Association for Information Systems
AIS Electronic Library (AISeL)

WHICEB 2015 Proceedings

Wuhan International Conference on e-Business

Summer 6-19-2015

Relationship between Design Elements and Performance in Online Innovation Contests: Contest Sequence is Moderator?

Liwei Wang
School of Economics and Management, Jiangsu University of Science and Technology, CHINA

Jian Tian
School of Economics and Management, Jiangsu University of Science and Technology, CHINA, tianjian@just.edu.cn

Yi Xu
School of Economics and Management, Jiangsu University of Science and Technology, CHINA

Relationship between Design Elements and Performance in Online Innovation Contests: Contest Sequence is Moderator?

Liwei Wang[1], *Jian Tian*[1*], *Yi Xu*[1]
[1]School of Economics and Management, Jiangsu University of Science and Technology, CHINA

Abstract: As an important issue in the field of innovation contest, performance of innovation contest has been attracting the attention of both academics and practioners over recent years. This paper explores the factors influencing performance of online innovation contest from the design elements perspective. The study is based on the empirical research of the online innovation contest community - studio.Topcoder.com. We find the longer the contest duration, the higher contest performance in the one-stage contest. The results also show that too much detailed task description will reduce the performance of the one-stage contests, but will increase the number of solvers in the two-stage contests. The results also reveal that the incentive effect of first prize in the one-stage contests is stronger than that in the two-stage contests, while the incentive effect of second prize in the two-stage contests is stronger than that in the one-stage contests, and if the amount of second prize is close to the prize amount, the number of solvers and eligible solutions will raise.

Key words: innovation contest; design elements; contest sequence; performance

1. INTRODUCTION

It is difficult for companies who depend on the internal innovation to response to the rapid changes of demand, and more and more companies convert to the online communities to solve the innovation difficulties by the means of contest (Piller & Walcher, 2006; Jeppesen & Lakhani, 2010)[1,2]. This emerging open innovation mode is called "online innovation contest" or "crowdsourcing contest" (Brabham, 2008; Poetz & Schreier, 2012)[3,4]. Innovation contest means companies release the innovation tasks through online communities (e.g., InnoCentive.com, and Topcoder.com), the solvers use their skills, experience and creativity to provide the solutions for specific tasks and the winner will obtain the contest reward(Bullinger et al., 2010)[5].

How to maximize the outcomes and performance of innovation contest is a long-standing question for researchers and seekers(Adamczyk, 2012; Terwiesch & Xu, 2008)[6,7]. To solve this problem, lots of previous studies pay more attention to the design of the number of constants (Terwiesch & Xu, 2008; Boudreau, Lacetera, & Lakhani, 2011; Che & Gale, 2003)[7,8,9], award amount (Archak, 2010; Giebe 2014)[10,11]and award structure (Cason, Masters, & Sheremeta, 2010; Terwiesch & Xu, 2008)[7,12]from the economic perspective by the economic model or secondary data collected from the online contest platforms. Prior studies also put forward many valuable implications on how to optimize the design elements of innovation contest by empirical research (Shao et al., 2012; Yang, 2012)[13,14]. In their papers, the impact of different elements such as duration of contest, task description and incentives mechanism on the quantity of solvers and solutions has been discussed. A longer period can attract more solvers, while too long task description will reduce the quantity of solvers(Yang, Chen, & Pavlou, 2009)[15]. Although contest bonus can encourage the solvers to participate in the contests (Terwiesch & Xu, 2008; Giebe, 2014; Yang, 2012; Yang et al., 2009)[7,11,14,15], it is dilemma how to choose the optimal incentive mechanism. In the context of traditional contest theory, the organizers will choose winner-take-all mechanism when the competitors are risk neutral and the cost function is linear or concave (Moldovanu & Sela, 2001; Sheremeta, 2011)[16,17]. But in the context of online contest, winner-take-all is optimal for the creative or trial and error projects while multi-award will be more effective for expertise projects (Terwiesch & Xu,

* Corresponding author. Email: tianjian@just.edu.cn (Jian Tian)

2008)[7]. When the solvers are risk aversion, the organizers will choose to set up multiple awards, instead of winner-take-all (Archak & Sundararajan, 2009)[18]. An experimental evidence was given that multi-award is better than winner-take-all for competitors (Cason et al., 2010)[12]. Further research showed the second prize could enhance the solvers' efforts and the balance of contest when there are three competitors or more (Szymanski & Valletti, 2005)[19]. In addition, traditional contest theories indicate that different sequence, single stage or multi-stage, has a significant impact on contest performance (Moldovanu & Sela, 2006; Fu & Lu, 2012)[16,20]. However, most of the existing researches focus on the impact of design elements on the performance in single stage innovation contests (Shao et al., 2012; Yang, 2012; Yang, et al., 2009)[13,14,15], and few about two-stage innovation contests. To address above-mentioned gaps, this paper tries to develop a research model to empirical study the influencing factors of performance from the viewpoint of design elements and identify the moderating effect of contest sequence on the relationship between design elements and performance.

The remainder of this paper is structured as follows: Section 2 gives the related hypotheses with regard to relations between contest elements and performance of online innovation contest and considers the moderating effect of contest sequence. In section 3, we present the research method and collect the data which are used in section 4 to verify the hypotheses. Section 5 discusses the results. Section 6 concludes the paper and points to future work.

