has jumped up to more than 40,000 occurrences. In turn, these figures suggest that, in spite of the recent surge, the body of knowledge on the crowdfunding phenomenon already accumulated in the literature is numerically significant. In addition, the interdisciplinary nature of the search results reveals that the crowdfunding phenomenon has been studied from different perspectives and by means of diverse research methodologies (Burtch et al., 2015; Drover et al., 2017; Mollick, 2014; Roma et al., 2017; Stanko and Henard, 2017).

Access to finance is essential to enhance the competitiveness and growth potential of small and medium enterprises. Crowdfunding is growing in popularity as a new form of both investment opportunity and source of venture capital. Crowdfunding, as the term implies, enables entrepreneurs to fund their capital requirements by means of a large group of investors ('the crowd'), facilitated by crowdfunding platforms on the internet (Mollick, 2013; Belleflamme, Lambert & Schweinbacher, 2013).

Crowdfunding is a new technology-enabled innovation process that is changing the capital market space. Internet-based applications, particularly those related to Web 2.0, have had a significant impact on sectors of society such as

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education, business, and medicine (Alexander, 2006; Andriole, 2010; Giustini, 2006; Lyytinen & Rose, 2003; Wagner & Majchrzak, 2007).

The investors or 'crowd' usually donates small amounts of money in return for a reward depending on the specific crowdfunding initiative employed, except for crowdfunding initiatives that are basically donations and revolve around social responsibility or desirability of the venture (Mollick, 2013; Belleflamme et al., 2013).

Crowdfunding thus involves (a) a large pool of investors (b) investing small amounts of Money (c) to provide funding for a project, (d) facilitated by crowdfunding platforms who act as a financial intermediary (Tomczak & Brem, 2013; Mollick, 2013; Hemer, 2011). Crowdfunding has quickly become a popular avenue of funding for investment, seed money, and start-up funding. The growth rates have been astounding over its short life span (Crowdfunding Industry Report, 2012).

Until the advent of crowdfunding, technology has had little influence on the capital markets in that entrepreneurs and small business was restricted to seeking capital to meet their funding needs through traditional channels shrouded by information asymmetry and personal networks (Shane & Cable, 2002).

One of the hardest things for any small entrepreneur to come with being start-up capital. The vast majority of entrepreneurs have failed to raise venture capital. There are two key reasons for this. First, most entrepreneurs don't qualify for venture capital since they can't scale fast enough, nor do they have the potential for a large enough exit. And second, there are too few venture capitalists versus the masses of entrepreneurs who need money (Lavinsky, 2010). The best possible option for entrepreneurs seeking capital, especially at the earliest stages of their development, is through business angels or angel investment (Ryu, and Kim, 2016).

Typically in the seed capital and early stages, ventures are not developed to the point where they can stand on their own and often are not appealing enough to outside investors to attract venture capital funding. These ventures are in between a stage of potential failure or success.

In addition, the dot.com bust of the early 2000s, along with the economic crisis beginning in 2008 greatly constrained the capital markets, significantly reduced debt financing for small and medium-sized businesses ("Capital remedy", 2013), and curtailed venture capital (VC) financing by over 82 percent between 2000 and 2009 (PricewaterhouseCoopers, 2010) However, this left a large segment of the fund-seekers unserved by current practices. New innovations, such as crowdfunding, emerge in response to these unfilled needs and gaps in services currently provided (Christensen, 2013).

Despite these funding difficulties, or perhaps because of these difficulties, a new process for obtaining capital has emerged in response to the current ineffective institutionalized capital markets (Caldbeck, 2011). Known as crowdfunding, the concept involves using the Internet and the power of the crowd to raise capital in an open and transparent manner. The crowdfunding phenomenon

represents an ICT enabled solution to the constraints and limitations that have arisen from institutionalization and economic pressures in the capital markets. Given the importance of entrepreneurs' and small businesses' role in a strong economy (Acs & Armington, 2006; Audretsch, Keilbach, & Lehmann, 2006; Audretsch & Thurik 2001), understanding the use of technology to overcome many of the current financial constraints in the capital markets is critical to a growing economy (Quero et al, 2017).

Crowdfunding could be one informal financing alternative to close the early-stage gap which represents one of the major obstacles when getting start-up projects off the ground (Hemer, 2011). Crowdfunding as a means to raise funds for micro startups (Pope, 2011). The motivation behind this article is the lack of a coherent article for showing a model for crowdfunding.

