

Accepted by *Industrial Management & Data System* (2020)

Title

Improving the effectiveness of social media based crowdsourcing innovations: Roles of assurance mechanism and innovator's behaviour

Yefei Yang (Logistics Management, Beijing Jiaotong University, Beijing, China); Ciwei Dong and Xin Yao (Zhongnan University of Economics and Law, Wuhan, China); Peter K.C. Lee and T.C.E. Cheng (Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University, Kowloon, Hong Kong)

Abstract

Purpose – With the development of social media and Internet technology, many firms have started to use various crowdsourcing innovations platforms to operate their open innovation business modes. The purpose of this study is to explore how such platforms' assurance mechanisms enhance the effectiveness of crowdsourcing innovations and how to apply assurance mechanism to handle different innovation tasks, thereby motivating more seekers to use crowdsourcing innovations.

Design/ methodology/ approach – The authors use a Python-based technology to collect the research data comprising 2,302 solvers and 8,390 trade records from zbj.com and apply statistical methods to test the postulated hypotheses.

Findings – The effectiveness of assurance mechanism is confirmed by its positive relationship with solver's behaviour, thereby improving seeker's retention behaviour. However, task complexity, task novelty, and task professionalization have different moderating effects on the relationships among assurance mechanism, solver's (innovator's) behaviour, and seeker's behaviour.

Research limitation/implications – This study enriches the literature on crowdsourcing innovations and extends the application of uncertainty reduction theory to innovation research. It also makes the theoretical contribution that the assurance mechanism adopted by the platform has different impacts on user's behaviour depending on the task characteristics.

Practical implications – The findings provide guidance to the platform operator on how to design the assurance mechanism to match the innovation task and innovator's behaviour to

reduce seeker's uncertainty, thereby facilitating the seeker's decision-making.

Originality/value – A particular value of this study lies in exploring the impact of the platform assurance mechanism of social media based crowdsourcing innovations on innovator's behaviour, which may further improve seeker's behaviour, based on uncertainty reduction theory.

Keywords: crowdsourcing innovations, uncertainty reduction theory, effectiveness, social media

1. Introduction

Innovation is a core competitive advantage of firms to achieve sustainable development (Chan et al., 2016). There is a trend that firms gradually expand their innovations from internal innovation that relies on R&D to open and external-oriented innovation that relies on customers, suppliers, and crowd sources (Johannessen and Olsen, 2010). With the increasing popularity of social media (Guo et al., 2020), “Internet plus”, and equality of information transformation, many firms have begun to use various crowdsourcing social media platforms to operate their open innovation business modes (e.g., IBM, General Motors, Procter & Gamble (P&G) and BMW) (Bayus, 2013). Crowdsourcing innovations refer to organizational efforts that seek creative business solutions and product/service innovations from the collective wisdom and expertise of pervasive social media platform users (Simula and Ahola, 2014; Fu et al., 2018; Hua et al., 2019). Indeed, there is evidence on the effectiveness of crowdsourcing innovations (e.g. providing low-cost problem-solving solutions and novel ideas for firms) (Boudreau et al., 2011).

However, such success is unlikely ubiquitous among crowdsourcing platforms and their users. Many crowdsourcing platforms are experiencing relatively small trade volumes from problem seekers and solvers, and finally many users fail to obtain innovation solutions and withdraw from the platforms (Jeppesen et al., 2010). For example, analyzing our collected service data, we found that on the platform of ZBJ Network, Inc. (<https://www.zbj.com/>), a famous Chinese crowdsourcing innovations platform focusing on various business solutions (e.g., product design, promotion, taxation, IT and technology development), 90.4% of solvers had no trade volume in the most recent three months and 32.5% of the innovation service tasks could not get the expected effective solutions. Indeed, some researchers have indicated that the ineffective crowdsourcing innovations platform can be attributed to several reasons (e.g., Wagorn, 2014; Malhotra and Majchrzak, 2014; Jean Pierre et al., 2019): 1) the risk of firms’ important information disclosure. Crowdsourcing is outsourced to groups of people that are undefined for firms to help them solve the problem by providing important information, which may create some risks of information disclosure. 2) Lack of confidence in the solver’s capability. Problem seekers face the difficulty of selecting suitable solvers and communicating with solvers about their problems, leading to some off-target and out-of-scope innovation services. Also, most of the current studies on the effectiveness of crowdsourcing innovations focus on whether the solvers can generate new ideas or how to organize the crowdsourcing

contest (Boudreau et al., 2011; Bockstedt et al., 2016). Little literature has studied how to mitigate the above uncertainties of crowdsourcing, i.e., concerning the possibility of information leverage and undefined crowds, to enhance the effectiveness of crowdsourcing innovations platform.

In our study, based on uncertainty reduction theory (URT) (Berger and Calabrese, 1975), the problem seeker is inclined to resort to the information-seeking behaviour, i.e., conducting comprehensive information search and detailed information search, to acquire more information about the solver to reduce their uncertainty, thereby enhancing their cooperation with the solver. Thus, we attempt to integrate the platform's assurance information and the solver's behavioural information as key quality information to meet the seeker's information-seeking requirements, which helps build trust between the seekers and innovators. Based on the literature on platform assurance practices of e-commerce (Nöteberg et al., 2003; Bolton et al., 2004) and service providers' attributes of e-commerce (Tseng et al., 2018), this study proposes two different kinds of assurance practices in online platform operations, namely *monetary guarantee* and *grade evaluation*, and two different aspects of solver's behaviour information, namely *task completion level* and *credibility level*. Also, continuous cooperative relationship between the seeker and solver is reflected by the seeker's retention behaviour. Consequently, this study examines the interactions among platform assurance mechanism, solver's behaviour, and problem seeker's behaviour.

Besides the platform mechanism and solver's behaviour, the effectiveness of crowdsourcing innovations is highly relevant to the types of innovation problems (Afuah and Tucci, 2012; Felin and Zenger, 2014). The types of innovation problems directly influence the solver's participation behaviour and effectiveness in solution generation (Boudreau et al., 2011; Felin and Zenger, 2014), and determine the problem seeker's requirements and expectations (Lopez-Vega et al., 2016). For different innovation problems, the solver could consider their existing knowledge in their knowledge domain and evaluate their benefits before deciding their participation in dealing with the problems (Bockstedt et al., 2016), thereby leveraging the role of platform mechanisms. Also, different types of innovation problems prompt the seeker to propose different solution spaces and different expectations about the optimal solutions (Lopez-Vega et al., 2016), which require different levels of solver's participation and problem-solving, thereby leveraging the effect of historical behaviour information on seeker's retention. The literature classifies innovation problems into dimensions, such as complexity, novelty, and

professionalization. Hence, we further explore the leverage roles of task complexity, task novelty, and task professionalization in the relationship among platform uncertainty reduction practice, solver's behaviour, and seeker's behaviour.

This study mainly focuses on following problems: 1) how platform's assurance mechanism influences solver's behaviour; 2) how solver's behaviour influences seeker's retention behaviour; and 3) how innovation problems type moderates these links. The posited hypotheses are shown in Figure 1. The study conducts a series of statistical analysis based on data comprising 2,302 solvers and 8,390 different tasks from a large crowdsourcing platform (zbj.com) in China. We find that assurance mechanisms positively influence solver's task completion level and credibility level, thereby increasing seeker's retention level. Also, under the circumstances of innovation tasks with different levels of complexity, novelty, and professionalization, the effects of assurance mechanism and solver's behaviour on seeker's retention are significantly different. These findings provide empirical support to many of the theoretical concepts in the relevant literature concerning how to enhance online crowdsourcing effectiveness (e.g., Malhotra and Majchrzak, 2014) and enrich the relevant literature on crowdsourcing innovations and assurance mechanisms. The findings also provide managerial insights on how to enhance the effectiveness of crowdsourcing innovations by developing social media based platforms.

