RISK AND INNOVATION BALANCE IN CROWDFUNDING NEW PRODUCTS

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Abstract

Many have considered that innovation through new and small companies is a vital driver for sustainable economic growth. Recent growth in Web 2.0 demands small companies to further incorporate risk management while developing innovative products. How to balance risk and innovation during new product development becomes a priority for small companies to survive the competition. Yet, the approach is not likely similar to that employed by incumbent firms. This paper explores innovation versus risk for small companies using crowdfunding products as a proxy for analysis. A database with 127 consumer electronics, namely 3D printers and smart watches, are collected from Kickstarter and Indiegogo. The metric of Real-Win-Worth is adapted to provide a well-rounded assessment of the product's innovation, risk and other related business and engineering aspects. Our result suggests a preliminary framework of innovation and risk balance for crowdfunding NPD success. A statistical model is developed to correlate the amount of crowdfunding raised with 64% predictability. These results may contribute to better understand and balance risk and innovation in crowdfunding and small company contexts.

Keywords: New Product Development, Innovation, Risk Management, Crowdfunding

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1 INTRODUCTION

Prior research on product development at new and small companies mostly focuses on fostering innovation through improved communication, design solutions and innovation speed (Marion and Schumacher, 2009). With very limited resources and capabilities, these small companies are driven by the need for innovation to survive competition. Even so, recent research by Hölttä-Otto et al. (2013) has reported that the characteristics of innovation presented in the small company products are comparable to, and sometimes even more than, those in the incumbent firm products. This indicates that product innovation could be a possible avenue to approach the design knowledge transformation from incumbent firms to small companies. In practice, the enabling factors for product success cover a much wider range than solely the product innovation (Tang et al., 2005). In order to balance innovation, risk management for product innovation becomes an immediate solution that small companies could benefit from (Oehmen et al., 2006). In this paper, the aim is set to explore the research question that how should small companies balance innovation and risk when developing new product.

Crowdfunding has recently emerged as a social-technical phenomenon that is driven by entrepreneurs' need for new product development (NPD) resources and enabled by the development of Internet and Web 2.0 technologies. Specifically for the donation- and reward-based crowdfunding campaigns, the *entrepreneurs* describe and publish their product ideas on the web-based *crowdfunding platforms (CFPs)* for fundraising. They usually set a funding goal for the crowdfunding campaign, hoping to receive direct donations or exchange underdeveloped products as rewards for individual financial contributions from the *supporters*. Many innovative consumer electronics have raised a considerable amount of funding, such as Pebble watch on Kickstarter with $10,266,845 raised and Misfit Shine on Indiegogo with $846,675 raised, so that the entrepreneurs could continue their product development efforts. Recently, Pebble Technology's second Kickstarter campaign comes with a new smart watch design, which has raised nearly twice the amount ($20,338,986) they've raised in their previous campaign. Such small companies managed the risk well, delivered the rewards, mostly early prototypes, to their supporters and eventually entered the commercial market, competing with incumbent firms.

This paper uses such crowdfunding campaigns, successful or not, as a proxy of small company's NPD initiatives. As an exploratory study, our attention is focused on 3D printers and smart watches from Kickstarter and Indiegogo, which are two of the most successful donation- and reward-based crowdfunding platforms. These two crowdfunding products present a similar state of development as their competitors in the consumer market, making it possible to apply the existing design knowledge for this research initiative. A small company going for crowdfunding makes their results a natural public record that is accessible. All crowdfunding products have clear milestones and results, the goal to be crowd-funded within a pre-set timeframe. Although this is different from the long-term product success, it could be viewed as market validation indicating a better chance of survival. Furthermore, the crowdfunding process directly involves early adopters as financial supporters, which might provide nuanced insights of design that is applicable to the NPD research and practice. As will be explained in the following sections, crowdfunding new products experience a very low "success rate", which is very similar to the NPD at both small companies and incumbent firms (Hölttä-Otto et al., 2013). In the following sections, the efforts are made to explore a balanced strategy of innovation and risk for the small companies to develop successful crowdfunding new products.