2. RELATED HYPOTHESES

Contest is a well-established and increasingly popular mechanism for facilitating innovation (Terwiesch & Xu, 2008; Boudreau et al., 2011; Terwiesch & Ulrich, 2009)[7,8,21]. Prior studies on traditional contests indicate that increasing the number of competitors will make the competitors reduce their effort and lower overall outcomes of contests, thereby scholars suggest sponsors should restrict the size of contests(Che & Gale, 2003)[9]. However, studies on innovation contests argue that open innovation contests to everybody will be more conducive to seekers (Terwiesch & Xu, 2008; Boudreau, et al., 2011)[7,8]. Because seekers can get different and various solutions from solvers in free-entry contests, and the benefits of diversity can mitigate the negative effect of solvers' underinvestment (Bayus, 2013; Terwiesch & Xu, 2008)[7,22]. Moreover, adding competitors in an innovation contest can increase the probability that find an extreme-value solution and enhance overall performance for high-uncertainty contest problems(Boudreau, et al., 2011)[8]. In addition, free-entry contests as a powerful tool to aggregate the efforts of the crowd (collective intelligence) are used to facilitate the generation and evaluation of innovative solutions (Yang, 2012; Lüttgens et al., 2014)[14,23]. Thus, the tendency of innovation contest is open to all external comers rather than restrict entry (Boudreau et al., 2011)[8]. Most of online innovation contests are free entry to all external solvers. If the contest bonus is fixed and the degree of contest sponsors' feedback is high enough, the number of solvers directly reflects the performance of online innovation contest(Yang, 2012)[14]. In addition, the performance also depends on the effort of solvers, which mean the quantity and quality of the final submissions (Terwiesch & Xu, 2008; Liu & Lu, 2014)[7,24].Then, this paper will analyze the impact of these factors on the number of solvers and the quantity of eligible submissions.

2.1 Relationship between contest duration and performance

The duration of contest refers to the length of time defined by the contest organizers to complete the task. Because the external solvers can enter the contest at any time, the length of duration will affect the number of entries. The longer contest duration can make more solvers to enter the contest (Yang, 2012)[14]. In addition, the inputs of online innovators mainly depend on their spare time and whether the innovators can win the contest have a significant positive correlation with their spent spare time (Lakhani et al., 2007)[25]. Thus, the longer the contest duration is, the more free time the competitors can spend and the higher the likelihood of participation and completion is. This discussion is summarized in the following hypotheses.

H1a: *Contest duration has a positive effect on the number of competitors.*

H1b: *Contest duration has a positive effect on the quantity of eligible submissions.*

2.2 Relationship between task description and performance

Task description refers to the specific requirements defined by the organizers for the solutions submitted by the solvers, reflecting the degree of certainty about the innovation issues. The length of task description approximately describes information quality. The longer the task description is, the higher the requirement for the accuracy of submitted information. The longer the task description and the more requirement or restriction for the solvers, the higher the learning cost for solvers are, which will lead to the decrease in the number of solvers (Yang et al., 2009)[15]. Thus, the following hypotheses are offered.

H2a: *Task description has a negative effect on the number of solvers.*

H2b: *Task description has a negative effect on the quantity of eligible submissions*

2.3 Relationship between award setting and performance

Winning the bonus is one of the main motivations for the participants to enter the online innovation contests (Brabham, 2010; Liu et al., 2011; Sun, Fang, & Lim, 2012)[26,27,28]. The higher the bonus is, the more participants involved in contest are (Sun et al., 2012; Yang, 2012)[14,28]. Especially for the creative contest task, the number of participants is logarithmic as the bonus increase (DiPalantino & Vojnovic, 2009)[29]. In general, the organizer will set first prize higher than second prize to seek more desirable solution. However, the higher contest bonus often requires more effort, so it will be almost impossible for those who are lack of knowledge accumulation or free time to complete the task. Thus, those solvers prefer second prize to first prize. The following hypotheses summarize these arguments.

H3a: *First prize and second prize have a negative effect on the number of competitors.*

H3b: *First prize has a negative effect on the quantity of eligible submissions, but the second prize has a positive effect on the quantity of eligible submissions.*

2.4 Moderating effect of contest sequence

Generally, the duration of single stage contest is shorter than that of two-stage contest. So solvers will devote more time to fulfilling the task in single stage contest. If the duration in single stage contest becomes longer, more solvers who are limited in free time but can provide valuable ideas will be motivated to participate in the contest and final eligible submissions will increase. Too long task description may reduce the performance of single stage contest because the solvers who are lack of knowledge accumulation or free time will drop out or even not participate due to high cost and the low possibility of completing the task. But in two-stage contest, the solvers can employ much more free time and it will weaken the negative effect of long task description on completing the task. This discussion is summarized in the following hypotheses.

