



Crowdfunding sustainable products with the product search matrix: niche markets vs. mass markets

Filippo Corsini¹ · Marco Frey¹

Accepted: 9 January 2023
© The Author(s) 2023

Abstract

This exploratory research aims at analyzing the success factors of environmentally sustainable products in crowdfunding campaigns by considering aspects such as the customer needs to be addressed by those products, the technology of those products, and the market targeted (niche vs. mass market).

Original data from creators of environmentally sustainable products in crowdfunding campaigns were collected through a questionnaire and then analyzed with regression analysis and additional descriptive statistics.

Results suggest that crowdfunding platforms are not the most appropriate instrument for addressing completely new customer needs with sustainable products nor for developing completely new technologies as the success of such initiatives is quite low. Moreover, results suggest that sustainable products, developed through crowdfunding platforms, targeted at niche markets are more successful in terms of financing than mass market products. In light of the results achieved, the paper formulates managerial suggestions for project creators in terms of paying attention to selecting the appropriate financing channel in light of the product characteristics.

Keywords crowdfunding · environmental sustainability · sustainable finance · sustainable product development · product design

1 Introduction

Nowadays businesses are becoming quite interested in environmental sustainability strategies; and some companies have begun to implement strategic efforts connected to sustainable product design. Such an approach aims to reduce a product's environ-

✉ Filippo Corsini
filippo.corsini@santannapisa.it

¹ Istituto di Management (Institute of Management), Scuola Superiore Sant'Anna (Sant'Anna School of Advanced Studies), 56127 Pisa, Italy

mental impact throughout its entire lifecycle (from material acquisition to production, use, and end-of-life management) without sacrificing other important product characteristics like quality, functionality, or other technical aspects. Indeed, crucial choices affecting the product's major properties, such as materials utilized, the energy needed, recyclability are made during this phase [1].

Environmentally sustainable products have been increasingly popular in recent years, being widely appreciated by customers [2]. Those are designed with the entire product lifespan in mind, thus addressing environmental concerns related to manufacturing, use, and disposal [1]. The specific objectives of product environmental sustainability can vary according to the products; however, the literature available in this field does identify different aspects that can be addressed. A typology of sustainable products acknowledges products made from low-impact materials. Products in this category are those made with renewable materials or recycled ones [3, 4]. Also products designed by reducing or eliminating components that can be hazardous to the environment belong to this category [5].

Another category of sustainable products comprehends those products with a longer lifespan. Those products are meant to be robust, designed to be modular and upgradeable but also repairable (i.e., the action ensuring that a damaged product can be repaired and used again) or re-manufacturable, (i.e. the industrial process that allows used products to be made useful again by replacing parts or updating) [6–8]. A product can also be placed in this category if it is easily reusable, which indicates that it can be utilized for various purposes in whole or in part [9].

Sustainable products are also those easy to recycle. Products in this category are designed in such a manner that the materials may be easily recycled several times into new ones [10, 11].

Another category of sustainable products acknowledges compostable or biodegradable products [10]. Those products are made of biological or organic components that may be safely returned to the biosphere after use without producing waste [12].

Finally, the last category of sustainable products includes use efficient products. Products in this category show improved efficiency in the usage phase, such as low energy consumption [13]. Also products powered by renewable energy sources like solar or wind power belongs to this category [14]. A use efficient product is also a product that is made for containing the consumption of resources and is also a product for which the material management is optimized for consumables or additional components that are employed during its entire lifecycle [15].

In such a context, crowdfunding (i.e. the mechanism where organizations attempt to undertake a specific project relying on funding collected from other individuals) may provide a large contribution to the development of environmentally sustainable products [16]. In recent years, for instance, crowdfunding platforms were useful instruments to bring to life products able to reduce single-use plastics [17] or products that can be reused many times thus avoiding the generation of waste [18] or even promoting the use of waste or by-products for realizing completely new products [19].

Lack of economic resources indeed represents a relevant barrier to the implementation of sustainable product development strategies, especially in SMEs. Such a barrier seems particularly impacting when developing completely new products

[20]. Moreover, crowdfunding sites enable the pre-ordering of products, which might encourage sales of early-stage products/prototypes and hence provide funds to the company for further developing the product [21].

The research on crowdfunding is quickly gaining momentum; nevertheless, studies evaluating how crowdsourcing has been used to develop environmentally sustainable products are currently under-represented in the literature [16]. This highlights the need of elucidating the key characteristics of the crowdfunding-sustainability relationship, as well as pointing the way forward for future study in this area. In this context, the paper analyses the predictors of success in crowdfunding campaigns for the creation of environmentally sustainable products by exploring their ability to develop completely new technology, their effectiveness in addressing completely new customers' needs, and their market target (niche or mass market). Furthermore, the paper contributes also to the literature about the "wisdom of the crowd" discussing whether the non-expert nature of individual backers can collectively evaluate and identify high-quality projects to be funded.

The originality of the research relies on the fact that data from creators of crowdfunding campaigns were collected with the help of a questionnaire administered in 2022. Those data were analyzed with regression analysis, descriptive statistics and results commented with relevant literature in the field.

Results suggest that crowdfunding campaigns are not the most appropriate tools for developing completely new technologies or addressing completely new needs with sustainable products. Indeed, the success rate of those initiatives is rather low. Results also show that environmentally sustainable products targeted to a niche market are more successful than those targeted to a mass market. In light of the results achieved, the paper formulates some managerial suggestions for project creators in terms of paying attention to selecting the appropriate financing channel in light of the product characteristics and the market targeted.

The paper is organized as follows: the next section provides an overview of the theoretical background presenting: definitions of environmentally sustainable products, the product search matrix, and the distinction between the niche market and mass market. The third section presents how data were collected and treated. The fourth section presents the results and draws implications for sustainability-oriented products using crowdfunding. Finally, in the conclusions, the study's most important contributions are emphasized.

2 Theoretical background and hypotheses development

2.1 The environmental wisdom of the crowd

Reward-based crowdfunding platforms are based on an agreement in which a campaign supporter receives a product in exchange for a cash contribution. In general, reward-based crowdfunding platforms allow supporters to pre-order a product before it becomes accessible to the general public [22]. Most well-known crowdfunding sites, such as Kickstarter and Indiegogo, use a reward-based paradigm to host campaigns [23]. More in detail, project creators on the Kickstarter and Indiegogo

platforms select a timeframe and a minimum financing target for their project. Both platforms follow an “all-or-nothing” rule, which means that project creators only get money if the total amount raised by the end of the campaign is equal to or greater than the campaign’s minimum funding goal decided by the creator at the beginning. Each participant in the crowd must register as a user on the crowdfunding platform since it is necessary to facilitate and regulate the payment of a monetary contribution. Although described as competent and qualified individuals [24], donors may not necessarily need to meet knowledge or solvency requirements [25]. Depending on a person’s social status, personal preferences, or life experiences, they are more or less likely to support a crowdfunding initiative. In general, various social groups are characterized by their openness to innovation, enthusiasm for new ideas, and consequently, their willingness to support new entrepreneurial endeavors at an early stage [26]. The younger generation of digital natives was raised in an environment where information was shared and online transactions were less of a concern. With the number of projects that have previously received financing and the success of those initiatives, more people are likely to join in crowdsourcing as funders [27].

Still, the research on how crowds may evaluate and participate in crowdfunding projects is scant and fragmented. Some research tried to understand whether decisions made by crowds are indeed founded on logical considerations with mixed results. This part of the research generally explores the so-called “wisdom of the crowd” referring to the phenomenon that aggregated individual judgments are often more precise than that of the smartest person in the crowd [28, 29].

For instance, Isenberg [30] supports the fact that crowds are smart only in a very narrow set of conditions as collective irrationality is well-documented. In this instance, the crowd can be prone to several group decision-making errors. The author suggests that crowdfunding is good only for the entrepreneurs and the platforms hosting the campaign; funders simply cannot know enough about the project or the highly complex venture investing process to make informed investment decisions. Similar results were achieved by Chen et al. [31], the authors show that crowds and experts do not agree in a lot of cases; crowds tend to focus on past performance and social engagement while experts, on the other hand, focus on quality.

On the other hand, Mollick and Nanda [32], confronting funding decisions for theatre projects from a panel of national experts and comprehensive data from a crowdfunding platform, support the quality of community feedback through the “wisdom of the crowd” concept, finding significant agreement between the funding decisions of crowds and experts.