2 LITERATURE REVIEW

The literature of product development can be split into several streams, but mostly set in the context of incumbent companies with established resources. One stream is about the engineering design methods to reduce the complexity of product development. Palani Rajan et al. (2003) explored the flexibility of product design and derived a set of guidelines to guide product architecture to a desired state of flexibility. Recent work by Chiriac et al. (2011) proposed using assembly decomposition, functional decomposition and service based decomposition to solve system complexity in design. Empirical guidelines are applied to decompose the design architecture of Xerox printing system.

Another stream of literature focuses on identifying the success factors of product development and using them as a diagnostic tool (Cooper, 1979). At enterprise level, Tang et al. (2005) identified 1106 enabling factors of successful product development and organizational performance. Through

statistical analysis to the content of the factors through surveys sent to companies, 61 factors were shortlisted as the critical factors to predict profit, market share, customer satisfaction, organizational effectiveness, and product quality. An actionable diagnostic tool is generated from this research to help companies guide product development. At the execution level, Knoblinger et al. (2011) systematically investigated the requirements of product development self-assessment tools for company practice.

There is also a stream of research focusing on the transformational applications of the existing product development knowledge. The technology readiness level is a comprehensive methodology that is widely applied to manage large and complex projects in the defense and aerospace industries. Tang and Otto (2009) adapted this metric for the use of industrial product development. On the design innovation side, recent empirical research by Hölttä-Otto et al. (2013) reviewed 197 award-winning new products and categorized the characteristics of innovation in functionality, architecture, user interaction, external interaction and cost. The advantage of these innovation characteristics is that they are applicable to products from both small companies and incumbent firms. Prior knowledge of risk management is mostly used for project management and financial risk management. However, Olechowski et al. (2012) further extended the discussion of risk management to product development through a survey research with 224 risk managers, where 7 categories factors are summarized to characterize product development risk management.

By reviewing the above literature, a research gap emerges as how to transform the existing knowledge of product development to the context of organizations other than incumbent firms, such as small companies. An exploratory research initiative is proposed in this paper to find a balanced strategy of innovation and risk for small company product development. The limited resources and capabilities with the small companies greatly limited the efficient applications of existing product development methods that are mostly set at the enterprise level (Tang et al., 2005, Chiriac et al., 2011, Tang and Otto, 2009). Recent work by Marion and Schumacher (2009) showed that the trend of growth in Web 2.0 also introduced new challenges for small companies to survive the fierce global competition. Crowdfunding is one of such examples where small companies are greatly challenged to survive with innovative new products (Belleflamme et al., 2013). The entrepreneurs on the crowdfunding platforms present their product ideas and raise funding directly from their supporters, or potential customers, for product development (Mollick, 2014). In the following sections, we are going to use the crowdfunding products as a proxy to explore the possible strategy of product development for small companies.

3 METHOD & DATA

3.1 The adapted metric of Real-Win-Worth

In this paper, the "Real-Win-Worth" (RWW) framework (Day, 2007) is adapted to the context of crowdfunding product development (see Table 1).

Table 1. The Real-Win-Worth framework with 26 detailed rating questions and criteria.

Is it **Real**?	Does our product have an *Attractive Market*?	26 detailed questions are developed so that a rater could make judgment using predefined criteria to identify Full/Partial/None evidence from project webpage, which are then transformed to 1/0.5/0 for analysis.
	Do we have a *Feasible Product*?	
Can We **Win**?	Do we have *Product Advantage*?	
	Does our company have *Synced Competency*?	
Is it **Worth** Doing?	Can we profit with an *Acceptable Risk*?	
	Does our product have a *Strategic Fit*?	

