1. Introduction

Increased competition and the reduced lifecycle for products, services and technologies are forcing companies to face and solve innovation problems more frequently than in the past to ensure firm survival and profits. To maintain the necessary pace with such a turbulent environment, firms can no longer rely only on internal R&D efforts; they must also exploit solutions and information generated from outside their boundaries (Chesbrough, 2003). A potential means toward this end, innovation contests have received increasing attention as a promising method of boosting a firm's innovation by obtaining solutions to specific innovation problems. Innovation contests are defined as competitions in which many individuals or teams (problem-solvers) submit ideas, proof of concepts or solutions in response to a specific innovation problem posted by a "seeker" firm. The problem-solver who develops the best solution receives a reward (Terwiesch and Xu, 2008). Innovation contests have been shown to be an effective method of solving firms' innovation problems. In 2006, Netflix[1], an on-line movie rental service, launched the "Netflix prize" innovation contest to determine ways to improve the accuracy of its DVD rental algorithm by an additional 10%. The company collected solutions from 5,169 problem-solvers and attained the target improvement (Bennett and Lanning, 2007). Similarly, Innocentive developed an online platform to support firms that launch and

[1] ww.netflixprize.com

manage innovation contests. Innocentive has received approximately 30,000 solutions since it was created and has solved more than 50% of the innovation problems it has received from the R&D departments of large established companies[2].

However, not all such contests have successfully attracted many interesting solutions. Levia is a medical device production company that launched an innovation contest in 2010. However, as the company posted on its website, "due to a lack of usable contents, the contest has been closed without awarding any prize" [3]. Given these opposing outcomes, it is important to determine what motivates problem-solvers to participate to innovation contests and provide high-quality solutions. Surprisingly, with certain remarkable exceptions (e.g., Zheng et al., 2011), the innovation contest literature has devoted limited attention to exploring the motivations underlying problem-solver participation and, more importantly, the provision of high-quality solutions. To shed light on these issues, one can review the human behavior literature, which yields useful insights. This field recognizes that human behaviors (e.g., participation in a contest and effort invested in producing a high-quality solution) can be motivated both by explicit rewards (e.g., awards or money) and by indirect and hidden motivations (e.g., the joy of solving complex problems). We claim that these

[2] http://www.innocentive.com/about-innocentive/facts-stats
[3] http://merriamassociates.com/2010/11/crowdsourcing-without-a-crowd-levias-failed-attempt/

different motivation orientations can explain problem-solvers' participation in innovation contests and the quality of their solutions.

Beginning with such considerations, this paper aims to explore the types of motivation that best explain solver participation in innovation contests and to investigate the impact of such motivations on solution quality. In particular, the paper was intended to answer to two research questions:

1. Is there a correlation between motivation orientation and participation in innovation contests?
2. Is there a correlation between motivation orientation and high-quality solution submission?

To answer these research questions, we focused on a special class of innovation contests, university contests. University contests operate similarly to traditional innovation contests but are different in two primary ways: i) the university is the intermediary, and ii) the population of problem-solvers is composed exclusively of students. The university contest was used as the object of study because the university is uniquely positioned to operate a competition in a controlled environment, which affords researchers the opportunity to investigate participants and non-participant motivations and to compare the motivation orientations of different problem-solver classes. Furthermore, university contests are becoming increasingly relevant to universities, which view such contests as a service to students and firms, and to the firms themselves, which view such contests as a method of supporting inbound, open innovation processes (Chesbrough, 2003; Chesbrough, 2006; Pisano and Verganti, 2008) as well as accessing and assessing undergraduate student skills in advance.

We strongly believe that this paper contributes meaningfully to the ongoing debate on innovation contests (e.g., Jeppsen and Lakhani, 2010; Terwiesch and Xu, 2008; Boudreau et al., 2011) by focusing attention on problem-solver motivations, which is an under-researched topic in the innovation contest literature. Although motivations have been thoroughly studied in research on open-source communities (e.g., Roberts et al., 2006), considerably less effort has applied motivation theories to studies of innovation contests.

The paper is organized as follows. In the next section, the relevant literature is briefly reviewed to highlight the primary research gaps and construct a theoretical framework. Next, the data collection process and analytical methodology are thoroughly discussed. Finally, the results, their managerial implications and opportunities for further research are presented.

2. Literature Review

Given the objectives of this paper, two literature streams are particularly relevant: the innovation contest literature and studies of motivation in self-engagement innovation activities.

2.1 Innovation contest literature

Innovation contests are a tool that firms use to implement open innovation practices (Terwiesch and Xu, 2008; Verona et al. 2006, Chesbrough 2006, Jeppesen and Lakhani 2010, Huston and Sakkab, 2006). The academic literature began to focus on the open innovation phenomenon in the early 21st century, when Chesbrough defined this phenomenon as "a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as

the firms look to advance their technology" (Chesbrough, 2003). This paradigm was described as an alternative to closed innovation, in which firms exclusively focus on their ideas and R&D departments in bringing innovations to the market. In particular, in an innovation contest, a firm broadcasts an innovation problem to a wide community of individuals with the knowledge and skills to develop a solution, who are referred to as solvers. Solvers submit their solutions to the seeker company, which screens the solutions and awards a prize to the developer of the best solution. Even while maintaining the general structure of innovation contests, different types of entities can run such contests, such as commercial firms that require solutions to innovation problems (e.g., Netflix in Bennett and Lanning, 2007), intermediaries (e.g., Innocentive in Sawhney et al, 2005) or universities (e.g., "SAPiens"[4] in collaboration with SAP University Competence Center in Ebner et al, 2009).