Focusing on environmentally sustainable products in light of the general framework just described, it is possible to infer that the decision to fund a completely new technology or a product aiming at addressing completely new customers’ needs could be irrational enough to discourage an expert in this field, but not funders from the crowd. This can be especially true if considering that also intrinsic drivers might motivate a founder to support a crowdfunding initiative, for instance, social incentives such as communal benefits [33]. For instance, Belleflamme et al. [22] support the idea that crowdfunding investors are motivated by other kinds of motivations than professional investors, such as a desire to assist environmental or social causes. Crowdfunding activities nowadays span from supporting cultural businesses to assist-

ing in humanitarian situations, from scientific research to back any type of innovation aimed at breaking down traditional financial investment barriers.

In such context, our research aims also at better understanding if extrinsic drivers, in our case environmental benefits for the society, are driving funders to the “madness of crowd” or if funders are wise enough to make an expert evaluation of those projects and fully understand the risks associated with funding a brand-new technology or a product aiming at addressing completely new customers’ needs.

The next paragraphs frame the research in the current literature and formulate the hypotheses to be tested.

2.2 Success factors in crowdfunding campaigns

Previous research has looked into how specific project characteristics can affect the success of a crowdfunding campaign. There have been studies specifically looking into whether the amount of project information published affects funding success [34, 35]. Other studies [36–38] focused on more broad project parameters including the amount requested or the campaign’s length. Other researchers [39] concentrated on both factors. The success elements of crowdfunding campaigns were also studied with respect to various project types. Cordova and colleagues [40] looked into the success of technology-related initiatives, Beier and Wagner [41] looked into tourism-related projects, and de Larrea and colleagues [42] looked into restaurant crowdfunding success. More recently, Corsini and Frey [43] explored success factors for environmentally sustainable products. Their research explored aspects such as the amount requested, the funding goal, and the duration of the crowdfunding campaign, but also how certain keywords (i.e. sustainable or ecologic) used to describe a sustainable product might impact the success of the project.

The present research aims at delving deeper into the success factors of environmentally sustainable products by considering the product’s characteristics. In more detail, the present research aims to explore if:

- i) addressing completely new customer needs with sustainable products increases the success of the crowdfunding initiative;
- ii) developing a completely new technology for a sustainable product increases the success of the crowdfunding initiative;
- iii) developing an environmentally sustainable product for a niche market increases the success of the crowdfunding initiative.

2.2.1 Using the dimensions of the product search matrix to predict the success of crowdfunding campaigns

The product search matrix was created for developing product ideas leveraging on continuous searching for changing needs in customers and new technology (Fig. 1). In detail, the matrix describes how a company has recognized the customers’ needs a certain product aims at satisfying, and the technology for meeting these needs. Such a matrix has been proposed in 1988 by Nielsen [44] and lately revised by Petersen [45]

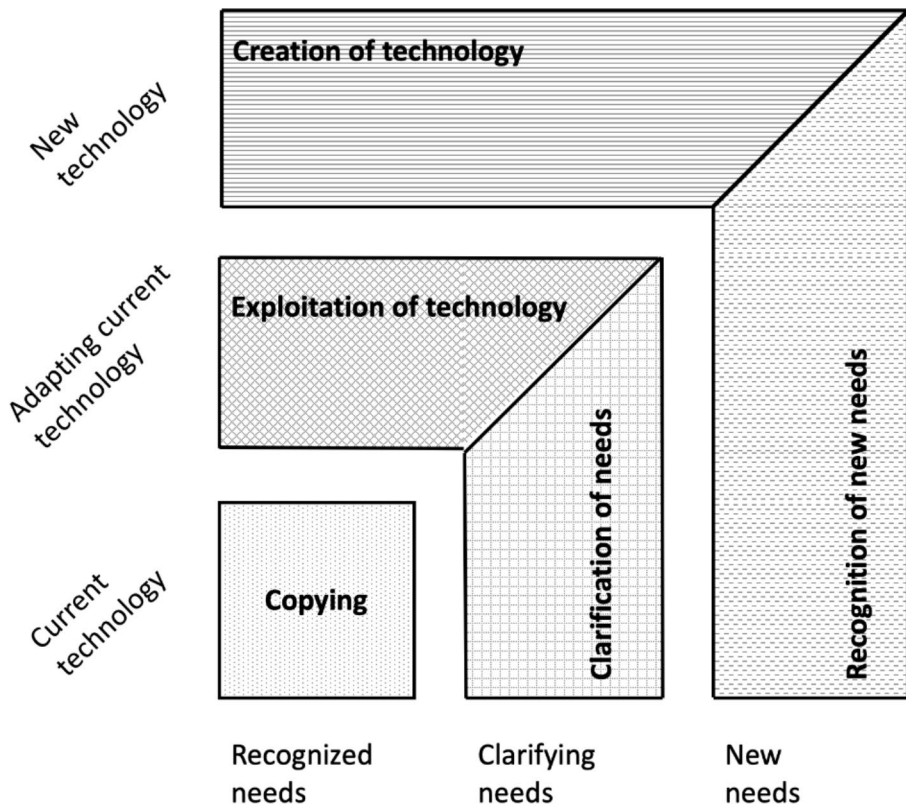


Fig. 1 The product search matrix. (adapted from Nielsen, 1988)

and Petersen & Ryu [46], who explored how market, technology, and design execution risks influence business performance.

According to such a matrix, a product can be developed in several ways. A product can be developed without any changes to the actual technology. In this case, the product is based on a current technology that the company already owns or knows and can get its hands on. In more detail, according to Nielsen [44, p.116] “exploitation of a current technology takes place when a known technology is made use of in a product” or a company “knows about and can get hold of” without substantial changes.

A product can be developed also relying on current technologies but adopting “technological improvements and changes which have appeared in the meantime” [44, p.119]; for instance, by exploiting the increased technological insight which has been obtained in the most recent years. According to Nielsen [44] new technological improvements arise when a product has been on the market for some time, “so that experience accumulated within the parts of the company and in society as a whole” (p.119). An example of a product relying on current technologies but adopting technological improvements and changes that have appeared in the meantime could be represented by a wireless-enabled energy-efficient LED light bulb.

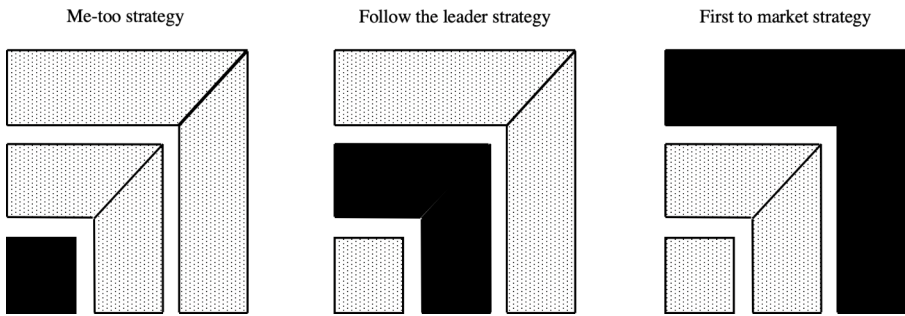


Fig. 2 Different product strategies. (adapted from Nielsen, 1988)

Finally, products can be made out grounding on a completely new technology that has been developed within the product. In this case, according to Nielsen [44, p.116], the “creation of a technology is the result of a research effort which can take place on several levels, typically within a company or in a research institute”. In this context, technologies can include both “new basic physical principles as well as new production processes”.

On the other hand, products can be developed also starting from the customers’ needs that a certain product aims at satisfying. In this case, a product can be developed aiming at addressing customers’ needs that have been already recognized and met before by other products. In general terms, by addressing recognized needs, a company aims at meeting those needs for which a customer is “willing to look for and pay for” [44, p.114].

Products can also aim at clarifying needs. This happens when the product aims at addressing customers’ needs that have already been recognized, but the product’s idea aims at better addressing those needs. (i.e. with new functionalities, materials, sizes, etc.). With the clarification of need, “a series of attributes of the need is determined” Nielsen [44, p.114]. The example made by Nielsen [44] for a clarifying need is represented by a Walkman that is redesigned for better address portability, sound quality, appearance, and weight.

Finally, a product can be developed also for the purpose of realizing needs completely new when a product is aimed at addressing completely new customers’ needs that were not recognized before; this happens when a need “is noticed for the first time” [44, p.114].

