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A CROWDSOURCING PLATFORM OFFERING REAL-TIME CHALLENGES FOR STUDENTS: HOW TO MOVE BEYOND DESIGN CHALLENGES

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ABSTRACT
Crowdsourcing is increasingly used to tap into the innovative potential of a crowd. Oftentimes, this co-creation is conducted using virtual spaces, with an approach of a contest. In this study, the emphasis is on understanding how to integrate crowdsourcing contests into universities and their students, in order for them to provide value for all of the participants. Furthermore, the specific platform that is presented has been successfully used for design and packaging contests, with the goal of extending it now to engineering challenges. With background information from crowdsourcing contests in general and with lessons learned from existing platforms, this paper presents findings and discussions about a web-based survey addressing how to move beyond design challenges for achieving better university-industry collaboration using crowdsourcing.

Keywords: Crowdsourcing, platform, design challenge, contest.

1 INTRODUCTION

The crowdsourcing model taps the productive and innovative potential of a crowd in the virtual space to accomplish business goals, with the assumption that the crowd's collective intelligence is greater than that of a limited pool of professional intellects [1]. Accordingly, some companies have opened both the idea-generation and idea-selection parts of the innovation process with success [2], for both their internal and external parties, hence tapping into the ideas and knowledge of many to develop new products and services.

The crowd usually is seen to include interested individuals in roles of users (consumers) and professionals on and off work. In our study, the emphasis is on university students as providing the collective intelligence toward the organizational business goals as they participate in contests, which are presented in a dedicated crowdsourcing platform.

As reported in our earlier papers [3] [4], the real-life challenges have taken place in the context of product design and packaging design with a crowdsourcing platform called NimbleBee. Design students from multiple universities have been involved in the contests as part of their coursework, with support from their professors and collaboration with their peers, lead-user communities and the experts from the specific organization with that specific problem. Importantly, and rather surprisingly from the company perspective, the student contribution has been very professional and subsequently instrumental for the company's innovation capabilities, resulting to faster and more disruptive innovation.

As organizations' problems go beyond design and packaging, there is an increased too to include engineering problems to contests. The research question hence becomes "how to move beyond design challenges", i.e. how to identify and implement changes that may be needed for the process, content and design of a crowdsourcing platform. First, a literature review for addressing the role of contests in crowdsourcing is conducted. Then an understanding and analysis of relevant existing crowdsourcing platforms and their contest allows us to get relevant contextual knowledge. With conducting a web-based survey, the key question and its implications are explored and discussed.

2 BACKGROUND

The rationale behind crowdsourcing innovation can be traced back to "customer innovation" [5] in management literature, where customers are regarded as a very special crowd, as well as to open innovation, which sees and seeks knowledge outside of the organizational boundaries [6]. There now are many crowdsourcing sites that enlist a crowd to help solve a problem: a recent search found almost 3000 examples of crowdsourcing and crowdfunding sites (crowdsourcing.org).

2.1 Value from crowdsourcing for companies and participants

Crowdsourcing demonstrates the value of openness, at least narrowly defined by disclosing problems, in removing barriers to entry for non-obvious individuals [7]. In this way organizations gain access to solutions that they would not have found through their own searches. Accordingly, crowdsourcing can be seen to generate value from mobilizing untapped resources in and out of the company and its personnel's work realm.

Crowdsourcing has been seen to channel societal excess capacities toward developing and producing goods and services: crowdsourcing utilizes 'cognitive surplus' [8]. Working in their free time, many contributors appear amateur, yet in terms of qualifications are professional. For example, in case InnoCentive, 65 percent of a crowd participating in crowdsourcing for problem solving reported holding Ph.D. degrees, 19 percent advanced degrees; on average, these solvers had completed their 16 years of formal education and used over 42 hours of their own time developing a solution [7].

As crowdsourcing is used for a wide range of purposes, from simple to complex, motivations of crowd members differ significantly based on the nature of a task [9]. These motives included the opportunity to make money, the opportunity to develop one's creative skills, the potential to find additional work and job opportunities, and to be part of community [10]. Motivations in intermediary crowdsourcing platforms seem to be mostly extrinsic [7].