(~Figure 1 here~)

2. Literature review

2.1 Crowdsourcing innovations

Crowdsourcing is conceptualized as outsourcing the job to an undefined group by an open call instead of specific and designated employee (Hwang et al., 2019; Boons and Stam, 2019). With the development of web 2.0 and online social network, crowdsourcing technological platforms as useful tools change innovation mode and provide the possibility of crowd innovation (Zhan et al., 2018; Boons and Stam, 2019). Studies on crowdsourcing innovations mainly focus on the configuration of various crowdsourcing types to the innovation of firms (Simula and Ahola, 2014; Deng et al., 2019), motivation of crowdsourcing participation (e.g., monetary, knowledge achievement and reputation) (e.g., Acar, 2019) and the comparison between users' idea and professions' idea (e.g., Poetz and Schreier, 2012). Also, some studies in the literature emphasize that quality issues of innovation are important and

inherent problems in the crowdsourcing platforms due to undefined crowds (e.g., Acar, 2019). To solve the quality problems in crowdsourcing marketing, some researchers propose that assurance mechanism can build trust and enhance the willingness of disclosing private information (e.g., Bansal et al., 2015), while others emphasize that assurance mechanism plays a very limited role in quality improvement and hinders solvers' innovation (e.g., Schulze et al., 2013). Therefore, whether assurance mechanism can solve the quality issues and enhance the effectiveness of crowdsourcing innovation needs to be further explored.

2.2 Uncertainty reduction theory, assurance mechanisms, and innovator's behaviours

Uncertainty reduction theory (URT) refers to that strategies in their interaction processes need to continuously reduce the uncertainty to increase the probability of predicting others' behaviours (Berger and Calabrese, 1975; Kellerman and Reynolds, 1990). URT suggests that information-seeking strategies are an important way for people to reduce uncertainty in interpersonal interaction circumstances before they communicate with one another directly. Specifically, information-seeking strategies include reactivity search, which individuals conduct to observe the target person by historical service information, and disinhibition search, which individuals conduct to gather important details beyond service observation about the target person's proactive behaviours (Berger & Bradac, 1982; Knobloch, 2015). As regards interpersonal communication, URT states that individuals could evaluate their partners' values and behaviours to further reduce their uncertainty in building ongoing relationships (Berger & Bradac, 1982; Knobloch, 2015). Also, the related literature has begun to use URT in various online settings, such as peer-to-peer lodging platforms and house renting platforms, and has examined if information cues can reduce uncertainty in interpersonal interaction (Larrimore et al., 2011). In our study, the problem seekers perceive that they pose problems for the crowds to examine and find solutions, which may involve innovator uncertainty and problem-solving uncertainty (Boudreau et al., 2011; Schäfer et al., 2017).

Viewed from URT (Knobloch and McAninch, 2014), the problem seekers are inclined to adopt the reactivity and disinhibition information-seeking behaviours to search more information to reduce their uncertainty. The assurance mechanism provided by the crowdsourcing platform can provide different kinds of quality information to meet the problem seekers' information-seeking requirements, and help build trust between the innovators and seekers (Pavlou et al., 2007; Dimoka et al., 2012). The assurance mechanism is generally classified into two categories, namely the default-independent and default-contingency

mechanisms. The former is adopted for general transactions, which could not provide direct protection for the buyers (e.g., a grade evaluation system), whereas the latter is adopted for specific transactions, which offers direct protection (e.g., money back guarantee) for the buyers (Kirmani and Rao, 2000; Li et al., 2009). Thus, in our study, we choose the grade evaluation system as the default-independent mechanism and monetary guarantee as the default-contingent mechanism to examine whether the assurance mechanism can meet the seekers' information searching needs, thereby reducing their uncertainty.

After the problem seekers complete the initial information searching process, they still need to evaluate their innovators' values, attributes, and behaviours to reduce the uncertainty concerning the maintenance of on-going relationships (Knobloch, 2015). Innovators' (solvers') interaction behaviours become the evaluation criterion for determining whether the relationships between the seekers and innovators can be established. The task completion level reflects the innovators' performance in undertaking different innovation tasks, which can generate some information about the innovators' capabilities such as work competence. Innovators' credibility levels, which are different from work capabilities, reflect the innovators' business ethics and are important information for continuous interactions and computer-mediated communication (Gibbs et al., 2011). Thus, we propose that the problem seekers use task completion level and credibility level, as information cues to help reduce innovator uncertainty and problem-solving uncertainty, facilitating on-going cooperative relationships with the innovators.

3. Hypothesis development

3.1 Assurance mechanisms, solver's behaviour and seeker's retention behaviour

Monetary guarantee mechanism involves specific service and offers the monetary protection for buyers (Kirmani and Rao, 2000). Under such mechanism, platform operators use monetary compensation offered by solvers to assure that a level of services provided can meet seekers' requirements (Wang et al., 2018). Viewed from the URT (Boudreaudet al., 2011), monetary guarantee can be perceived as quality signal for problem seekers in reducing their uncertainty in initial information-seeking stage, which facilitates their interaction with innovators proactively. Also, in the interaction process, it can impel the innovators to make great effort to complete their tasks to avoid their money loss, thereby improving their commitment to work. In addition, it usually involves the privacy protection and security policy

(Kim and Benbasat, 2009), which avoid problem seekers' information leakage, thereby improving solvers' credibility. All in all, monetary guarantee mechanism can enhance innovation tasks completion level and solvers' credibility. Such behaviours or outcomes can offer evidence for problem seekers to reduce the uncertainty of maintaining on-going relationship, thereby enhancing seekers' retention.

Grade evaluation system has become the service providers' competition advantage in online markets (Delgado-Ballester et al., 2008), which can also provide the quality information for problem seekers to reduce their uncertainty of innovative crowd, helping push their interaction forward smoothly. Thus, viewed from the URT (Knobloch and McAninch, 2014; Knobloch, 2015), innovation solvers make more efforts to advance their reputation ranking by making effort to complete the different kinds of tasks and offering the superior service to show their credibility. In turn, solvers' task completion level and their credibility can be as approaches to reduce the uncertainty from interaction process of generating innovation solutions, i.e., lack of confidence in their problem-solving capacity and the protection of company private information. Consequently, we propose:

H1: a) Monetary guarantee mechanism and b) Grade evaluation mechanism positively influence the solvers' behaviour, further increasing the seekers' retention behaviours.

3.2 The moderating effect of task complexity

Campbell (1988) proposes four basic characteristics for the task complexity, i.e., multiple path ways, multiple outcomes, conflicting interdependence among ways and outcomes, and many probability linkages among ways. Complex patterns of actions are more difficult to learn, control and change for performer than simple one, because they need greater behavioural and multifaceted information processing demands (Hærem et al., 2015). To avoid the risk of monetary loss and establish the cooperated relationship with seekers, solvers in the initial interaction with seekers will analyze complex tasks more accurately and realistically, and decompose the complex problems into simple sub-tasks to assure the accomplishments of the complex tasks, reducing their uncertainty of innovation process. Also, the monetary guarantee for complex task is relevantly high, which hinder seekers' information disclosure to their competitor, thereby enhancing the effectiveness of monetary guarantee on solver's credibility.