According to such a matrix, companies that enact a “first to market” strategy are those that aim at developing products addressing completely new customers’ needs, based on a completely new technology that will be developed with the product.

A different strategy can be called “follow the leader”, such strategy is adopted by companies that have chosen to follow the footsteps of the innovative company, by rapidly introducing products adapting current technologies, and clarifying already recognized customers’ needs. Finally, there is a third strategy of merely imitating competitors’ products without any changes to actual technologies and addressing customers’ needs that have been met before. This strategy takes the name of the “me-too” strategy. The three strategies proposed by Nielsen [44] are depicted in Fig. 2.

Petersen [45] investigated how technology and design execution influenced sixty-one start-ups' operating in Silicon Valley. The author discovered that observed start-ups have success, expressed in terms of a greater funding rate when they are positioned in the central area of the matrix (i.e. relying on the improvement of technology and aims at satisfying customers' needs that have been recognized, but in a better way).

To our knowledge, the development of environmentally sustainable products with crowdfunding has never been investigated by adopting the product search matrix before. There are some research highlighting that crowdfunding platforms might be the right place to address completely new customers' needs [47, 48]. For instance, Guillaud et al. [47] suggest that crowdfunding instruments are the right place to drive completely new customer wants and disrupt the inertia and isomorphism of the traditional video-game industry. A good example of a campaign addressing completely new needs could be represented by Pebble; the company raised, through Kickstarter, \$10 million in orders for a new smartwatch idea in 2012 addressing a customer needs that was never recognized before [49]. So far, no one tried to understand if crowdfunding initiatives addressing completely new customers' needs – i.e. a customers' needs “noticed for the first time” [44, p.114] – with environmentally sustainable products are more successful than those addressing needs that have been recognized and met before by other products; thus, the intent of this research is to fill the gap in the literature by formulating the following hypothesis:

HP1: Addressing completely new needs with sustainable products increases the success of the crowdfunding initiative.

According to Mollick [37] crowdfunding platforms allow people to have early access to a new product or service that is not currently on the market, generally with a high level of innovation built around a unique and new technological application. For instance, Giones & Brem [50] describe a crowdfunding campaign conducted by BSX Athletics for releasing the first hydration monitor band, incorporating a unique and innovative technology into a wearable band, and aiming for the worldwide fitness industry. Also in this case, there are several anecdotal evidence suggesting that crowdfunding platforms are the proper instruments to develop and commercialize completely new technologies including both “new basic physical principles as well as new production processes” [44, p.116]. As no one tried to understand if crowdfunding initiatives adopting a completely new technology for environmentally sustainable products are more successful than those adopting a current technology; thus, the intent of this research is to fill the gap in the existing literature by formulating the following hypothesis:

HP2: Developing a completely new technology for a sustainable product increases the success of the crowdfunding initiative.

2.2.2 Niche markets vs. mass markets

When addressing themes like marketing strategy [51], segmentation, and differentiation [52], the terms “niche market” and “mass market” are commonly employed [53]. Despite their widespread use, however, there is no commonly agreed definition of what a niche market is. Nonetheless, a closer examination of the most common fea-

tures exposes two underlying criteria for a market to be labeled as a niche: specificity and relativity [54]. In other words, the relative specificity of a product is influenced by the number of products with a similar market position. When comparing two complementary products – one aiming at the mass market and the other at the niche market – the product attributes and/or attribute levels of the product targeted to the niche market will create a significantly higher degree of relative specificity. At the same time, there will be a lower product variety in a niche market than in the respective mass market [55].

For the aim of this research, we decided to adopt the definition provided by Schaefer [55, p.1806] that describes a niche product as “more individualized product tailored to the needs of a very specific target group rather than to the mass market”.

Whether a niche market is described as having a tiny market volume, limited competition, or a higher price level, all of these characteristics must be considered in comparison to a counterpart, i.e. a referral market [54]. This counterpart is commonly known as the mass market [56], which refers to a relatively big market sector with little granularity. When comparing two complementary goods, one aimed at the mainstream market and the other at the niche market, the latter’s product qualities and/or attribute levels will result in a much greater degree of relative specificity. At the same time, a niche market will have less product diversity than a mass market.

Literature on niche markets [57] initially labeled all environmentally sustainable products as niche products as the number of environmentally sustainable companies and products was limited. Nowadays environmentally sustainable products can no longer be considered a niche. For instance, Karjalainen and Moxham [58] suggest that sustainable labeled cocoa and coffee, once considered as niche products, are increasingly adopted by market leaders such as Mars and Nestle and thus they can be considered mass-market products. Beltagui et al., [59] suggest another example of a green product that can be considered targeted to the mass market: Fairphone, a smartphone designed for longevity, easy repair, and modular upgrade. The company started from a small batch (initially 5000 units) production targeting a niche market of customers keen on fairer materials usage and better working conditions of the supply chain and became an established phone brand sold by several mobile network operators across Europe [59]. Also, the environmental management literature suggests that environmentally sustainable products as a broad category cannot be considered a niche. Schaltegger [60] and Petersen [61] suggest that environmentally sustainable entrepreneurial activities can be distinguished by the market targeted and can be differentiated between activists, bioneers, and ecopreneurs. Activism is a type of non-professional recreational activity. As a result, the most common organizational structure is a society or an association, rather than a profit-oriented corporation. Bioneers want to be lucrative ventures, yet they operate in market niches, servicing the niche’s specialized client needs. Finally, ecopreneurs run traditional businesses serving mainly mass markets to increase market share.

Considering the aspects mentioned above environmentally sustainable products searching for funding in mainstream crowdfunding platforms can target either a niche market or a mass market. For instance, a 3D printing filament made of recycled material and seeking for funding on a crowdfunding platform can be seen as an example of a niche product [62]. On the other hand, a solar battery [63] or an e-bike [64] are

representations of mass market products. So far, no one has tried to investigate if environmentally sustainable crowdfunding initiatives targeted for a niche market are more successful than those targeted for the mass market; thus, this research intends to fill the gap in the existing literature by formulating the following hypothesis:

HP3: Developing an environmentally sustainable product for a niche market increase the success of the crowdfunding initiative.

3 Methods

3.1 Data collection

In a previous research [43] 3082 campaigns launched on Kickstarter and Indiegogo for developing sustainable products were identified. In such research, in order to track down campaigns aimed at the development of environmentally sustainable products, keywords present in the product description were used to select: low-impact products, long-life products, recyclable products, compostable or biodegradable products, and energy-efficient products or more general sustainable projects.

The 3082 campaigns were targeted with a questionnaire that has been prepared to test the research hypotheses formulated above. In more detail, the questionnaire included several sections; one was aimed at collecting general information about the crowdfunding campaign (i.e. typology of product, the platform used in the campaign, amount requested and received in the campaign). A second section of the questionnaire was aimed at evaluating the product proposed on the crowdfunding campaign according to the two dimensions of the product search matrix (i.e. technology adopted and customer needs to be targeted). In this case, the two dimensions were assessed with the help of a Likert scale containing the options available in the matrix. For both questions (see Appendix 1) possible options were in-depth described and examples were provided. Another section of the questionnaire was aimed at assessing if the projects were targeted to the mass market or a niche market using three potential options, also in this case descriptions and definitions of a niche market and mass market were provided together with examples. Finally, there was also the possibility to provide a link to the crowdfunding campaign for those respondents willing to share this kind of information. The questionnaire used to collect such information is presented in Appendix 1.

The questionnaire was pre-tested with the support of one company that conducted a crowdfunding campaign for developing sustainable products. In more detail, once the questionnaire was ready we asked the company to answer the questionnaire by itself. Later three independent experts (i.e. the authors of the research and a venture capitalist) evaluated both the project (using the project link) and the answers provided by the company responding to the questionnaire. The experts and the company testing the questionnaire agreed on the terms of the technology used, the needs that the product aimed at satisfying, and the market targeted (mass market or niche market).