2.2 Crowdsourcing contests

A firm can implement co-creation and crowdsourcing through either its own firm-hosted communities or third-party providers, who work with the firm to set up and administer portals to conduct crowdsourcing contests. Using these, in recent years individuals have started to participate in open innovation by means of innovation challenges or crowdsourcing contests, both of which mean that individuals or teams compete to win a contest designed by a firm or sponsor [11].

The commercial marketplaces for open innovation or crowdsourcing contests have been around for about 15 years. InnoCentive, which was started in 2001, was the first [11]. The commercial marketplaces can be described as online platforms designed by a third party for requesters (i.e. seekers) to outsource tasks to the crowd (i.e. solvers); hence, they are not websites designed by the requesting company [15].

The benefits of the challenge or contest approach have been articulated by many researchers. Schweitzer et al. (2012) claim that idea competitions lead to more and better ideas at a lower cost per idea, whereas focus groups yield richer interactions with users. Boundreau and Lakhani [12] have stated that "contests are most effective when the problem is complex or novel or has no established best-practice approach" and that they are best used for "highly challenging technical, analytical, and scientific problems; design problems; creative or aesthetic projects"—hence making no difference between the design and technical problems, but not extending the applicability to engineering problems.

At the same time, there are important limitations diminishing the potential benefits drawn from the crowd. For example, a recent study found that in the current use of a waterfall process type approach, the requirements for clients (or companies with problems) to be intimately involved, and the evaluation of quality only late in the process have been mentioned [14]. In addition, [7] report that only a third of the problems that were broadcast—a term that they use for crowdsourcing—were deemed solved by the seeker firms through a market mechanism, highlighting the importance of problem decomposition.

3 METHODOLOGY

The paper aims to understand and support the expansion of a crowdsourcing platform into new markets, i.e. from design and packaging related problems to engineering type problems. Though the aim exists in the real-world of a specific crowdsourcing platform (NimbleBee) and its organization

(CogniStreamer), the paper also extends its contribution to general understanding about designing crowdsourced engineering contests—overall contributing to better practices related to open innovation.

First, the understanding and analysis of relevant existing crowdsourcing sites was performed to get relevant contextual knowledge. The five contests chosen were: Ennomotive and InnoCentive, representing engineering challenges (InnoCentive also being the leading platform with 375,000 + registered users since 2001); TopCoder representing software challenges (though also addressing design challenges), DesignContest representing design contests, and ImagineCup representing a contest for students (though also TopCoder presents contests as a way for becoming more professional). Four of these sites are commercial, and one (the last) is Microsoft's. We acknowledge that by choosing these sites and only five of them, inherent limitations to the study were introduced.

Then, we approached experts of engineering design/education to get their insights into the key question. The experts were handpicked from the extensive network of the participating crowdsourcing organizations, and a snow-ball method was also used (the participants were asked to identify other potential participants). A survey was created using Surveymonkey, an online survey software.

The survey first included background information to set up the context and motivation for the respondents. The background information explained about the specific process and policies of hosting engineering challenges by the platform provider. The second part of the survey included the questions to get insights from the respondents. The twenty (20) questions (with drop-down menus as well as open-ended questions) addressed the specifics of the contest process, the motivation of students and the university, as well as the practical aspects of the contest such as financial rewards, prototype kit, and timing of the contests to fit the university curriculum.

For both the analysis of the existing crowdsourcing sites and for the analysis of the survey results, the method for data analysis used was based on the triple-focus of crowdsourcing research introduced by Zhao and Zhu [14], which introduces the focuses of conceptualization (core elements), system (interactions) and implementation (policies and processes). It has previously successfully been applied for showing the integral facets of crowdsourcing and its related complexities [4].

4 FINDINGS

To answer the key question of "how to move beyond design challenges", i.e. how to identify and implement changes that may be needed for the process, content and design of a crowdsourcing platform, the analysis of supply and demand was conducted. The supply was addressed with insights from relevant crowdsourcing contests, the demand was addressed with insights from experts in engineering design/education.

