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Weaving Risk Identification Into Crowdsourcing Lifecycle

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Abstract

Crowdsourcing enables companies and individuals as well to tap into the versatile knowledge, creativity, and talent of a large population of crowd contributors. Yet, crowdsourcing can expose companies to a myriad of risks that can have drastic impact on the profitability and competitive position. This paper presents a Risk Breakdown Structure (RBS) of crowdsourcing projects that spans the entire project's lifecycle. The paper first reports on a lifecycle model that captures the main phases of a crowdsourcing project. It then identifies the risk factors associated with each phase of the crowdsourcing lifecycle and discusses the impact of these identified risk factors on the crowdsourcing company. The proposed RBS calls for the need to pay close attention to risk monitoring during each phase of the crowdsourcing lifecycle.

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1. Introduction

There are no doubts that the social fever has caught every single activity of people's daily life. Activities include sharing live experiences online, asking for the dress code on a special occasion, and campaigning against products. This social fever is exemplified by the large number of Web 2.0 applications available to people ranging from Facebook and Twitter to Instagram and WhatsApp. Web 2.0 applications capitalize heavily on the ability and willingness of users to interact, share, collaborate, and recommend. Despite all the hype and excitement around Web 2.0 applications many organizations are still reluctant to embracing them. Different concerns have been raised, including whether these applications are bringing any value-added to companies (according to Gartner, "... *many large companies are embracing internal social networks, but for the most part, they are not getting much from them*"¹) and whether they are the sources of new forms of security threats, privacy breaches, and/or distraction to employees. Despite this reluctance, a report published by Demos, a London-based think tank, encourages enterprises to allow their employees to embrace social network applications in order to establish and foster contacts with stakeholders such as their colleagues, customers, and suppliers².

Crowdsourcing is one of the Web 2.0 applications that has lately drawn the attention of the R&D community. Howe and Robinson are the first who suggested the term "*crowdsourcing*" for the online collaboration of people around the world despite their differences in terms of ethnicities, languages, backgrounds, cultures, to cite just a few³. Howe decomposes crowdsourcing into four categories²: crowd wisdom, crowd creation, crowd voting, and crowd funding.

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Geiger *et al.*⁴ identify the four main phases of the crowdsourcing lifecycle: preselection of contributors, accessibility of peer contributions, aggregation of contributors and remuneration of contributors. More details are given later.

Crowdsourcing raises some concerns when it comes to knowing who is dealing with whom, what is shared with whom, what is expected in return, etc. Engaging a crowd in business operations might turn into a nightmare. Crowdsourcing projects are exposed to various potential risks and uncertainties that can inhibit their success. Studies like⁵ and⁶ reveal the damages that crowdsourcing inappropriate-use could cause to organizations in terms of reputation risks, financial losses, and/or legal disputes. An example is Google's Prizes.org. Prizes.org, which launched in the middle of 2011, was a place where participants can win real cash prizes by coming up with the best ideas to help others out. People create contests on Prizes.org with real money bounties for anything they need like advice for the perfect weekend getaway and plan for losing weight in summer. Prizes.org is one of the very few platforms that Crowdsourcing.org received multiple complaints about from readers regarding fraudulent contests and shill entries⁷. Prizes.org finally went offline on January 31, 2013. This example illustrates the importance of effectively recognizing and managing crowdsourcing risks so as to reduce the incidence and effects of project failure. However, before we can develop proper crowdsourcing risk management strategies, these risks need to be identified.

A closer examination of the crowdsourcing lifecycle of Geiger *et al.*⁴ reveals that some important phases of a typical crowdsourcing project are missing. Accordingly, there is a need to define a more comprehensive lifecycle model. In this paper, we first identify the different phases of the crowdsourcing lifecycle along with their associated risk factors, and then discuss the impact of these risks on the success of crowdsourcing projects. This results into developing a Risk Breakdown Structure (RBS) for crowdsourcing that spans the entire lifecycle. Section 2 discusses related work. The proposed crowdsourcing lifecycle is presented in Section 3. The risk factors according to the new proposed lifecycle are identified in Section 4. Concluding remarks and findings of this work are discussed in Section 5.

2. Related Work

The failures reported in multiple crowdsourcing projects have confirmed that risk management is overlooked. Risk is intrinsic to any project independently of the nature of this project. To explore crowdsourcing risk factors, one needs to acquire a good understanding of the lifecycle that underpins the progress of a crowdsourcing project. In this section, we present Geiger *et al.*'s lifecycle model which is, to our knowledge, the only cited contribution on crowdsourcing lifecycle models and then summarize previous literature on crowdsourcing risk management.