This R&D assessment framework is comprehensive to cover a wide range of product development factors and is also very flexible for adaptation. The adapted RWW framework is developed with 26 detailed RWW questions addressing the possibly influential factors of crowdfunding product success. Both the innovation aspects (as in the market attractiveness, product advantage, and synced competency) and risk aspects (as in the product feasibility, acceptable risk, and strategic fit) of small company product development are covered. In order to achieve an acceptable level of inter-rater reliability, an assessment process is conducted through intense discussions among three researchers. For each sample product, a trained rater needs to first read through the *product description* of each crowdfunding webpage, then find the evidence to answer the 26 *detailed RWW questions*, and finally record ratings based on predefined *rating criteria*. Individually, each detailed RWW question reflects

part of the *Real*, *Win* or *Worth* factors. Collectively, they formulate the basis of our research method, reflecting the maturity level of crowdfunding products. The rating process is very time consuming as it takes several hours of judgment and review to answer the 26 questions for each crowdfunding product. Three 3D printer samples from Kickstarter are used to develop the rating criteria for each detailed RWW question, which includes three levels of evidence, namely Full/Partial/None. An additional rater, who had not been exposed to crowdfunding products and our research method, was invited to test our adapted RWW metric with these three samples. In this manner, we fine-tuned the detailed RWW questions and rating criteria with this additional rater before rating the whole sample products. We benchmarked the repeatability with this additional rater and reached a weighted Kappa of 80%.

3.2 Samples of crowdfunding consumer electronics

The consumer electronics present great interests from both the *entrepreneurs* and their *supporters* on the *CFPs*. They are usually listed under, but not limited to, the category of Technology on many CFPs. For instance, the four most funded projects among Kickstarter's total 73,551 projects spread through the categories of Design (Coolest Cooler and Pebble), Games (OUYA) and Technology (Pono Music). Based on product descriptions, they all could be described as consumer electronics. However, most other crowdfunding consumer electronics significantly suffer from a low rate of getting funded. As shown in Figure 1, projects under the *Technology* category on Kickstarter rank the highest in total *live projects* (the projects that are currently raising funding) and total *live dollars* (the total pledges to the currently funding projects). Interestingly and yet unfortunately, these *Technology* projects made the lowest "success rate" of 26.2% (the rate of projects that meet their funding goal).

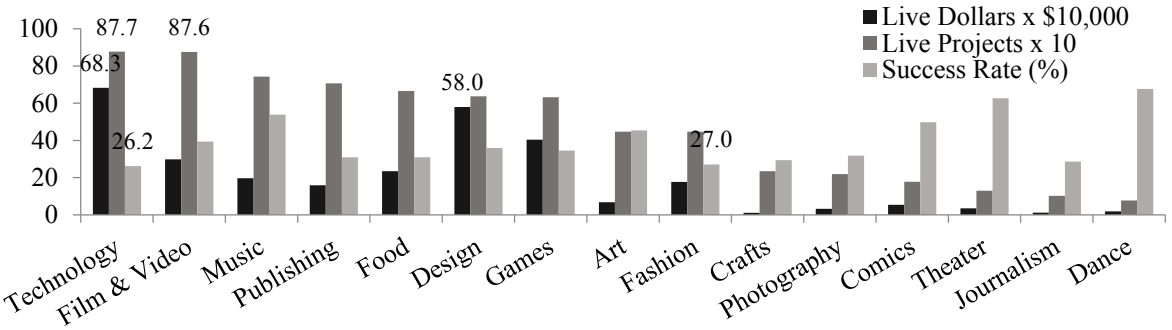


Figure 1. On Kickstarter, Technology projects are presented with great interests from both entrepreneurs in Live Projects and supporters in Live Dollars, but suffer significantly on the Success Rate. Only the extreme two in each category are labelled with numbers.

