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Who Can Survive in an ICT-Enabled Crowdfunding Platform?

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Abstract: The importance of socio-technical ecosystems is growing due to the emergence of technology-based platform businesses. However, few researchers have offered theoretical explanations of this phenomenon drawing on the ecosystem perspective. Existing studies on ecosystems have been limited to either natural or social ecosystems and have examined ecosystems as a whole. This study focuses on the survival and evolution of individual participants in the socio-technical ecosystem of a crowdfunding platform. It is hypothesized that adaptability (i.e., intra-role and inter-role exchange) and relationality (i.e., feedback and feed-forward interactivity) are positively related to the amount of funding received and the likelihood of campaign success. Empirical results from regression analysis show that the quality of intra-role and inter-role exchanges determine their influence on funding success. High relationality has a significant, positive influence on the funding received by a campaign. With this insight, this paper lays the groundwork for expanding theoretical research on socio-technical ecosystems.

Keywords: ecosystem; socio-ecological system; socio-technical system; evolution; selection; survival; adaptation; relationality

1. Introduction

Technological platforms play a key role in innovative digital businesses, though only a few of them survive and prosper, while hundreds are born and disappear quickly. These platforms represent socio-technical systems and evolve just like socio-ecological systems [1,2]. The available knowledge of socio-ecological systems provides insight into how platform-centric ecosystems (i.e., Kickstarter, Indiegogo, Crowdfunder) will evolve, and the characteristics of the ecosystem complementors (i.e., participants in the ecosystems) who survive and, in turn, determine the survival and evolution of the platform-centric ecosystem as a whole [3–5].

The ecological perspective assumes an evolutionary process [6,7] in which the focus is on which complementors survive, how, and under what conditions [1,8]. The emphasis is on the social and human factors from the socio-technical systems perspective, due to the importance of the dynamics and changes that result from participating actors' relationships, interactions, and adjustments. The dynamics, by definition, are constantly changing and are often unpredictable. Nonetheless, they shape the system and determine the evolutionary direction.

Research on platform-centric socio-technical ecosystems thus far has focused on comparing ecosystems as a whole and has consisted of macro-level analysis. Although the platform features that affect its survival have received significant research attention [4,9,10], the survival, growth, and evolution of complementors in a socio-technical ecosystem has rarely been a focus of research. This study explores the two critical factors of adaptability and relationality, which influence the survival

of individual actors in an ecosystem, as well as the defining components of these two concepts. Thus, the research questions guiding the study are:

- Which factors affect survival in an ICT-Enabled Platform?
- Do adaptational activities determine survival?
- Do relational activities determine survival?

Whereas past research has been limited to qualitative analysis, this study forges the path for an empirical and quantitative analysis of socio-technical ecosystems by applying the socio-ecological system view and evolutionary framework. The following section builds a foundational understanding of socio-ecological systems, socio-technical systems, evolutionary selection, survival, adaptation, and relationality.

2. Theoretical Background

2.1. Socio-Ecological Systems (SES) vs. Socio-Technical Systems (STS)

The discipline of ecological study has recently started paying critical attention to socio-ecological systems (SES) [1,8,11], though the topic has been broadly researched in the discipline of social and environmental ecology [1,8,12]. The underlying thought regarding SES is that human beings and nature are closely connected; thus, various types of SES can be identified [8]. A socio-ecological system should have resilience, adaptability, and transformability to survive and thrive in a competitive ecological environment [1]. Various SES are engendered by the interaction between humans and nature in contemporary society. Particularly noteworthy studies of SES include those on land degradation by agricultural conversion [13], the dependence of South East Asia's households on coastal resources [8], the losses of fisheries from an oil spill in 1992 on the Malaysian island of Langkawi [14], the mountainous and wetland ecosystems in Papua New Guinea [15], the volatile timber harvest in Orinofo, Idaho, which has affected employment in the town [16], population displacement owing to food insecurity caused by climatic extremes or wars [17], and mangrove loss due to human agriculture and pollution [18].

Now, researchers are extending the boundary of SES to embrace information technology (IT), thus applying the dyadic concept of SES to define the concept of socio-technical systems (STS) [3,5,9,19]. The social implication of technology has been discussed in different disciplines, including sociology [20], ecology [21], economics [22], and management [3]. For instance, capturing the anthropological conception of technology, some scholars define the socio-technical landscape as "a landscape in the literal sense, something around us that we can travel through; and in a metaphorical sense, something that we are part of, that sustains us" [23]. Apple, Google, Amazon, and Kickstarter are all new forms of platform-centric ecosystems that exemplify the process of ecological evolution, but with respect to STS [5,24].

Studies of socio-materiality conceptualize STS as a network of indefinite relationship between tasks and technologies where a technology's fixed materiality could support various tasks, depending on people's intention and goals [19]. This socio-material realization of human goals and the technology's materiality is described as being "constitutively entangled" [25] or "jointly optimized" [26]. STS characterized by socio-materiality share the same features of survival as SES.