However, grade evaluation mechanism tends to reflect the sellers' quality in general transaction and have no interdependent loss for sellers' default in the online marketplace

(Kirmani and Rao, 2000). Under the circumstances of complex tasks, the uncertainties in interaction process between seekers and innovators could increase. Solvers without substantial loss are less likely to evaluate their ability and resources cautiously in completing such complex tasks, which results in the difficulty of achieving optimal solution, thereby influencing their tasks completion level. Also, solvers with complex tasks are inclined to focus on the challenging tasks, thereby placing the credibility level of the less important position. Consequently, we propose:

H2a-b: Task complexity can positively moderate the relationship between the monetary guarantee and a) solvers' task completion level; b) solvers' credibility.

H2c-d: Task complexity can negatively moderate the relationship between the grade evaluation system and c) solvers' task completion level; d) solvers' credibility.

In addition, under the circumstances with task complexity, problem seekers could pay more attention to solvers' task completion level as their assessment standard for problem-solving capabilities, thereby making decision for crowdsourcing innovations. Also, complex tasks need more seekers' information to obtain the optimal solutions, which could further increase the risk of information leakage. Thus, problem seekers with complex tasks are inclined to select high level of credible solvers. Consequently, we propose:

H3a-b: Task complexity can positively moderate the relationship between a) solver's task completion level; b) solvers' credibility level, and seeker's retention behaviour.

3.3 The moderating effect of task novelty

Task novelty can be reflected by the novel extent of task content, involving high level of creativity (Kaufmann, 2004). Novel problems need to be performed by novel technology, novel user interface and novel scheme and their solutions are difficult to draw from long-term memory and experiences (Tomasi et al., 2018). Due to some conflicts between individuals' resources and the tasks' requirements, an individual could spend more energy to compensate their cognition defects (Tomasi et al., 2018). In crowdsourcing innovations platforms, tasks with high level of novelty could be unfamiliar and non-routine innovation problems. Based on the URT, facing higher level of uncertainty, seekers could have much higher requirements to innovators to reduce their uncertainty (Knobloch, 2015). However, such high level of novel tasks could be beyond the prior knowledge that is generated by similar tasks stored in solvers'

memory. Thus, under such circumstances, the incentive effect of assurance mechanisms on solvers' problem-solving and participation behaviour is limited. In addition, solvers with high-novelty tasks take new and novel alternatives to serve the seekers, which could lead to assurance mechanisms taking a limited role in their control in solvers' credibility behaviour. Consequently, we propose:

H4a-b: Task novelty can negatively moderate the relationship between monetary guarantee and a) solvers' tasks completion level; b) solvers' credibility level.

H4c-d: Task novelty can negatively moderate the relationship between grade evaluation system and c) solvers' tasks completion level; d) solvers' credibility level.

In addition, viewed from the URT (Knobloch, 2015), high level of uncertainty impels the individuals to conduct more information seeking activities and pay more attention to detailed interaction process. The evidences in the decision literature indicate that the novelty situation could stimulate much scrutiny in decision-making process and increase the depth and width of information searching and assessment processes (Tyszka, 1986). Thus, in the context of crowdsourcing innovations, seekers with high-level novel tasks are more likely to use analytic and elaborate ways to evaluate the innovation solvers' capability. Thus, we propose:

H5a-b: Task novelty can positively moderate the relationship between a) solvers' task completion level; b) solvers' credibility level, and seeker's retention behaviour.

3.4 The moderating effect of task professionalization

Task professionalization refers to that the essential nature of tasks and solutions need to be understood and proposed by some professionals with certain body of knowledge (Malhotra et al., 2006). Also, the study on professionalization emphasized that it amplifies professionals' preference for autonomy and self-regulation (Von Nordenflycht et al., 2010). Thus, in crowdsourcing platforms, when solvers choose to participate in solving the professionalized tasks, they should have a strong body of knowledge base and the ideology with normal code and self-regulation, thereby weakening the role of assurance mechanisms in controlling behaviours. Also, the tasks with high level of professionalization increase service uncertainty for seekers. Based on the URT (Knobloch, 2015), seekers are more likely to concentrate on the details in the innovation process of these tasks to reduce their uncertainty rather than generally search their comprehensive evaluation, i.e., assurance mechanisms. As a

result, under the circumstances with professional tasks, assurance mechanisms could take limit role in influencing solvers' behaviours. Consequently, we propose:

H6a-b: Task professionalization can negatively moderate the relationship between monetary guarantee and a) solvers' tasks completion level; b) solvers' credibility level.

H6c-d: Task professionalization can negativity moderate the relationship between grade evaluation system and c) solvers' tasks completion level; d) solvers' credibility level.

A high level of task professionalization may create information asymmetry for problem understanding and solving between the agent and non-expert clients, which causes the difficulty in evaluating the outcomes for clients (Levin and Tadelis, 2005). Thus, some historical evaluations are sought as the quality signal (Greenwood et al., 2005). Thus, to reduce the uncertainty, the seeker is more inclined to search some historical information, i.e., solver's task completion level and credibility level, as their quality cues, thereby increasing their effectiveness of such information cues on seeker's behaviour. Consequently, we propose:

H7a-b: Task professionalization can positively moderate the relationship between a) solvers' task completion level; b) solvers' credibility level, and seeker's retention behaviour.

4. Research method

4.1 Research setting, data collection and variable measurements

The context of this research is zbj.com (ZBJ), the largest crowdsourcing business solution platform in China, which has over 19 million registered users and launched a global online crowdsourcing service website (witmart.com) to facilitate oversea users. Also, industrial design as one of the popular services in ZBJ's platform, includes product design, mechanical design, hardware development, and mold design. In addition, problem solvers can easily post their ability and the service they can provide by opening an online account in the ZBJ's crowdsourcing platform and then solution seekers can match their requirements and abilities and get contacted with problem solvers within the platform. After each service is completed, the solution seekers can evaluate the solutions and the innovators. Thus, based on proposed a large scale of users, rich crowdsourcing resource and professional operational process, it is a representative crowdsourcing platform and suitable context for the current research.

We use a Python-based web crawler to collect the research data from the website.

Similar methods to collect data from websites are commonly found in the literature (see, e.g., Zhang et al., 2019). In this study, we collected the data from “industrial design” zone to keep the similarities of innovate activities and finally got 8390 items of innovation services provided by 2,302 innovators including individuals and companies, including all the description information, transaction records, and comments from the home pages of service providers and home pages of service activities. Figures 2 and 3 are examples of service providers’ description information, transaction information, and comments. In addition, the definitions and measurements of variables are shown in Table 1.

(~Table 1 and Figure 2 here~)

4.2 Data analysis and result

4.2.1 Descriptive statistics

As shown in Table 1, the mean of city level is 3.71 and the standard deviation of it is 1.195, implying that the service providers concentrate in the big cities. It is consistent with common sense because lots of design companies and professionals in this field are more likely to choose big cities as the location of their headquarters. The mean of solvers’ credibility is 7.89, but its standard deviation is up to 26.88, which indicates that solvers’ credibility is volatile and dynamic. The mean of customer retention ratio is 2% and the standard deviation is 10%, which indicate that a part of problem solvers have very high level of seeker retention, but another part of the solvers have a low level of seeker retention. In addition, the high standard deviation for task professionalization and tasks novelty is highly volatile. In crowdsourcing platforms, the differentiation of solvers’ abilities are very large, because the basic requirements for solvers’ abilities and qualifications are relatively low to assure more solvers to participate the crowdsourcing platforms and conduct problem-solving activities. Thus, some solvers with professional knowledge base can complete high level of professional tasks and novel tasks, whereas the others can complete simple creative activities with low level of professionalization and novelty. The standard deviation of task complexity is relatively low. It needs time and efforts to complete the complex task, which seems to have no close linkage with solvers’ professional abilities.