## 2. Literature Review

### 2.1. Crowdfunding

Crowdfunding a new financing method for funding ideas or ventures through a large number of relatively small contributions from many individuals have witnessed the phenomenal development over the past decade. Even though the crowdfunding industry is still very young, with the first platform launched in 2008, the annual amount raised through crowdfunding had already reached 64.8 billion USD in 2018 (Massolution, 2018).

These booming figures clearly illustrate the increasing significance of crowdfunding in modern finance and the possibility to overthrow conventional entrepreneurship under the widespread availability of the Internet and social media (Paschen, 2017).

Therefore, there has been considerable interest over the last few years in trying to identify the possible dynamics and determinants of crowdfunding success while crowdfunding is still in the evolutionary phase. So far, signaling quality has been the major focus of the extant literature on crowdfunding success because crowdfunding is characterized by high information asymmetry.

For example, researchers have looked at a project-specific characteristics, such as the use of media, updates, spelling errors, and language used in project descriptions, as signals of crowdfunding project quality (Mollick, 2014; Parhankangas and Renko, 2017). Founder-related signals of quality, including founding experience, capabilities, and skills, have also been examined (Gafni et al., 2018).

As a novel way to fund new ventures, crowdfunding offers a distinct avenue for community-oriented campaigns to acquire financial resources through altruism (Calic and Mosakowski, 2016).

Crowdfunding research in entrepreneurship has proceeded at an increasing pace. While scholars initially sought to describe the overarching phenomenon (Bruton et al., 2015; Mollick, 2014), the field has recently taken a more nuanced approach and begun to investigate specific parts of the process (Short et al., 2017).

In general, this work has sought to identify similarities with traditional investment processes and drawn upon existing theories such as signaling (Lin and Viswanathan,

2016), social capital (Colombo et al., 2015), and legitimacy perspectives (Fisher et al., 2017).

However, the application of such traditional theories in the context of crowdfunding has generally produced mixed results. As a result, a door has been opened for future research focusing on funders' distinctiveness relative to traditional investors (Cholakova and Clarysse, 2015; Davis et al., 2017). Traditional investors, such as angel investors or venture capitalists are typically due-diligence experts (Ahlers et al., 2015).

In contrast, funders are often laypersons, possessing little to no formal investment experience (Davis et al., 2017; Lin et al., 2014; Ordanini et al., 2011). Moreover, funders are also distinct in that they commit relatively small amounts of financial capital and are only rewarded via non-financial incentives, such as the product being funded (Mollick, 2014).

Collectively, these factors highlight the extent to which funders do not invest capital in the traditional sense found in the entrepreneurial resource acquisition literature (Macmillan et al., 1985). As a result, non-traditional theories may need to be incorporated into the entrepreneurial resource acquisition research stream in order to better understand the crowdfunding phenomenon.

## *2.2. Crowdfunding models*

It is possible to represent crowdfunding like a new way for project organizers, entrepreneurs, and startups to raise money for their purposes. Alleviated by the spread of online technologies (and specifically, social media), crowdfunding capitalizes on the many-to-many form of communication that has already opened up new opportunities in industries from e-commerce (e.g., eBay) to accommodation and travel (e.g., Airbnb, Uber).

During the last five years, the size of the crowdfunding market has raised about 23 times (from \$1.5b to \$34.4 b) (Husain & Root, 2015). Overall a distinction can be made between the following four main crowdfunding models (Collins & Pierrakis, 2012; Cornell, 2014; Gajda & Mason, 2013; Mitra, 2012; Steinberg, DeMaria & Kimmich, 2012; Husain & Root, 2015):

1. Donation-based crowdfunding
2. Reward-based crowdfunding
3. Lending-based crowdfunding
4. Equity-based crowdfunding

## *2.3. Crowdfunding Ecosystem*

Understanding who the actors are in the crowdfunding space is important to understand how crowdfunding works. Different participants influence crowdfunding in diverse ways by creating an ecosystem that determines the way the process functions and the practices that are enabled.

A useful way to understand the ecosystem is to identify the stakeholders and their respective influence on the process. Traditionally, a stakeholder refers to "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman,

1984, p. 46) and can be identified as those that have power, legitimacy, and impart a sense of urgency in the organization (Mitchell, Agle, & Wood, 1997).

The purpose of stakeholder theory is to uncover the roles in an organization that goes beyond a focus on upper management and shareholders whose single stake is the mantra "increase shareholder value". A stakeholder approach has been used in contexts outside a profit-centered business to explore the roles and interrelationships in contexts as diverse as e-government (Flak & Rose, 2005), healthcare (King, 2008) and cloud computing (Marston, Li, Bandyopadhyay, Zhang, & Ghalsasi, 2011).