2.1 Geiger's Crowdsourcing Lifecycle. Research on crowdsourcing lifecycle is scarce with the exception of the scholarly contribution of Geiger *et al.*⁴ that identifies four main phases (Fig. 1):



Figure 1. Crowdsourcing lifecycle⁴

1. Pre-selection of contributors phase: the crowdsourcing organization needs to decide whether to set specific criteria to shortlist the potential contributors or to keep the project open to the crowd (i.e., no pre-selection). In the former case, potential contributors can be preselected based on meeting some minimum qualification prerequisites, some context-specific (demographics) requirements, a combination of both, etc.
2. Accessibility of peer contributions phase: the crowdsourcing organization needs to decide if potential contributors from the crowd will be authorized to view, rate/review, update, or delete each other's contributions. The opposite is possible with keeping the contributions private.
3. Aggregation phase: the crowdsourcing organization compiles the set of received contributions to come up with a solution that best serves its needs. This aggregation can be integrative whereby filtered individual contributions are pooled together and synthesized to yield the final desired outcome. Alternatively, the aggregation of contributions can be selective whereby among the evaluated submissions, one or more contributions are chosen as the "winning" entries that best match the desired outcome.
4. Remuneration phase: If applicable, the crowdsourcing organization compensates contributors for their inputs or participation according to the terms and conditions of the crowdsourcing agreement that should have been drafted in the first phase. This enumeration can be fixed whereby all eligible contributors receive a flat payment irrespective of the value of their contributions, or success-based whereby contributors are paid based on their individual contribution towards meeting the crowdsourcing desired outcomes.

2.2 Risks in Crowdsourcing. Academics and practitioners have looked into the risks in crowdsourcing and how to mitigate them^{8,5,6}. However, most of these earlier contributions are limited either to a narrowed risk area or to a specific phase of the crowdsourcing lifecycle. There are no attempts to identify these risks from a holistic approach, considering the fact that each phase of the crowdsourcing lifecycle has its own risk exposure elements.

Chandler *et al.*⁸ focused on the risks and rewards of using online marketplaces so that crowdsourced human computation is enabled. They investigated the issue of data quality in crowdsourcing marketplaces in general and in the context of Amazon Mechanical Turk in particular. Sze⁹ investigated the strategic risks of crowdsourcing in terms of reducing competitive advantages and core competencies. According to Sze, open collaboration reduces the companies' ability to develop competitive strategies, which can make long-term success difficult to achieve. De Souza¹⁰ presented some preliminary results on crowdsourcing risk management based on the work of Byrd and Brown¹¹. However crowdsourcing risk factors are not identified. Further De Souza only focussed on two crowdsourcing models, namely collective intelligence and crowd creation. Kannangara and Ugucioni¹² discussed some intrinsic crowdsourcing risk factors, based on generic risk categories from the business ecosystem literature. Their conceptual approach to risk management within crowdsourcing business ecosystems, however, offers a broad coverage of the research topic that lacks contextualization to the unique risk factors pertaining to crowdsourcing.

3. Proposed Crowdsourcing Lifecycle

Prior to illustrating the risks of crowdsourcing and how to tackle them, we propose a new crowdsourcing lifecycle. In the next section, the risks associated with each phase will be identified. A closer examination of Geiger *et al.*'s crowdsourcing lifecycle shows that some important phases that should be part of a typical crowdsourcing project are missing. Accordingly, we propose a more comprehensive lifecycle model that will constitute a roadmap for identifying crowdsourcing risk factors. As shown in Fig. 2, this lifecycle consists of five phases: initiation, preparation, engagement, evaluation, and commitment.

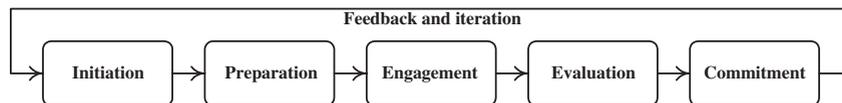


Figure 2. Proposed crowdsourcing lifecycle

1. Initiation Phase. The organization needs to state the rationale of crowdsourcing and ensure that it is aligned with its business strategies and objectives. This requires developing a strong business case in terms of problems to solve and goals to achieve, performing a stakeholder analysis, analyzing existing options and recommendations, and setting major assumptions and constraints. Additional activities include sponsor and scope definition of the project, budget establishment, and schedule and resource estimates. Potential issues, e.g., lack of appropriate contributors and delay in deliverable submission, that might surface during the project need to be identified in the initiation phase.