The questionnaire was administered between November 2021 and March 2022 by email and responses were collected through an online platform. As recommended by Nederhof [65], the anonymity of survey respondents was guaranteed to overcome

Table 1 Descriptive statistics

Platform used in the campaign	Number of projects (n)	Percentage (%)
Kickstarter	76	67.26%
Indiegogo	26	23.01%
Both platforms	11	9.73%
Total projects	113	100%
Project final state	Number of projects (n)	Percentage (%)
Successfully financed	77	68.14%
Not financed	36	32.86%
Total projects	113	100%

Table 2 Descriptive statistics about the typologies of products

Typology of sustainable product	Financed		Not financed		Total	
	Number of projects (n)	Percentage (%)	Number of projects (n)	Percentage (%)	Number of projects (n)	Percentage (%)
Products made from low impact materials (i.e. products made from biological material or recycled material, renewable material, etc.)	36	31.86%	9	7.96%	45	39.82%
Long-life products (i.e. products made for be durable easily repairable, upgradable, modular, reusable, etc.)	26	23.01%	6	5.31%	32	28.32%
Products that are easily recyclable at the end of the lifetime	4	3.54%	4	3.54%	8	7.08%
Products that are easily compostable or biodegradable	7	6.19%	6	5.31%	13	11.50%
Use efficient products (i.e. energy efficient products or products using renewable energy)	4	3.54%	11	9.73%	15	13.27%
Total	77	68.14%	36	31.86%	113	100.00%

social desirability bias; that is, the possibility that respondents will answer more positively.

Considering the 3082 campaigns identified on Kickstarter and Indiegogo was possible to collect contact details (e.g. website and email address) for only 1411 of those campaigns that were emailed the questionnaire, as many of the campaigns resulted not have a website or a contact mail anymore.

A total of 113 subjects completed the questionnaire, accounting respectively for 3.69% of the initial population of 3082 campaigns launched on Kickstarter and Indiegogo and 8.07% of the contactable population.

We used the formula from Dillman [66] to assess the adequate sample size representative of the population (3082 campaigns). According to such a formula, the optimal number of respondents for generalizing a population at a 95% confidence level with $\pm 10\%$ margin of error is 93 respondents. The number of respondents is slightly higher than the one suggested by Dillman's formula and thus there are no concerns about generalizability issues. Descriptive statistics of the respondents are presented in Tables 1 and 2, and Table 3.

Table 3 Descriptive statistics about the market target

Market target	Financed		Not financed		Total	
	Number of projects (n)	Percentage (%)	Number of projects (n)	Number of projects (n)	Number of projects (n)	Percentage (%)
Mass market	40	35,40%	25	22,12%	65	57,52%
Niche market	37	32,74%	11	9,73%	48	42,48%
Total	77	68,14%	36	31,86%	113	100,00%

Table 4 Comparison between the contactable population and the final sample in terms of success rate

	Contactable population		Final sample	
	Number of projects (n)	Percentage (%)	Number of projects (n)	Percentage (%)
Successfully financed	979	69.38%	77	68.14%
Not financed	432	30.62%	36	32.86%
Total	1411	100%	113	100%

Table 5 Comparison between the contactable population and the final sample in terms of the amount requested and the amount received

	Average amount requested	Standard dev. for amount requested	Average amount received	Standard dev. for amount received
Contactable population	\$ 41.448	\$ 108.286	\$ 50.295	\$ 305.493
Final sample	\$ 35.816	\$ 84.521	\$ 62.147	\$ 346.431

In order to assess any bias related to the self-selection process, Tables 4 and 5 show some comparisons between the contactable population and the final sample. In more detail, Table 4 provides a comparison between financed and not financed projects; Table 5 provides a comparison in terms of the amount requested and the amount raised by the projects of the contactable population and in the sample.

Considering the values presented in Tables 4 and 5 and the similarities between the contactable population and the sample, self-selection bias cannot be considered an issue.

3.2 Regression analysis

A logistic regression analysis was performed to assess the assumptions and to better understand the success drivers of sustainable initiatives. Regression analysis examines the correlations between a dependent variable and multiple independent factors, determining if the independent variables have a meaningful relationship with the dependent variables and the relative strength of that relationship.

The hypotheses presented above were tested with two models. In Model 1 independent variables were tested with a logistic regression according to the following equation:

Table 6 Results of the regression analysis

Variables short name	Variables full name	Model 1	Model 2
		Coef. (P>z)	Coef. (P>z)
AREQ	Amount requested	-	-0.00006 (0.029)**
NBAK	Number of backers	-	0.0397 (0.000)***
LENG	Length of the campaign	-	-0.1082 (0.882)
EXP	Past experience	-	0.7274 (0.133)
TECH	Technology adoption	-0.314 (0.117)	-1.0737 (0.139)
NEED	Needs targeted	0.263 (0.199)	0.8014 (0.254)
TARG	Market targeted	0.452 (0.037)**	0.9745 (0.003)**

*** $p < 0.000$; ** $p < 0.05$

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1TECH + \beta_2NEED + \beta_3TARG$$

where,

p =probability of success of the crowdfunding campaign.

TECH, NEED, TARG=Independent variables (for variable full name see Table 6).

$\beta_0, \beta_1, \beta_2, \beta_3$ = Parameters of model

In Model 2, in addition to the variables collected to test the hypothesis (i.e. technology adoption; needs targeted and market targeted), we decided to add several control variables to the model. Those variables were suggested by previous research affirming that these are important factors related to crowdfunding success. In more detail we added as control variables:

- The amount requested in the crowdfunding campaign;
- The number of backers of the crowdfunding campaign;
- The length of the campaign (measured in days);
- Past experience in running a crowdfunding campaign.

In Model 2 then independent variables are tested with a logistic regression according to the following equation:

$$\log\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1AREQ + \beta_2NBAK + \beta_3LENG + \beta_4EXP + \beta_5TECH + \beta_6NEED + \beta_7TARG$$

where,

p =probability of success of the crowdfunding campaign.

AREQ, NBAK, LENG, EXP, TECH, NEED, TARG=Independent variables (for variable full name see Table 6).

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ = Parameters of model

Two variables may be in perfect linear combination with one another in regression analysis. Multicollinearity is a phenomenon that causes the coefficient to become unstable and the standard errors for the coefficient to be exaggerated as the regression model estimates increase. As proposed by O'Brien [67], the presence of collinearity was tested for both models by computing the tolerance and variance inflationary factors (VIFs) for all variables. Multicollinearity was not present in the empirical model, as evidenced by low variance inflation factors and a VIF of less than 5.

4 Results and discussion

The results of the regression analysis are presented in Table 6 for both Model 1 and Model 2. With regards to Model 1, HP1 is not statistically significant ($p > 0.1$) and thus is rejected. HP2 is also not statistically significant ($p > 0.1$) and thus is also rejected. Only HP3 is statistically significant ($p < 0.05$) supporting the fact that developing environmentally sustainable products for a niche market increases the success of the crowdfunding initiative.

With regards to Model 2, the amount requested resulted to be statistically significant ($p < 0.05$) suggesting that an increase in the project funding goal is correlated with a lower probability of success; thus, in line with past research [37, 43]. The second control variable i.e. the number of backers resulted also to be statistically significant ($p < 0.000$). In more detail, the number of backers is a key factor positively affecting funding success as suggested for instance by Zhang & Chen [68]. The third control variable, the length of the campaign did not result to be statistically significant. Such an outcome might reflect the different results reached by the literature available on the topic according to which some research suggests a negative influence of the variable on the success of the project [39] while others [40] do not. The fourth control variable which is represented by the past experience in running a crowdfunding campaign did not result significant also in this case in line with the mixed results reached by the literature in this field of research [69].

With regard to the original hypothesis tested in this research, Model 2 supports the same results obtained for Model 1. In particular, HP1 is not statistically significant ($p > 0.1$) and thus is rejected; in other terms addressing completely new needs with sustainable products does not increase the success probability of the crowdfunding initiative. HP2 is also not statistically significant ($p > 0.1$), alternatively developing a completely new technology for a sustainable product does not increase the success of the crowdfunding initiative. Only HP3 is statistically significant ($p < 0.05$) supporting the fact that developing an environmentally sustainable product for a niche market increase the success of the crowdfunding initiative.

To explore more in-depth the success of environmentally sustainable product initiatives in crowdfunding campaigns, an analysis of the data collected was performed using descriptive statistics showing how the projects were distributed into the clusters identified by the product search matrix (Fig. 3).