2.2. Platform-Centric Ecosystems

The dynamics of technology platforms has been an increasingly important topic in both research and practice [4,27–29]. Armstrong [30] and Rochet and Tirole [29] define technology platforms as multi-sided markets consisting of various types of participants on different sides, such as buyers and sellers [31]. Gawer and Henderson [32] argued that many technology products and services can be regarded as "systems of interdependent components, built around and on top of platforms" (p. 1), which are often constituted of a complex network of firms [10]. From the ecosystem perspective, technology platforms can be considered to be hubs [33], keystones [10], or orchestrators [34,35].

The interrelationship among participants in a platform-centric ecosystem has been analyzed based on organizational theories of interfirm collaboration and alliances [36]. The resource dependency perspective has explored factors of why and when firms interact with each other and form relationships [37]. Dyer and Singh [38] conclude that firms participate in interfirm networks primarily to collect and integrate complementary information and capabilities for the improvement of unresolved issues in their respective organizations, such as innovation, revenues, and market promotion [38]. In addition, the embeddedness perspective views relations of firms as a network of social interactions and investigated the endogenous factors that influence a firm's behavior in a system where firms are linked [31,39].

More recently, a complex networked systems perspective has integrated both the resource-dependency and embeddedness perspective and asserted that networks are complex systems composed of co-evolving actors committed to collaboration and coopetition [10,40]. This perspective emphasizes that the value of complex networks, such as ICT-enabled platforms, is realized through a complex web of relationships among value network actors [31,41,42].

The commonality amongst all the perspectives discussed is that participants in a network, platform, or ecosystem behave cooperatively and develop relationships with others, not only for direct, financial transactions but also to increase their likelihood of long-term survival. By cooperating, individual participants can increase their own competitive advantage.

2.3. Selection and Survival in Platform-Centric Ecosystems

The ecological perspective assumes an evolutionary process. The Darwinian theory of natural selection explains order in the biological world with competition between organisms through the interaction of four processes: Variation, selection, retention, and struggle [43–45]. Research on the evolutionary process has focused on understanding which actors in the ecosystem survive, how, and under which conditions. "Survival of the fittest" is the central concept of natural evolution theory [43]. The environment selects the most adaptive creature, which fits best to it, and eventually, only the selected ones survive to compose and characterize the whole ecosystem. The concept of "survival of the fittest" has not only been applied to natural ecosystems, but also to social and organizational systems, which are constituted by interactions between humans, the environment, and systems [6,7,46].

The natural system view in organizational studies includes different theories such as "social Darwinism" [6], "population ecology of organizations" [47], or "quasi-natural organization science" [48]. These ideas are applied to organizational development and assume that the participating organizations in an ecosystem build social order through well-adopted collaborative behaviors [46]. Various organizational theories advance a process explanation for why and how certain organizations are "selected in" and "selected out" [47,49,50]. Adaptational factors that determine the selection include a balance of exploration and exploitation adaptations [51]. From a population ecology perspective [47], it is the environment that optimizes and selects optimal combinations of organizations depending on whether or not individual organizations are consciously adapting [52].

A focus on selection leads to an emphasis on competition. Selection eliminates the weakest competitors. Some organizational forms presumably fail in environmental circumstances where other forms successfully compete with them for essential resources. As long as the resources that sustain organizations are finite and populations have limited capacity to expand, competition must ensue [47]. At multiple levels in an organism or firm, thousands of Darwinian mechanisms operate over time, whereby competitive pressures create changes in an organism, or organization, via the systematic selection of favored over disfavored entities [48].

However, other theories emphasize cooperation and interaction, rather than competition among participants in populations or ecosystems. From this perspective, evolution must generally be considered as coevolution [48]. Kauffman [44] asserted that "the true and stunning success of biology reflects the fact that organisms do not merely evolve, they coevolve both with other organisms and

with a changing abiotic environment" (p. 237). Organizational scientists now study coevolution at community, firm, and intrafirm levels and have found that coevolutionary effects take place at multiple levels within firms (micro-coevolution), as well between firms and their niche in the market (macro-coevolution). March [53] models the interaction of evolutionary (selectionist) adaptive learning at both the micro level (changes in individual beliefs) and the macro (i.e., firm) level (changes in the organizational code).

In the current study, we argue for a reformulation of the platform ecosystems problem in terms of population ecology and we analyze the micro-level of creators (i.e., businesses) and backers (i.e., investors) as participants in Kickstarter, a crowdfunding site and platform-centric ecosystem. While the macro-level of platform units has been compared and explored in recent research on platform businesses, the process of adaptation and the development of relationality between the actors, which are two factors that are known to determine selection and survival based on environmental conditions, are the focus of this study. Therefore, this research will shed new light on the survival of ecosystems by understanding the behavior of participants within a socio-technical system.