To build our product database, an exhaustive search of 3D printers and smart watches on Kickstarter and Indiegogo is performed. Kickstarter and Indiegogo are two of the most popular donation- and reward-based crowdfunding platforms in the United States (Zouhali-Worrall, 2011). Many researchers used their data to approach crowdfunding (Mollick, 2014, Sharp, 2014). The 3D printers and smart watches are two of the most popular consumer electronics on both CFPs. The state of development with these two crowdfunding products is very similar to their competing products on commercial websites like Amazon. For each sample product, the entrepreneurs create a webpage with product descriptions on CFPs using text, figures, videos, tables, etc., asking for financial support in ways of direct donations or products as rewards. A few samples with insufficient details are removed from our database. The resultant 127 samples include 47 3D printers and 23 smart watches from Kickstarter, and 31 3D printers and 26 smart watches from Indiegogo. On Kickstarter, the number of 3D printer and smart watch samples that reached their goals is about twice as those that failed to reach their goals. Differently, about half of 3D printer samples on Indiegogo reached their goals. For smart watches on Indiegogo, only 4 out of the 26 samples reached their funding goals. In the summary statistics of Table 2 in the next section, the average funded per cent of smart watch samples from Indiegogo appears to be about three times higher than those from Kickstarter. One reason could be the slightly different funding rules between Kickstarter and Indiegogo (that will be explained in the next section). Since the market for both 3D printers and smart watches are still in their early stages, providing a precise definitions for both product categories is found to be difficult. When selecting the samples, we primarily chose to honor the entrepreneurs' opinion if they self-claim that they are developing a 3D printer or a smart watch. For those with ambiguous product categorization, we searched online for

interviews, reports, and articles by the media to decide the competing products by which we could categorize them as 3D printers or smart watches.

3.3 The variables

The variables used in this exploratory analysis are selected to characterize the two platforms, two products and their success levels. Most of these dependent and control variables in this study are used in prior studies (Mollick, 2014, Sharp, 2014). Each variable is explained in the following and the statistics are summarized in Table 2.

Table 2. Summary Statistics on the 127 samples (KS=Kickstarter, IGG=Indiegogo, 3DP=3D Printer, SW=Smart Watch).

Variables	3DP on IGG	3DP on KS	SW on IGG	SW on KS	All 3DPs	All SWs	All samples
Funding Raised	37957.81 (16194.62)	344679.89 (94821.62)	117776.19 (65641.55)	676108.04 (440848.71)	222777.53 (59747.62)	379850.33 (211233.26)	283380.42 (89131.83)
Funding Goal	67650.19 (33331.21)	70196.64 (12560.61)	131477.85 (30600.81)	84676.13 (12757.22)	69184.59 (15127.49)	109509.69 (17468.97)	84743.09 (11567.29)
Funded Percent	1.70 (0.46)	7.33 (1.90)	5.09 (1.19)	1.36 (0.84)	7.14 (4.39)	4.07 (2.12)	4.70 (1.10)
Characters	9270.71 (1300.15)	10688.57 (1025.14)	9178.44 (1260.87)	11515.87 (917.60)	10125.06 (803.93)	10298.46 (800.43)	10191.12 (581.62)
Figures	6.68 (0.98)	12.66 (1.19)	17.81 (2.72)	19.17 (1.87)	10.28 (0.88)	18.45 (1.68)	13.43 (0.91)
Tables	0.52 (0.20)	1.09 (0.24)	1.19 (0.34)	0.35 (0.16)	0.86 (0.17)	0.80 (0.20)	0.83 (0.13)
Videos	0.84 (0.10)	2.34 (0.28)	1.62 (0.50)	1.78 (0.26)	1.74 (0.19)	1.69 (0.29)	1.72 (0.16)
Rewards	7.94 (0.89)	12.15 (0.97)	9.19 (1.12)	9.30 (0.87)	10.47 (0.72)	9.24 (0.71)	10.00 (0.52)
Team Intro [Yes/No =1/0]	0.45 (0.09)	0.38 (0.07)	0.77 (0.08)	0.59 (0.11)	0.41 (0.06)	0.69 (0.07)	0.52 (0.04)
Timeline [Yes/No =1/0]	0.32 (0.09)	0.43 (0.07)	0.69 (0.09)	0.86 (0.07)	0.38 (0.06)	0.77 (0.06)	0.53 (0.04)

Note: the values outside the parenthesis are the mean values, and those in the parenthesis are standard errors.