Stakeholders are not isolated groups, but act and interact with each other to create a dynamic environment (Laplume, Sonpar, & Litz, 2008). Using a stakeholder approach, major participants in the crowdfunding ecosystem, including Website Providers, Founders, Backers, Angel/VC Funds/Banks, and Legal/Ethical.

## *2.4. Entrepreneurial ecosystems*

The fundamental ideas behind entrepreneurial ecosystems emerged in the 1980s and 1990s as part of a shift in entrepreneurship studies away from individualism, personality-based research towards a broader community perspective that incorporates the role of social, cultural, and economic forces in the entrepreneurship process (Nijkamp, 2003; Steyaert and Katz, 2004).

Van de Ven (1993), for example, argued that individual entrepreneurs cannot command all the resources, institutions, markets, and business functions that are required to develop and commercialize their entrepreneurial ventures. Popular folklore notwithstanding entrepreneurship is a collective achievement that resides not only in the behaviors of individual entrepreneurs but requires key roles from numerous entrepreneurs in both the public and private sectors to develop an industrial infrastructure that facilitates and constrains innovation.

Works by Pennings (1982), Dubini (1989), Van de Ven (1993), and Bahrami and Evans (1995) developed the concept of an 'entrepreneurial infrastructure' in order to explain the influence regional economic and social factors have over the entrepreneurship process.

Building on previous movements that decentered the individual entrepreneur as the sole locus of value creation, the new contextual turn emphasizes the importance of situating the entrepreneurial phenomenon in a broader context that incorporates temporal, spatial, social, organizational, and market dimensions of context (Zahra, 2007; Zahra et al., 2014; Autio et al., 2014).

An entrepreneurial ecosystem consists of all the infrastructure elements that are required to sustain entrepreneurship in a geographical region. Van de Ven (1993) was one of the first to propose three broad components of an ecosystem (or what he terms an 'infrastructure') for entrepreneurship, including: (1) Institutional arrangements that legitimate, regulate, and incentivize entrepreneurship, (2) public resource endowments of basic scientific knowledge, financing

mechanisms, and pools of competent labor, the market demand of informed consumers for the products and services offered by entrepreneurs, and of course, (3) proprietary business activities that private entrepreneurs provide through R&D, manufacturing, marketing, and distribution functions (Van de Ven, 1993).

### 3. Methodology

The present study is based on the system dynamics method and this research, in terms of the purpose is applied and in terms of the survey method. In system dynamics modeling, the system optimization method first provides a rich image that is the basis of modeling. Based on the systematic methodological dynamics of systems, cause-effect models are formed from theoretical foundations based on observations of the system's behavior and inspired by valid views. To develop a cause and effect model, the dynamic hypothesis that describes the structure of the system is presented, and then a rich image and a macro system of drawing and causal model of the system are explained.

Finally, dynamic modeling is presented by examining different scenarios and practical suggestions. This research, the method describes the steps of the research of a model for designing crowdfunding in technological entrepreneurship ecosystem with a focus on technology incubator centers Using System Dynamics Approach. There are five principal steps to establish an SD model, described as follows.

Step (1): Define the objective of an SD model. The objective of this model is to analyze the crowdfunding by simulating the system, and then determine the effects of technological entrepreneurship ecosystem on crowdfunding because they are related. There by the contractor can choose the optimum condition within the possible range.

Step (2): Identify the model boundary. To explore the behavior mode of crowdfunding under the influence of the entrepreneurship ecosystem. All of the key factors which have impacted crowdfunding. The straight line shows the boundary of the model. Step (3): Screen out the variables. The model variables are selected based on the literature review, the information gathered from the real system, and the interviews conducted by experts.

Step (4): Identify the causal relationship. Shows the feedback loop of crowdfunding model which will be explained in the following paragraph. The system consists of several reinforcing and balancing loops. The dynamic process is defined as an operation loop in crowdfunding.

### 4. Result and Discussion

System dynamics (SD) are usually characterized as the “strategy and policy laboratory” and “social-economic system laboratory” (Wei et al., 2012). SD provides an efficient tool to test the effects of strategies and policies in a complex system, especially for socio-economic systems, which has a logic with limited data (Radzicki, 2011). Figure (1) visualizes the relationship among factors for

Crowdfunding on the technological entrepreneurship ecosystem. It shows the basic relations of the model in system dynamics, which illustrates the basic logic of crowdfunding system. The arrows represent the influence of one factor to another; relations are based on the result of model analysis. In the system dynamics model, Entrepreneur, Crowdfunder and Crowdfunding platform give a positive influence on Value Creation.