4.1 Insights from relevant crowdsourcing contests

All five sites selected were active and had up-to-date information. The triple-focus framework of crowdsourcing [4] was implemented to highlight some aspects from each of the crowdsourcing contests when it comes to concept, system and implementation (table 1). For the purposes of this paper, the analysis was not intended to provide an in-depth understanding of all elements nor was it intended to be used for comparisons between the contests.

All sites required some registering at some point. Four commercial sites used numbers explaining their popularity to showcase their legitimacy and relevance (such as the number of participants or community members, the number of challenges etc). Notably, Microsoft's Innovation Cup site did not provide numbers about the participation. In addition to showing these statistics, InnoCentive showed visualizations about the solvers, submissions and the solvers geographical location.

The motivation to participate was clearly addressed in the four commercial sites. For example, Innocentive listed making a positive impact, exercising your brain, promoting yourself and earning awards as motivation for the participants; for the companies the benefits mentioned were innovate better, faster and more cost effectively. Also, the participants were publicly and transparently recognized for their contributions, with for example Ennomotive providing a list of top challenge winners and Topcoder presenting a large array of statistics about participation.

Out of the five sites analyzed, two sites offering engineering challenges (Ennomotive and InnoCentive). They provided more detailed information related to the problem or challenge: for example Ennomotive also included a full challenge description, which can be very detailed, with pictures of equipment, process flows, video's etc. No tool kits were provided. In addition to contest or

challenge details, the sites offered additional support for participants in forms of codes of conduct, font policies, supporting legal documents etc.

Table 1. Highlights from selected crowdsourcing contests

Ennomotive http://www.ennomotive.com/	
Concept	For participants: *@Ennomotive* you have the opportunity to face and solve real challenges. For companies: *@Ennomotive* you have the opportunity to connect with thousands of bright engineers and thinkers from all over the world and solve your challenges.
System	A full challenge description
Implementation	A list of top challenge winners (of the 3000+ engineers participating)
InnoCentive http://www.innocentive.com/	
Concept	Externally crowd-sourced Challenge programs and innovation competitions uniquely tailored to solve problems and breakthrough innovations Common Challenge types include also a Reduction-to-Practice (RTP): A prototype that shows an idea in actual practice and requires an artefact (e.g., physical evidence).
System	Basic info available for public, Log-in to see further details of the challenge
Implementation	An experienced team of Challenge experts are engaged in the Challenge process from beginning to end.
Topcoder https://www.topcoder.com/	
Concept	Topcoder gathers the world's experts in design, development and data science to work on interesting and challenging problems.
System	Includes for example blogs
Implementation	Supporting information for getting around (for example connecting with members, learning & practicing skills) and for competing Important Policies such as font policy, stock art policy, screening
DesignContest https://www.designcontest.com/	
Concept	"Simply start a contest, pick your prize amount, and relax while dozens of design options are created by talented designers, especially for you, in just hours, instead of weeks."
System	Use system to set up your brief, choosing from pre-set design categories Works also on mobile devices
Implementation	"Design Copyrights Transfer document" to support the process You can also continue working with your favourite designers individually, without setting up another contest
ImagineCup https://www.imaginecup.com/	
Concept	Microsoft Imagine Cup is a student technology competition. **Beginner** competitions are for anyone. **Medium** competitions are for older students with some coding familiarity. **Advanced** competitions are for experienced teams of student developers.
System	Registering
Implementation	Official rules, code of conduct

For InnoCentive, the challenge prizes reflected the size of the challenge as the prizes were in tens of thousands of dollars. Similarly, the prize money in Ennomotive was in the thousands. In comparison, problems such as de-bugging in TopCoder offered prizes of 75-500 dollars, and the design challenges of DesignContest in the range of 100-200 dollars.