We regard survival as the final stage of campaigns in a crowdfunding platform, which is whether they are successful in funding or not. If it were a natural ecosystem, the participant's life or death would be the measure of survival. In crowdfunding platforms, the success or failure of funding terminates the campaign lifecycle and there is no after-life for the campaign. If they wish to continue campaigning, they must create a new one. Therefore, a campaign, as a unit of analysis in our study, has a final destination, which we operationalized as survival. Here, our research hypotheses have been designed to extract the antecedent factors affecting the campaign's survival, one of which was the interaction between creators and backers.

It is not only the ecosystem that selects which participants will survive; the participants of an organization similarly determine which organization will survive. The organization that facilitates welfare and collaboration of participants will survive and prosper [54]. For instance, among crowdfunding platforms, the creators and backers have multiple choices where they can upload their project to attract investors. The best platform, which most effectively provides creators and backers with what they want, will be selected and sustained. Thus, the platform that supports the adaptability or relationality of participants through governance, policies, or incentives, will be selected. In the next section, we will discuss the two primary factors that determine the selection and survival of complementors in a platform-centric ecosystem, which are adaptability and relationality.

2.4. Adaptability for Selection

Adaptation is a concept with a long history in biology, referring to the ways in which fit is brought about between living systems [43]. Adaptation has also been used in analysis of human and cultural ecology [55,56] to denote aspects of the interaction between social units and their environments [57]. There is a direct relationship between selection and adaptation. Processes involving selection by a population consist of the adaptation of individuals in a population [47]. In organizational science, adaptation might be translated to encompass extreme changes that transform an organization from one form to another, which could result in the new form being selected and the old one being dissolved [47,58]. For instance, when organizations move from "small form" to "large form," the process is indistinguishable from the dissolution ("death") of small organizations and their replacement by the "birth" of large organizations [47].

As Folke et al. [1] asserted, the most critical factors for survival are resilience, adaptability, and transformability. Among the three factors, adaptability is the only one that focuses on the behavior of the actors inside the ecosystem and hence, it is the focus of our study. Adaptability relates to the need for complementors participating in the ecosystem to have the capacity to adapt to the environment. The adaptability of complementors constituting SES is reflected in their capacity to enhance resilience through collective action [1,12]. Adaptability of the system is a function of a diversified group of complementors collaborating at different ecological scales [1,2]. Here, social

networks where participants interact with each other fulfill an important role in facilitating information flows, identifying knowledge gaps, and hence, enabling complementors to adapt to the ecosystem [2]. The role of social networks has intensified in the present era of social network sites (SNS) and this has influenced platform-centric eco-systems such as Kickstarter.

This development of adaptability has the potential to make SES more robust to disruptive change. It allows ecosystem managers to change ecosystem management policies as a result of interactions between complementors, thereby reducing the risk of entering unsustainable and undesirable trajectories [2]. That is, the more actors learn how to adapt and succeed in the ecosystem, the better the ecosystem will evolve. Adaptation could be magnified when actors find that their adaptable behavior is reinforced with incentives and as actors get better at adapting and surviving, the ecosystem itself evolves [12]. The evolved ecosystem will generate or induce adaptive actors and their success or survival, in turn, enriches the ecosystem. This is where selection occurs and ecosystems evolve according to "natural evolution theory" [1].

In our study, we decomposed adaptability into inter-role exchange and intra-role exchange. We choose these exchanges as measures of adaptability based on our consideration of asymmetric power. Asymmetric power in a society is not permanent but is changed by creating balance and making the reverse power relationship possible [22]. The power-dependence relationship between creator and backers can be interchanged. Originally, the backers, who provide finance for the creator to achieve their dream, have the power; but the relationship is reversed when a backer takes on a creators' role and starts their own campaign. This form of role-reciprocity often occurs in crowdfunding platforms. This is discussed in detail in the hypothesis building section.

2.5. Relationality for Selection

The concept of "relationality" is often applied to organizational dynamics [59]. From the relational perspective, self and others are inseparable; they co-evolve [59]. Several organizational models have been developed to explore the simultaneous modifications that occur between an organization and its immediate environment, where the organization is altered by its industry partners, just as its partners are altered by the organization [48,60]. Similarly, the socio-material worldview asserts a relational ontology such that humans, technologies, and other non-humans do not preexist as separate entities with given properties and boundaries, but are enacted and emerge through relations in practice [61]. The importance of relationality in selection and survival in ecosystems is presented in studies of socio-materiality, organizational evolution, buyer-seller relationships, co-opetition, social-exchange theory, and multi-sided markets.

Actor Network Theory (ANT) views relationality such that actors are enacted and brought into being through relations and have no existence outside actor networks, which implies that human actors or technologies "are not given and do not exist in and of themselves," [62] (p. 161) but are continuously enacted by relational effects [62]. In line with ANT, the relational view of socio-materiality [63] views heterogeneous actors as relational effects. The concept of relationality is embedded in the notion of intra-action proposed by Barad [64]. In contrast to interaction, which assumes a form of interchange among independently existing actors (entities), the notion of intra-action denotes emergence and reconfiguration of actor networks within which the properties and boundaries of actors are continually reconstituted [64,65]. From a relational ontology perspective, individual actors are not taken as given and preexisting before entering relations, rather, they "emerge through and as part of entangled intra-relating" [65] (p. 88) and exist only in relations. The properties of actors and their mutual boundaries are enacted in relations, and thus become determinate [61].