Figure 3 shows the distribution of the environmental projects in the product search matrix. In particular, the clusters were created according to the information provided by the respondents in the questionnaire. For each cluster, Fig. 3 shows the number

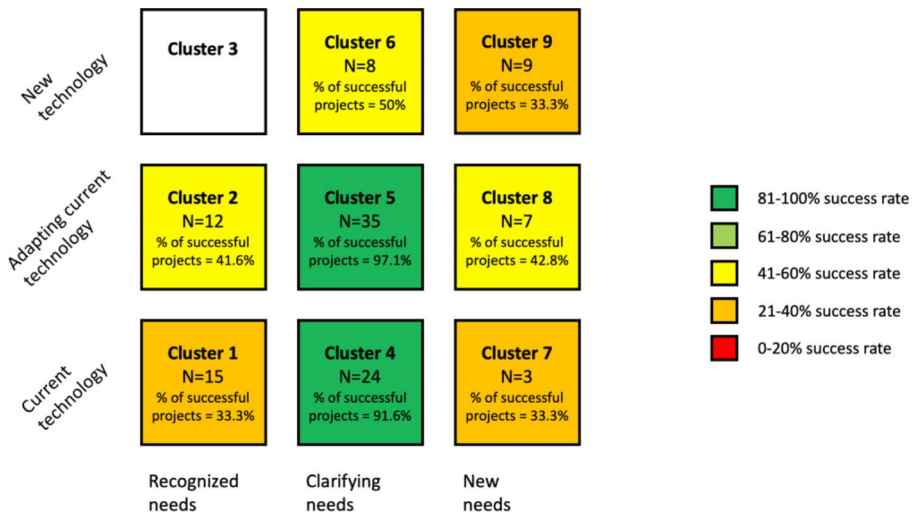


Fig. 3 Project success distribution in the product search matrix

of projects grouped and the success rate for each cluster calculated as the number of successful projects divided by the total number of projects in such cluster. Additional descriptive statistics about the amount requested and the amount received for projects in the 9 clusters are presented in Appendix 2.

As presented in Fig. 3, most of the projects mapped with the questionnaire are allocated in cluster 4 and cluster 5 of the product search matrix (52.21%). Moreover, the success rate in those clusters is the highest compared to the success in all other clusters, being respectively equal to 91.6% for projects in cluster 4 and 97.1% for projects in cluster 5.

Figure 3 thus suggests that the success of crowdfunding campaigns depends on the needs addressed by the environmental product developed in the campaign. In more detail, descriptive statistics suggest that crowdfunding campaigns are more successful when addressing customers' needs that have been recognized, but the product idea is just aimed at better addressing those needs (i.e. with new functionalities, materials, sizes, etc.). This result seems to suggest that the potential of crowdfunding initiatives is under-utilized for developing environmentally sustainable products. In general, technologies facilitating interaction between parts have increased the importance of discovering unmet wants in value creation [70]. In such a context, crowdfunding can work as a mechanism to allow and engage customers to participate in the creative process of new product development, improving the match between product features and customer needs by enabling dynamic interaction between project creators and backers [71, 72]. The quick feedback loop between a project creator and its backers, as well as the continuous upgrades the project creator offers, characterize this approach [73]. However, project creators seem to not benefit from that input and not using much of a discovery-driven product design to turn unmet needs into successful products [74].

On the other hand, descriptive statistics show that the success of a crowdfunding campaign is influenced also by the technological level developed within the product.

In this case, it is possible to infer that both adopting actual technologies or relying on current technologies (but adopting some technological improvements) will result in the highest probability of success of the initiative. Such a result is in line with previous research from Petersen [45], suggesting that to succeed at the upper level of technology, where a completely new technology is developed, a large amount of financial, human, and social capital is required. In other words, also for environmentally sustainable products this part of the market is dominated by well-established companies, making it nearly impossible for crowdfunding projects to compete.

Finally, the results of the regression indicated that developing an environmentally sustainable product for a niche market increases the success of the crowdfunding initiative. The results achieved seem to disagree with Hörisch [75] that analyzed sustainable crowdfunding projects from two German platforms. The author found that most of the projects in those platforms could have been identified as bioneers, thus aiming at being profitable ventures operating in market niches and thus serving the specific customer needs of these niches. The present research, using data directly collected from project creators, seems to suggest a different reality. In more detail, it seems that most environmentally sustainable project creators aim at serving mainly mass markets; however, those targeting niche products are more successful. In such context, individual differences variables should also account for niche product success in crowdfunding environmentally sustainable products. For instance, because niche products are clearly distinguished from mass market alternatives, niche customers may decide to support a crowdfunding environmentally sustainable initiative to also distinguish themselves [76]. Our results are thus in line with the finding suggesting that the project proposer will need to focus on a market niche and address altruistic motives to be successful [77] and that crowdfunding participants are mostly driven away by the monotonous repetition of mainstream projects [78]. Moreover, interpreting the results illustrated in Model 2 (i.e. the significance of the number of backers and the niche market target) we might say that when niche market products have the chance of attracting buyers, this choice sends a stronger quality signal to potential buyers. Somehow niche market products might deeper benefit from popularity information and then generate a sort of bandwagon effect than mass-market products. A similar phenomenon has been suggested for other products commercialized on the internet [79].

In more general terms, the tendency for crowdfunding to serve niche markets products is also visible in the whole crowdfunding environment. Initially, the market was consolidating into a few big players covering general crowdfunding activities (i.e. Kickstarter and Indiegogo). However, as the market matures and the general public becomes more aware of these types of funding mechanisms, platforms with a niche focus are becoming more viable [80]. Sites focused on a certain sector, such as video games, fashion, computer products, or the food business, are able to adapt their services to their target audience and create communities around a shared passion. These customized sites can provide significant competitive advantages over more generic alternatives. Some of these have already begun to surface also in the field of environmentally sustainable products. Indeed, in recent years, new crowdfunding sites have been developed that are designed expressly for hosting such sustainable initiatives. Ecocrowd and Oneplanetcrowd are useful examples.

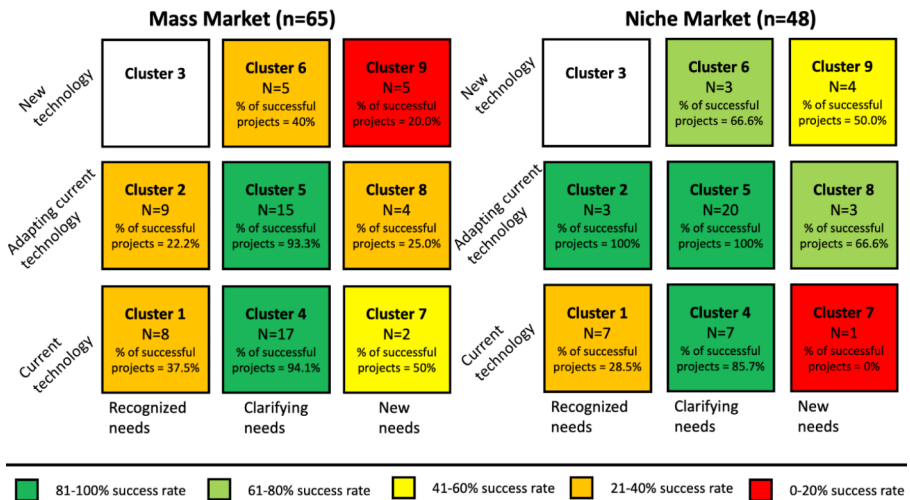


Fig. 4 Project success distribution in the product search matrix for mass market products and niche market products

To further explore the success of environmentally sustainable product initiatives data collected were distributed into two separate product search matrixes one displaying products addressed to the mass market and products addressed to niche markets. Figure 4 presents descriptive statistics dividing projects according to the market targeted (mass market or niche market). In this case, the small sample size results in a high variation in funding success rate, making it difficult to assess whether projects in certain clusters have a higher or lower funding success rate. However, such representation could be a useful tool for illustrating the difference between the mass market and the niche market, presenting some examples of projects filling the questionnaire and inspiring future research avenues. Also, in this case, additional descriptive statistics about the amount requested and the amount received for projects in the 9 clusters for different market targeted are presented in Appendix 2.

The product search matrix for projects targeted to the mass market displays a similar situation presented in Fig. 3 thus suggesting cluster 4 and cluster 5 as the sweet spot for such crowdfunding initiatives targeted to the mass market. An example of an environmentally friendly product targeted for the mass market addressing needs that have been recognized before in a different way and adopting current technologies (cluster 4 – mass-market matrix) might be represented by a pair of sneakers made of discarded materials. Those shoes are made of low-impact materials such as pineapple leaves, apple skin, and other inedible parts of apples. On the other hand, an example of an environmentally friendly product targeted for the mass market addressing needs that have been recognized before in a different way and adapting technologies (cluster 5 – mass-market matrix) might be represented by a reusable menstrual pad successfully financed with a crowdfunding platform. The product represents an example of a long-life product thus easily reusable. In such case, the technology adaptation refers to the increased technological insight which has been obtained in the most

recent years in material science to foster some propriety of such materials to be bacterial proof, to be able to increase the absorption capacity, etc.