Given the relevance of innovation contests in recent years, many authors have begun to investigate this phenomenon to understand the key variables that impact the probability of generating solutions to innovation problems through contests. Terwiesch and Xu (2008) demonstrate that increasing the solver population can benefit the seekers because it increases the likelihood of attracting unexpected solutions from unknown knowledge domains. However, having many solvers working

[4] www.sapiens.info

on an innovation problem will lead to lower effort from each solver because each solver has a lower probability of winning the competition, which is undesirable for the seeker. However, for certain types of problems, the authors show that the positive influence of an increased number of solvers outweighs the effect of the solvers' underinvestment in their effort (Terwiesch and Xu 2008). Similar results are obtained by Boudreau et al. (2008), who empirically demonstrate the positive effect of tackling certain problems by increasing the number of solvers. This conclusion is based on 645 problems that were solved on topcoder (www.topcoder.com) through innovation competitions (Boudreau et al. 2008). Jeppesen and Lakhani (2010) investigate the solver characteristics that impact the probability of solving a problem. According to that study, problem-solving success is associated with the ability to attract specialized solvers with a range of diverse scientific interests. Furthermore, successful solvers have solved problems at the boundary of or outside their fields of expertise, which indicates that information is being transferred from one field to others in such cases (Jeppesen and Lakhani 2010).

However, despite these relevant contributions that have increased our knowledge of innovation contests, such studies have viewed the problem from the seeker's perspective and have not considered the problem-solvers' motivations for participating in innovation contests or the impact of such motivations on the quality of the solutions provided. This paper helps to fill this gap by exploring solvers' motivations and their impact on solution quality in university contests.

2.2 University contest literature

Despite their increasing relevance to both firms and academic institutions,

university contests remain largely unexplored in the literature. Existing contributions regard various aspects of contest design and management. Ebner et al. (2008) focus on the diagnosing and planning phase to develop an integrated concept of the contest within virtual community, finding promising results for all the stakeholders involved. Other studies suggest the introduction the cooperation inside the contest should increase the degree of innovativeness (Ihl et al., 2012). Finally Haller et al. (2011) analyzed the effectiveness of rewards, monetary or not, in attracting solvers.

Mainly these pieces of research utilized university contests only as convenient empirical field of the innovation contest (Ihl et al., 2012; Haller et al., 2011; Ebner et al., 2008), generalizing the results to every initiative.

Nevertheless, even if some characteristics of university contest management are similar to any other contest initiative, it's important to highlight some crucial differences that should discourage this oversimplified results' generalization. First, the relationship between the solvers, students, and the organizer, university, exists beyond the contest initiative and, even more relevant, the main mission of the university institution isn't to manage contests. In the company intermediary model (e.g. Innocentive), the objective is to develop a problem-solving platform. In that model, solvers decide to subscribe the community only to solve competitions. The students instead are involved in university activities for completely different reasons and the participation to a contest is just an add on activity among already existing and more relevant ones. These differences impact heavily on motivations that lead them to participate (e.g. having visibility towards the professors who should then give a grade) (Ihl et al., 2012).

Second, moving from a company intermediary to a university may also open different perspectives in terms of contest main objective.. While company intermediary competitions have as main goal the acquisition of ideas or solutions to innovation problems ,the university contests can have also a second goal (which in many cases can become the main one): networking with students and access to a source of potential high level new resources for hiring (Ebner et al., 2009).

2.3 Motivation underlying self-engagement in innovation activities

Motivation is a psychological feature that leads a person to act; it is defined as the impetus toward a behavior (Hughes, 2007). In particular, the literature on motivation has devoted particular attention to exploring the motivations underlying voluntary innovation activities. Within this category, innovation contests are a particular example of spontaneous participation in innovation activities. Through an open innovation platform such as Innocentive, problem-solvers around the world decide to actively participate in such contests. Such participation is not their normal job; the solvers simply want to participate as volunteers. Because such participation is spontaneous, it is interesting to consider why people decide to self-engage; if participation is not their job, what are their underlying motivations?

In the literature on innovation contests, few studies have analyzed the motivations underlying innovation contest participation (e.g., Zheng and Hou, 2011). However, motivations underlying participation in self-engagement activities have been investigated in different empirical settings, such as open-source software development (Linux case in Hars and Ou, 2001; Apache Projects in Robert et al, 2006; in Lakhani and Von Hipple, 2003), open-knowledge communities (Wikipedia in Rafaeli and

Ariel, 2008), the communities of practice (Wasko and Faraj, 2000), the web platform for virtual NPD (Fuller et al, 2010; Fuller, 2006; Rohrbeck et al, 2008; Ihl et al, 2012), customer communities (Fuller et al, 2008) and online innovation communities (Janzik and Herstatt, 2008).