Completing the above activities leads into initiating additional ones such as defining the criteria for pre-selecting contributors, deciding whether contributors will be able to access their peers' submissions, outlining remuneration policies and incentive means (e.g., community engagement and service, and reputation building), and selecting an appropriate crowdsourcing platform. These activities correspond to the “*pre-selection of contributors*”, “*accessibility of peer contributions*”, and “*remuneration of contributions*” phases of Geiger *et al.*'s lifecycle.

2. Preparation Phase. This phase consists of (1) elaborating the crowdsourcing tasks and (2) deciding on how to manage the crowdsourcing contracting process. While the former activity focuses on defining concise requirements, instructions, deadlines, and expected outcomes for the assigned tasks to the crowd, the latter includes the specification of the crowdsourcing terms and conditions and the development of the contractual agreements. This might need to be reviewed by the organization's legal team or consultants. When specifying the tasks for the crowd, the requester needs to decide if a pilot trial needs to be conducted before fully engaging the crowd. Staff's feedback in this case can provide valuable insights into further refining the tasks. In addition, for complex tasks, the organization might decide to pre-assess the crowd ability to complete these tasks and shortlist only those contributors who demonstrate the required competence.

3. Engagement Phase. The organization advertises the “*call for contributions*” on appropriate social media or dedicated Web-based crowdsourcing platforms as agreed-upon in the initiation phase. This constitutes an invitation

for participants to contribute ideas and/or solutions, and/or to offer support. If the contributors were to be remunerated, then the requester should shortlist those eligible based on meeting some minimum qualification requirements as stated in the initiation phase. During the engagement phase the organization monitors continuously the crowd's responses to detect any potential issue early on or deviation from the agreements elaborated in the preparation phase.

4. Evaluation Phase. During this phase, the crowdsourcing organization aggregates, filters, and then evaluates the submitted contributions. Benchmarks and/or rubrics need to be developed to properly assess the submitted crowd contributions and guidelines should be provided to measure the reliability of the gathered data and discard outlier responses. These activities map onto the “*aggregation of contributions*” phase of Geiger *et al.*'s lifecycle. A major outcome of the evaluation phase is the down-selection of the final desired outcome, which can be based on a single (“*winning*”) contribution or on the aggregation of various contributions, as discussed earlier. For the sake of transparency, the evaluation process and recommended final outcomes need to be communicated to the crowdsourcing project's sponsor and to key decision makers within the organization.

5. Commitment Phase. It involves remunerating the contributors, post-assessing the crowdsourcing project, identifying lessons-learned, closing-out the project, releasing the project resources, and last but not least deciding on whether another iteration of the crowdsourcing project is necessary. Final approvals and signatures from all stakeholders are obtained and the key outcomes of the crowdsourcing project are disseminated within the organization.

4. Crowdsourcing Risk Factors Identification

Despite the acclaimed benefits of crowdsourcing, the associated risks can be noticeably high and with consequences on the crowdsourcing organization⁵. In this paper, we adopt Boehm's definition of risk¹³, being “*the possibility of loss or injury*” that is the likelihood of occurrence of undesirable outcomes. Crowdsourcing is a managerial decision that can entail various risks and undesirable outcomes. Managing a crowdsourcing project involves planning, identifying, analyzing, responding to, and monitoring and controlling risk throughout the project's lifecycle. The main “*generic*” tasks associated with each of these risk management processes are illustrated in Table 2. Risk management aims to take the proper measures either to thwart risks from affecting the project or to reduce their impact¹⁴.

This paper mainly focuses on risk management planning, risk identification, and risk monitoring and control phases of the risk management process within the context of crowdsourcing. Risk analysis and risk response are beyond the scope of this paper and are left for future research. In particular, we recognize the importance of identifying the potential problems that might occur throughout the crowdsourcing lifecycle and how they might hinder the crowdsourcing organization's success. In fact, the absence of risk identification can push the crowdsourcing organization to operate in a reactive mode by draining substantial resources to mitigate the impact of unwanted outcomes. Hence there is a need not only to conduct an upfront risk identification and assessment at the beginning of the crowdsourcing project, but also to monitor and manage the risk throughout the project's lifecycle. In this section we identify the risk factors that are associated with each proposed phase of the crowdsourcing project, along with the corresponding undesirable organizational outcomes. These potential risks have been identified based on extensive empirical literature review and some reported cases of crowdsourcing project failures. The resulting RBS can serve as an integrative model to assist in the management of crowdsourcing engagement. In essence, and inspired by Boehm's risk management theory¹³ and the ISO/IEC/IEEE Risk Management Standard¹⁶, our approach calls for the need to continuously control and manage the risks pertaining to each phase of the crowdsourcing lifecycle. This approach is based on premise that crowdsourcing risk factors can be inextricably linked to the crowdsourcing project phases.