(~Table 2 here~)

4.2.2 Hypothesis testing

This study conducts the hierarchy regression to test posited hypotheses. The results

show that grade evaluation and monetary guarantee respectively have positive influence on the task completion level ($\beta=0.526$, $p<.01$; $\beta=0.093$, $p<.01$ in Model 2 Table 3) and on their credibility level ($\beta=2.981$, $p<.01$; $\beta=0.636$, $p<.01$ in Model 7 in Table 3). Also, solvers' task completion level and their credibility level both have significantly positive effects on customer retention ($\beta=0.125$, $p<.01$; $\beta=0.001$, $p<.01$ in Model 2 Table 4). These results indicate that assurance mechanisms influence the seekers' retention by improving solvers' behaviours, i.e., task completion level and their credibility level, supporting H1.

The results show that the moderating effect of task complexity on the effectiveness of monetary guarantee on solvers' behaviours, i.e., task completion level and credibility level, is positive significantly ($\beta=0.159$, $p<.01$ in Model 5 Table 3; $\beta = 0.166$, $p<.01$ in Model 10 Table 3), supporting H2a-b. Also, the moderating effect of task complexity on the relationship between grade evaluation and solvers' behaviour is negative significantly ($\beta=-0.459$, $p<.01$ in Model 5 Table 2; $\beta=-0.315$, $p<.01$ in Model 5 Table 3), supporting H2c-d. In addition, task complexity can slightly and positively moderate the relationship between solvers' task completion level and seekers' retention ($\beta=0.005$, $p<.1$ in Model 5 Table 4), supporting H3a, whereas task complexity have no moderating effect on the relationship between solvers' credibility level and seekers' retention, not supporting 3b.

Besides, the analysis results show that the task novelty has negative moderating effect on the effectiveness of monetary guarantee on solvers' task completion level ($\beta=-0.048$, $p<.05$ in Model 3 Table 3), supporting H4a. The moderating effect of task novelty on the relationship between grade evaluation and solvers' behaviour is negative significantly ($\beta=-0.666$, $p<.01$ in Model 3 Table 3; $\beta=-0.013$, $p<.01$ in Model 8 Table 3), supporting H4c-d. Also, task novelty can positively moderate the relationship between solvers' task completion level and seekers' retention ($\beta=0.003$, $p<.01$ in Model 3 Table 4), whereas task novelty can negatively moderate the relationship between solvers' credibility and seekers' retention ($\beta=-3.009e-5$, $p<.01$ in Model 3 Table 4), partly supporting H5a-b. In addition, task novelty has no moderating effect on the relationship between monetary guarantee and solvers' credibility level, not supporting H4b.

Moreover, the analysis results show that the task professionalization has negative moderating effect on the effectiveness of monetary guarantee on solvers' task completion level ($\beta=-0.058$, $p<.01$ in Model 4 Table 3), supporting H6a, whereas it has no moderating effect on the relationship between monetary guarantee and solvers' credibility, not supporting H6b. Also,

the moderating effect of task professionalization on the relationship between grade evaluation and solvers' behaviour is negative significantly ($\beta=-0.947$, $p<.01$ in Model 3 Table 3; $\beta=-0.015$, $p<.01$ in Model 8 Table 3), supporting H6c-d. Also, task professionalization can positively moderate the relationship between solvers' task completion level and seekers' retention ($\beta=0.002$, $p<.01$ in Model 4 Table 4), whereas task professionalization can negatively moderate the relationship between solvers' credibility and seekers' retention ($\beta=-2.011e-5$, $p<.01$ in Model 3 Table 3), partly supporting 7a-b.

(~Table 2, 3 and 4 here~)

5. Discussion and Conclusion

5.1 Discussion

Some studies relevant with crowdsourcing innovation have investigated the uncertainties in the transaction between the seekers and solvers, such as information leakage and solvers' insufficient capabilities (Wagorn, 2014; Malhotra and Majchrzak, 2014). However, there is little literature exploring the solutions to the above mentioned uncertainties. In addition, the relationship among three key elements of crowdsourcing innovations, i.e., platform, seekers, and solvers, is also lack of exploration, which causes less systematically understanding of crowdsourcing innovations process. In addition, types of tasks influence the solver's participation behaviour and generation of effective solutions (Felin and Zenger, 2014), and also affect the seeker's requirements and expectations (Lopez-Vega et al., 2016), which are highly relevant to crowdsourcing innovations and important contingent factors for the platform's effectiveness. Thus, based on the uncertainty reduction theory (Berger and Calabrese, 1975), our study explores whether assurance mechanisms can leverage the uncertainties of crowdsourcing to reduce the potential risks and how the different tasks moderate their relationships, thereby enhancing effectiveness of crowdsourcing innovations platform and providing the important contribution regarding how to apply the different categories of assurance mechanism for different innovation problems.

Our findings (H1) indicate that assurance mechanisms can be perceived as quality signal for seekers in reducing their uncertainty in initial information-seeking stage, which facilitates their interaction with innovators proactively. Also, in the interaction process, such assurance mechanisms are perceived as their materials and reputation compensation, when solvers break their promises for problem seekers. To avoid such loss, innovation solvers make

effort to complete the different kinds of tasks and offer the superior service to express their credibility, hence, improving solvers' task completion level and credibility level. In turn, solvers' task completion level and their credibility can reduce seekers' confusion about undefined crowds and solvers' problem-solving capacity, thereby enhancing their retention behaviour, i.e., the effectiveness of crowdsourcing platform.

Our findings (H2a-b) imply that under the task complexity circumstances, monetary assurance can play a more effective role in improving solvers' task completion level and credibility level. Task complexity could increase the uncertainty of crowdsourcing innovations on generating optimal solutions. Under such circumstances, solvers in the initial interaction with seekers can analyze complex tasks more accurately and realistically to assure the accomplishments of the complex tasks and avoid the risk of monetary loss, thereby improving solvers' completion level. Also, the findings (H2c-d) imply that task complexity weakens the impelling role of grade evaluation system in solvers' behaviour improvement. Indeed, grade evaluation system is relevant with general evaluation and has no interdependence compensation when solvers break the promise. Solvers without interdependent loss for certain tasks are less likely to make huge efforts and complete cautiously. In addition, relevant findings show that the task complexity can slightly strengthen the role of completion level in influencing seekers' behaviours (H3a), whereas it has no role in the relationship between seekers' credibility level and their behaviour. A plausible reason is that seekers with task complexity consider the task accomplishment as their priority for deciding their repeat cooperation with solvers, and seekers' attributes could be only as reference for solvers' re-selections.