The authors include various motivation factors in such analyses; thus, it is difficult to compare the results obtained. However, the motivations can be divided into two primary categories: motivations that are related to objective outcomes rather than the activities themselves (e.g., monetary rewards and visibility) and motivations based on the expectation that the participant will in fact benefit from performing the activities. Based on these differences, the motivations can be grouped into two clusters: extrinsic (EM) and intrinsic motivations (IM). According to the theories of motivation, EM emerges when an individual activates a specific behavior due to a clear anticipated consequence such as a tangible return; in this case, the satisfaction derives from the extrinsic consequences of the behavior (Gagnè and Deci, 2005; Antikainen et al, 2010; Frey, 2000; Lee et al, 2005; Kristensson et al, 2008). Individuals who are motivated by EM may not particularly enjoy the task but may be motivated to perform it well to receive a reward or avoid negative consequences (Deci and Ryan, 2000). In contrast, IM occurs when behaviors are performed based on interest, enjoyment; and the prospect of personal fulfillment; the person may experience a feeling of pleasure or joy, and accomplishing such tasks creates satisfaction and pleasure because the work is meaningful or stimulating. When IM is a factor, motivations such as external stimulation, pressure, and rewards are less important to the final behavior (Antikainen et al, 2010; Lee et al, 2005; Deci and Ryan, 2000).

Motivation sources were classified as intrinsic or extrinsic to compare previous studies. The previous findings regarding the effects of the two motivation sources on innovation activity participation are contradictory. Certain authors declare that extrinsic motivation is superior to intrinsic stimuli (Robert et al, 2006; Hars and Ou, 2001; Wasko and Faraj, 2000; Ihl et al, 2012). In contrast, other studies claim the opposite and attribute more importance to intrinsic motivation than extrinsic stimuli (Fuller et al, 2010; Fuller, 2006; Fuller et al, 2008). Moreover, the literature suggests that the predominance of one or other motivations depends on the type of contributor: whether the person is a student, hobbyist or professional (Ihl et al, 2012; Hars and Ou, 2001). Finally, Deci (1972) suggests that the effects of extrinsic and intrinsic rewards cannot be considered additive because extrinsic rewards impact intrinsic stimuli; intrinsic motivation to perform an activity decreases when extrinsic factors are considered (Deci, 1972).

Despite the relevance of these studies to the question of what motivates people to participate in self-engagement activities, the previous research primarily examines open source communities and does not address the particularities of innovation contests. Thus, further research should investigate the role of intrinsic and extrinsic motivation in participation and solution quality in the context of innovation contests.

3 Theoretical framework

To address our research questions, we investigated relationships between the different motivation orientations and the problem-solvers' behavior, considering their participation in innovation contests as well as solution quality.

Fuller's motivations can be applied in different contexts, but it was necessary to determine the relevance of such motivations to innovation contests. Because Fuller's motivations apply to consumers in a virtual community, we selected only the motivations that are also applicable to University Contests. For example the community support was not included in the model as there is not community support in UCs contests, as shown in Table 1[5].

Autotelic-Playful Task	Individuals engage in tasks due to the feelings of pleasure that they derive from performing the task. The activity is considered rewarding.
Curiosity - Exploration-Arousal Seeking	Participation is driven by the satisfaction of exploring new information. Curiosity is the desire for knowledge rather than the desire to obtain the results that may be gained from such knowledge.
Achievement-Challenge-Self Efficacy	The opportunity to prove oneself motivates participation.
Skill Development - Knowledge Acquisition	People are motivated because they want to improve their skills and enhance their knowledge.
Recognition-Visibility	Visibility, fame and reputation gained from the activity motivate participation.
Compensation-Monetary Reward	People engage in innovation activities for immediate or delayed compensation.

Table 1: Innovation sources (adapted from Fuller, 2006)

Other potential motivation sources derived from Fuller (2006) are linked to community activities, such as community support, or are help consumers to fully reach a community (e.g., product or software development). Given the particularities of innovation contests, in which community interactions are irrelevant and the

[5] Please refer to the methodology paragraph for details regarding the variable operationalization analysis of the process to select scale and variables.

problem-solvers are not users, these motivation sources were excluded from the analysis. Similarly, motivations such as user willingness to access information that is otherwise inaccessible or difficult to find were also excluded from this study because a company does not typically release confidential information to the solvers in innovation contests.

As described in the literature, the motivations considered in this study can be divided into two groups: intrinsic and extrinsic sources of motivation. The first four motivations fall within the intrinsic cluster because they are related to the activity and not the output (Amabile, 1994). However, compensation and recognition are linked to the contest output and are extrinsic. Fuller's motivations can be applied in different contexts, but it is necessary to discern the contribution of such motivations to innovation activities.

In examining the solvers' behavior, we wanted to investigate their motivation orientation and how it facilitates participation in innovation contests. Furthermore, given that the objective of a contest is not only to attract more people but also to attract the individuals who are likely to provide the best solutions, the number of participants is not the only behavior that we wanted to analyze. We also investigated what motivated the solvers to submit the best solutions.