H4a: *Contest sequence plays a moderator role in the relations between contest duration and the number of solvers. With the extension of contest duration, the increasing trend of solvers in single stage contest is more significant than that in two-stage contest.*

H4b: *Contest sequence plays a moderator role in the relations between contest duration and the number of eligible submissions. With the extension of contest duration, the increasing trend of eligible submissions in single stage contest is more significant than that in two-stage contest.*

H5a: *Contest sequence plays a moderator role in the relations between task description and the number of solvers. With the increase of task description, the decreasing trend of eligible submissions in single stage contest is more significant than that in two-stage contest.*

H5b: *Contest sequence plays a moderator role in the relations between task description and the number of eligible submissions. With the increase of task description, the decreasing trend of eligible submissions in single stage contest is more significant than that in two-stage contest.*

Given a two-stage contest, in the first round the organizer expect to attain a set of solutions and then provide feedback to solvers to improve the quality of the final solution and reduce the risk; in the second round the solvers would update their previous solutions. So the solvers participate in the second stage is not limited to the results of the first stage, and they can also win the prize if the solvers can provide the eligible solution. Because the organizers will select some eligible solutions, the probability that the selected solvers win the first prize in the second round will be large and most of those who have not been selected would prefer the second prize. But in single stage contest, information of each solver is always private, so they prefer to try their best to win the first prize. This discussion is summarized in the following hypotheses.

H6a: *Contest sequence plays a moderator role in the relations between the first prize, the second prize and the number of solvers. The first prize's incentive effect on the solvers is stronger in the single stage than that in the multistage contest while the second prize's incentive effect on the solvers is weaker in the single stage than that in the multistage contest.*

H6b: *Contest sequence plays a moderator role in the relations between the first prize, the second prize and the number of eligible submissions. The first prize's negative effect on the number of eligible submissions is weaker in the single stage than that in the multistage contest while the second prize's positive effect on the number of eligible submissions is stronger in the single stage than that in the multistage contest.*

3. METHODOLOGY

3.1 Data collection

We select a famous online innovation community-Topcoder.com creative studio (studio.topcoder.com) to gather data and verify hypothesis in our research. The creative design contest tasks of Topcoder include logo design, print design, web application design, icon design, and wireframe design and so on. The total number of tasks has been completed up to 1770 in early June 2013 and 1572 of them are valid. This paper collected 823 from the 1572 tasks happened from August of 2008 to May of 2013, including 397 single-stage contests and 426 two stage contests.

Table1. Types of Innovation Contest Project in Survey Sample.

Project Types	Frequencies	%
Logo Design	77	9.4
Print/Presentation	101	12.3
Web Design	292	35.5
Application Front-End Design	60	7.3
Banners/Icons	88	10.7
Wireframes	167	20.3
Idea Generation	11	1.3
Widget or Mobile Screen Design	27	3.3
Total	823	100.0

3.2 Variables measuring

We refer to the approaches of the measurement of variables in previous research (Shao et al., 2012; Yang, 2012; Yang et al., 2009)[13,14,15], and make necessary amendments in accordance with the contents of this paper. The dependent variables in this paper are as follows: Number of Solvers (NS): measured by the actual number of participants in each contest; Number of Eligible Submissions (NES): measured by the quantity of qualified plans submitted by selected participants. The independent variables include Contest Duration (CD): measured by task deadline time minus start time; Task Description (TD): collect the descriptive information about the task requirements of each contest in Topcoder, and then extract the information of effective character description using Excel; Amount of First Prize(FP), Second Prize(SP) and Total Bonus(TB): measured by the amount of the reward provided by Topcoder.com; and Ratio of Two Prizes (RTP): measured by the ratio of the second prize and first prize, the ratio is closer to 1, indicating that the second prize is closer to the first prize. We assume that the Contest Sequence (CS) as the moderator in our paper. In Topcoder, the solvers just submit one idea or plan in a single stage of the contest to win the prize; However in a two-stage contest, the solvers must submit a draft of ideas or programs in the first stage and they need to submit final specific proposals or ideas in the second stage. A dummy variable D is introduced to encode, $D=0$ means "one-stage contest" and $D=1$ means "two-stage contest."

In addition to the above factors, the performance of contest may also be affected by market factors (Shao et al., 2012; Yang, 2012)[13,14]. On the basis of reference, Competition Intensity (CI): measured by the number of the same type contest in the same contest duration; and Market Price (MP): measured by the average contest prize of the same type contest which is being carried out or over in the front or during the contest in the community are regarded as the control variables.

3.3 Research Method and Model Estimation

A moderated multiple regression (MMR) method is used in this paper to examine whether contest sequence has moderating effect on the relationship between design elements and performance of innovation contests. In addition, in order to reflect the elasticity impact of the explanatory variables on the dependent variables and eliminate the effects of heteroscedasticity, all continuous dependent variable and independent variables are calculated by log-transformed, and then analyzed using least squares regression. Taking into account the multicollinearity between the variables, in the next regression analysis, we will place the first and second prizes in a group regression, and place the total prize and bonus distribution ratio into another set of regression in this paper. Regression model equations are listed as follows:

$$\begin{aligned} Ln(NS) = {} & \beta_{10} + \beta_{ci}Ln(CI) + \beta_{mp}Ln(MP) + \beta_{cd}Ln(CD)) + \beta_{td}Ln\ ((TD) \\ & + \beta_{fp}Ln(FP) + \beta_{sp}Ln(SP) + \beta_{cs\times cd}D \times Ln(CD) \\ & + \beta_{cs\times td}D \times Ln(TD) + \beta_{cs\times fp}D \times Ln(FP) + \beta_{cs\times sp}Ln(SP) + \varepsilon_1 \end{aligned} \tag{1}$$