- Dependent Variable
  - *Funding raised*: This variable is the dependent variable for analysis. It indicates the total amount of funding a product has raised from its supporters. This is a different choice of dependent variable comparing to the prior research, where getting funded is usually used as the independent variable. One reason for this choice is that our samples are from two CFPs with different funding rules. Kickstarter uses *all-or-nothing* funding rule, meaning that the entrepreneurs will receive all funding raised as long as they reach their funding goal, or they will get nothing. Indiegogo has two funding rules, *fixed* or *flexible*. The *fixed* funding rule is the same as the all-or-nothing rule on Kickstarter. The *flexible* funding rule does not have constraint on reaching the funding goal, as the entrepreneurs will receive any amount of funding raised. Therefore, a different depended variable is required. The other reason for this choice is that the amount of funding raised is a more comprehensive and valuable information reflecting the product nature, development status as well as supporters' interest. The natural log of this variable is used during analysis.
- Control Variables
  - *Funded per cent*: This variable indicates the percentage of funding raised over funding goal. Although this variable is not used during analysis, it is still listed in Table 2 for reference.
  - *Funding goal*: This is an important variable for crowdfunding. Ideally it should be the minimum amount needed to complete the project and fulfil rewards. It reflects the entrepreneurs' confidence to the crowdfunding campaign, and yet it is also very difficult to determine a suitable value for this variable. Most of the time, it depends on the entrepreneurs'

crowdfunding strategy as they might set a funding goal that is very high or very low to manipulate the crowdfunding outcome. The natural log of this variable is used during analysis.
  - *Number of characters in project description*: This variable is used to reflect the length of description text the entrepreneurs have prepared for the crowdfunding campaign. Similar to the former variable, the natural log of this variable is used during analysis.
  - *Number of figures, videos, tables, and rewards*: The appearance of each describing objects in the project description section. These are different indicators of the entrepreneurs' preparation for the crowdfunding campaign.
  - *Dummy of team introduction*: This variable records whether there is a description about the team members, their experiences and responsibilities in the project description section. The development team is an important factor to implement effective product development risk management (Castro et al., 2011).
  - *Dummy of timeline*: This variable records whether there is a description about the project schedule, like when to finish design, arrange production, and deliver the rewards, in the project description section. The timeliness is an important factor of product development (Cooper and Kleinschmidt, 1994).
- Independent Variables
  - We incorporate RWW ratings as the independent variables. For each detailed RWW question, a rating is recorded as Full, Partial, or None based on the evidence found on the product description. These ratings are then transformed into a scale of 1/0.5/0 and treated as independent variables during analysis. The table in the appendix presents a summary of the RWW rating statistics for the 127 samples. The entrepreneurs have the full power to decide what level of details they would prefer to share when describing their products. Therefore, it is reasonable that they might choose to selectively disclose some aspects of their products with more details and skip others. This is reflected in the table in the appendix for questions 2, 17, 22 and 26, where the average ratings are below 0.03, indicating that there is no sufficient information available in the description to provide sufficient evidence for rating. The ratings to these four questions are therefore removed during analysis in the following sections. However, we would like to mention that this does not necessarily mean that the entrepreneurs failed to consider these factors when developing product solutions.

Prior research has found that social network factors are an important predictor to whether the project will get funded (Greenberg et al., 2013). Etter et al. (2013) found that social features could significantly improve the prediction accuracy of crowdfunding success. However, as discussed by Mollick (2014), social network variables suffer greatly on missing values. Special care must be taken when interpreting results using the social network variables. The samples in our database also suffer from the same problem. We found that social network variables are not available for most of our samples, which makes it difficult to include them for analysis. From this paper' research view on product development, we chose to exclude social network factors at the current research stage.

4 RESULTS AND DISCUSSIONS

Our database is assembled with two product types (i.e. 3D printers and smart watches) on two crowdfunding platforms (i.e. Kickstarter and Indiegogo). Rather than formal hypothesis testing, the following will focus on the innovation and risk balance of crowdfunding product development with specific attentions paid to our empirical database. The goal is to identify the innovation and risk factors for crowdfunding product development success, as reflected in the adapted RWW metric, that are significantly associated with the amount of crowdfunding raised, irrespective of platform and product differences. In order to achieve this goal, we begin by identifying the RWW factors showing no significant differences for samples across platforms and products. Then, we shortlist a set of platform-wise RWW factors that demonstrate significant associations to predict the crowdfunding raised. A similar set of product-wise RWW factors are identified as well. Finally, we synthesize the platform-wise and product-wise RWW factors into a prediction model for the amount of crowdfunding raised that is irrespective of platform or product differences.