As suggested by Amabile et al. (1994) the social psychological research had documented conspicuous differences in task performance between intrinsically and extrinsically motivated individuals (Garbarino, 1975; Bahrick, Fitts, & Rankin, 1952; McGraw & McCullers, 1979; Amabile, 1985). Assuming that there are different motivation orientations, we hypothesized that different orientations produce different

levels of solution quality. Beginning with the above considerations, we considered a single dependent variable that encompassed both participation and participation quality. Hence, the level of participation (non-participation, low-level participation and high-level participation) was the behavior studied.

Figure 1 summarizes the research framework for this study.

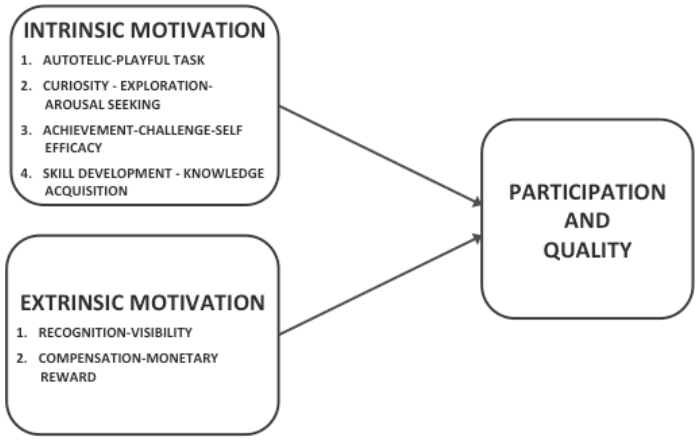

Figure 1: Research Framework

4. Research Methodology

To answer these research questions, a confined empirical setting was necessary. In this research, we needed to study not only the motivation orientations underlying solver participation in the innovation contest but also the motivations that resulted in non-participation. In studying both behaviors (participation and non-participation), we compared the motivation orientations and deduced the actual participation motivators. Such information can only be collected in a controlled environment in which we know the entire community of potential solvers. General online contests (e.g., Innocentive) are often entirely open to the external community; thus, it is impossible to study the motivation orientations of the non-participants. Non-participants can be

people who decide not take part in the contest or people are unaware of the opportunity.

4.1 Investigation area

We collected data from university contests at the Politecnico di Milano because this controlled empirical setting facilitated data collection, which would have been impossible with traditional innovation contests. University contests offer the potential to survey students who decided not to participate, whereas in traditional innovation contests, it is almost impossible to identify and survey individuals who knew about the contest but decided not to participate.

Furthermore, because of the types of contests administered by universities, we were able to study a specific community that is particularly interesting from a company perspective. Through university contests, companies can access young, smart and open-minded potential problem-solvers. Moreover, students at a technological university are constantly updated on new technologies, products and ideas as well as methodologies, theories and tools that they can use to solve new problems. As a result, these individuals have the potential to provide disruptive ideas. In addition, such initiatives are extremely valuable to universities because students are now increasingly interested in meeting companies before they end their academic careers and universities are attempting to support this goal. University contests are a new promising way to improve placement services for students.

Politecnico di Milano has developed a structured process to manage its contests (see Figure 2). The Career Service office is now responsible for organizing contests developed in collaboration with companies. First, when a company asks to collaborate

with students, the university aids the managers in identifying the innovation problem and designing the contest. Then, the Career Service office and the company choose the courses in which the contest will be launched. For the case considered in this study, the contest targeted three different departments within the university (engineering, architecture and industrial design). After the problem was identified and the brief prepared, the contest process began. The contest process was similar to those implemented by well-known open innovation platforms (e.g., Innocentive) except that the company experts and solver community were able to interact online and face-to-face.

The primary steps are summarized in Figure 2. The contest was presented during select courses and on the university website. Students who wanted to participate registered for the contest to obtain more information; they were also required to send their solutions by the deadline to finalize their participation. Thereafter, firm experts evaluated the solutions and selected the list of winners, which was publicly announced. The winners were given their awards during a ceremony held for that purpose.

Figure 2: University Contest Process

The contests were launched by two firms: a telecommunication company and an electronics and electrical engineering company. The first contest was aimed at facilitating innovation in the education industry by creating a new, digital learning environments that provides future students with a new set of digital learning tools.

The second contest was intended to develop an energy management system to improve home energy consumption.

4.2 Research phases

To investigate the motivations underlying student participation, we analyzed the university contest organized by the Politecnico di Milano using a two-step approach that comprised a quantitative phase based on a survey and a qualitative phase based on 6 in-depth interviews (Figure 3).

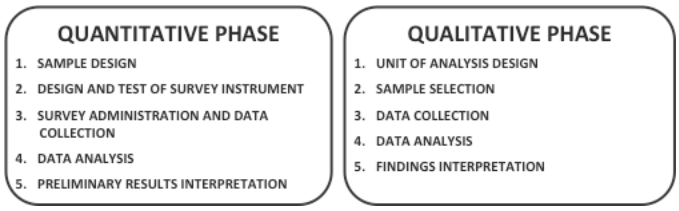

Figure 3: Research Process

The literature on motivation is already quite detailed, which made it easier to develop the survey used in this study. The quantitative phase provided us with an opportunity to investigate the impact of motivation orientations (intrinsic and extrinsic) on participation and solution quality using a large sample. So that we could conduct an in-depth analysis of the variables that explain motivation, we performed interviews. The qualitative phase facilitated a deeper analysis of a smaller sample of solvers and thus helped to validate the preliminary survey results.