4.1. Initiation Phase: Risk Factors Identification. The initiation phase is divided into two subphases: investigation and selection. In the following we identify the risk factors associated with each subphase.

4.1.1. Investigation Phase. Poor planning and management of the crowdsourcing project can be a recipe of direct failure in delivering the desired outcome. This happens for instance when no plans are put in place to properly handle all crowd submissions within a specified deadline. Poor governance, combined with the lack of incentives and poor communication can damage the relationship with the crowd and create mistrust that can eventually hurt the reputation of the crowdsourcing organization¹². According to Sze⁹, total dependence of the crowdsourcing organization on external crowd contributions can hinder its capability to exploit and develop its in-house knowledge and competencies. Employee resistance can be a major risk when crowdsourcing a given task to external contributors, especially in the absence of proper communications. This resistance can quickly evolve to yield undesirable outcomes including loss

Table 1. Crowdsourcing risk breakdown structure (Pot. standing for Potential)

Risk Factor	Crowdsourcing phases					Pot. undesirable outcomes
	Initiation	Preparation	Engagement	Evaluation	Commitment	
Performance risk	<ul style="list-style-type: none"> Lack of experience and expertise with crowdsourcing process and contract management Lack of contributors' expertise Lack of a rigorous strategic sourcing methodology 	Inaccuracies and vagueness in the instructions		<ul style="list-style-type: none"> Contributions do not meet expectations Poor evaluation of contributions 		Legal disputes and litigation; Poor quality outcome
Strategic resource risk	Potential neglect of in-house knowledge and competency					Loss of organizational competencies
Market risk	Providing insights to competitors about future products, innovations or strategic directions					<ul style="list-style-type: none"> Financial losses Competitive disadvantage
Financial risk	Failure to estimate upfront the total cost of the ownership of the crowdsourced project			Cost escalation		Failure to meet the promised cost savings and financial losses
Legal risk	Privacy right violations			Receiving plagiarized contributions from the crowd that contain infringing materials.	Claims for non-payment	Legal disputes and litigation
Technology risk	Performance/security issues with the selected crowdsourcing platform			New improvements made it easier to identify people		<ul style="list-style-type: none"> Legal disputes and litigation Network performance issues Security breaches Privacy threats
Publicity risk					Potential liabilities and damage exposures	Bad reputation
People risk	<ul style="list-style-type: none"> Employee resistance Lack of contributors 			Cognitive and perceptual biases among contributors		<ul style="list-style-type: none"> Loss of morale, productivity, resignations, and sabotage Poor outcome quality
Process risk	Poor project planning and management: no plans to handle the submissions within a specified deadlines, no plans for incentives, no plans for communication with the crowd, etc.		<ul style="list-style-type: none"> Delays in delivering the desired outcome Failure to properly advertise the call for crowd participation Poor communication Sharing information and opinions about the assigned task among contributors 	Consensus failure		<ul style="list-style-type: none"> Failure in delivering the desired outcome Bad reputation

Table 2. Risk management processes¹⁵

Risk Management Process	Main Tasks
Risk management planning	Plan the risk management activities for the project at early stages of the project's life-cycle.
Risk identification	Determine which risks might affect the project.
Risk analysis	Perform a qualitative risk analysis to prioritize identified risks based on their likelihood and impact. Perform a quantitative risk analysis to estimate the impact of identified risks on project objectives.
Risk response planning	Develop risk response strategies, including risk avoidance, acceptance, transference, and mitigation.
Risk monitoring and control	Evaluate the effectiveness of risk strategies throughout the project's life-cycle by monitoring identified and potential new risks and developing a risk response plan accordingly.

of morale and productivity, resignations, and may be sabotage. If achieving cost savings is the main driver of a crowdsourcing initiative then special care must be exercised to properly estimate upfront the total cost of ownership of the crowdsourced project, validate it and then monitor it throughout the project's life-cycle. Failure to do so can expose the crowdsourcing organization to cost escalation and failure to meet the promised cost savings. For example, the cost associated with sanitizing hundreds of submissions against potential copyright infringement can become a cost burden that outweighs the savings gained from the crowdsourcing process. In addition the legal fees associated

with the settlement of lawsuits or the acquisition of Intellectual Property (IP) rights for the crowdsourced work can escalate the project's cost.