The role of relationality has also been asserted in the cooperative relationship of inter-organizational exchange. Traditional exchange theory explains that the parties to a relationship become willing to cooperate when the benefits of cooperation exceed the costs; hence, cooperation is viewed as a means of maximizing economic or psychologic benefits [22]. This study further predicts that information sharing will indirectly benefit the success or growth of the participants in the socio-technical ecosystem.

Although natural selection is commonly conceptualized as a competitive process, which is not compatible with cooperation, Nowak [21] recognized that the selection process of evolution does not only relate to competition, but also to collaboration. Some researchers have directly related concepts from natural evolution to a market context by examining the co-evolutionary forces within and between organizations and their institutional environments, which create an ecology of markets [50,66]. Network theory [20] explains cooperation in terms of the position of the cooperating partners in a network of relationships, in which complementors' adaptability in an ecosystem is determined by the number and strength of the relationships among actors [11]. Hence, this study considers how the number and strength of relationships can be defined in the context of a crowdfunding platform. That is, relationships are analyzed with respect to feedback and feed-forward interactivity. In a socio-technical platform such as Kickstarter, competitors exchange feedback or feed-forward information as much as possible for their visibility, and hence, long-term survival.

3. Hypotheses

3.1. Adaptation as Inter/Intra-Role Exchange

Adaptation means changing based on learning how to fit in an ecosystem. One way to learn how to behave appropriately in an ecosystem is by exchanging roles with the counterpart in an ecosystem [53]. In biological ecosystems, daughters become mothers and predators become prey; in a market ecosystem, sellers become buyers. Merton [67] articulated the role-exchanging phenomena using the concept of "role-set" in which each social status is not just based on one role, but an array of roles. For instance, as people pursue daily activities, they take on a remarkable succession of roles. Within hours, people are likely to be called on to switch back and forth between different roles as students, as roommates, as daughters, as church members, as discussion group leaders, and so on [68].

The ability to change their existing roles in response to dynamics in the ecosystem is a measure of adaptability since the experience of "thinking in the opposite role" gives actors an opportunity to understand how to change their attitude or correct their behavior to resolve conflicts with the counterpart [12]. Behaviors that are appropriate for one role may well be inappropriate for others, and the attitudes of each party in a role are in one way or another affected by the attitudes of other members [67]. Exchanging roles frequently is effective when it enables one party to remember what the other party wants, how they behave, or why they decide in a certain way. They can then apply this knowledge in a conflicting issue to enhance negotiations with the other party [67]. Thus, role-exchanging behavior corresponds to adaptation in an ecosystem. Just as in the case of two symbiotic parties in an ecosystem, interdependent behavior can lead to both actors strengthening their ecological adaptive capability through reciprocity and trust [57].

If individuals are to interact for more than short periods, they must continue to adapt to each other's needs [57]. Social exchange theory explains that when role reciprocity occurs within an organization, it will evolve [69] since one party's effort to adapt to the relationship is reciprocated by the other's in a dyadic relationship [57]. This form of exchange process, in which two or more individuals are simultaneously affected by each other in relatively enduring ways, is an adaptation process [68].

In this study, role-exchange behavior is considered in two ways. The first is intra-role exchange, which is the exchange in the same role. On the Kickstarter platform, it is very common for a creator of one business item to be the creator of another item. A backer can also invest in multiple businesses at the same time or at different times. Therefore, we hypothesize that repeatedly experiencing the same role will give a participant a deeper understanding of the platform and result in adaptive behavior.

The second is inter-role exchange, which is the exchange between different roles in a role-set. It is also a very common behavior on Kickstarter for the creator of a business item to become a backer of another item. The reverse, whereby a backer becomes a creator of their own business, is also common. These are both forms of inter-role exchange. We hypothesize that the experience of the opposite role will give a participant a deeper understanding of the platform and result in adaptive behavior.

Hypothesis 1 (H1). *The more frequently platform participants exchange roles with the same side (intra-role exchange), the more likely the participant will be to survive in the ecosystem.*

Hypothesis 2 (H2). *The more frequently platform participants exchange roles with the opposite side (inter-role exchange), the more likely the participant will be to survive in the ecosystem.*

3.2. Relationality as Feedback and Feed-Forward

In an online crowdfunding platform such as Kickstarter, the platform participants include creators (venture firms), backers (investors), and the governing business platform (Kickstarter). Successful creators are presumed to have frequent interaction with their potential backers and exhibit feed-forward behaviors such as campaigns, updates, comments, and responses to backers' questions. Similarly, they will get more feedback from (potential) backers in response to their feed-forward input. Feed-forward and feedback behavior is a sign of relationality, the second feature identified above as being a determinant of the survival of complementors in an ecosystem. To conduct quantitative analysis on this topic, it is necessary to further clarify how feed-forward and feedback constitute relationality among participants in the STS.