In this type of research, timing is relevant. Attribution theory indicates that a person enhances his responsibility through positive behavior and he self-protect himself, attributing externally the cause of negative behavior (Kelley and Michela, 1980; Campbell and Sedikides, 1999), which can generate bias if we question solvers about their motivations only after participation. To remove self-serving bias that may

yield self-perceived motivations, we performed the analysis after the contest was presented but before the students had decided to participate. The in-depth interviews were performed at the end of the contest (i.e., after participation), which provided us the opportunity to investigate the motivations acknowledged after the contest and compare them with the motivations acknowledged during the survey.

5. Quantitative phase

5.1 Methodology

To collect the data, we submitted the survey to the students after registration. The first questionnaire was given to each student in each of the selected courses to investigate the students' motivations prior to their participation. The contest information was presented to 198 students; each student was asked to answer a questionnaire on his/her motivation to participate (or not participate). One hundred seventeen students answered the questionnaire (69% response rate). After the deadline, we divided the sample into students who had submitted solutions (*solvers*) and those who had decided not to participate (*non-solvers)*. One hundred two respondents did not participate; 15 provided solutions.

<u>Independent variables</u>

To operationalize motivations, we started from the research contribution by Fuller

(2006). Fuller proposes 10 different motivational categories and measures each of them using multiple-item Likert scales. We adapted Fullers work first of all by reducing the number of categories from 10 to the 6 included in framework6. Then measured each one of them with a single item scale under the constraint that the global sum was equal constant. In the questionnaire, students were asked to distribute a total of 100 points across the six motivation variables, identifying the categories that might persuade them to participate. Constant-sum allocation was used to overcome the limitations of the rating approach and explicitly determine trade-offs among attributes which might not emerge clearly otherwise (as the respondents could easily indicate that every attribute is relevant to motivate them) (Netzer and Srinivasan, 2009). For each category the reduction from multiple to single-item scale was operated by asking separately to 5 PhD students and to 5 potential participants student which of the three items proposed by Fuller7 better represented the category for them.

The most voted items were finally selected and are included in Table 2.

	Variable (from Fuller, 2006)	**Item**
MI	*Autotelic - Playful Task*	To enjoy myself
	Curiosity - Exploration-Arousal Seeking	To satisfy my curiosity on the subject and discover a new company

[6] Please refer to the framework paragraph for more details
[7] Items were partially rephrased to make sense in a University contest environment

	Achievement-Challenge-Self Efficacy	To prove my value to myself
	Skill Development–Knowledge Acquisition	To increase my knowledge of the contest subject and improve my problem-solving
ME	*Recognition -Visibility*	To demonstrate my value to someone (e.g., friends, colleagues, professors)
	Compensation-Monetary Reward	To receive rewards (money, gadgets and/or higher course grades) or contact the company for potential future collaborations

Table 2: Scale derived from Fuller's variables.

The questionnaires were examined before the data-gathering phase using two students from the final sample and other researchers not only to verify the questionnaire's validity but also to determine whether the questionnaire could accomplish the study objectives (Forza, 2002). We collected this information by requesting the students' participation in a 20-minute online survey before the contest deadline.

A cluster analysis of the motivations was performed to examine the motivation orientations in the sample. We used a two-stage procedure. A cluster with a hierarchical algorithm was used to define the number of clusters and cluster centroids (Milligan and Sokol, 1980; Punj and Stewart, 1983). We used different methods to define the number of clusters.

- Visual inspection of a dendrogram for Ward's clustering method and analysis of the coefficients' incremental changes
- Lehmann's (1979) approach, which suggests that the optimal number of clusters is between n/30 and n/60, where n is the sample size.
- Two-step cluster

The stopping rules suggested that we select two clusters. Ward's method centroids were utilized as a starting point for non-hierarchical clustering (K-means).

Dependent variables

Our research objectives were to analyze both the binary choice to participate or not participate in the contest and the solution quality submitted. To assess the solution quality, we solicited the help of a panel of experts from inside the companies (Amabile, 1982, Piller and Walcher, 2006). The experts evaluated solution quality using the following four variables.

1. Novelty: the level of newness of the submitted solution
2. Readiness: the extent to which a solution can be launched in the market with little effort
3. Usefulness: the extent to which a contribution satisfies the company requirements
4. The clarity of the solution

The panel of experts was also asked if, in terms of total quality, the four dimensions have the same importance or should have different weights. Final weights were estimated according to the average of their answers. As a result the total quality variable was calculated by weighting novelty, readiness and usefulness three times greater than clarity.

Total Quality = 0.3*Novelty + 0.3* Readiness+ 0.3 Usefulness + 0.1 Clarity

Experts from the company were asked to evaluate the quality of the solutions submitted at the end of the contest by completing a pre-defined form.

Finally, to stress the differences among the subjects, the continuous quality variable was modified into a binary variable. Solvers with a total quality greater than

the mean were coded as high performers and vice versa (Griffin and Page, 1993; Griffin and Page, 1996). Using this measure, we divided the sample into subsamples of three different behaviors: the *non-solvers*, the students who did not submit a solution; the *low-quality solvers*, who submitted a solution with a total quality less than the mean; and the *high-quality solvers*, who submitted a solution greater than the mean quality.