4.1.2. Selection Phase. If the crowdsourcing project aims to capture contributors' initial impressions about a target theme or matter, then it might run into the risk of contributors sharing information and opinions about the assigned task⁸, which jeopardizes the validity of the crowdsourcing process. When an organization posts an assignment on a crowdsourcing marketplace, it might inadvertently provide insights to the competition about its future products, innovations or strategic directions. Competition also becomes plausible if contributors exploit some of the know-how, divulged by the crowdsourced task, for their own benefits. This threat can reduce the long term competitive advantage of the crowdsourcing organization^{12,9}. During this phase, the crowdsourcing organization might enter into legal suits for privacy right violations under state law if it decides that potential contributors will be authorized to view each other contributions and fails to explicitly reflect this policy under the terms and conditions of the crowdsourcing campaign. The same legal liability can arise if the crowd personal identifiable information is used or made public without a prior consent⁵. Privacy violations can also occur if the crowdsourcing platform lacks the proper security mechanisms to protect the confidentiality of the participants. Vendor lock-in can occur if the organization heavily relies on a third-party crowdsourcing platform for running its online campaign. During the selection phase, failure to carefully select and qualify the outsourcing contributors might lead to poor quality outcomes, affecting customer satisfaction and organizational reputation. The lack of a rigorous strategic sourcing methodology presents a significant risk to the crowdsourcing organization. It is therefore important to carefully assess the contributors' risk profile during this stage by cross examining each potential contributor against a set of established risk criteria.

Lack of contributors' motivation is another risk. If contributors are promised to be paid based on participation and not necessarily on their contributions, they might turn into "*satisficers*" who might settle for the first (good enough) option to safeguard payment⁸. Screening potential contributors (using reputation, experience, or competence) and providing them with intrinsic rewards or incentives for paying attention while completing a task can help in enhancing the quality of the contributions and maintaining loyal crowd for future contributions.

4.2. Preparation Phase: Risk Factors Identification. Potential inaccuracies and vagueness in the instructions provided to the crowd can adversely affect the appropriateness and quality of the gathered responses. This threat is often associated with the failure of the crowdsourcing organization to conduct peer reviews and pilot tests of the assigned tasks before submitting them to the general crowd⁸. In addition, failure to acquire exclusive rights for the crowd-sourced work can potentially subject the crowdsourcing organization to legal suits for violating ownership and intellectual property rights. For example, U.S copyright laws do not consider crowdsourcing contributors as employees with "*work for hire*" status. As a result, and unless the terms and conditions of the crowdsourcing campaign ascertains that the crowd-sourced work is for hire, the crowdsourcing contributor can regain possession of the work after a statutory time period⁵. Regardless, the outsourcing contract should be overseen by a written agreement that stipulates if contributors can retain IP rights or if they fully grant this right to the crowdsourcing company.

4.3. Engagement Phase: Risk Factors Identification. Delays in delivering the desired outcome might happen because the organization has little control over the time needed by the crowd to complete the assigned task(s). These delays can be triggered by factors that often go beyond the control of the crowdsourcing organization and may include Internet access interruptions, large number of received submissions, misinterpretation of assigned tasks, and lack of contributors' commitments, among others. Delays can also occur because of the lack of resources that are needed to screen and evaluate submissions. Failure to properly advertise the call for crowd participation can lead to few received entries, which can jeopardize the final outcome of the crowdsourcing project.

4.4. Evaluation Phase: Risk Factors Identification. Failure to reach consensus on the finest received contribution(s) that best match the desired outcome may create friction among employees and will likely delay the completion of the crowdsourcing project. There is also a risk that the crowd fails to come up with a solution to the assigned task. Failure of the aggregation process to statistically measure the reliability of the collected data or to identify poor quality contributors and exclude their responses poses another threat to the reliability of the crowdsourced outcome.

Failure to effectively evaluate the submitted contributions is another risk that can hinder the success of the crowdsourcing project. Many factors can contribute to this failure, including tight time constraints, poor evaluation techniques, ambiguous evaluation criteria, lack of in-house expertise and risk assessment overlook. For example, in 2006, Netflix, the DVD-rental company promised \$1 million to the team that could make a 10 percent improvement in the company's recommendation engine. Netflix gave the award to seven technology professionals in September 2009.