$$\begin{aligned} Ln(NS) = {} & \beta_{20} + \beta_{ci}Ln(CI) + \beta_{mp}Ln(MP) + \beta_{cd}Ln(CD)) + \beta_{td}Ln\ ((TD) \\ & + \beta_{tb}Ln(TB) + \beta_{rate}Ln(RTP) + \beta_{cs\times cd}D \times Ln(CD) \\ & + \beta_{cs\times td}D \times Ln(TD) + \beta_{cs\times tb}D \times Ln(TB) + \beta_{cs\times rate}Ln(RTP) + \varepsilon_2 \end{aligned} \tag{2}$$

$$\begin{aligned} Ln\ (NES) = {} & \beta_{30} + \beta_{ci}Ln(CI) + \beta_{mp}Ln(MP) + \beta_{cd}Ln(CD)) + \beta_{td}Ln\ ((TD) \\ & + \beta_{fp}Ln(FP) + \beta_{sp}Ln(SP) + \beta_{cs\times cd}D \times Ln(CD) \\ & + \beta_{cs\times td}D \times Ln(TD) + \beta_{cs\times fp}D \times Ln(FP) + \beta_{cs\times sp}Ln(SP) + \varepsilon_3 \end{aligned} \tag{3}$$

$$\begin{aligned} Ln\ (NES) = {} & \beta_{40} + \beta_{ci}Ln(CI) + \beta_{mp}Ln(MP) + \beta_{cd}Ln(CD)) + \beta_{td}Ln\ ((TD) \\ & + \beta_{tb}Ln\ (TB) + \beta_{rate}Ln(RTP) + \beta_{cs\times cd}D \times Ln(CD) \\ & + \beta_{cs\times td}D \times Ln(TD) + \beta_{cs\times tb}D \times Ln(TB) + \beta_{cs\times rate}Ln(RTP) + \varepsilon_4 \end{aligned} \tag{4}$$

4. RESULTS

Descriptive statistical results are listed in Table2, including the mean, standard deviation and coefficient of correlation. Regression analysis results are shown in table 3. Through the multicollinearity inspection, we found that the Variance Inflation Factor (VIF) of the first prize and second prize are less than 5, and the VIF of the other independent variables are less than 2.Thus, there are no serious multicollinearity problems in multiple regression models. From table2, model 1 and model 5 analysis results show that competition intensity and market price have negative significant effect on the number of solvers(β_{ci} =-0.07,p<0.01; β_{mp} =-0.34,p<0.001) and the number of eligible submissions (β_{ci} =-0.09,p<0.01; β_{mp} =-0.51,p<0.001). It revealed that if the sponsors conducting innovation contest in large competition intensity, they may get lower innovation contest performance, and if amount of prize is lower than the market price also will lead to performance drop.

4.1 The Influence of the Design Elements

From Table3, the results of model1 and model 5 show that, contest duration has a positive significant effect on the number of solvers (β_{cd} =0.30, p<0.001) and the number of eligible submissions (β_{cd} =0.16, p<0.01), H1a and H1b were supported. However, task description does not exist negative significant effect on the number of solvers (β_{td} =0.05), hypothesis 2a wasn't stand. But task description has a negative significant influence on the number of eligible submissions (β_{td} =-0.39, p<0.001), supporting H2b. In addition, the results of model1 show that second prize has a positive significant influence on the number of solvers (β_{sp} =0.09, p<0.05), but first prize has no significant influence on the number of solvers (β_{fp} =-0.04), H3a was part supported. The results of model5 show that first prize has a negative significant influence on the number of eligible submissions (β_{fp} =-0.44, p<0.001), but second prize has a positive significant influence on the number of eligible submissions (β_{sp} =0.24, p<0.01), H3b was supported. From the regression results of model 3 and model 7, we further find that if the proportion of the second prize bonus get greater, the number of solvers (β_{rate} =0.08, p<0.1) and eligible submissions (β_{rate} =0.29, p<0.001) will be increased.

4.2 The Moderating Effect of Contest Sequence

From table3, the MMR analysis results of model2 and model6 show contest sequence plays a significant moderator role in the relations between contest duration and the number of solvers($\beta_{cs\times cd}$ =-0.04, p<0.05), and the relations between contest duration and the number of eligible submissions($\beta_{cs\times cd}$ =-0.06, p<0.1). From Figure1, we find that with the extension of contest duration, the number of solvers and eligible submissions in one-stage contest has a more significantly increasing than in two-stage contest, H4a and 4b were supported. Moreover, contest sequence also plays a significant moderator role in the relations between task description and the number of solvers ($\beta_{cs\times cd}$ =0.06, p<0.05), and eligible submissions ($\beta_{cs\times cd}$ =0.08, p<0.05). From Figure2, with the increasing of task descriptive, the number of solvers increase in one-stage contest, but decrease in two-stage contest, moreover, the number of eligible submission fall more intense in one-stage contest than two-stage contest, H5a and H5b were supported.

The results of model2 and model6 show that contest sequence plays a significant moderator role in the relations of the first prize, the second prize and the number of solvers ($\beta_{cs\times fp}$ =-0.07, p<0.05; $\beta_{cs\times sp}$ =0.09, p<0.01). Contest sequence also plays a significant moderator role in the relations of the first prize, the second prize and the number of eligible submissions ($\beta_{cs\times fp}$ =-0.11, p<0.1; $\beta_{cs\times sp}$ =0.09, p<0.1). Figure3 shows with the increase of amount of the first prize, the number of solvers participating in one-stage contest is more than in two-stage contest, and the number of eligible submissions in one-stage contest is more than in two-stage contest, H6a was supported. From Figure4, with the rising of amount of the second prize, the number of solvers and eligible submissions have significant increase in one-stage contest, but the number of solvers dropped in two-stage contest, the number of eligible submissions shows a straight line, H6b was supported. From Figure5, we further find with the proportion of second prize increasing, the number of solvers and eligible submissions are significantly increased.