The data were gathered from the solvers and company experts and were analyzed. A cluster analysis was performed to identify the motivation orientations within the sample. The cross tab analysis then allowed us to test for significant differences in each motivation orientation.

5.2 Results

As described in the methodological section, a cluster analysis was performed to identify the motivation orientations of the population of solvers beginning with the motivation drivers. Two distinct clusters were identified, as depicted in Figure 4.

Final Cluster Center

	Cluster	
	Self-Empowerment Oriented	**Reward Oriented**
MI1: Autotelic, Playful Task	7,29	10,11
MI2: Curiosity, Exploration, Arousal Seeking	22,82	16,10
MI3: Achievement, Challenge, Self-Efficacy	9,44	5,58
MI4: Skill Development, Knowledge Acquisition	33,38	12,10
ME1: Recognition, Visibility	4,78	3,29
ME2: Compensation, Monetary Reward	22,29	52,82

Figure 4: K-means cluster centers.

First, both clusters showed that certain motivation orientations were less relevant due to the particular sample that was used. The visibility and recognition drivers were

not important to students because the professor relationship was not long-lasting; thus, the students considered demonstrating their value to the professor to be less important. Moreover, sample choice impacted the achievement driver score. It is typical for students to be challenged at the end of each course; the final tests are a way that they can prove themselves.

In contrast, certain important differences emerged between the clusters for the other drivers. The first cluster (self-empowerment oriented) exhibited the desire to develop personal skills. In addition, the respondents in this cluster considered curiosity to be an important factor in their decisions to participate in the contest. These two intrinsic components explained more than 50% of the participation. Solution submission was primarily an intrinsic decision. Interestingly, the monetary reward offered also motivated the choices of the students in the first cluster; the respondents were principally motivated by intrinsic factors but balanced this motivation with the promise of extrinsic compensation.

The second cluster comprised respondents who were primarily interested in compensation. More than 50% of their motivation was extrinsic. The intrinsic motivation drivers were less important and did not contribute substantially to their participation decisions. The possibility of compensation from the contest motivated the respondents in the second cluster (i.e., they were reward oriented).

The two clusters exhibited two different motivation orientations. The self-empowerment-oriented cluster can be defined as “intrinsically motivated” because that cluster was primarily influenced by intrinsic drivers. On the other hand, the reward-oriented group can be defined as “extrinsically motivated” because

compensation was the primary driver that motivated the potential problem-solvers to participate.

To answer the research questions, the relationship between the two motivation orientations and behaviors were investigated. In Figure 5, for each behavior, the percentages of people in each cluster are showed (e.g. 69% of non-solvers are included into the self-empowerment oriented cluster).

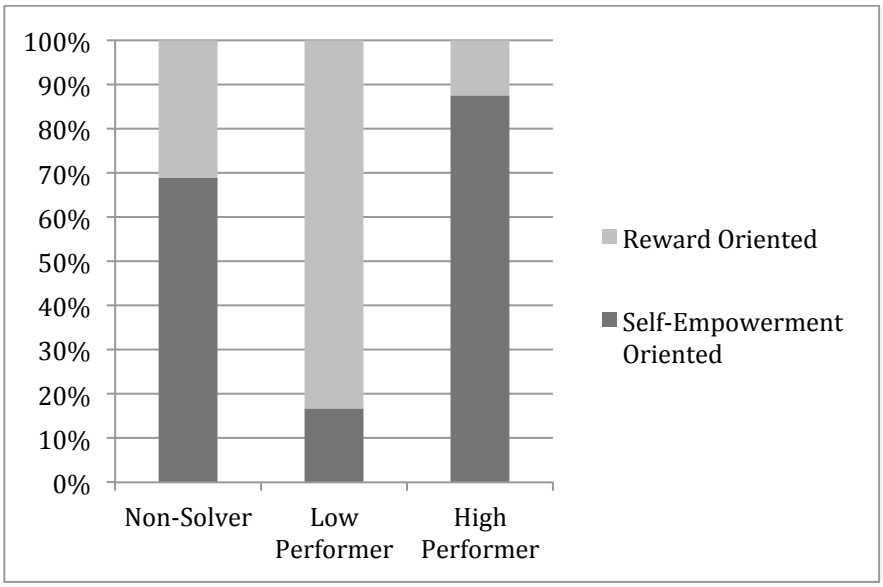

Figure 5: Motivation orientations for the three behaviors

First, we must consider whether the distributions of the three behaviors are significantly different. The chi square test was performed to test for significant differences between the observed distribution and the distribution expected based on probability (Siegel, 1956; Woodside, 2010). The test showed that the distribution was statistically significant (chi square: 0,013), as showed in Figure 6.

Cluster * Participation Crosstabulation

Count

	Participation			Total
	Non-Solver	Low Performer	High Performer	

Cluster	Self-Empowerment Oriented	71	1	7	79
	Reward Oriented	32	5	1	38
	Total	103	6	8	117

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8,625[a]	2	,013
Likelihood Ratio	8,438	2	,015
Linear-by-Linear Association	,003	1	,958
N of Valid Cases	117		

a. 3 cells (50,0%) have expected count less than 5. The minimum expected count is 1,95.