The product search matrix for projects targeted to niche markets presents also a slightly different situation than the one presented in Fig. 3. Also, in this case, most of the projects mapped are allocated in cluster 4 and cluster 5 of the product search matrix (56.25%), and also the success rate in such clusters is quite high, being respectively equal to 85.7% for projects in cluster 4 and 100% for projects in cluster 5. An example of an environmentally friendly product targeted for a niche market addressing needs that have been recognized before in a different way and adopting current technologies (cluster 4 - niche market matrix) might be represented by a stone made for steadily releasing beer's carbonation to enhance appearance, aroma, and flavor. The product is designed to be a long-life product easily cleanable and reusable. The nature of the product fits well with the idea that these products might be addressed to market niches serving specific customers.

The product search matrix for projects targeted to niche markets, however, shows that there are several clusters in which the success probability is slightly higher compared to mass-market products. In particular, for projects addressed to niche markets, adapting current technologies either for recognized needs, clarifying needs or addressing completely new needs might translate to a greater success of the initiative. As well, clarifying customer needs with current technologies or with completely new technologies might result in the success of the initiative. In this case, within a niche group, project creators are confined to a certain persona with a specific need inside narrow group [81] which makes it much easier to understand their unmet wants or develop a new technology for a quite specific niche product.

5 Conclusion

The experimental research conducted aimed at analyzing the creation of environmentally sustainable products through crowdfunding platforms by using original data collected from 113 product creators on Kickstarter and Indiegogo. Results suggest that crowdfunding platforms are not the most appropriate instrument for addressing completely new needs with sustainable products nor for developing completely new technologies as the success of such initiatives is quite low. Results show also that environmentally sustainable products targeted to a niche market are more successful in comparison to those targeted to a mass market.

From a managerial point of view, results can serve crowdfunding project creators in supporting their choices of developing environmentally sustainable products. In more detail, given the results presented, project creators can better evaluate according to the product characteristics the appropriate financing channel. In this context, crowdfunding could be seen as a tool for enhancing traditional forms of finance for developing particular environmentally sustainable products.

From a theoretical perspective, the paper introduces also several novelties. Firstly, the research contributes to the academic discussion about the "wisdom of the crowd", in more detail it provides evidence about the understanding of the crowd on risks associated with funding a completely new technology or a product aiming at address-

ing completely new customers' needs. Secondly, the research contributes to enriching the literature on the success factors of crowdfunding campaigns. With this respect, the research suggests that not only the amount of project information provided or other parameters (i.e. the amount requested, the campaign length, etc.) might influence the success of a crowdfunding initiative, but also the characteristics of the products themselves and the market targeted. Finally, the research proposes to use the product search matrix in combination with the analysis of the typology of the market a product is addressed to (mass market or niche market).

Despite the importance of the findings, some limitations must be acknowledged. Firstly, data gathered are self-reported, and so do not represent the outcome of a controlled laboratory experiment. Second, even if we used various precautionary precautions to reduce bias (i.e. confidentially), more quantitative research might be backed up by objective data (where available) to make the analysis and results even more organized. Indeed, even if the questionnaire was tested before the submission some bias can be nested in the way measurements were assessed and questions were presented to respondents. Future research could, for instance, rely on a multiple-item scale for measuring some of the aspects such as niche market and mass market.

Finally, the samples examined represent only a subset of the total number of crowdfunding projects, as a result, the study cannot be considered a comprehensive representation of all crowdfunding activities and issues, and thus future research could test the validity of the findings also for other crowdfunding projects. The findings presented above paved the path for more research in this burgeoning field. Environmentally sustainable products can be seen as projects addressing at the same time both customer's needs and societal needs [82]. Further research can better address the issues connected with societal needs in exploring the success of environmentally sustainable products developed through crowdfunding platforms. A highly perceived need for society might increase the positive feelings of supportiveness concerning the provision of the project outcome to society (or to specific target groups) and thus increase the success probability of the project.

Finally, future research could also focus more on crowdfunding platforms especially created for supporting the development of environmentally sustainable products to better understand the typologies of products that aim to be funded through such platforms and their characteristics.

6 Appendix 1 - questionnaire on crowdfunding sustainable projects

6.1 Introduction

The questionnaire aims at better understanding the development of environmentally sustainable products through the crowdfunding instrument. The questionnaire does not only target successfully financed campaigns but also those who were not successful or suspended.

If you have proposed several campaigns aimed at developing an environmentally sustainable product on crowdfunding platforms, please compile a different questionnaire for each of them.

6.2 Section 1 - general information

1. Which kind of product the crowdfunding campaign was aimed at supporting (choose the most appropriate option)?
 - A product made from low impact materials (i.e. a product made from biological material or recycled material, renewable material, etc.)
 - A Long-life product (i.e. a product made for be durable easily repairable, upgradable, modular, reusable, etc.)
 - A product that is easily recyclable at the end of the lifetime.
 - A product that is easily compostable or biodegradable.
 - A use efficient product (i.e. energy efficient or a product using renewable energy).
 - Other please explain _____.
2. Year of the crowdfunding campaign: [open end question]
3. The project was:
 - Successfully financed.
 - Not financed.
 - Suspended.
 - Other please explain _____.
4. Amount requested in the crowdfunding campaign (in dollars): [open end question]
5. Amount received (in dollars): [open end question]
6. Number of backers: [open end question]
7. Length of the crowdfunding campaign (number of days): [open end question]
8. The crowdfunding campaign was hosted by:
 - Kickstarter.
 - Indiegogo.
 - Both.
 - Other, please explain [open end field].
9. Did you used previously crowdfunding platforms to develop a product (not compulsory an environmentally sustainable product).
 - Yes, please indicate the number of campaigns conducted [open end field].
 - No.

6.3 Section 2 – technology used and needs your product aimed at satisfying

9. Which of the following descriptions of the **technology** used best matches the product launched with your crowdfunding campaign:
- The product was based on current technologies, no changes to actual technologies were made in developing the product.
 - The product was applying current technologies adopting some technological improvements exploiting the increase technological insight which has been obtained in the most recent years (e.g. a wireless enabled energy efficient LED light bulb);
 - The product was based on a completely new technology that has been developed within the product (e.g. a new technology for producing energy, a completely new technical material, etc.).
10. Which of the following **needs** your product aimed at satisfying:
- the product aimed at addressing customers' or users' needs that has been recognized and met before by other products;
 - the product aimed at addressing customers' or users' needs that has been recognized, but the product idea aimed at better addressing those needs (i.e. with new functionalities, materials, sizes, an example could be a jumper made out from recycled material);
 - the product aimed at addressing completely new customers' or users' needs, noticed for the first time, which was not been met before by other products and/or services (e.g. for instance the pebble smartwatch).

6.4 Section 3 – market targeted

11. Which of the following descriptions of the **market targeted** by your product best matches the product launched with your crowdfunding campaign:
- Due to its high degree of relative specificity, the product can be described as a more individualized products tailored to the needs of a very specific target group rather than to the mass market (in other words addressed to the niche market; an example could be a 3d filament made out of recycled material);
 - The product was intended to be bought by as many people as possible, not just by people with a special interest (in other words addressed mass market; an example could be an electric bike or a solar power battery);
 - None of the above; the project could be seen as activism and can be described as a non-professional leisure time activity and therefore was not profit oriented.

6.5 Section 4 – project link

12. Please copy paste the link of the project campaign on Kickstarter or Indiegogo or any other platforms (not compulsory): [open end question]

7 Appendix 2

Descriptive statistics about the amount requested and the amount received for projects in the 9 clusters presented in Fig. 2.

	Average amount request	Standard deviation amount request	Average amount received	Standard deviation amount received	Average amount received / average amount requested
Cluster 1	\$ 10.940	\$ 12.623	\$ 4.533	\$ 8.784	41%
Cluster 2	\$ 56.691	\$ 158.583	\$ 33.401	\$ 81.153	59%
Cluster 3	-	-	-	-	-
Cluster 4	\$ 16.333	\$ 18.804	\$ 32.448	\$ 59.216	198%
Cluster 5	\$ 15.283	\$ 12.572	\$ 180.129	\$ 610.254	1179%
Cluster 6	\$ 101.875	\$ 179.800	\$ 18.562	\$ 25.999	18%
Cluster 7	\$ 74.666	\$ 108.583	\$ 28.333	\$ 40.414	38%
Cluster 8	\$ 15.857	\$ 12.130	\$ 14.850	\$ 16.278	94%
Cluster 9	\$ 125.105	\$ 114.362	\$ 24.786	\$ 40.964	20%

Descriptive statistics about the amount requested and the amount received for projects in the 9 clusters presented in Fig. 3.