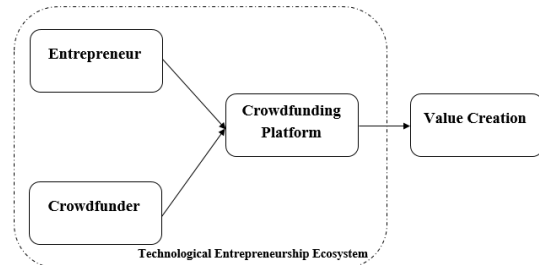


Fig. 1. The basic relations of crowdfunding system in technological entrepreneurship ecosystem

The development of crowdfunding needs technological entrepreneurship ecosystem. Technological entrepreneurship ecosystem may promote crowdfunding activities with policies thus help to solve the problems of Funding entrepreneurial ideas. The development of crowdfunding may help to transfer the economic model and improves the economic value and social value. Based on the research conclusions in economic value and social value, this research develops a model of the crowdfunding system in technological entrepreneurship ecosystem with system dynamics which is shown in Figure (2) this system dynamics model will help us to understand the crowdfunding system in technological entrepreneurship ecosystem.

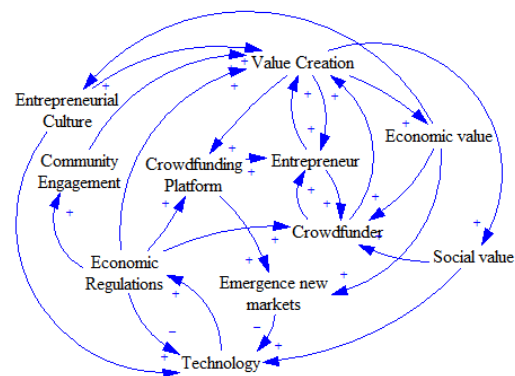


Fig. 2. The crowdfunding system in technological entrepreneurship ecosystem

Figure (2) shows the model of crowdfunding system in technological entrepreneurship ecosystem. The technology uses Economic Regulations and Community Engagement to control and influence the market. The crowdfunding contributes to the Crowdfunding platform between Entrepreneur and Crowdfunder. With financial and intellectual support from Crowdfunder, the Value Creation will be launched rapidly. Value Creation will develop an Entrepreneurial Culture which creates more economic value and social value.

With the development of Entrepreneurial Culture and social value, the Technology performance will be improved. With the complete Economic regulations and Emergence of new markets, Technology will Increase the market intervention. In the general market theory, a mature market is dynamically stable, which implies maximum entry and departure. Otherwise, there are minimum market entry and departure in an emerging market. Crowdfunding platform, Value Creation, and Entrepreneurial Culture development will marginally decline when the scale is close to the maximum.

#### 4.1. Simulation model

The evaluation is a process in which users acquire confidence in the system dynamics model (Richardson et al, 1981). The experience shows that it is very important that the process of model evaluation is conducted in parallel to the development of the model, rather than after the model completion. It means that evaluation of the model should be an iterative procedure conducted during all phases of the simulation model. This is especially important since it is well known that too fast model development is the common beginners' mistake. Most frequently beginners develop whole models in a single stage and conduct evaluation tests only when the model is already finished. This approach cannot guarantee the development of high quality and robust model whose behavior and structure matches reality. Because of the formerly mentioned problem with the use of casual-loop diagrams (causal-loop diagrams obscure the stock and flow structure of systems) we recommend the development of the stock and flow diagram right after the system analysis. Because of all these this research uses several steps for development of the system dynamics model:

1. Development of the basic model
2. Conducting the basic evaluation tests - extreme condition tests, behavior sensibility test, and dimension consistency test
3. Expansion of the model with one or more feedbacks
4. Re-conducting aforementioned evaluation tests for the new version of the model
5. If (a) these tests are not given satisfactory results or if (b) the user on the basis of understanding the system reaches the conclusion that it is necessary to expand the model with new feedbacks, step two is repeated and the whole procedure is continued
6. If the results of the aforementioned tests are satisfied, and the modeler concludes that the model is complete, the other evaluation tests mentioned before are carried out the simulation model is major developments from the prototype in Figure (2) the factors' relations and the numerical relations are derived from statistical analysis and reference. According to the regression analysis of standardized data from technology incubator centers, one unit increment of Crowdfunder will increase 100 units of Raised ( $R=0.736$ , square= $0.541$ ). Combining with the linear regression analysis, transaction-cost and the function of marginal. Figure (3) shows the model of the

crowdfunding in technological entrepreneurship ecosystem.