Table2. Means, Standard Deviations and Correlations of the Variables [a].

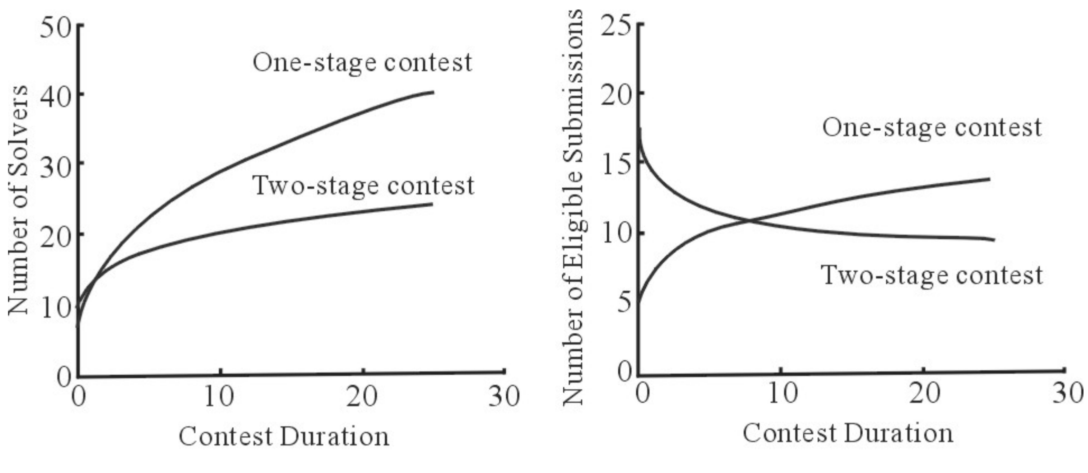
Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1. Competition Intensity	3.78	3.55										
2. Market Price	1108.	467.6	0.55									
3. Contest Duration	6.77	3.91	0.43	0.36								
4. Task Description	6527.	1775.	0.24	0.34	0.26							
5. Total Prize	1258.	701.0	0.42	0.63	0.55	0.48						
6. Amount of First Prize	833.8	445.2	0.36	0.58	0.48	0.41	0.96					
7. Amount of Second	249.4	139.9	0.31	0.51	0.43	0.38	0.87	0.83				
8. Rate of Two Prizes	0.31	0.10	-0.10	-0.09	-0.08	-0.08	-0.14	-0.25	0.25			
9. Contest Sequence	0.52	0.50	0.50	0.60	0.56	0.48	0.62	0.46	0.41	-0.11		
10. Number of Solvers	21.7	11.41	-0.17	-0.33	0.25	-0.06	-0.07	-0.08	-0.03	0.07	-0.11	
11. Number of Eligible	14.09	13.45	-0.21	-0.36	0.06	-0.16	-0.24	-0.28	-0.20	0.13	-0.06	0.65

[a] n=823; all correlations larger than 0.07 are significant at p<0.05.

Table3. Results of Regression Analysis[b].

	Dependent Variables							
	Number of Solvers				Number of Eligible Submissions			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Controls								
Constant	4.18***	4.25***	4.17***	4.11***		10.69***		10.78***
Competition Intensity	– 0.07**	– 0.08*	– 0.07**	– 0.08**	– 0.09*	– 0.10*	– 0.09*	– 0.09*
Market Price	– 0.34***	– 0.31***	– 0.35***	– 0.31***	– 0.51***	– 0.47***	– 0.53***	– 0.48***
Independent Variables								
Contest Duration		0.29**	0.30***	0.28***	0.16**	0.14**	0.15**	0.12*
Task Description	0.05	0.01	0.05	0.01^{+}	– 0.39***	– 0.45***	– 0.40***	– 0.46***
Amount of First Prize	– 0.04	– 0.05			– 0.44***	– 0.47***		
Amount of Second Prize	0.09*	0.13**			0.24**	0.28**		
Total bonus			0.07*	0.10**			– 0.18**	– 0.17**
Rate of Two Prizes			0.08^{+}	0.11*			0.29***	0.33***
Contest Sequence	– 0.05	– 0.05	– 0.07	– 0.08*	0.66***	0.67***	0.70***	0.71***
Interactions								
Contest Sequence×Contest Duration		– 0.04*		– 0.04*		– 0.06^{+}		– 0.07*
Contest Sequence×Task Description		0.06*		0.06**		0.08**		0.08**
Contest Sequence×Amount of First Prize		– 0.07*				– 0.11^{+}		
Contest Sequence×Amount of Second Prize		0.09**				0.09^{+}		
Contest Sequence×Total bonus				0.03				0.00
Contest Sequence×Rateof Two Prizes				0.04**				0.05^{+}
R^2	0.28	0.30	0.28	0.30	0.24	0.26	0.24	0.25
F	44.47***	31.28***	44.84***	31.70***	36.97***	25.19***	36.46***	24.91***
ΔR^2		0.02***		0.02***		0.02**		0.01**

[b] n=823; $^{***}p<0.001$; $^{**}p<0.01$; $^{*}p<0.05$; $^{+}p<0.1$.