The analysis results indicate that task novelty can weaken the effectiveness of monetary guarantee and solvers' completion level (H4a) and weaken the effectiveness of grade evaluation system on solvers' behaviour (H4c-d). Indeed, when solvers face unfamiliar tasks and non-routine innovation problems that require knowledge beyond what they have gained from undertaking other tasks stored in their memory, their abilities to cope with such problems are limited. Also, facing the high levels of uncertainty associated with novel tasks, seekers have higher requirements for innovators to reduce their uncertainty (Knobloch, 2015). Under such circumstances, monetary guarantee plays a limited role to incentivize the solvers to complete the novel tasks, thereby weakening the effectiveness of monetary guarantee in raising the solvers' task completion level. Also, when task novelty increases the uncertainty between the seekers and solvers, the solvers with low reputations, i.e., low grade evaluations, for certain

tasks are less likely to make the efforts needed to acquire the new knowledge to meet the seekers' higher levels of requirements. Thus, in dealing with novelty tasks, assurance mechanism plays a limited role in raising the solvers' task completion level. In addition, to cope with task novelty, the solvers need to pursue various ways to generate solutions, while monetary guarantee plays no role to incentivize the solvers to strengthen their abilities to tackle novel tasks. In addition, the analysis results (H5a-b) indicate that with task novelty, seekers are more likely to use analytic and elaborate ways to evaluate the innovation solvers' capability. Solvers' completion level could become the first priority for seekers' consideration and some superior additional service become less important consideration, leading to less important role of the credibility.

Finally, our findings indicate that task professionalization can weaken the effectiveness of monetary guarantee on solvers' completion level (H6a), and weaken the effectiveness of grade evaluation system on solvers' behaviour (H6c-d). Solvers possessing a certain body of knowledge and professionalized ideology are likely to complete these professional tasks. Studies in the literature suggest that such professional individuals with high levels of skills prefer autonomy to supervision (DeLong & Nanda, 2003), and regulations are difficult to direct highly skilled individuals to conduct something that they do not like (Von Nordenflycht, 2010). Thus, external assurance mechanisms, e.g., monetary guarantee and a grade evaluation system, play a limited role in influencing solver's behaviour, so under the circumstances of task professionalization, such assurance mechanism has a limited role in improving solver's behaviour. In addition, our findings show that task professionalization has no moderating effect on the link between the platform's monetary guarantee and the solver's credibility level, which is more likely developed from the professionals' ideology overlapping with their ethics codes. In other words, professionals' credibility level is developed by the professional ethics codes that are not related to the incentive effects of monetary guarantee. Also, our analysis results indicate that task professionalization can strengthen the role of solvers' completion level in seekers' retention behaviours (H7a), which is similar to the moderating effect of task novelty. As high level of task professionalization may cause information asymmetry for problem understanding and solving between expert agents and non-experts clients, problem seekers could seek historical evaluations as quality signals to reduce their transaction uncertainty (Greenwood et al., 2005). Hence, the seeker is more inclined to search for completion level as their quality cue. In addition, our surprise finding is that task professionalization can weaken the role of credibility level in seeker's retention behaviour (H7b). It is because under the

professional context circumstances, the seeker perceives the participant as the professional that has received superior professional training and is subject to codes of professional ethics, thereby weakening the searching for credibility level when determining their problem solver.

5.2 Theoretical implications

First, this study systematically and empirically explores the relationships among crowdsourcing innovations platform, solver's operational behaviour, and seeker's behavior, which further enriches the literature relevant with crowdsourcing innovation. Studies on crowdsourcing innovations mainly focus on classifications of crowdsourcing innovations and operational process (e.g., Simula and Ahola, 2014; Bockstedt et al., 2016), and propose the hidden risks and the importance of risk control (Wagorn, 2014). On the contrary, our study attempts to explore some platform assurance mechanisms to control platform operational risks and induce solver's problem-solving behaviour, thus improving their task completion level and their credibility level, which further influences the seeker's decision-making in the crowdsourcing mode. Besides, our study systematically examines the relationships among the core elements of the crowdsourcing innovations mode, finding that assurance mechanism is an effective means of uncertainty reduction to enhance seeker's retention behaviour, which enriches the relevant literature on crowdsourcing innovations.

Second, our study extends the application of uncertainty reduction theory to the crowdsourcing platform. With the development of social media, crowdsourcing innovations have been pursued on the platform, where the problem seeker presents their innovation problem to the crowd, facing innovator uncertainty and problem-solving uncertainty (Boudreau et al., 2011; Schäfer et al., 2017), so the platform has the responsibility to reduce the uncertainties. Thus, our study applies uncertainty reduction theory mitigate the uncertainties associated with the three parties, i.e., platform operator, innovation solver's behaviour, and seeker's behaviour.

Third, our study identifies the different impacts of assurance mechanism on solver's behaviour and different impacts of solver's behaviour on seeker's behaviour under different circumstances of task complexity, task novelty, and task professionalization. The studies on task characteristics has found that innovation tasks are highly relevant to the quality of innovation and innovator's creativity (Afuah and Tucci, 2012; Felin and Zenger, 2014). Our empirical study supports the theoretical descriptions of the tasks of crowdsourcing innovations and finds different moderating roles.

5.3 Managerial implications

The practical implications of our study are threefold. First, in the crowdsourcing innovations context, the platform operator needs to be aware of the importance of their assurance mechanisms and the innovation solver needs to pay more attention to their task completion level and credibility level as their quality signals. Second, the platform operator needs to re-consider and implement different assurance mechanisms according to different tasks' attributes, i.e., tasks complexity, task novelty, and task professionalization, by text mining the task descriptions in crowdsourcing innovations. Under the task complexity circumstances, the platform operator should use monetary guarantee that plays a more effective role in impelling solver's task accomplishment and credibility; whereas under such circumstances, grade evaluation system plays a limited role in improving solver's behaviour. The platform operator should encourage the solver to offer monetary assurance and the seeker to search for solvers with monetary assurance, especially under the circumstances with complex tasks. However, under the task novelty and professionalization circumstances, assurance mechanism plays less important roles in improving solver's behaviour, as assurance mechanism overlaps with solver's self-regulation. Thus, the platform operator should adopt the reward mechanism instead of the control mechanism. Finally, our findings indicate that under all three types of tasks, solver's completion level is perceived as a more important quality cue than their credibility that influences seeker's choice for crowdsourcing innovations. Thus, both the platform operator and innovator should accord top priority to task completion level. For credibility level, under all three kinds of tasks, it has a less impact on seeker's behaviour.

5.4 Limitations

Our study has several limitations that need to be further studied. First, regarding the innovation solver's behaviour and customer retention level, we extract cross-sectional data from a well-known crowdsourcing platform. However, some causal relationships could be predicted more accurately by multi-period data from the platform, such as the completion levels and retention levels in different periods. Second, we adopted the reasonable transaction value as the proxy of task complexity, because it shows the value of the solver's unit time in completing the tasks. However, besides the time of completing the task, the transaction value is also related to other issues, such as the scarcity of the services that the solver can provide on the platform. In future research, we may explore new proxy indicators or combine several indicators to improve the measurement accuracy of task complexity. Third, in this study, all the

data are collected from the sector of industrial design on the crowdsourcing platform. Future studies can examine user's behaviour in different innovation service sectors. Finally, since we focus on social media based crowdsourcing innovations platform in China, our conclusions may not be fully generalizable to the Western culture. Thus, future studies should further explore the effectiveness of the crowdsourcing innovations mode in different cultures.