Network externality draws on the presumption that a participant is influenced by others' actions, that is, feedback and feed-forward effects exist in a network or platform. In a buyer-seller relationship, the feed-forward from buyer to seller is "trust" and the feedback from seller to buyer is "commitment" or "non-retrievable investment" [70]. The relational view of organizations argues that an increasingly important unit of analysis for understanding competitive advantage is the relationship between firms, and more specifically, relation-specific assets and knowledge-sharing routines [38,71]. Alliance partners accumulate specialized information, language, and know-how together and this allows them to communicate well, which reduces communication errors, thereby increasing quality and speed to market [38,71,72]. Further, they are able to increase their efficiency as they increase the volume and scope of transactions between partners [38].

The interactivity between actors in a STE occurs by means of information flow, such as feed-forward and feedback. Ecosystems monitor and respond to environmental information flow through social networks and they help create feedback loops for improved management [2,73]. Management of ecosystems is an information-intensive endeavor. It is important to facilitate the flow of information and knowledge from multiple sources in the context of ecosystem management [74]. Social networks in ecosystem management are parts of social memory and enhance an ecosystem's capacity to survive [1].

From the perspective of creators, we divide relationality into two parts, feed-forward interactivity and feedback interactivity, and hypothesize the relationships as follows:

Hypothesis 3 (H3). *The more feed-forward information competitors provide to others, the more likely the participant will be to survive in the ecosystem.*

Hypothesis 4 (H4). *The more feedback competitors are provided from others, the more likely they will be to survive in the ecosystem.*

4. Method

4.1. Data Collection and Variables

We validated our research model using data from the Kickstarter.com crowdfunding platform. Kickstarter provides a digital platform service whereby creators and backers, as platform participants, are matched with one another, so that creators can finance their business idea and backers can receive the reward from creators who successfully finance and implement their idea. Data were collected by web-crawling Kickstarter.com for five months from 16 November 2015 to 28 April 2016. We used the

data to evaluate our hypotheses on the effect of role-reciprocity and feedback/feed-forward interactivity on funding success. The Kickstarter site was crawled every 24 h at 11 o'clock in the evening to ensure that time intervals remained consistent. Information was collected on all current projects by the crawler. The information included updates, rewards, comments, funding amount, and the number of backers.

To test our hypotheses, we sampled both successful and unsuccessful projects that completed funding during the data collection period on Kickstarter.com. Kickstarter only discloses backer information for projects that have more than five backers, so some projects had to be excluded from our data set because backer information was not available. This resulted in a final sample size of 4683 projects that were successfully funded and 10,826 projects that failed to achieve the funding goal but still had more than five backers. The total sample represented each of the 15 product categories offered on Kickstarter. To examine the adaptability of selection in each project, we used crowdfunders' historical behavior as a fundraiser (defined by the number of projects created) and investor (defined by the number of projects backed). Among 15,509 creators, 10,372 had never created a project before and 116 had created more than 10 projects; 12,722 creators had never backed a project before and 170 had backed more than 10 projects. We distinguished successful experiences according to the funding results of each experience (using the variables created_success, backed_success). In addition, the social network activity of a creator (using the variables of SNS and friends, as defined below) was used to infer their overall motivational profile, over and above their direct experience on the funding platform.

As a dependent variable that measured the result of the campaign, we constructed two variables:

1. "Funded" is a ratio of the amount of funding received relative to the goal of the project. Even if a project was not successful in raising enough money to achieve its goal, this measure captures how close the project was to achieving its goal.
2. "Success" is coded as a dummy variable based on Funded, where it is 1 (success) when the funded ratio is higher than 1 and it is 0 (fail) otherwise. As only a successful project receives funds from Kickstarter.com, this indicates whether the creator actually received the funding to pursue their idea.

For each creator, we constructed 6 variables:

1. "Created" is the number of past projects created by a creator on Kickstarter, regardless of whether the project was successfully funded or not. This variable measures the experience of the platform participant in creating projects, which is vital for identifying adaptability of intra-role exchange.
2. "Created_Success" is the number of projects launched by a creator that were successfully funded. Successful experiences infer the "quality" of the creator, which may be a sign of adaptability.
3. "Backed" is the number of projects backed by a creator on Kickstarter, regardless of whether the project was successfully funded or not. This variable measures the project investing experience of the creator, which is important in identifying inter-group adaptability of platform participants.
4. "Backed_Success" is the number of backed projects that were successfully funded. Successful backer experience is inferred as the creator's ability to select qualified projects.
5. "SNS" is whether the creator is active in online social networks, in this case Facebook, which can be used to infer their overall motivational profile in terms of creative behavior. It was coded as 1 if the creator has Facebook page, and 0 otherwise.
6. "Friends" is the number of friends of a creator in the online social network of Facebook.