(a) (b)

Figure1. Interactive effects of contest sequence on contest duration, the number of solvers and eligible submissions.

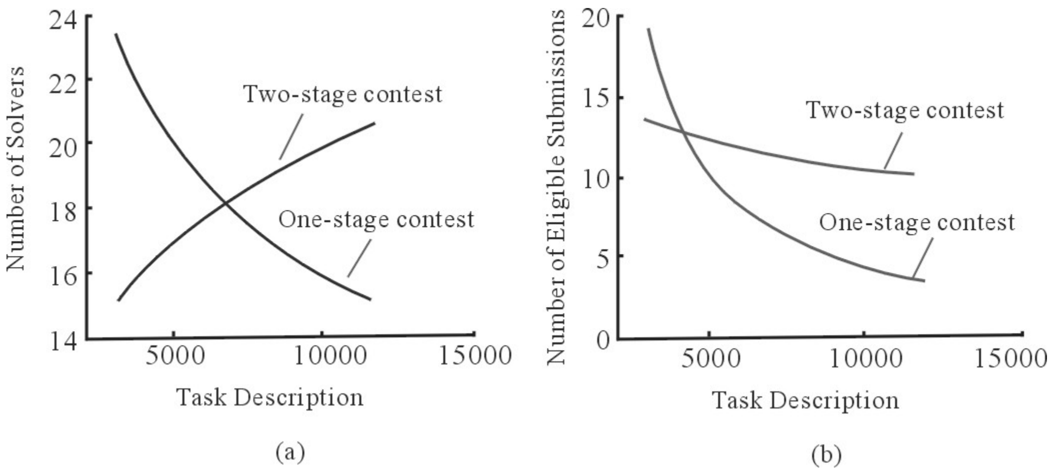


Figure2. Interactive effects of contest sequence on task description, the number of solvers and eligible submissions.

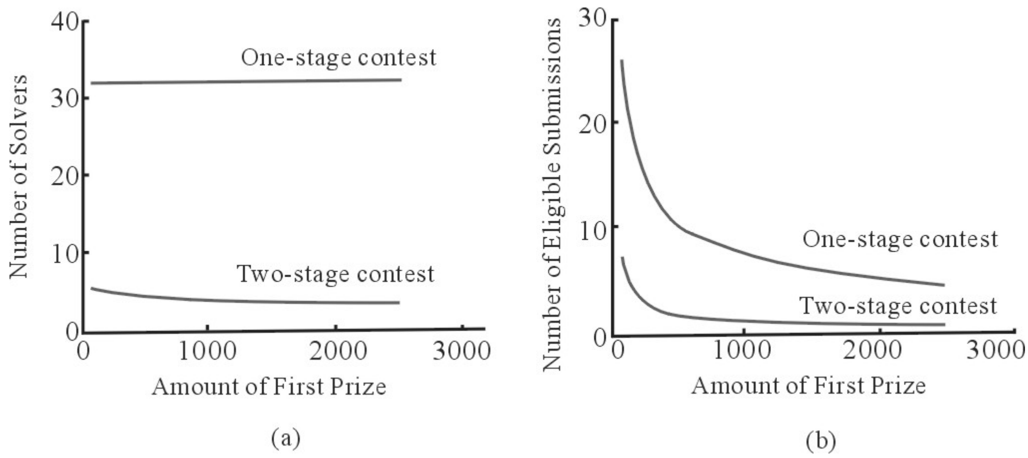


Figure3. Interactive effects of contest sequence on amount of first prize and the number of solvers and eligible submissions.

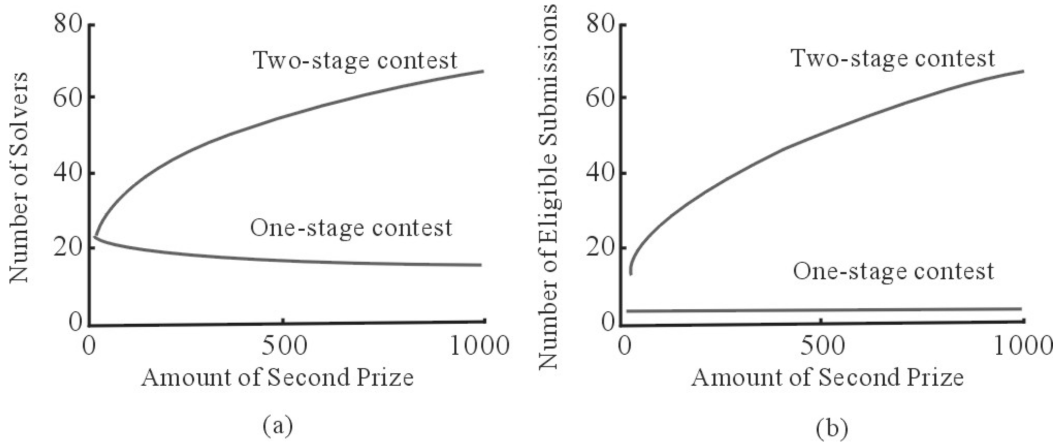


Figure4. Interactive effects of contest sequence on amount of second prize and the number of solvers and eligible submissions.