Mass Market					
	Average amount request	Standard deviation amount request	Average amount received	Standard deviation amount received	Average amount received / average amount requested
Cluster 1	\$ 7.750	\$ 7.681	\$ 2.963	\$ 3.436	38%
Cluster 2	\$ 72.033	\$ 183.085	\$ 37.942	\$ 94.568	53%
Cluster 3	-	-	-	-	-
Cluster 4	\$ 16.618	\$ 18.095	\$ 39.810	\$ 68.712	240%
Cluster 5	\$ 12.042	\$ 7.414	\$ 20.211	\$ 15.888	168%
Cluster 6	\$ 107.000	\$ 219.790	\$ 7.320	\$ 7.274	7%
Cluster 7	\$ 12.000	\$ 4.243	\$ 20.000	\$ 49.497	167%
Cluster 8	\$ 20.500	\$ 14.387	\$ 15.450	\$ 19.990	75%
Cluster 9	\$ 178.930	\$ 126.995	\$ 16.015	\$ 12.273	9%

Niche Market					
	Average amount request	Standard deviation amount request	Average amount received	Standard deviation amount received	Average amount received / average amount requested
Cluster 1	\$ 14.586	\$ 16.549	\$ 6.329	\$ 12.619	43%
Cluster 2	\$ 10.667	\$ 1.155	\$ 19.778	\$ 8.913	185%
Cluster 3	-	-	-	-	-
Cluster 4	\$ 15.642	\$ 21.945	\$ 16.573	\$ 18.036	106%
Cluster 5	\$ 17.715	\$ 15.095	\$ 300.069	\$ 794.292	1694%
Cluster 6	\$ 93.333	\$ 127.900	\$ 37.300	\$ 37.648	40%
Cluster 7	\$ 200.000	-	\$ 5.000	-	3%
Cluster 8	\$ 9.667	\$ 5.508	\$ 27.383	\$ 35.850	283%
Cluster 9	\$ 57.825	\$ 50.089	\$ 35.750	\$ 63.131	62%

Funding Open access funding provided by Scuola Superiore Sant'Anna within the CRUI-CARE Agreement.

Declarations

Conflict of interest The authors state that there is no conflict of interest.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

1. Handfield, R. B., Melnyk, S. A., Calantone, R. J., & Curkovic, S. (2001). Integrating environmental concerns into the design process: the gap between theory and practice. *IEEE Transactions on Engineering Management*, 48(2), 189–208.
2. Bhamra, T., & Lofthouse, V. (2007). *Design for sustainability: a practical approach*. Gower Publishing, Ltd.
3. Mestre, A., & Cooper, T. (2017). Circular product design. A multiple loops life cycle design approach for the circular economy. *The Design Journal*, 20(sup1), S1620–S1635.
4. Shogren, R., Wood, D., Orts, W., & Glenn, G. (2019). Plant-based materials and transitioning to a circular economy. *Sustainable Production and Consumption*, 19, 194–215.
5. Bodar, C., Spijker, J., Lijzen, J., Waaijers-van der Loop, S., Luit, R., Heugens, E., & Traas, T. (2018). Risk management of hazardous substances in a circular economy. *Journal of Environmental Management*, 212, 108–114.
6. Guide, V. D. R. Jr. (2000). Production planning and control for remanufacturing: industry practice and research needs. *Journal of operations Management*, 18(4), 467–483.
7. Linton, J. D., & Jayaraman, V. (2005). A framework for identifying differences and similarities in the managerial competencies associated with different modes of product life extension. *International journal of production research*, 43(9), 1807–1829.

8. Jayaraman, V. (2006). Production planning for closed-loop supply chains with product recovery and reuse: an analytical approach. *International Journal of Production Research*, 44(5), 981–998.
9. Bocken, N. M., De Pauw, I., Bakker, C., & Van Der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, 33(5), 308–320.
10. McDonough, W., & Braungart, M. (2010). *Cradle to cradle: remaking the way we make things*. North point press.
11. Geyer, R., Kuczenski, B., Zink, T., & Henderson, A. (2016). Common misconceptions about recycling. *Journal of Industrial Ecology*, 20(5), 1010–1017.
12. Clark, J. H., Farmer, T. J., Herrero-Davila, L., & Sherwood, J. (2016). Circular economy design considerations for research and process development in the chemical sciences. *Green Chemistry*, 18(14), 3914–3934.
13. Herring, H., & Roy, R. (2007). Technological innovation, energy efficient design and the rebound effect. *Technovation*, 27(4), 194–203.
14. Boks, C., & McAloone, T. C. (2009). Transitions in sustainable product design research. *International Journal of Product Development*, 9(4), 429–449.
15. Söderholm, P., & Tilton, J. E. (2012). Material efficiency: an economic perspective. *Resources conservation and recycling*, 61, 75–82.
16. Petruzzelli, A. M., Natalicchio, A., Panniello, U., & Roma, P. (2019). Understanding the crowdfunding phenomenon and its implications for sustainability. *Technological Forecasting and Social Change*, 141, 138–148.
17. Kickstarter (2019). LastSwab - The Reusable Cotton Swab. Available at: <https://www.kickstarter.com/projects/193289139/lastswab-the-reusable-cotton-swab/description> Accessed on the 12 Dec 2022
18. Kickstarter (2016). The Everlast Notebook. Available at: <https://www.kickstarter.com/projects/rock-etbook/everlast> Accessed on the 12 Dec 2022
19. Kickstarter (2020). Sneakers, sustainable & cruelty free, from fruit waste Available at: <https://www.kickstarter.com/projects/id-eight/sneakers-sustainable-and-cruelty-free-from-fruit-waste> Accessed on the 12 Dec 2022
20. Ortas, E., Burritt, R. L., & Moneva, J. M. (2013). Socially responsible investment and cleaner production in the Asia Pacific: does it pay to be good? *Journal of Cleaner Production*, 52, 272–280.
21. Roma, P., Petruzzelli, A. M., & Perrone, G. (2017). From the crowd to the market: the role of reward-based crowdfunding performance in attracting professional investors. *Research Policy*, 46(9), 1606–1628.
22. Belleflamme, P., Lambert, T., & Schwienbacher, A. (2014). Crowdfunding: tapping the right crowd. *Journal of Business Venturing*, 29(5), 585–609.
23. Marchegiani, L. (2018). From mecenatism to crowdfunding: Engagement and identification in cultural-creative projects. *Journal of Heritage Tourism*, 13(2), 143–151.
24. Howe, J. (2008). *Crowdsourcing*. New York: Crown Publishing Group.
25. Schenk, E., & Guittard, C. (2009, December). Crowdsourcing: What can be Outsourced to the Crowd, and Why. In Workshop on open source innovation, Strasbourg, France (Vol. 72, No. 3).
26. Rogers, E. M. (2003). *Diffusion of innovations (Fifth Edition)*. New York: Free Press.
27. Brabham, D. C. (2008). Crowdsourcing as a model for problem solving: an introduction and cases. *Convergence*, 14(1), 75–90.
28. Hogarth, R. M. (1978). A note on aggregating opinions. *Organizational behavior and human performance*, 21(1), 40–46.
29. Surowiecki, J. (2005). The wisdom of crowds. Anchor.
30. Isenberg, D. (2012). “The Road to Crowd funding Hell”, Harvard Business Review,, Viewed 10 april 2022.
31. Chen, L., Xu, P., & Liu, D. (2015). *Experts versus the crowd*. A Comparison of Selection Mechanisms in Crowdsourcing Contests.
32. Mollick, E., & Nanda, R. (2016). Wisdom or madness? Comparing crowds with expert evaluation in funding the arts. *Management science*, 62(6), 1533–1553.
33. Belleflamme, P., Lambert, T., & Schwienbacher, A. (2010, June). Crowdfunding: An industrial organization perspective. In Prepared for the workshop Digital Business Models: Understanding Strategies’, held in Paris on June (pp. 25–26).