For each project, we construct four variables for basic information and four variables describing creators' and backers' activity while a campaign is in progress.

7. "Goal" is the overall funding goal of the projects, which can be regarded as a proxy for the level of risk of the project. Prior research has found that projects with a higher goal are at higher risk of not reaching their goals, meaning they are less likely to be successfully funded and projects with larger goals tend to be more ambitious in their product offerings [75,76].

8. "Period" is the duration of the fundraising campaign. A long campaign duration is likely to yield a higher chance of achieving the funding goal.
9. "TotalRewards" is the number of versions of the final product offered as a reward to backers. Rewards offered on Kickstarter take non-monetary forms, ranging from t-shirts and thankyou mementoes to early access to a prototype or finished product. Project creators can customize their own funding levels and corresponding reward categories based on Kickstarter guidelines [75,76].
10. "ind2~ind15" are variables indicating the category to which a project belongs. There are a total of 15 project categories on Kickstarter, ranging from Art to Technology.
11. "TotalUpdates" counts the number of updates communicated by the creator during the campaign. This variable measures the feed-forward interactivity. It captures the creator's motivation to interact with backers. To see a marginal effect, the integer result was squared.
12. "UpdatesLikes" is the total number of "likes" on an update by a creator. Platform participants can click "like" to respond to an update. This measures the feedback interactivity.
13. "CommentsCreator" is the number of comments posted by the creator. This is a second measure of feed-forward interactivity. Typical comments are responses to enquiries made by other platform participants.
14. "CommentUser" is the number of comments posted by platform participants, irrespective of whether they are backing the project. This variable measures feedback interactivity. All platform participants can post comments. Generally, comments are enquiries about the delivery of the product and feedback on the shipped product. Other comments are likely to be suggestions for improvements to the product. Platform participants are also allowed to interact with each other. The number of comments posted by a platform participant measures how active the participant is, not only in backing projects, but also in terms of providing feedback on projects.

Some studies on crowdfunding propose potential endogeneity between the goal and the likelihood of successful funding. Although the goals and the period of projects are predetermined, creators are likely to focus on projects' goals to signal their commitment and entrepreneurial expectations. To control this endogeneity problem, Cumming et al. [77,78] used industry level data for instrumental variables, such as the industry average of Goal. We found endogeneity in ln_Goal, with the log of average of Goal in the same industry. However, we also found endogeneities in Period and TotalRewards, which represent variables predetermined by the creator. The preliminary results lead us to acknowledge the existence of non-observables, which are characterized by industry. Therefore, we employed industry dummies instead of instrumental variables.

The descriptions of the variables are summarized in Tables 1–3 show the descriptive statistics and correlations, respectively.

Table 1. Constructs and corresponding variables.

Construct	Sub-Construct	Variables	Description
Relationality	Interactivity: Feedforward	Total_Rewards	Number of versions of the final product offered as rewards
		Comments_Creator	Number of comments posted by the creator
		Total_Updates	Total number of updates
		Total_Updates^2	Square of Total_Updates integer
	Interactivity: Feedback	Comments_User	Number of comments posted by platform participants
		Updates_Likes	Total number of all likes
Adaptability	Reciprocity: Intra-group	Created	Number of projects created
		Created_Success	Number of successful projects created
	Reciprocity: Inter-group	Backed	Number of projects backed
		Backed_Success	Number of successful projects backed
Control		SNS	Number of connected social networks (Facebook)
		Friends	Number of friends in social networks
		Likes	Number of likes, Y/N
		Period	Total duration of funding
		Goal	Goal amount
Dependent Variables		Success	Indicator for funded ratio above 1
		Ln(Funded)	Log of funded ratio relative to goal of the project

Table 2. Summary of variables.

	Average	Standard Deviation	Range	Max
Funded	153.4	5050.3	363,800.0	363,800.0
Goal	73,037.4	1,771,780.0	152,058,876.2	152,058,877.2
Period	32.8	11.4	61.0	62.0
Created	1.0	2.6	34.0	34.0
Created Success	0.1	0.5	11.0	11.0
Backed	0.4	2.1	32.0	32.0
Backed Success	0.2	0.9	16.0	16.0
Total Rewards	6.3	5.1	67.0	68.0
Comments Creator	0.4	4.8	223.0	223.0
Comments User	4.1	36.4	1000.0	1000.0
Total Updates	1.7	3.4	44.0	44.0
Updates Likes	4.8	35.7	2140.0	2140.0

Table 3. Correlation coefficients of variables.