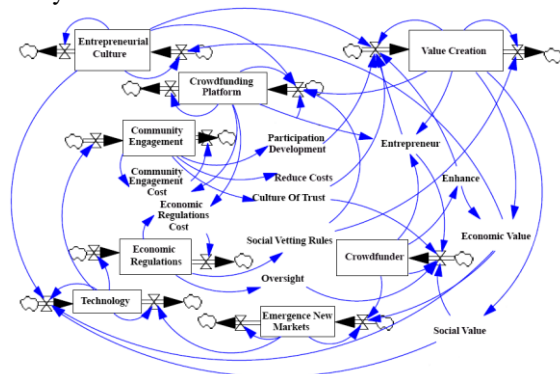


Fig. 3.

Simulation model of crowdfunding model in technological entrepreneurship ecosystem

The equations of the model are:

$$\text{Enhance} = \int_{t_0}^t \text{Crowdfunder, Entrepreneur, platform}(t_0)$$

$$\text{Develop crowdfunding} = \int_{t_0}^t \text{economic value} + \text{social value}$$

Influence the market =

$$\int_{t_0}^t e \text{Economic Regulations} + \text{Community Engagement}$$

$$\text{Entrepreneurial Culture} = \int_{t_0}^t (\text{Value Creation})$$

$$\text{Technology performance} = \int_{t_0}^t (\text{Entrepreneurial Culture} + \text{social value})$$

$$\text{Intervention Technology in market} = \int_{t_0}^t (\text{Economic regulations} + \text{Emergence of new markets})$$

In the simulation model, there are five auxiliaries (Participation Development, Reduce Costs, Culture Of Trust, Social Vetting Rules and Oversight), which denote Technology policies, six auxiliaries (Entrepreneur, Enhance, Economic Value, Social value, Community Engagement cost and Economic Regulation cost) represent the major factors and eight levels (Entrepreneurial Culture, Value Creation, Crowdfunding platform, Community Engagement, Economic Regulation, Technology, Crowdfunder and Emergence of New Markets) display the observations. This system dynamics model has two-floor loops. One loop, the crowdfunding loop includes Crowdfunding platform, Value Creation, Entrepreneur, Enhance and Crowdfunder. The relations built in this loop are based on the formula ( $\text{Enhance} = \int_{t_0}^t (\text{Crowdfunder, Entrepreneur, platform}(t_0))$ ), in this loop, Crowdfunding platform, Crowdfunder and Value Creation have positive influences on Entrepreneur. The entrepreneur has a positive effect on the increasing rate of both Value Creation and Crowdfunder, while Value Creation positively influences the increasing rate of the Crowdfunding platform and two loops, The technological entrepreneurship ecosystem policy loop includes Technology, Economic Regulation, Community Engagement, Community Engagement cost, Economic Regulation cost, Emergence of New Markets, Social value, Economic value, and Entrepreneurial Culture.

Crowdfunding platform, Value Creation and Crowdfunder are the system interaction nodes of the two loops. The relations in the technology entrepreneurship ecosystem policy loop are developed from Figure (2). In the technological entrepreneurship ecosystem loop,



technology decides the increasing rate of Community Engagement and economic Regulation, while the costs (Community Engagement cost and economic Regulation cost) influence the decreasing rate. Three Community Engagement policies (Participation development, Reduce Costs, and the Culture of Trust) are determined by Community Engagement. In the same manner, two Economic regulated policies (Social Vetting Rules and Oversight) are determined by Economic Regulation. Then, the policies influence the crowdfunding loop directly and the related economic value and Social value indirectly.

The Participation Development positive effects on the Crowdfunding platform increasing rate. The Reduce Costs influences the increasing rate of the Value Creation. The Oversight will contribute to increasing the Crowdfunder. The Culture of Trust will encourage the Crowdfunder to support, communicate and inverse, moreover, it also encourages the entrepreneur to set up more Value Creation. On the one hand, Social Vetting Rules offer a better market environment for Crowdfunding platform. On the other hand, it increases the entry criteria which may reduce the number of Value Creation.