34. Mitra, T., & Gilbert, E. (2014). The language that gets people to give: Phrases that predict success on kickstarter. In: Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing (pp. 49–61).
35. Xiao, S., Tan, X., Dong, M., & Qi, J. (2014). How to Design Your Project in the Online Crowdfunding Market? Evidence from Kickstarter. In: Proceedings of the Thirty Fifth International Conference on Information Systems, Auckland: Australia.
36. Etter, V., Grossglauer, M., & Thiran, P. (2013). Launch hard or go home! Predicting the success of Kickstarter campaigns. In: Proceedings of the first ACM conference on Online social networks (pp. 177–182).
37. Mollick, E. (2014). The dynamics of crowdfunding: an exploratory study. *Journal of business venturing*, 29(1), 1–16.
38. Chen, M., Liu, Z., Ma, C., & Gong, X. (2019). A distinctive early bird price in reward-based crowdfunding. *Electronic Commerce Research* 1–24.
39. Koch, J. A., & Siering, M. (2019). The recipe of successful crowdfunding campaigns. *Electronic Markets*, 29(4), 661–679.
40. Cordova, A., Dolci, J., & Gianfrate, G. (2015). The determinants of crowdfunding success: evidence from technology projects. *Procedia-Social and Behavioral Sciences*, 181, 115–124.
41. Beier, M., & Wagner, K. (2014). Crowdfunding Success of Tourism Projects-Evidence from Switzerland. Available at SSRN 2520925.
42. de Larrea, G. L., Altin, M., & Singh, D. (2019). Determinants of success of restaurant crowdfunding. *International Journal of Hospitality Management*, 78, 150–158.
43. Corsini, F., & Frey, M. (2021). Exploring the development of environmentally sustainable products through reward-based crowdfunding. *Electronic Commerce Research*, 1–25.
44. Nielsen, H. J. (1988). Systematic search for product ideas. *Creativity and Innovation: towards a European Network* (pp. 111–126). Dordrecht: Springer.
45. Petersen, S. I. (2015). Design Driven Startups. In DS 80 – 3 Proceedings of the 20th International Conference on Engineering Design (ICED 15) Vol 3: Organisation and Management, Milan, Italy, 27-30.07.15 (pp. 143–152).
46. Petersen, S. I., & Ryu, H. B. (2015). Gamification in concept design: applying market mechanisms to enhance innovation and predict concept performance. *Journal of Design Business & Society*, 1(1), 95–110.
47. Guillaud, R., Hänninen, R., Mariot, P., & Perret, E. (2013). *Crowdfunding and the video-games industry* (p. 95). Industry Evolution.
48. Allen, J. P. (2019). *Digital entrepreneurship*. Routledge.
49. Riedel, J. (2013). Crowdfunding technology innovation. *Computer*, 46(03), 100–103.
50. Giones, F., & Brem, A. (2019). Crowdfunding as a tool for innovation marketing: Technology entrepreneurship commercialization strategies. In Handbook of Research on Techno-Entrepreneurship, Third Edition. Edward Elgar Publishing.
51. Porter, M. E. (1980). Competitive strategy: Techniques for Analyzing Industries and Competitors.
52. Carpenter, G. S., & Nakamoto, K. (1996). Impact of consumer preference formation on marketing objectives and second mover strategies. *Journal of Consumer Psychology*, 5 No(4), 325–358.
53. Dibb, S., & Simkin, L. (1991). Targeting, segments, and positioning. *International Journal of Retail & Distribution Management*, 19 No(3), 5–10.
54. Toften, K., & Hammervoll, T. (2013). Niche marketing research: status and challenges. *Marketing Intelligence & Planning*, 31 No(3), 272–285.
55. Schaefers, T. (2014). *Standing out from the crowd: niche product choice as a form of conspicuous consumption*. European Journal of Marketing.
56. Dalgic, T., & Leeuw, M. (1994). Niche marketing revisited: concept, applications and some european cases. *European Journal of Marketing*, 28 No(4), 39–55.
57. Peattie, K., Ottman, J., Polonsky, M., & Charter, M. (2002). Marketing and sustainability.
58. Karjalainen, K., & Moxham, C. (2013). Focus on Fairtrade: propositions for integrating Fairtrade and supply chain management research. *Journal of business ethics*, 116(2), 267–282.
59. Beltagui, A., Kunz, N., & Gold, S. (2020). The role of 3D printing and open design on adoption of socially sustainable supply chain innovation. *International Journal of Production Economics*, 221, 107462.
60. Schaltegger, S. (2005). A framework and typology of ecopreneurship: Leading bioneers and environmental managers to ecopreneurship. Making Ecopreneurs: Developing sustainable entrepreneurship 43–60.

61. Petersen, H. (2010). The competitive strategies of ecopreneurs: striving for market leadership by promoting sustainability. *Making Ecopreneurs: Developing Sustainable Entrepreneurship*, 2, 223–236.
62. Rayna, T., & Striukova, L. (2021). Involving consumers: the role of digital technologies in promoting ‘prosumption’ and user innovation. *Journal of the Knowledge Economy*, 12(1), 218–237.
63. Agnew, S., & Dargusch, P. (2017). Consumer preferences for household-level battery energy storage. *Renewable and Sustainable Energy Reviews*, 75, 609–617.
64. Srinivasan, S., Li, Z. F., Han, Y. L., & Camburn, B. A. (2020). The impact of prototyping strategies on crowdfunding success. In *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference* (Vol. 83976, p. V008T08A045). American Society of Mechanical Engineers.
65. Nederhof, A. J. (1985). Methods of coping with social desirability bias: a review. *European journal of social psychology*, 15(3), 263–280.
66. Dillman, D. A. (2011). *Mail and internet surveys: the tailored design method—2007 update with new internet, visual, and mixed-mode guide*. John Wiley & Sons.
67. O’Brien, R. M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & quantity*, 41(5), 673–690.
68. Zhang, H., & Chen, W. (2019). Crowdfunding technological innovations: Interaction between consumer benefits and rewards. *Technovation*, 84, 11–20.
69. Hsieh, H. C., Hsieh, Y. C., & Vu, T. H. C. (2019). How social movements influence crowdfunding success. *Pacific-Basin Finance Journal*, 53, 308–320.
70. Amit, R., & Han, X. (2017). Value creation through novel resource configurations in a digitally enabled world. *Strategic Entrepreneurship Journal*, 11(3), 228–242.
71. Wang, N., Li, Q., Liang, H., Ye, T., & Ge, S. (2018). Understanding the importance of interaction between creators and backers in crowdfunding success. *Electronic Commerce Research and Applications*, 27, 106–117.
72. Brown, T. E., Boon, E., & Pitt, L. F. (2017). Seeking funding in order to sell: Crowdfunding as a marketing tool. *Business Horizons*, 60(2), 189–195.
73. Ries, E. (2011). *The lean startup: how today’s entrepreneurs use continuous innovation to create radically successful businesses*. New York, NY: Crown Business.
74. McGrath, R. G., & MacMillan, I. C. (1995). Discovery-driven planning recognizes that planning. *Harvard business review*, 45.
75. Hörisch, J. (2018). ‘Think big’ or ‘small is beautiful’? An empirical analysis of characteristics and determinants of success of sustainable crowdfunding projects. *International Journal of Entrepreneurial Venturing*, 10(1), 111–129.
76. Mason, R. (1984). *Conspicuous consumption: a literature review*. *European journal of Marketing*.
77. Steigenberger, N. (2017). Why supporters contribute to reward-based crowdfunding. *International Journal of Entrepreneurial Behavior & Research*, 23(2), 336–353.
78. Kan, Y., Yu, Y., Jiang, Y., & Tan, Y. (2022). Afraid of Niche, Tired of Mass: Atypical Idea Combination on Crowdfunding Platform. *Tired of Mass: Atypical Idea Combination on Crowdfunding Platform* (August 3, 2022).
79. Tucker, C., & Zhang, J. (2011). How does popularity information affect choices? A field experiment. *Management Science*, 57(5), 828–842.
80. Chandler, J. A., Short, J. C., & Wolfe, M. T. (2021). Finding the crowd after exogenous shocks: exploring the future of crowdfunding. *Journal of Business Venturing Insights*, 15, e00245.
81. Dalgic, T. (Ed.). (2006). *Handbook of niche marketing: principles and practice*. Psychology Press.
82. Bendapudi, N., Singh, S. N., & Bendapudi, V. (1996). Enhancing helping behavior: an integrative framework for promotion planning. *Journal of Marketing*, 60(3), 33–49.