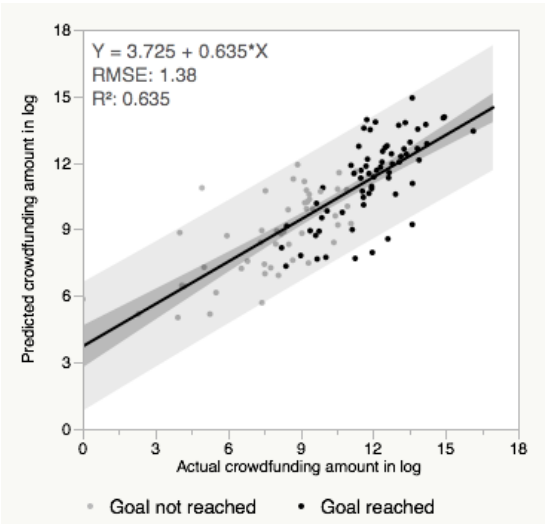
For the first step, take the samples across two platforms for example. We start by performing three t-tests of the RWW factors between Kickstarter and Indiegogo using all 3D printer samples, all smart

watch samples and all product samples, respectively. The t-statistics of each t-test are examined to select the common RWW factors that do NOT show significant differences (or those with p-values greater than 0.05) between Kickstarter and Indiegogo for all three t-tests. These screened RWW factors are viewed as commonly presented for both CFPs, i.e. Kickstarter and Indiegogo. Similarly, we could use all Kickstarter samples, all Indiegogo samples and all platform samples between 3D printer and smart watch to screen for the common RWW factors that are commonly presented for both products, i.e. 3D printers and smart watches. Next, we build multiple linear regression models to predict the amount of crowdfunding raised using variables in Table 2 as well as the common platform-wise or product-wise RWW factors identified in the first step. By using K-fold cross-validation through stepwise screening, we are able to shortlist the *important* RWW factors that are significantly associated with predicting the amount of crowdfunding raised. Specifically, we identified that Q01, Q12, and Q16 are the platform-wise important RWW factors that contribute significantly to the crowdfunding raised disregard of the product differences. We also identified that Q08, Q16 and Q25 are the product-wise important RWW factors that contribute significantly to the funding raised disregard of the platform differences.

The final step is to synthesize the above results into a single model that is applicable to predict all 127 samples disregard of the platform and product differences. Note that Q16 is presented in both the important platform-wise factors (Q01, Q12, and Q16) and product-wise RWW factors (Q08, Q16 and Q25). We then introduce the Q01 and Q12 into the model with three important product-wise RWW factors, respectively. Similarly, we repeat the above process by introducing Q08 and Q25 to the model with three important platform-wise RWW factors, respectively. In these experiments, we found that the p-values of model estimates for all RWW factors are less than 0.05. Finally, we construct a prediction model with Q01, Q08, Q12, Q16 and Q25 as the critical RWW factors in Table 3. This resultant model fits our product samples with an overall R^2 of 64% and an adjusted R^2 of 58%, indicating an effective prediction of crowdfunding raised. For only Kickstarter, Indiegogo, 3D printer and smart watch samples, the model exhibits R^2 of 65%, 43%, 60% and 67%, respectively.

Five critical RWW factors are identified in the resultant model to predict the amount of crowdfunding raised irrespective of platform-wise or product-wise differences in our database. Q01 examines *the voice-of-customer*, suggesting innovation in tackling problems that serve a market need instead of looking for an interesting problem. Q08 examines *functional feasibility*, suggesting that a well-managed risk in the product's functionality is critical to the acceptance of any technological or material advancement. Q12 focuses on *tangible & intangible benefits*, which formulate the basis of an innovative product. Q16 emphasizes *vulnerability risk evaluation*, which alerts the entrepreneurs to pay attention to the competitors' offers during NPD risk management. Finally, Q25 examines *growth strategy* of the new product for the start-up's future growth, which looks at the long-term development risk of the product's innovation.