Figure 6: CrossTabulation analysis.

In particular, the *high performers* were principally driven by an intrinsic orientation; more self-empowerment-oriented students showed this behavior than the reward-oriented students. The *low performer* orientations were the opposite; only a few such solvers were self-empowerment oriented, and extrinsic motivation explained the participation of the majority of the low performers. Interestingly, students who did not submit solutions (*non-solvers*) were similar to the high performers in terms of their motivation orientation in that they were influenced primarily by their intrinsic orientation. They may have been high performers, but something prevented their participation.

6. Qualitative phase

The qualitative phase was needed to better understand the preliminary results of the quantitative analysis. The objective of this second phase was to validate the quantitative results and to give a clear interpretation of the strong, and somehow counterintuitive, similarity between non-solvers and high performers of the university contest. Interviews allowed us to examine the motivations for the different types of participation in depth. Note that the quantitative results were generated from

motivations acknowledged before the contest; in the qualitative phase, the data were gathered after the contest.

6.1 Methodology

Eisenhart (1989) suggests using seven cases because this is the maximum number f cases a person can mentally process. In this research, we conducted six case studies to investigate how motivations impacted on participation and quality. In order to take into account both the performances (participation and quality) we included in the sample an equal number of individuals who exhibited the three different behaviors: two *non-solvers*, two *low performers* and two *high performers*. We selected the sample after the company already processed the submissions ad decided the winners.

A semi-structured interview protocol was designed. We conducted a guided conversation and adapted the questions to the respondent answers (Yin, 1981; Yin, 2003). Respondents started answering about their context experience and activation phase. Then they where specifically asked about what motivations were the main drivers of their (non)participation. Not-solvers and low performers were asked to explain what could have been done to improve their efforts. This planning structure increased the data completeness; thus, the data collection was more systematic, but the interviews remained conversational and situational (Hancock, 2006).

Interviews lasted between 20 and 50 minutes; half of them were in presence and half through video calls. The interviews were video- and tape-recorded and transcribed. Data collected were integrated with the interviewer notes. The information was organized in a table based on the operational motivation orientations described in the framework. This method of data organization allowed to compare

interview results with the preliminary survey findings.

6.2 Results

We generated useful insights from the qualitative analysis performed through direct interviews with the different classes of solvers (i.e., the *non-participants*, *low performers* and *high performers*). The analysis results are reported in Table 3 and were compared with the survey results.

N	Behavior	Motivations that may have facilitated participation	IM	EM	Main Motivation
1	Non-Solver	To contact the company for potential future collaborations;		X	EM
		To work on a subject I would like to use in the future in my thesis;		X	
2	Non-Solver	To contact the company for potential future collaborations;		X	EM
		To win an award;		X	
N	**Behavior**	**Motivations that facilitated participation**	**IM**	**EM**	**Main Motivation**
3	Low Performer	To contact the company for potential future collaborations;		X	EM (IM)
		To satisfy my curiosity on the subject;	X		
		To win an award;		X	
4	Low Performer	To win an award;		X	EM
		Personal enrichment (to use the contest to learn skills for future jobs);		X	
5	High Performer	To satisfy my curiosity on the subject;	X		IM
		To prove my value to myself;	X		
		To contact the company for potential future collaborations;		X	
6	High Performer	Personal enrichment;	X		IM
		To prove my value to myself.	X		

Table 3: Qualitative Analysis Results.

From a cursory analysis of Table 3, one can see that the *high performers* were clearly highly motivated by intrinsic factors; the *low performers* and *non-solvers* were more driven by extrinsic factors.

7. Discussion

When we compared the results obtained during the two study phases, we found that only certain results from the survey were validated by the qualitative analysis (Table 4).

Phase	Non-Solvers	Low Performers	High Performers
Quantitative phase (survey)	IM	EM	IM
Qualitative phase (interviews)	EM	EM	IM

Table 4: Result Comparison.

Both phases show that the *high performers* were highly motivated by the intrinsic factors and that the *low performers* were more driven by extrinsic factors. In contrast, the results for non-solvers were inconsistent: they resulted to be extrinsically motivated in the qualitative phase while they resulted to be intrinsically motivated in the quantitative one. It is important to note that this incontinency did not emerge at the beginning of the interview. A deeper analysis can reveal underlying reasoning for certain behaviors (Campbell et al, 1999). In this case it lead to discover that the non-solvers are influenced by the social desirability bias: non-participants define intrinsic motivations that are considered socially acceptable, to project a favorable image of themselves to others (Maccoby and Maccoby, 1954; Crowne and Marlowe, 1964; Thomas and Kilmann, 1975; Nederhof, 1985). The qualitative analysis revealed a large influence of extrinsic stimuli on non-participants. When asked what could be done to improve their participation, the non-solvers answered that greater extrinsic rewards would have motivated them. In this way, they were similar to the *low performers*. The second *non-solver* stated the following.

"If the awards had been bigger, I would have participated. We could buy the same thing with 400€ in an Apple store, and the internship is not enough. It's better to be a part of the team with a contract

of one year at least; we need to find a job, but if this contest couldn't help us in this way, it's better to win money."