Furthermore, Enhance and Value Creation give impact on Economic Value, and in turn influence the Entrepreneurial Culture and Technology. Meanwhile, Value Creation gives impact on Social value which also influences Technology. Based on the Vensim PLE, the model sets the simulation period of 10 years, simulate the technological entrepreneurship ecosystem policy influence of the crowdfunding and the reaction of economic value and social value.

In the simulation model, the technological entrepreneurship ecosystem policies contain Community Engagement policies and Economic regulation policies. Community Engagement policies include Participation Development, Reduce Costs to Value Creation, and Culture of Trust to the public). Economic regulation policies include the Social Vetting Rules of Value Creation and crowdfunding, and Oversight of the Crowdfunder).

The policies cost will reduce the motivation of both Economic regulation and Community Engagement. The Technology has great power to influence the Emergence of New markets, but limited to the public opinions by the government. Thus, the Economic regulation cost is set less than Community Engagement cost as all policies have the same effects. Crowdfunder is the major significant variables that influence crowdfunding's result. Due to financial problems entrepreneurs, it is displayed as only Crowdfunder has a direct impact on Enhance in the simulation model. Rationally, social value and economic value give a positive impact on Crowdfunder.

According to the data analysis algorithm, after examining the fitting of the measurement, structural and general models, we examine the hypotheses of the study by examining the meaningful coefficients Z (T-values) of each of the paths, as well as the standard factor load factors associated with the paths of the research. If the value of the coefficient of each of the paths is more than 1.96, then the corresponding path is confirmed at 95% and 99% confidence level and the related hypothesis is confirmed.

Table 1  
Direct effects, T statistics

Path	T-Value	Path coefficient ( $\beta$ )	Result
Economic Regulations → Crowdfunding platform	8/061*	0.592	confirmed
Economic Regulations → Technology	5/531*	0.662	confirmed
Economic Regulations → Community Engagement	5/362*	0.791	confirmed
Economic Regulations → Technology	13/103	0.743	confirmed
Economic Regulations → Value Creation	11/649	0.663	confirmed
Economic Regulations → Crowdfunder	17/910	0.803	confirmed
Economic Regulations → Community Engagement	14/901	0.532	confirmed
Crowdfunding platform → Emergence of new markets	5.115**	0.549	confirmed
Crowdfunding platform → Entrepreneur	6.287**	0.612	confirmed
Economic Value → Emergence of new markets	5.520**	0.728	confirmed
Economic Value → Crowdfunder	5.757**	0.701	confirmed
Social Value → Crowdfunder	8.298*	0.638	confirmed
Social Value → Technology	32.141	0.563	confirmed
Crowdfunder → Value Creation	28.096	0.623	confirmed
Crowdfunder → Entrepreneur	33.349	0.592	confirmed
Entrepreneur → Value Creation	16.900	0.545	confirmed
Entrepreneur → Crowdfunder	14.691*	0.631	confirmed
Value Creation → Entrepreneur	14.471*	0.674	confirmed
Value Creation → Economic Value	23.373	0.719	confirmed
Value Creation → Social Value	19.151	0.845	confirmed
Value Creation → Crowdfunding platform	5.754**	0.724	confirmed
Entrepreneurial Culture → Value Creation	20.135	0.633	confirmed
Entrepreneurial Culture → Technology	32.523	0.711	confirmed
Economic Value → Entrepreneurial Culture	11.228*	0.602	confirmed
Emergence of new markets → Technology	22.791	0.648	confirmed
Technology → Economic Regulations	14.669*	0.826	confirmed
Community Engagement → Value Creation	12.210	0.753	confirmed

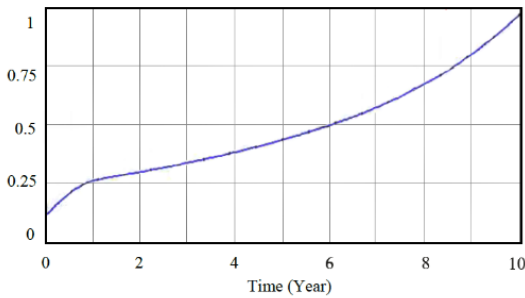
\*Significantly at a 95% confidence level. \*\* Significantly 99% confidence level

According to Table (1) and since the value of the statistic is greater than 1.96, it can be said that all components have a significant and positive effect on each other.