However, in December, Netflix faced a lawsuit from the Federal Trade Commission (FTC) on the ground that the new improvements to the recommendation engine made it easier to recognize people identity through allegedly anonymous information. As a result, Netflix had to scrap the winning crowdsourcing algorithm and incurred undisclosed penalty to settle the law dispute¹⁷.

Cognitive and perceptual biases are inherent among contributors⁸ and these might hinder the objectivity and correctness that some crowdsourcing projects aim to achieve, especially if the aggregation phase of the project is unable to filter out these biases. A closely-related threat occurs when contributors share information among each other, leading to deceptive groupthink patterns or correlated errors that aggregation cannot correct^{18,19,9}. Further, the anonymity and ample size of the crowd make it very difficult to recognize duplicate contributions and these can jeopardize the reliability of the collected responses⁸.

Previous research²⁰ found that if contributors find it advantageous to lie, then they might dishonestly provide false responses that can endanger the reliability of the contributions or lead to failure. This can be a real concern if the assigned task is about opinions that have no utterly correct responses or if it requires answers that cannot be validated (such as lying about one's age, citizenship, etc.). The design and implementation of internal quality control mechanisms can help in validating the data generated by the crowd. A crowd contributor may reuse the idea he submitted for a company to address the requests of another competing firm. Crowdsourcing organizations are constantly facing the risk of receiving plagiarized contributions from the crowd that contain infringing material which violates copyright, privacy, and IP rights⁵. While time, resources, and technical constraints might impede the ability of the crowdsourcing organization to scrutinize the received submissions during the evaluation phase, due care is warranted if infringement risks were to be minimized.

4.5 Commitment Phase: Risk Factors Identification. The crowdsourcing organization might be the subject of potential implied condition for payment claims under state law if the payment terms did not explicitly state that contributors will not be remunerated⁵. Recent studies like⁹ highlighted that the hourly wage rates for crowdsourcing contributors are typically 60-70% lower than the minimum US Federal wage rates. These low wages can raise serious ethical and corporate social responsibility concerns that can damage corporate reputations. Potential liabilities and damage exposures are other risk factors that can threaten the image of a crowdsourcing organization. For example, in 2013, the San Francisco-based crowdsourcing platform, Crowdflower, was sued by two of its U.S. crowd contributors for the alleged violation of the minimum hourly wage of \$10.55, as required by the Fair Labor Standards Act in San-Francisco. This class action lawsuit raised serious legal concerns on whether crowd members should be paid as independent contractors or employees²¹. In this case, a win in favor of the plaintiffs would have serious impact on the reputation and business model of crowdsourcing platforms.

5. Discussion & Conclusion

Putting things together, we present in Table 1 the RBS of a crowdsourcing project that spans across all phases of its lifecycle. This RBS serves as an integrative model to assist in the management of crowdsourcing engagements. From Table 1 and considering the interdependencies among the five phases, we observe that, from a risk management perspective, the most critical phase is the initiation phase. Plans about handling crowd submissions within a specified deadline, communicating with the crowd, enumerating the participants, evaluating the submissions, protecting the privacy of the crowdsourcing enterprise and the participants and specifying plans to deal with emerging problems should be outlined up front during the initiation phase. Poor planning at this phase will affect the results of all the subsequent steps. From a risk perspective, the preparation phase comes next to the initiation phase in term of importance. It is important because both the evaluation and commitment phases depend on it. Inaccuracies and vagueness in the instructions and the contracts can potentially lead to poor contributions and financial losses. In general, the crowdsourcing organization needs at the end of each phase, and before embarking on the next phase to consider all the risks in the current phase. Failing to do so will threaten the success of the crowdsourcing project.

The paper has proposed a five-phase crowdsourcing lifecycle model and identified the associated risk factors that can impede the success of crowdsourcing projects. Our research led not only to the identification of the risk factors associated with each phase of the crowdsourcing lifecycle, but also to new insights into how risk assessment needs to be embedded in each phase. More precisely, our proposed risk model calls for the need to pay close attention to risk identification and monitoring during each phase of the crowdsourcing lifecycle. In this manner, risk management

becomes an integral part of the methodology for developing crowdsourced-based artifacts, rather than an extra process that needs to be amended to the development process. A natural extension of this contribution can focus on conducting empirical studies to rank and assess the relative importance of the identified crowdsourcing risk factors. Another potential area for future study would be to identify appropriate risk response strategies to address the various risk factors that have been identified in this study.

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