The *non-solvers* and *low performers* both chose whether to participate based on a combination of explicit benefits and perceived necessary effort. Their different behaviors were related to their different perceptions of the benefits of participating and the level of necessary effort. The first *low performer* (N3) perceived the contest as having more value due to his intrinsic motivation; he stated that he was interested in the contest topic (see table). In contrast, the second *low performer* (N4) perceived that lower effort would be necessary for her to participate than the *non-solvers* did. She stated the following:

"I already knew the topic and I feel confident in it. In addition, I asked my colleagues and I discovered that there were few participants: the probability of winning was high."

The *non-solvers'* perceptions of the effort required by the contest and the benefits of participation did not facilitate participation. As the second *non-solver* stated in the previous quotation, the proposed prize was insufficient given the effort that the contest required. He preferred different compensation, such as a contract for one year of work with a company.

Finally, the *high performers* were primarily motivated by intrinsic factors. The first *high performer* (N5) stated that substantial interest in the contest subject and the challenge were his two primary motivations for participating. The second *high performer* stated the following:

...(the contest) is a way to open my mind and my skills in general. In the master's degree, in my courses, we are always stimulated to challenge ourselves to improve our capability, and this is a good opportunity to try.

8. Conclusion

According to Deci and Ryan (1985), the participants' motivation orientations (intrinsically motivated, extrinsically motivated and amotivated individuals) can be understood as existing on a continuum according with their level of self-determination, where intrinsic motivation represents the highest level and facilitates pleasure as well as autonomous behavior (Deci and Ryan, 1985; Deci and Ryan, 2000; Gagnè and Deci, 2005). Participating in a contest is a spontaneous behavior, and it is unsurprising that such behavior is highly intrinsically motivated.

However, different levels of extrinsic and intrinsic motivation were observed across the different participant groups. *Low-performers* were primarily driven by the activity outcomes; they participated for the rewards (both monetary and non-monetary) and balanced these rewards with the perceived required effort and the probability of obtaining such benefits. Thus, these participants seemed similar to the *non-solvers* whom we interviewed. Beginning with the same extrinsic orientation, the *non-solvers* and *low performers* made their participation decisions based on a combination of explicit benefits and their perception of the effort required to develop a solution. As in previous studies (Locke and Latham, 1990; Bandura, 1977), *low performers* participated in the contest based on their belief that they could submit a good solution (self-efficacy) and the perception that they had a high probability of obtaining the reward. In contrast, the *non-solvers* perceived the effort as unbalanced by the reward (see cit. N2 in the Discussion).

On the other hand, the *high performers* were driven more by the benefits of the activity itself than by the benefits of the activity's outcome. The important factors

were the fun and challenge associated with the activity, not the possible rewards (monetary or otherwise). The choice to participate was not rational; the participants did not compare the benefits and effort because they enjoyed the path. As Csiksgentmihalyi (2002) suggests, people who enjoy participating in a particular activity may sink into the experience and be fully absorbed, losing any sense of time and space (state of flow). The extrinsic motivation was necessary for participation in general but was insufficient to produce a high-quality solution; the fifth interviewee (*high-performer*) stated the following:

> *For me, the award is not important. Surely, if it's a thing that I like, it is one of the reasons why I participated in the contests. Still, I don't think that it is the real reason why I put all this effort in working to my solution. Once I started, I actually enjoyed it.*

8. Managerial implications, Limitations and Future Research

These results have managerial implications for organizations willing to manage a university contests. The implications may differ with the aim of the contest.

Different aims can lead organizers to design a university contest. First of all the contest can be developed in order to increase the brand awareness, for marketing purposes or to have a preferred communication line for future hiring processes. In this case, a high number of participants is desirable. Our data suggest that leverage on the extrinsic motivation is sufficient to increase the participation in the initiative. Therefore, if the aim of the contest is linked to a marketing-related purpose, the company should leverage on the extrinsic drivers giving higher prizes or higher visibility to the winners. Increasing these design variables it's possible to engage more solvers but the quality is not guarantee.

Another option is that companies launch University Contests actually seeking for high quality solutions. The aim of the contest in these cases is to find a solution to a problem or generate insights and potential new ideas or, finally, to scout high potential talents among students. In these cases the quality of the solution turns out to be the most important parameter. Our data suggest that in this cases companies cannot avoid to leverage on extrinsic motivations because otherwise none would participate. Still, they should also leverage on intrinsic motivations to increase the quality of the proposed solutions. Previous researches shown that extrinsic motivation variables (e.g., rewards) are not always the best way to motivate people to contribute (Antikainen et al, 2010; Lakhani and Panetta, 2007); our data confirm that this is especially true for high-quality contributions.

The results of this study are limited, primarily due to the small sample size. However, the preliminary results suggest that a more detailed and widespread investigation of this topic is necessary. Further research may enhance the internal validity of the results by using a large sample and replicating the survey results for other university contests. Moreover, to increase the external validity of the results, the analysis could be extended beyond university contests. The research process could be adapted so that researchers might explore the motivations underlying participation in self-engagement innovation activities in companies, communities and internal forums, for example.

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