	Funded	Created	Created Success	Backed	Backed Success	Comments Creator	Comments User	Total Updates	Updates Likes
Funded	1								
Created	0.030	1							
Created Success	0.045	0.409	1						
Backed	0.004	0.120	0.187	1					
Backed Success	0.003	0.113	0.183	0.705	1				
Comments Creator	0.010	0.032	0.038	0.017	0.033	1			
Comments User	0.027	0.042	0.092	0.041	0.057	0.335	1		
Total Updates	0.016	0.073	0.116	0.191	0.207	0.241	0.356	1	
Updates Likes	0.043	0.028	0.070	0.050	0.065	0.236	0.762	0.433	1

4.2. Linear and Logit Regression

To test the adaptability and relationality of platform participants, we apply linear regression and logit regression. Linear regression on ln_Funded enables changes in adaptability and relationality to be measured in terms of the percent change increase in the amount funded relative to the funding goal. This detects how the interaction between the creator and other platform participants increases funding, regardless of whether the final funding goal is actually reached. On the contrary, the logit regression compares successful and failed projects, in terms of receiving funding due to having reached the funding goal. Since only successful projects actually receive funding on Kickstarter.com, the variables that actually increase the probability of successfully generating funding can be identified.

5. Results

In testing Hypothesis 1 regarding the effect of inter-role exchange, the experience of success in funding, rather than the sheer number of projects created, seems to increase the likelihood of funding success. More specifically, the results show that the funding ratio increases 8.2 percent ($p = 0.000$) when the count of the experience of success of a project creator increases by one. This can be interpreted in two ways: First, the project creator's experience of funding success enhances backers' trust and results in a higher willingness to back a project. Second, successful creators created more projects than failed creators, which suggests there may be a self-selection effect. The variable counting the sheer number of projects created by a creator did not have a statistically significant effect on the funding increase. In fact, the evidence suggests that the probability of funding success decreases as the number of campaigns increases ($p = 0.893$). Hence, Hypothesis 1 was partially validated.

Results for Hypothesis 2 showed a similar pattern of partial validation. The sheer number of campaigns backed by a creator did not have a significant effect on the funding ratio or funding success for their campaign at the 5 percent significance level ($p = 0.060$). However, the number of successful projects backed by a creator did have a significant explanatory effect on the funding success of their campaign as a creator ($p = 0.000$). Hence, it can be concluded that extra-role exchange, particularly as a backer of a successful project, does have an impact on the level of funding received and on funding success.

In testing feed-forward interactivity in Hypothesis 3, it was confirmed that the number of updates, as measured by updates and update^2, was positively related to the level of funding received. Both variables were statistically significant in explaining the funding ratio. The first update increased funding by 42.1 percent; however, the marginal effect diminished with every update. Logically, higher values of updates and updates^2 also led to an increased likelihood of funding success. The other measure of feed-forward interactivity, comment_creator, also exemplified a significant, positive explanatory effect on funding. According to Table 4, when a creator posted one comment to the users' reaction to their updates, this was associated with a 0.7 percent increase in funding and increased the likelihood of funding success as well. In sum, Hypothesis 3 was fully supported.

Hypothesis 4 was also fully supported. As update_like increases, which means platform participants are fond of the updates, the funding ratio, and thereby, the likelihood of funding success, increased. Comment_user, the other measure of feedback interactivity, also exemplified a positive relationship with the funding ratio and likelihood of funding success. The effect of comment_user was greater than that of update_like on the funding ratio, which can be explained by the assumption that comment_user is a more active expression of a participant's preference and commitment and thus results in a higher probability of backing. However, while update_like increased the probability of funding success, comment_user was not statistically significant for explaining an increase in funding success. The full results of the analysis are depicted in Tables 4 and 5 below.

Table 4. Linear regression results on ln(Funded).

Ln(Funded)	(1)	(2)	(3)	(4)
ln_GOAL	−0.7468 ***	−0.7438 ***	−0.7597 ***	−0.6819 ***
	(0.0130)	(0.0130)	(0.0129)	(0.0145)
Period	−0.0163 ***	−0.0163 ***	−0.0182 ***	−0.0160 ***
	(0.0017)	(0.0017)	(0.0017)	(0.0020)
TotalRewards	0.1199 ***	0.1214 ***	0.1265 ***	0.1873 ***
	(0.0036)	(0.0036)	(0.0036)	(0.0038)
CommentsCreator	0.0068 **	0.0069 **	0.0081 ***	
	(0.0023)	(0.0023)	(0.0023)	
TotalUpdates	0.4207 ***	0.4197 ***	0.4400 ***	
	(0.0084)	(0.0084)	(0.0082)	
$TotalUpdates^2$	−0.0117 ***	−0.0117 ***	−0.0123 ***	
	(0.0003)	(0.0003)	(0.0003)	
CommentsUser	0.0039 ***	0.0039 ***	0.0044 ***	
	(0.0004)	(0.0004)	(0.0004)	
UpdatesLikes	0.0020 ***	0.0021 ***	0.0023 ***	
	(0.0005)	(0.0005)	(0.0005)	
Created	0.0009	0.0002		0.0110
	(0.0069)	(0.0069)		(0.0078)
CreatedSuccess	0.0823 ***	0.0843 ***		0.1083 ***
	(0.0120)	(0.0121)		(0.0135)
Backed	0.0161	0.0151		0.0572 ***
	(0.0086)	(0.0086)		(0.0096)
BackedSuccess	0.0321 ***	0.0317 ***		0.0758 ***
	(0.0044)	(0.0044)		(0.0049)
SNS	−0.2694 ***			
	(0.0422)			
Fiends	0.0001 ***			
	(0.0000)			
_cons	7.6379 ***	7.5209 ***	7.7293 ***	7.2230 ***
	(0.1277)	(0.1263)	(0.1250)	(0.1410)
ind2~ind15	Yes	yes	yes	yes
Adj R-squared	0.4823	0.4804	0.4725	0.3418
obs	12613	12613	12613	12613