Table 3. The resultant prediction model for the amount of crowdfunding raised.

Baseline Model	Values	Actual by Predicted Plot
Self-training data	All 127 observations	
Intercept	1.97 (0.48)	
Category [3DP=0/SW=1]	0.62 (<.01)	
Platform [IGG=0/KS=1]	-1.01 (<.01)	
# of figures	.000 (0.99)	
# of tables	0.06 (0.63)	
# of videos	-0.15 (0.15)	
# of rewards	0.05 (0.12)	
Team Intro (1/0)	0.17 (0.68)	
Timeline (1/0)	0.22 (0.63)	
ln(Goal)	0.14 (0.40)	
ln(Chars)	0.33 (0.25)	
Voice-of-customer - Q01	2.09 (0.01)	
Functional feasibility - Q08	1.29 (<.01)	
(In)tangible benefits - Q12	1.91 (<.01)	
Vulnerability risk evaluation - Q16	1.67 (0.05)	
Growth strategy - Q25	1.31 (0.04)	
Self-prediction $\boldsymbol{R^2}$	0.64	
Adjusted Self-prediction $\boldsymbol{R^2}$	0.58	

Note: The values outside the parenthesis are model estimates, and those inside are p-values of model estimates.

5 CONCLUSION AND LIMITATIONS

This paper set out to fill the research gap of understanding the innovation and risk balance strategy for new product development (NPD) at small companies. The consumer electronics projects on the donation- and reward-based crowdfunding platforms are used as a proxy to analyze small company NPD. It is selected for its root in entrepreneurship, ease of data access, clarified NPD progress, and the comparable state of development to the products on the commercial market. A database with 127 samples of 3D printers and smart watches on Kickstarter and Indiegogo is assembled for empirical analysis. The Real-Win-Worth (RWW) framework is adapted from the existing NPD literature to reflect various factors of innovation and risk. As a result, five critical RWW factors are identified, including *voice-of-customer*, *functional feasibility*, *tangible & intangible benefits*, *vulnerability risk evaluation*, and *growth strategy*, which suggest a preliminary framework of innovation and risk balance for crowdfunding product success. *These factors are assembled in a statistical model to* predict the amount of crowdfunding raised by our sample products with an R^2 of 64% and an adjusted R^2 of 58%, irrespective of platform or product differences.

The results from this paper are interesting and also practical to the balancing of innovation and risk for small company NPD. The entrepreneurs could follow these results to formulate specific NPD strategies focusing on the most critical innovation and risk factors, which could greatly improve the small companies' rate of survival, as demonstrated in the case of crowdfunding in this paper. One extension from these results may help the crowdfunding platforms to provide more tailored services or re-design their platforms to help the entrepreneurs better prepare and market their products, and also help the supporters to quickly locate a new but great product. Early-stage investors, incubators and even incumbent firms may also adapt our results to estimate the market potential of a product initiative.

A few limitations are worth mentioning. The adapted RWW metric might require further refinement before becoming applicable to a wider selection of products and crowdfunding platforms. Also, the current rating process is relatively slow to generate a large dataset for analysis. Results from this paper could be used to generate experience to design better machine learning tools for a faster and more rigorous data collection and analysis. Finally, the implications from this paper are still constrained to the context of crowdfunding. Cautious shall be taken before interpreting the results for other areas. Nevertheless, the results in this paper open many doors for future small company NPD research and the entrepreneurial NPD strategy through crowdfunding.

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APPENDIX

Table of average ratings of the 26 RWW questions for the 127 sample products based on the adapted RWW metric (1=Full, 0.5=Partial, 0=None).