4.2. Simulation results and analysis

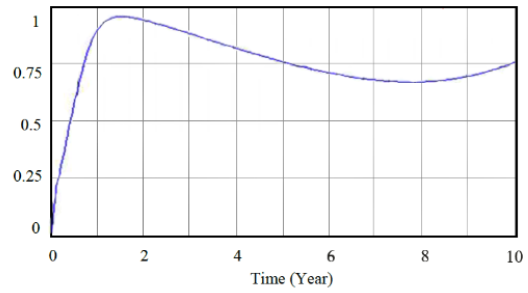
This study aims to suggest a dynamic analysis and illustrate a process of analysis rather than obtain accurate results from scenario analysis. Hence, a basic scenario composed of certain assumptions, and not exact parameters, was constructed, and the other scenarios, such as population growth, regional development policy, and feedback, were developed through altering some part of the assumptions from a basic scenario.

The simulation results are presented in Figures 4 to 8. In these Figures, all observed values are set in the range of 0 to 1. As crowdfunding is an emerging new market, this model sets all the initial values of technological entrepreneurship ecosystem activities to 0.1. For the Technology indicators, the initial value of Technology is 0.1, and the initial value of the policy (Community Engagement and Economic regulation) is 0, which means there is no policy effect at the initial phase. When an observed value achieves the maximum value, it implies that the decision, market, activity, economy or policy is developed or reaching the maximum scale. When the value of observation indicator decreases to the minimum, it implies the recession. In Figure (4) The Entrepreneurial Culture tag represents the development of Entrepreneurial Culture. It denotes the Entrepreneurial Culture develops from the initial to maximum Economic value.



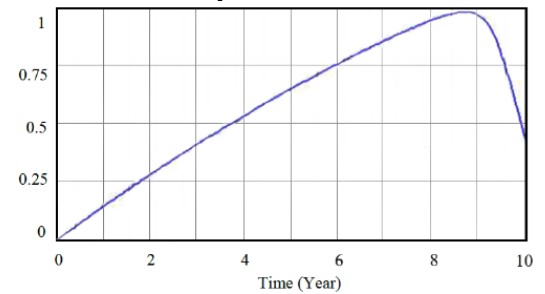
Base Model: Entrepreneurial Culture — Fig. 4. The simulation of the Entrepreneurial Culture

In Figure (5) The Value Creation tag represents the activities of crowdfunding for Value Creation. When this curve reaches 1, it denotes the maximum number of Value Creation funded successfully.



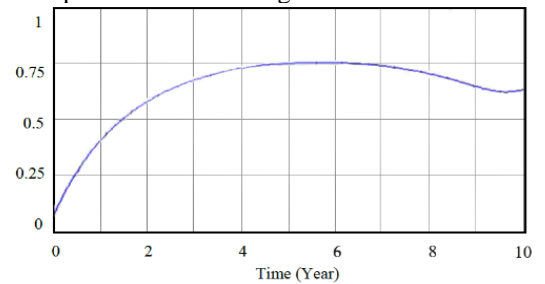
Base Model: Value Creation — Fig. 5. The simulation of the Value Creation

In Figure (6) the crowdfunding platform tag represents the crowdfunding activeness or maturity. When the curve reaches 1, it implies that the crowdfunding is at maximum activeness or maturity.



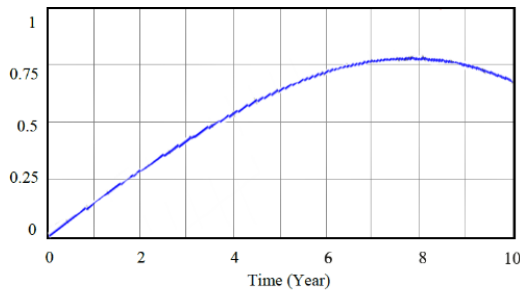
Base Model: Crowdfunding platform — Fig. 6. The simulation of the Value Creation

In Figure (7) The Crowdfunder tag denotes the participation of Crowdfunder. When its value reaches 1, it represents the maximum number of Crowdfunder participate in crowdfunding.



Base Model: Crowdfunder — Fig. 7. The simulation of the Crowdfunder

In Figure (8), the technological entrepreneurship ecosystem Policies tag represents the strength of technological entrepreneurship ecosystem Policies intervention in Crowdfunding, including the sum of Economic regulation and Community Engagement intensity. The technological entrepreneurship ecosystem Policies intervene in the activities under existing Economic regulation at initial phase. Ascending curve denotes an intense intervention and the interventions are reduced when the curve falls.