References

- Acar, O.A. (2019) Motivations and solution appropriateness in crowdsourcing challenges for innovation. *Research Policy*, Vol. 48 No.8 (103716), pp.1-13.
- Afuah, A. and Tucci, C.L. (2012), Crowdsourcing as a solution to distant search. *Academy of Management Review*, Vol. 37 No. 3, pp. 355-375.
- Bansal, G., Zahedi, F.M. and Gefen, D. (2015) The role of privacy assurance mechanisms in building trust and the moderating role of privacy concern. *European Journal of Information Systems*, Vol. 24 No.6, pp. 624-644.
- Bayus, B.L. (2013) Crowdsourcing new product ideas over time: An analysis of the Dell IdeaStorm community. *Management Science*, Vol. 59 No. 1, pp. 226-244.
- Berger, C.R. and Calabrese, R.J. (1975) Some explorations in initial interaction and beyond: Toward a developmental theory of interpersonal communication. *Human Communication Research*, Vol. 1 No. 2, pp. 99-112.
- Bockstedt, J., Druehl, C. and Mishra, A. (2016) Heterogeneous submission behaviour and its implications for success in innovation contests with public submissions. *Production and Operations Management*, Vol. 25 No. 7, pp. 1157-1176.
- Bolton, G.E., Katok, E. and Ockenfels, A. (2004) How effective are electronic reputation mechanisms? An experimental investigation. *Management Science*, Vol. 50 No. 11, pp. 1587-1602.
- Boons, M. and Stam, D. (2019) Crowdsourcing for innovation: How related and unrelated perspectives interact to increase creative performance. *Research Policy*, Vol. 48 No.7, 1758-1770.
- Boudreau, K.J., Lacetera, N. and Lakhani, K.R. (2011) Incentives and problem uncertainty in innovation contests: An empirical analysis. *Management Science*, Vol. 57 No. 5, pp. 843-863.
- Campbell, D.J. (1988) Task complexity: A review and analysis. *Academy of Management Review*, Vol. 13 No. 1, pp. 40-52.
- Chan, H.K., Yee, R.W.Y., Dai, J. and Lim, M.K. (2016) The moderating effect of environmental dynamism on green product innovation and performance. *International Journal of Production Economics*, Vol. 181, pp. 384-391.
- Delgado-Ballester, E. and Hernández-Espallardo, M. (2008) Effect of brand associations on

- consumer reactions to unknown on-line brands. *International Journal of Electronic Commerce*, Vol. 12 No. 3, pp. 81-113.
- DeLong, T. J. and Nanda, A. (2003) *Professional Services: Text and Cases*. Boston: McGraw-Hill Irwin.
- Deng, W., Xu, G., Ma, S. and Liu, S. (2019) Selection of crowdsourcing formats: Simultaneous contest vs sequential contest. *Industrial Management & Data Systems*, Vol.120 No.1, pp.35-53.
- Dimoka, A., Hong, Y. and Pavlou, P.A. (2012) On product uncertainty in online markets: Theory and evidence. *MIS Quarterly*, Vol. 36.
- Felin, T. and Zenger, T.R. (2014) Closed or open innovation? Problem solving and the governance choice. *Research policy*, Vol. 43 No. 5, pp. 914-925.
- Fu, W., Wang, Q. and Zhao, X. (2018) Platform-based service innovation and system design: Research opportunities. *Industrial Management & Data Systems*, Vol.118 No,5, pp.975-997.
- Guo, Y., Fan, D. and Zhang, X. (2020) Social media-based customer service and firm reputation. *International Journal of Operations & Production Management*, Forthcoming, <https://doi.org/10.1108/IJOPM-04-2019-0315>.
- Gibbs, J.L., Ellison, N.B. and Lai, C.H. (2011) First comes love, then comes Google: An investigation of uncertainty reduction strategies and self-disclosure in online dating. *Communication Research*, Vol. 38 No. 1, pp. 70-100.
- Greenwood, R., Li, S.X., Prakash, R. and Deephouse, D.L. (2005) Reputation, diversification, and organizational explanations of performance in professional service firms. *Organization Science*, Vol. 16 No. 6, pp. 661-673.
- Hackl, F. , Kummer, M.E., Winter-Ebmer, R. and Zulehner, C. (2014) Market structure and market performance in e-commerce. *European Economic Review*, Vol. 68, pp.199-218.
- Hærem, T., Pentland, B.T. and Miller, K.D. (2015) Task complexity: Extending a core concept. *Academy of Management Review*, Vol. 40 No. 3, pp. 446-460.
- Hua, X., Huang, Y. and Zheng, Y. (2019) Current practices, new insights, and emerging trends of financial technologies. *Industrial Management & Data Systems*, Vol.119 No.7, pp.1401-1410.
- Hwang, E.H., Singh, P.V. and Argote, L. (2019) Jack of all, master of some: Information network and innovation in crowdsourcing communities. *Information Systems Research*. <https://doi.org/10.1287/isre.2018.0804>
- Jean Pierre, G.G., Libaque-Saenz, C. and Chang, Y. (2019) Social-media-based risk communication for data co-security on the cloud. *Industrial Management & Data Systems*, Vol.120 No.3, pp. 442-463.
- Jeppesen, L.B. and Lakhani, K.R. (2010) Marginality and problem-solving effectiveness in broadcast search. *Organization Science*, Vol. 21 No. 5, pp. 1016-1033.

- Johannessen, J.A. and Olsen, B. (2010) The future of value creation and innovations: Aspects of a theory of value creation and innovation in a global knowledge economy. *International Journal of Information Management*, Vol. 30 No. 6, pp. 502-511.
- Kaufmann, G. (2004) Two kinds of creativity—but which ones? *Creativity and Innovation Management*, Vol. 13 No. 3, pp. 154-165.
- Kim, D. and Benbasat, I. (2009) Trust-assuring arguments in B2C e-commerce: Impact of content, source, and price on trust. *Journal of Management Information Systems*, Vol. 26 No. 3, pp. 175-206.
- Kirmani, A. and Rao, A.R. (2000) No pain, no gain: A critical review of the literature on signaling unobservable product quality. *Journal of Marketing*, Vol. 64 No. 2, pp. 66-79.
- Knobloch, L.K. (2015) Uncertainty reduction theory. *The International Encyclopedia of Interpersonal Communication*, 1-9.
- Knobloch, L.K. and McAninch, K.G. (2014) Uncertainty management. In P.J. Schultz & P. Cobley (Series Eds.) & C.R. Berger (Vol. Ed.), *Handbooks of Communication Science: Vol. 6. Interpersonal Communication* (pp. 297–319). Berlin, Germany: De Gruyter Mouton.
- Levin, J. and Tadelis, S. (2005) Profit sharing and the role of professional partnerships. *The Quarterly Journal of Economics*, Vol. 120 No. 1, pp. 131-171.
- Li, S., Srinivasan, K. and Sun, B. (2009) Internet auction features as quality signals. *Journal of Marketing*, Vol. 73 No. 1, pp. 75-92.
- Lopez-Vega, H., Tell, F. and Vanhaverbeke, W. (2016) Where and how to search? Search paths in open innovation. *Research Policy*, Vol. 45 No. 1, pp. 125-136.
- Malhotra, N., Morris, T. and Hinings, C.R. (2006) Variation in organizational form among professional service organizations. In *Professional Service Firms* (pp. 171-202). Emerald Group Publishing Limited.
- Malhotra, A. and Majchrzak, A. (2014) Managing crowds in innovation challenges. *California Management Review*, Vol. 56 No. 4, pp. 103-123.
- Pavlou, P.A., Liang, H. and Xue, Y. (2007) Understanding and mitigating uncertainty in online exchange relationships: A principal-agent perspective. *MIS Quarterly*, Vol. 31 No. 1, pp. 105-136.
- Poetz, M.K. and Schreier, M. (2012) The value of crowdsourcing: Can users really compete with professionals in generating new product ideas? *Journal of Product Innovation Management*, Vol. 29 No. 2, pp. 245-256.
- Schäfer, S., Antons, D., Lüttgens, D., Piller, F. and Salge, T.O. (2017) Talk to your crowd: Principles for effective communication in crowdsourcing a few key principles for communicating with solvers can help contest sponsors maintain and grow their base of participants. *Research-Technology Management*, Vol. 60 No. 4, pp. 33-42.
- Schulze, T., Nordheimer, D. and Schader, M. (2013) Worker perception of quality assurance