The dependent variable is the natural logarithm of Funded, which is the ratio of the amount of funding received, relative to the goal of the project. Standard errors are in parentheses. ** $p < 0.01$, *** $p < 0.001$.

Table 5. Logit regression results on success.

Success	(1)	(2)	(3)	(4)
ln_GOAL	−0.7394 ***	−0.7425 ***	−0.7410 ***	−0.4623 ***
	(0.0201)	(0.0201)	(0.0196)	(0.0155)
Period	−0.0082 ***	−0.0085 ***	−0.0106 ***	−0.0069 ***
	(0.0023)	(0.0024)	(0.0023)	(0.0020)
TotalRewards	0.1014 ***	0.1027 ***	0.1052 ***	0.1657 ***
	(0.0054)	(0.0054)	(0.0053)	(0.0046)
CommentsCreator	0.0535 ***	0.0700 ***	0.0594 ***	
	(0.0115)	(0.0116)	(0.0115)	
TotalUpdates	0.3775 ***	0.3996 ***	0.3977 ***	
	(0.0139)	(0.0137)	(0.0136)	
$TotalUpdates^2$	−0.0162 ***	−0.0172 ***	−0.0174 ***	
	(0.0007)	(0.0007)	(0.0007)	
CommentsUser	0.0026	0.0017	0.0046 *	
	(0.0021)	(0.0021)	(0.0023)	

Table 5. *Cont.*

Success	(1)	(2)	(3)	(4)
UpdatesLikes	0.0822 ***	0.0801 ***	0.0824 ***	
	(0.0044)	(0.0043)	(0.0043)	
Created	−0.0487 ***	−0.0516 ***		−0.0400 ***
	(0.0100)	(0.0101)		(0.0086)
CreatedSuccess	0.3698 ***	0.3892 ***		0.4492 ***
	(0.0376)	(0.0387)		(0.0367)
Backed	−0.0009 ***	−0.0002 ***		0.0548 ***
	(0.0115)	(0.0116)		(0.0107)
BackedSuccess	0.0175 **	0.0187 **		0.0698 ***
	(0.0066)	(0.0066)		(0.0059)
SNS	−0.3062 ***			
	(0.0567)			
Fiends	0.0002 ***			
	(0.0000)			
_cons	3.6862 ***	3.6331 ***	3.7240 ***	1.8398 ***
	(0.1698)	(0.1684)	(0.1620)	(0.1406)
ind2~ind15	yes	yes	yes	yes
chi2	7781.98	7730.85	7528.2	4277.14
Pseudo R^2	0.4136	0.4109	0.4001	0.2273
obs	15,509	15,509	15,509	15,509

The dependent variable is Success which is coded as a dummy variable based on Funded, where it is 1 (success) when the funded ratio is higher than 1 and it is 0 (fail) otherwise. Standard errors are in parentheses. ** $p < 0.01$, *** $p < 0.001$.

6. Conclusions

This research applied theories from the socio-ecological discipline to explore which factors determined the survival and evolution of technology-based platforms. Hypotheses 1 and 2 were partially supported in that the number of successfully created and backed campaigns was significant in predicting campaign success but the sheer number of campaigns created and/or backed was not. Hypotheses 3 and 4 were fully supported whereby it was clear that feed-forward and feedback were statistically significant indicators of the funding ratio. However, the number of user comments was not statistically significant for explaining overall funding success. Future research could expand on the results presented here to compare the various technology platforms and thereby ascertain whether these results hold in other contexts. This would enhance the research on the evolution of platforms as a socio-technological ecosystem and researchers could continue research on what the pre-requisites of a successful crowdfunding campaign are. The implication for practice is that new entrepreneurs starting a platform business can learn from these findings and develop new economic governance measures accordingly to ensure their platform is a sustainable ecosystem. This study implies that platform participants engaged in feed-forward and feedback, who are more likely to have successful campaigns, are also more likely to contribute to the success of Kickstarter as an ecosystem (as suggested by the evidence on Hypotheses 1 and 2). Parties looking to start a campaign should thus engage in feed-forward and feedback, as evidenced by Hypotheses 3 and 4.

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