Base Model: Policies

Fig. 8. The simulation of the technological entrepreneurship ecosystem Policies

In Figures (4 to 8), all five curves keep rising in the first simulation period. In the second period, Value Creation, Crowdfunder and Crowdfunding platform almost reach the maximum scale. Entrepreneurial Culture rises as in a growth social. Moreover, Technology turns up in the second half of the second period. In the third and fourth periods, Value Creation, Crowdfunder and Crowdfunding platform stabilized at the maximum scale. Entrepreneurial Culture rises and almost reaches the maximum scale.

Technological entrepreneurship ecosystem Policies fall and goes to a stable state. In the last period, all the five curves remain stable. So that with the prosperity of the Value Creation activities, the financing demand will increase, and the crowdfunding activities will be prosperous. Crowdfunding will attract more crowdfunders, and the number of crowdfunders will increase more rapidly. When the number of crowdfunders reaches the maximum in the new market, the Value Creation and crowdfunding platform will be advanced developers.

Therefore, Emergence new market power will gradually replace the traditional markets. Eventually, the technological entrepreneurship ecosystem Policies will maintain the basic new market supervision. The policy intensity of economic regulation and Community Engagement has two peak values. It is rationally noticed that the first peak value correspondences to the Value Creation, which also implies the promotion of Value Creation is effective.

Second one related to the Crowdfunder and Entrepreneurial Culture which represents the promotion of the Culture of Trust and the “entrepreneurship and innovation”. With the development of the new markets, the technological entrepreneurship ecosystem Policies will intensify Economic regulation. Economic Regulations implemented in three stages. In the first stage, when the market is emerging. The regulation keeps slack in order to let the market gets more potential ideas and be organizational restructured.

In the second stage, following the development of Value Creation, there would be more and stricter regulations. In the third stage, the market is in the maturity. Crowdfunding will adapt to technological entrepreneurship ecosystem environment and promotion policies become costly-inefficient. Therefore, in order to maintain market stability, the technological

entrepreneurship ecosystem will reduce the promotion and keep a general economic regulation.

## 5. Conclusion

In the last few years, the crowdfunding phenomenon has been booming, becoming a viable opportunity for entrepreneurs, artists and other individuals to get funding for their innovative projects. Particularly, many have started using crowdfunding to raise funds for sustainability-oriented initiatives, given that these types of initiatives face considerable obstacles in raising funding from traditional channels. However, in spite of the rapid accumulation of research contributions on the crowdfunding phenomenon, as well as the increasing relevance of this phenomenon for sustainability-oriented projects, the number of studies investigating the relationship between crowdfunding and dynamic is still scant (e.g., Calic and Mosakowski, 2016; Hörisch, 2015; Vasileiadou et al., 2016). In the attempt to contribute to filling this gap, so this research discussed some important implications of crowdfunding model in technological entrepreneurship ecosystem. Specifically, transferring and tailoring the findings obtained by the general literature on crowdfunding to the context of technological entrepreneurship ecosystem initiatives, this research have developed several theoretical propositions under a comprehensive several-dimension framework, which essentially includes the main actors, the process, and the outcomes of crowdfunding, and thus can be easily understood by researchers.

The presented model in this paper is the first large system dynamics crowdfunding model in technological entrepreneurship ecosystem with a focus on technology incubator centers, and its approach is to analyze how the complicated factors, including Entrepreneur, Entrepreneurial Culture, Value Creation, Crowdfunding platform, Community Engagement, Economic Regulation, Technology, Crowdfunder and Emergence of New Markets and its approach is to analyze how the complicated factors influence the whole system.

From the analysis, this research finds that Public opinion influences the public demand, and further influences the theme of the crowdfunding. In the short term, crowdfunding can contribute to raising funds for entrepreneurial projects. Entrepreneurial ideas come to be a real business. It promotes Community Engagement and makes new markets.

As a result, more crowdfunders would help to launch more crowdfunding and accelerate the development of economic value and social value for Stakeholders. In the long term, crowdfunding could promote entrepreneurial to give a greater impact on economics, and contribute to building a more sustainable society.

Technological entrepreneurship ecosystem policies represented by policy combinations, including Community Engagement policies (Participation Development, Reduce Costs, and the Culture of Trust) and Economic regulated policies (Social Vetting Rules and Oversight) could significantly improve the social



value and economic value within a shorter time. When the market is at the stage of emerging and growth, powerful Community Engagement policies and a complete set of economic regulatory policies are needed. When the market becomes mature, the supervision, maintains fixed. In this paper, the author proposed the analysis of the impact of the creation of economic value has an incremental behavior. The incremental increase in economic and social value results from an increase in the flow of economic and social value creation. It is suggested to survey the effects of government roles in crowdfunding.

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