- mechanisms in crowdsourcing and human computation markets. *Proceedings of the Nineteenth Americas Conference on Information Systems*, Chicago, Illinois, August 15-17, 2013.
- Simula, H. and Ahola, T. (2014) A network perspective on idea and innovation crowdsourcing in industrial firms. *Industrial Marketing Management*, Vol. 43 No. 3, pp. 400-408.
- Tseng, M.L., Lim, M.K., Wong, W.P., Chen, Y.C. and Zhan, Y. (2018) A framework for evaluating the performance of sustainable service supply chain management under uncertainty. *International Journal of Production Economics*, Vol. 195, pp. 359-372.
- Tomasi, S., Schuff, D. and Turetken, O. (2018) Understanding novelty: How task structure and tool familiarity moderate performance. *Behaviour & Information Technology*, Vol. 37 No. 4, pp. 406-418.
- Tyszka, T. (1986) Information and evaluation processes in decision making: The role of familiarity. *New Directions in Decision Research*, pp. 151-161.
- Von Nordenflycht, A. (2010), "What is a professional service firm? Toward a theory and taxonomy of knowledge-intensive firms. *Academy of Management Review*, Vol. 35 No. 1, pp. 155-174.
- Wagorn, P. (2014) The problems with crowdsourcing and how to fix them. Available at: <https://www.ideaconnection.com/blog/how-to-fix-crowdsourcing.html> (accessed April 22, 2019).
- Wang, Y., Qu, Z. and Tan, B. (2018) How do assurance mechanisms interact in online marketplaces? A signaling perspective. *IEEE Transactions on Engineering Management*, Vol. 65 No. 2, pp. 239-251.
- Zhan, Y., Tan, K.H. and Perrons, R.K. (2018) A proposed framework for accelerated innovation in data-driven environments. *Industrial Management & Data Systems*, Vol.118 No,6, pp.1266-1286.
- Zhang, X., Gong, X., Lai, K. and Wu, Y. (2019) How does online interactional unfairness matter for patient–doctor relationship quality in online health consultation? The contingencies of professional seniority and disease severity. *European Journal of Information System*, Vol. 28 No. 3, pp. 336-354.