RWW Detailed Factors			3D Printer	Smart Watch	Kick-starter	Indie-gogo	All samples
Is it Real?	Market Attractiveness	Q01-voice of customer	0.32 (0.04)	0.42 (0.03)	0.37 (0.03)	0.39 (0.04)	0.37 (0.02)
		Q02-budget analysis	0.02 (0.01)	0.00 (0.00)	0.00 (0.00)	0.02 (0.01)	0.01 (0.01)
		Q03-market demographic	0.17 (0.03)	0.24 (0.03)	0.21 (0.03)	0.21 (0.04)	0.21 (0.02)
		Q04-benefits understood	0.46 (0.03)	0.68 (0.03)	0.59 (0.03)	0.56 (0.04)	0.58 (0.02)
		Q05-subjective barrier	0.37 (0.04)	0.53 (0.03)	0.41 (0.04)	0.53 (0.04)	0.46 (0.03)
	Product Feasibility	Q06-concept evolution	0.50 (0.05)	0.79 (0.03)	0.61 (0.04)	0.73 (0.05)	0.66 (0.03)
		Q07-development compatibility	0.12 (0.03)	0.49 (0.03)	0.33 (0.03)	0.31 (0.04)	0.32 (0.03)
		Q08-functional feasibility	0.46 (0.06)	0.51 (0.06)	0.41 (0.05)	0.61 (0.07)	0.49 (0.04)
		Q09-cost-efficient manufacturing	0.28 (0.05)	0.60 (0.04)	0.46 (0.04)	0.46 (0.06)	0.46 (0.03)
		Q10-clarified tradeoffs	0.26 (0.04)	0.42 (0.03)	0.35 (0.03)	0.35 (0.05)	0.35 (0.03)
		Q11-competition validation	0.17 (0.04)	0.29 (0.03)	0.22 (0.03)	0.26 (0.04)	0.24 (0.02)
Can we Win?	Product Advantage	Q12-(in)tangible benefits	0.25 (0.04)	0.54 (0.04)	0.38 (0.04)	0.44 (0.05)	0.41 (0.03)
		Q13-unique advantage	0.08 (0.03)	0.07 (0.02)	0.06 (0.02)	0.09 (0.03)	0.07 (0.02)
		Q14-patent strategy	0.04 (0.02)	0.05 (0.02)	0.01 (0.01)	0.09 (0.03)	0.04 (0.01)
		Q15-patent maintenance	0.11 (0.04)	0.16 (0.03)	0.12 (0.03)	0.17 (0.04)	0.14 (0.02)
		Q16-vulnerability evaluation	0.16 (0.03)	0.10 (0.02)	0.12 (0.02)	0.13 (0.04)	0.13 (0.02)
		Q17-competition measures	0.02 (0.01)	0.00 (0.00)	0.00 (0.00)	0.02 (0.01)	0.01 (0.01)
	Synced Competency	Q18-enhanced perception	0.09 (0.03)	0.21 (0.03)	0.15 (0.03)	0.16 (0.03)	0.15 (0.02)
		Q19-leadership in marketing	0.08 (0.03)	0.06 (0.02)	0.04 (0.02)	0.10 (0.04)	0.07 (0.02)
		Q20-leadership in PD	0.11 (0.03)	0.18 (0.04)	0.14 (0.03)	0.15 (0.04)	0.15 (0.03)
		Q21-feedback management	0.01 (0.01)	0.16 (0.03)	0.10 (0.03)	0.07 (0.03)	0.09 (0.02)
Is it Worth Doing?	Acceptable Risk	Q22-understood profitability	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
		Q23-cash flow robustness	0.17 (0.03)	0.44 (0.02)	0.32 (0.03)	0.31 (0.04)	0.31 (0.02)
		Q24-failure migration	0.08 (0.02)	0.39 (0.03)	0.27 (0.03)	0.21 (0.04)	0.25 (0.02)
	Strategic Fit	Q25-growth strategy	0.24 (0.04)	0.29 (0.03)	0.27 (0.03)	0.27 (0.05)	0.27 (0.03)
		Q26-agreed management	0.03 (0.02)	0.03 (0.01)	0.03 (0.02)	0.02 (0.01)	0.03 (0.01)

Note: the values outside the parenthesis are the mean values, and those in the parenthesis are standard errors.