4.2 Insights from experts

The insights from experts, mostly professors of engineering design/education, are based on their responses to the online questionnaire, to which 27 of them were invited and 13 responded (response rate 48 per cent). The experts came mostly from Europe (83 per cent), with one respondent from Canada and one from India. Most questions received 11-13 responses. One explanation to the missing

answers and the response rate was stated by a respondent: "The first two pages of the survey are necessary to understand the background of the challenge, but a bit demotivating".
None of the respondents challenged the proposed process of the challenge with two rounds, and fitting it to the academic calendar and curriculum was natural for most. Also, the majority of the respondents were already familiar with participating in contests. Furthermore, they were willing to share that information with the customer in order to support the crowdsourcing challenge. Again, the responses were analysed with the three focus areas of crowdsourcing: conceptual, system and implementation, which all were addressed with the survey questions (table 2).

Table 2. The survey mapped to the triple-focus of crowdsourcing framework

	Survey question	**Answers**
Concept	We ask that participation to the competition is part of a program or class in the curriculum. How does this influence your ability to participate? What would be the most important reasons for your university to participate? What would be the most important reasons for your students to participate in such a competition?	Fitting the challenge competition to an academic calendar and curriculum was seen natural, though 3 responses said that the classes and programs are not flexible For students: #1: Potential student employability (73%), #2: Prospect of a long term collaboration between your university and a large corporation (67%) For universities: #1: Being able to solve real world problems as part of the curriculum (75%), #2: Solving real world problems (55%)
System	How important are the following elements of the Platform Service to you?	#1: Open communication #2: A transparent service in which you can have total confidence #3: Online moderation and early feedback by the sponsoring organization
Impl.	In your opinion, what would be a fair engagement fee? What kind of information would you need from us that enables you, as a university, to decide whether you want to enter the competition or not? What would you expect to find in the prototype kit? In your opinion, what would be fair prize money for the 1st, 2nd and 3rd winning solutions?	1500-3000 Eur (31%); 500-1500 EUR (23%) Enough detail, background info and information about timing Technical drawings, materials, supplies Prize money range of 500-15,000 Euros, majority suggesting the first price of 5000 Euros, with smaller sums for the 2nd and 3rd price winners

The important financial aspects of the contest were addressed with the survey. The majority of experts emphasized the need for an engagement fee to support the overhead and other costs that participating in the crowdsourcing challenge might present. However, two respondents challenged the need for monetary rewards. In addition, only 36 percent of the respondents saw financial income a motivator for the students, though the same percentage of respondents mentioned the link between the financial rewards and the status of the contest.
The need for support throughout the contest was clearly stated by respondents. For example, some contact with the customer was mentioned by majority—such as launch events and skype calls. The platform was expected to be (1) a place for open communication, (2) transparent and (3) with online moderation. The prototype kit was recommended to include technical drawings, materials, components, samples and tools, though 40 percent of the respondents mentioned that they do have all the needed materials and tools such as 3d printers, but they only need a production budget.

5 DISCUSSION AND CONCLUSIONS

The findings of crowdsourcing site analysis and surveys are intended to guide the crowdsourcing platform development so that it can address the more complex challenges such as engineering challenges. The aim is not only to provide input for the platform developer CogniStreamer, but for all

stakeholders, also at the universities, in their quest for creating value for themselves through crowdsourcing. Hence, the paper bears implications for addressing cross-disciplinarity at universities and for university-enterprise collaboration as well as for supporting those with programs.

The supply side analysis showed that there already are many crowdsourcing contests, with large global participation. For most of them, university students are not the key audience, though for example TopCoder does address the contest as a way to learn and to become more professional. The demand side analysis showed that the survey respondents of engineering/design education experts already had experiences from contests. Still, motivation is there—from both the university perspective as well as from the student perspective. With the emphasis on internal motivation, our paper agrees with a previous study which stated that students would submit innovative ideas or innovations without monetary awards as long as their works were recognized [15].

Using toolkits and openly sharing favourite ideas as part of idea contests aids the communication of what consumers deem important and desirable [5]. The toolkits offered by the analysed contests did not include materials nor components but rather the information about such requirements. The experts liked the suggestions of additional materials, however, did not emphasize their importance.

Overall, based on the analysis, we see potential for increased use of crowdsourcing in the context of learning and innovation. The potential can be supported with more practical experiments as well as with further research.

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