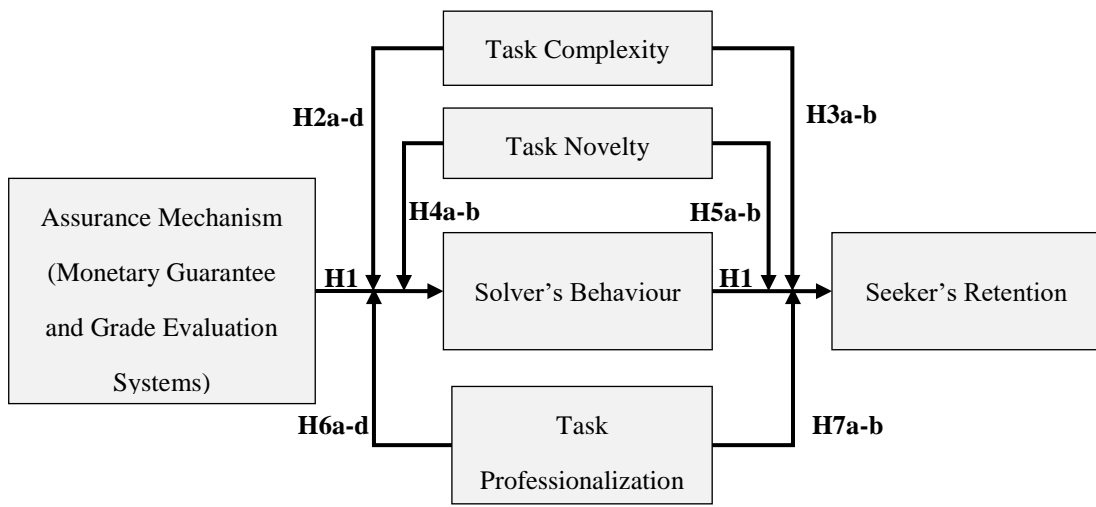


Figure 1 Conceptual model

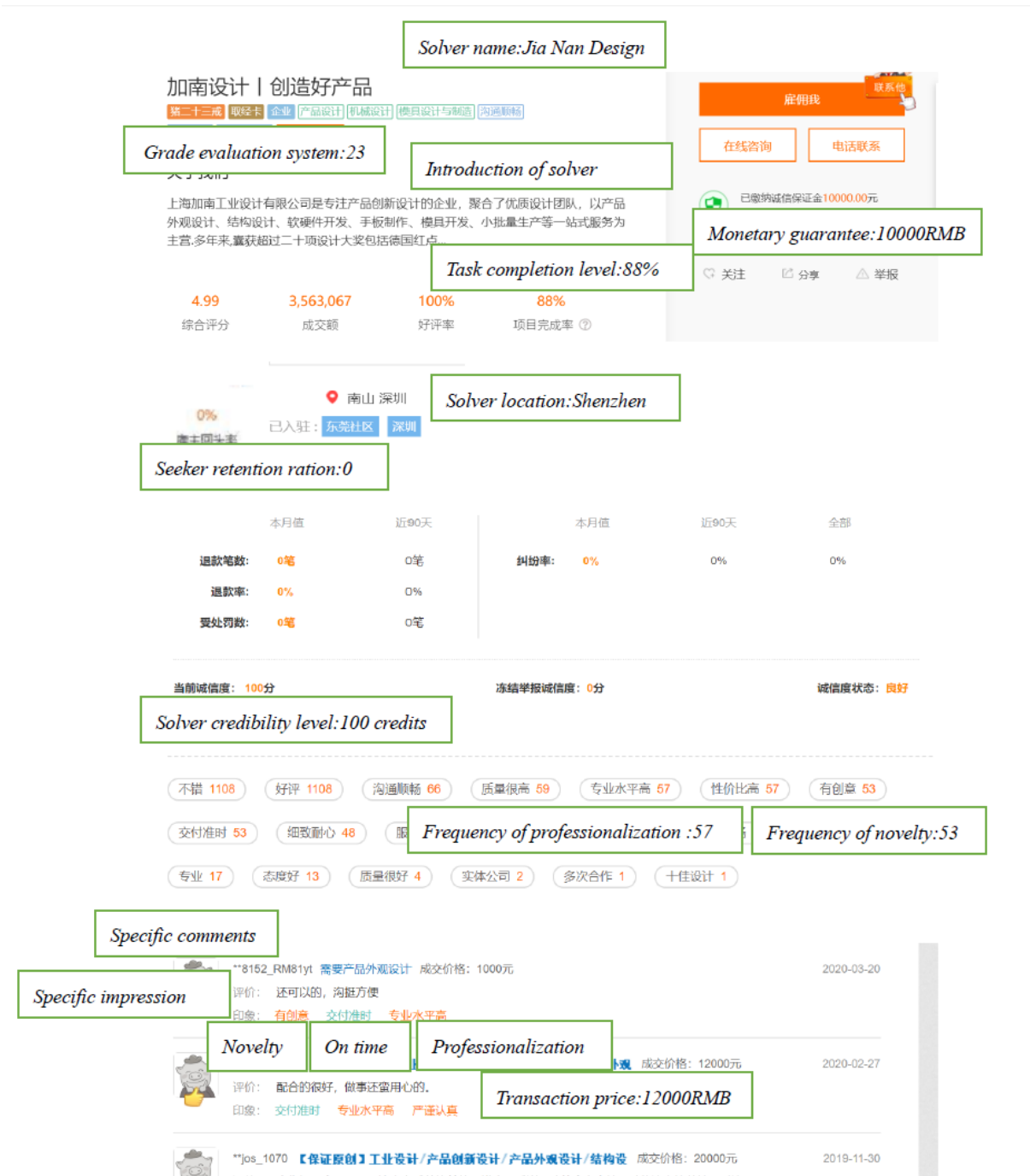


Figure 2 Examples of a service provider's main homepage information, transaction information and comments

Table 1 Definitions and measurements of variables

Variables	Definition	calculations
<i>Seeker's retention</i>	The degree to which a seeker repeatedly chooses the same solvers to solve his problems.	No. seekers repeatedly purchased the service to total No. the seeker (the ratio have been shown in the platform see Fig.2)
<i>Task completion level</i>	Solvers' effectiveness of completing the tasks posted on the platform.	No. orders the solver finished to No. the orders that solver received (the ratio have been shown in the platform see Fig.2)
<i>Solvers' credibility level</i>	The degree of the integrity of solvers' behaviour in their transaction processes	The average score of the solvers that seekers evaluate about solvers' service process, which is between 0 and 100 (the ratio have been shown in the platform see Fig.2)
<i>Grade evaluation system</i>	Providing seekers with important information about solvers' integrative service performance.	The platform designs the grade evaluation system that evaluates service performance from grade 0 to higher grades (See Fig2).
<i>Monetary guarantee</i>	The money that the solvers provide to the platform in some certain innovation problems to avoid some uncertain risks from solvers' behaviour.	The logarithm of the total cash assurance shown in the different types of innovation service of the solvers (cash assurance shown in Fig 2).
<i>Task complexity</i>	The tasks with multiple path ways, multiple outcomes, conflicting interdependence among ways and outcomes, and many probabilities (Campbell, 1988)	The logarithm of the price of the design service (service price shown in Fig 2). Reasons: 1) the data from similar innovation service, assuring the extent of task complexity is similar for different solvers. 2) platforms with intense and free market competition assures that solvers' abilities almost keep the consistence and service brand is difficult to be developed, thereby eliminating the effects of abilities and brands on price setting. 3) The literature relevant with platforms indicates that the pricing decisions for

		specific tasks based on the service process (e.g. Hackl et al., 2014).
<i>Task novelty</i>	The novel extent of task content(Kaufmann, 2004)	The frequency of the keywords (i.e., new, novel, innovate, fresh, original, and creative) appearing in the documents as the level of task novelty provided by the solvers (The frequency of novelty shown in Fig 2)
<i>Task professionalization</i>	The essential nature of tasks and solving approaches need to be understood and proposed by some professionals with certain body of knowledge (Malhotra et al., 2006).	The frequency of the keywords (professional, specialized and expertise) relevant with professionalization appearing in the documents as the level of task professionalization provided by the solvers.
<i>Control variables</i>	Adopting the economic level of the cities where the solvers located as the control variable	Ranking the economic level of the cities that the solvers located in with the value from 1 to 5. The most developed cities are marked as 5 and the least developed cities are marked as 1. Reasons: the economic development of different geographic development influences the level of digitization (Bockstedt et al., 2016).

Table 2 Mean, standard deviation and correlations

	Mean	S.d.	CL	MG	GE	TCL	SC	SR	SP	SN
City Level(CL)	3.71	1.20	1							
Monetary Guarantee (MG)	2.84	4.19	.18**	1						
Grade Evaluation(GE)	2.96	4.75	.06**	.21**	1					
Task Completion Level(TCL)	.15	.34	.03	.20**	.54**	1				
Solver Credibility(SC)	7.89	26.88	.06**	.21**	.55**	.59**	1			
Seeker Retention(SR)	.02	.10	.06**	.17**	.43**	.56**	.46**	1		
Task Professionalization(SP)	4.93	54.75	-.00	.03	.48**	.24**	.33**	.27**	1	
Task Novelty (SN)	7.63	69.99	-.01	.02	.41**	.20**	.28**	.24**	.96**	1
Task Complexity (TC)	6.60	2.49	.17**	.16**	.17**	.10**	.11**	.07**	.04	.04

** . Correlation is significant at the 0.01 level (2-tailed).

Table 3 Hierarchical regression analysis of solvers' task completion level

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Dependent variable:	task completion level					Solvers credibility				
Control variable										
Constant						3.514*	-3.309*	-2.960*	-2.791*	-5.950*
City Level	0.034	-0.015	-0.015	-0.014	-0.012	1.276**	.156	.195	.251	.220
Independent variable										
Grade evaluation(GE)		0.526***	0.520***	0.496***	0.946***		2.981***	2.560**	2.215***	5.373**
Monetary Guarantee(MG)		0.093***	0.097***	0.097***	-0.040		.636***	.642***	.627***	-0.465
Task Novelty (TN)			0.656***					.451***		
Task professionalization(TP)				0.951***					.512*	
Task complexity(TC)					0.034					.281
Moderator effect										
GE*TN			-0.666***					-0.013**		
MG*TN			-0.048**					.004		
GE*TP				-0.947***					-0.015***	
MG*TP				-0.058***					0.003	
GE*TC					-0.459***					-0.315***
MG*TC					0.159***					.166***
R ²	0.001	0.304	0.322	0.333	0.318	0.003	0.309	.345	0.372	0.324
R ² change		0.303	0.018	0.011	-0.015	0.003	0.306	.036	0.027	-0.048
Observation			2,302					2,302		

Note: *p < .10; **p < .05; ***p < .01. All tests are tailed. The above coefficients for dependent variable (i.e. task completion level) are standardized, for some unstandardized coefficients, i.e., the value of 0.00, couldn't show negative or positive relationship; whereas dependent variable (i.e. solvers credibility) has no such problems, thus we adopt unstandardized coefficients in the table, which can be seen intercept clearly.

Table 4 Hierarchical regression analysis of seekers' retention

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable:	seekers retention				
Constant	.005	-.011	-.011	-.011	-.006
Control variable					
City Level	.005***	.003*	.003*	.003**	.003*
Independent variable					
Task completion level(TCL)		.125***	.114***	.112***	.093***
Solvers credibility(SC)		.001***	.001***	.001***	.000
Task Novelty (TN)			-1.365E-6		
Task professionalization(TP)				-0.000	
Task complexity(TC)					-.001
Moderator effect					
TCL*TN			.003***		
SC*TN			-3.009E-5***		
TCL*TP				.002***	
SC*TP				-2.011E-5***	
TCL*TC					.005*
SC*TC					3.756E-5
R ²	0.003	0.338	0.356	0.357	0.341
R ² change	0.003	0.335	0.018	0.001	-0.016
Observation			2,302		
Note: *p < .10; **p < .05; ***p < .01. All tests are tailed. The above coefficients are unstandardized.					