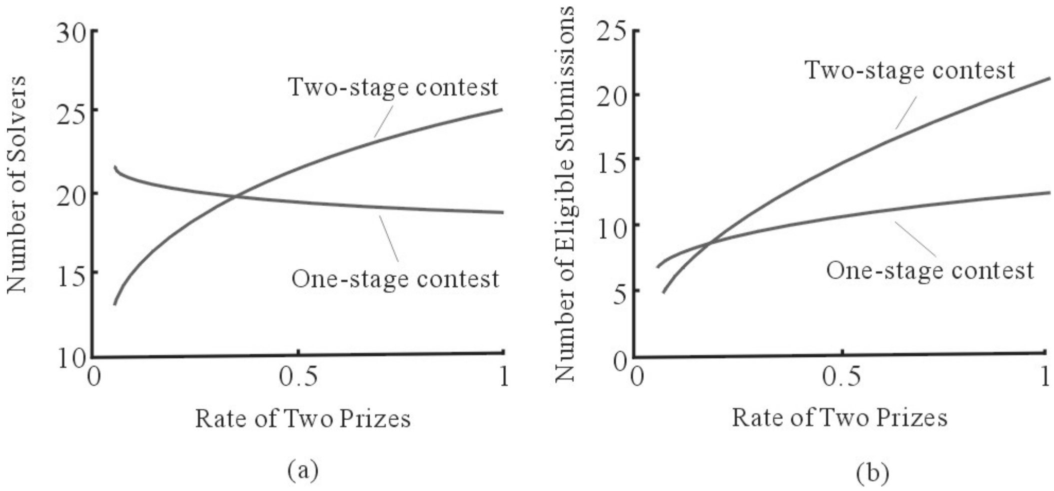


Figure5. Interactive effects of contest sequence on rate of two prizes and the number of solvers and eligible submissions.

5. DISCUSSIONS AND IMPLICATIONS

This study empirically analyzes the factors affecting the performance of online innovation contest from the perspective of design elements. In this study, we also deeply discuss the mechanism of design elements on innovation contest performance under different contest sequences. Analyzing detailed data from 823 innovation contests, we find the following conclusions:

(1) The longer the contest duration, the higher contest performance in the one-stage contest than that in the two-stage contest. Prior studies (Shao et al., 2012; Yang et al., 2009)[13,15]only indicate a positive correlation between the length of contest duration and the contest performance. However, in this paper, the analysis results show that with the extension of contest period, the number of solvers and eligible submissions are significantly increased in the one-stage contest, but the growth trend of the number of solvers is weak and the number of eligible submissions is falling. This is because that the contest duration of single stage is relatively short (average 4.5 days) and extending it can help solvers whose spare time is insufficient to participate in the contest and complete the task, however the contest duration of the two-stage is relatively long (average 8.9 days), the effect of extending the contest duration on the promotion of competition performance is not significant, on the contrary, some solvers might give up halfway because competition time is too long and the cost input is too high.

(2) Too much detailed task description will reduce the performance of the one-stage contests, while attract more solvers in the two-stage contests. Previous research was just pointed out that too much description can reduce the contest performance (Shao et al., 2012; Yang et al., 2009)[13,15], but does not take the influence of different race sequence into account. This paper found that different task descriptions have different influence on the innovation contest performance under different competition sequences. It indicates that, the contest duration of single stage is relatively short and the solvers are limited by their free time more obviously. The longer the task description, the higher demands of the detailed and accuracy level about the submissions. These cause the solvers with insufficient spare time give up to participate in or quit halfway which is because the opportunity cost is too high, thereby reducing the performance of the whole innovation contest. The contest duration of the two-stage is relatively longer, the solvers have relatively enough time to complete the race tasks. The task description is more detailed so that the solvers can grasp the requirements of the organizers about the final submissions more accurately, so as to have more confidence to win, therefore, the participation enthusiasm of the solvers are higher.

(3) The effect of the first prize incentive for the solvers in the single stage is stronger than that in the two-stage; as for the second prize, the conclusion is opposite, and if the amount of the two prizes is more close, the number of solvers and eligible submissions is larger. Prior literatures using the game model noted that the effect of incentive and the contest performance of the second prize is always less than that of the first prize (DiPalantino & Vojnovic, 2009; Terwiesch & Xu, 2008)[7,29]. But in this paper, the empirical results show that the incentive effect of the first prize for the solvers is only significant in the single stage contest but not in the two-stage contest. Although the incentive effect of second prize is smaller than that of the first prize in a single stage contest but is larger in the two-stage contests, and if the second prize is more close to the first prize, the incentive effect of solvers participate in and complete the task is greater. Thus it can be seen, adopting the winner-take-all reward mechanism is optimal in a single stage contest, however multi-awards mechanism can improve the whole performance in the multi-stage contests.

The conclusions above sends us the message that, in practice, to improve the performance of online innovation contests can be considered from the following aspects: organizers descript the task abstract for the innovation problem with high degree of uncertainty which can leave large creative space for the solvers, so the organizers can consider to choose a single stage competition sequence and adopt the winner-take-all reward mechanism to attract high level solvers to participate in the contest and make more solvers submit solutions by setting a longer contest duration. Organizers descript the task specific for the innovation problem with high degree of certainty so that organizers can consider choosing multi-stage competition sequence and multiple awards in order to attract more solvers to participate in the contest and submit the plan.

6. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The aim of this article is to conduct the empirical study about the impact of online innovation contest's design elements on the performance of innovation contest, and analyzes different contest sequences' effects on influence factors of innovation contest's performance and explores effective mechanisms in online innovation environment, providing a basis for the applications of online innovation contest and the design of effective contest mechanisms. However, the shortage of this paper is that this is mainly involved in creative projects not refer to the professional knowledge and trial and error projects, so we can study the effect factors of different types of innovation contest projects on performance. In addition, this paper only analyzes the problems from the angle of competition design elements, if further research can be combined with the characteristics of the solvers(such as risk appetite) to analyze the effect of elements on the performance of innovation contest, the accuracy of the research conclusion will be higher.

ACKNOWLEDGEMENT

This research was supported by the National Natural Science Foundation of China under Grant 71371088.

REFERENCES

[1] Piller, F. T., & Walcher, D. (2006). Toolkits for idea competitions: A novel method to integrate users in new product development. R&D Management, 36(3), 307-318.

[2] Jeppesen, L. B., & Lakhani, K. R. (2010). Marginality and problem-solving effectiveness in broadcast search. Organization Science, 21(5), 1016-1033.

[3] Brabham, D. C. (2008). Crowdsourcing as a model for problem solving: An introduction and cases. Convergence: The International Journal of Research into New Media Technologies, 14(1), 75-90.

[4] Poetz, M. K., & Schreier, M. (2012). The value of crowdsourcing: Can users really compete with professionals in generating new product ideas? Journal of Product Innovation Management, 29(2), 245-256.

[5] Bullinger, A. C., et al. (2010). Community-based innovation contests: Where competition meets cooperation. Creativity and Innovation Management, 19(3), 290-303.

[6] Adamczyk, S., Bullinger, A. C., & Möslein K. M. (2012). Innovation contests: A review, classification and outlook. Creativity and Innovation Management, 21(4), 335-359.

[7] Terwiesch, C., & Xu, Y. (2008). Innovation contests, open innovation, and multiagent problem solving. Management Science, 54(9), 1529-1543.

[8] Boudreau, K. J., Lacetera, N., & Lakhani, K. R. (2011). Incentives and problem uncertainty in innovation contests: An empirical analysis. Management Science, 57(5), 843-863.

[9] Che, Y. K., & Gale, I. (2003). Optimal design of research contests. American Economic Review, 93(3), 646-671.

[10] Archak, N. (2010). Money, glory and cheap talk: analyzing strategic behavior of contestants in simultaneous crowdsourcing contests on TopCoder.com. In: Proceedings of the 19th international conference on World wide web, 21-30.

[11] Giebe, T. (2014). Innovation contests with entry auction. Journal of Mathematical Economics, 55, 165-176.

[12] Cason, T. N., Masters, W. A., & Sheremeta, R. M. (2010). Entry into winner-take-all and proportional-prize contests: An experimental study. Journal of Public Economics, 94(9), 604-611.

[13] Shao, B., et al. (2012). Factors affecting participation of solvers in crowdsourcing: An empirical study from China. Electronic Markets, 22(2), 73-82.

[14] Yang, Y. (2012). Open innovation contests in online markets: Idea generation and idea evaluation with collective intelligence. PhD thesis, Philadelphia: Temple University.

[15] Yang, Y., Chen, P., & Pavlou, P. (2009). Open innovation: an empirical study of online contests. In: Proceedings of the 30th International Conference on Information Systems, 1-15.

[16] Moldovanu, B., & Sela, A. (2006). Contests architecture Journal of Economy Theory, 126(1), 70-96.

[17] Sheremeta, R. M. (2011). Contest design: an experimental investigation. Economic Inquiry, 49(2), 573-590.

[18] Archak, N., & Sundararajan, A. (2009). Optimal design of crowdsourcing contests. In: Proceedings of the 30th International Conference on Information Systems, 1-16.

[19] Szymanski, S., & Valletti, T. M. (2005). Incentive effects of second prizes. European Journal of Political Economy, 21(2), 467-481.

[20] Fu, Q., & Lu, J. (2012). The optimal multi-stage contest. Economic Theory, 51(2), 351-382.

[21] Terwiesch, C., & Ulrich, K. T. (2009). Innovation tournaments: Creating and selecting exceptional opportunities. Boston: Harvard Business School Press.

[22] Bayus, B. L. (2013). Crowdsourcing new product ideas over time: An analysis of the Dell IdeaStorm community. Management Science, 59(1), 226-244.

[23] Lüttgens, D. et al. (2014). Wisdom of the crowd and capabilities of a few: Internal success factors of crowdsourcing for innovation. Business Economics, 84:339-374.

[24] Liu & Lu. (2014).The effort-maximizing contest with heterogeneous prizes. Economics Letters, 125: 422-425.

[25] Lakhani, K. R., et al. (2007). The value of openness in scientific problem solving. Working paper (No 07-050), Harvard Business School.

[26] Brabham, D. C. (2010). Moving the crowd at Threadless: Motivations for participation in a crowdsourcing application. Information, Communication & Society, 13(8), 1122-1145.

[27] Liu, T. X., et al. (2011). Crowdsourcing with all - pay auctions: A field experiment on Taskcn. Proceedings of the American Society for Information Science and Technology, 48(1), 1-4.

[28] Sun, Y., Fang, Y., & Lim, K. H. (2012). Understanding sustained participation in transactional virtual communities. Decision Support Systems, 53(1), 12-22.

[29] DiPalantino, D., & Vojnovic, M. (2009). Crowdsourcing and all-pay auctions. In: Proceedings of the 10th ACM conference on electronic commerce, 119-128.