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Factors Influencing the Decision to Crowdsource

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Abstract. In order to integrate a crowdsourcing strategy to an organization's business processes, managers need to decide whether or not crowdsourcing is suitable for the organizational context. This study conducted a structured literature review to identify factors related to this decision. These identified factors have been synthesized into a framework for supporting the decision to crowdsource. Based on this framework, recommendations for managers, which were summarized in the decision tables, have been proposed.

Keywords: Crowdsourcing, crowdsourcing decision, business process, literature review, socio-technical system

1 Introduction

Since its introduction, the term "crowdsourcing" was firstly introduced by Howe [1] to refer to a model that relies on the crowd, a large undefined group of individuals, to achieve specific tasks. Pioneering studies have suggested that this model can bring multiple competitive advantages for organizations, such as more flexibility and responsiveness to business strategy, cost savings [2], and harvesting expertise, information, skills, and labour [3, 4]. Some organizations that successfully utilize this model for their business strategies are Wikipedia for writing and editing articles, Threadless for T-shirt design, and Starbucks, i.e. MyStarbucksIdea project, for collecting customers' ideas.

Given that crowdsourcing can benefit organizations, it is reasonable to expect that crowdsourcing should be potentially integrated with existing organizational business processes. However, this does not seem to have happened. A recent survey [5] reports that only 10% of surveyed organizations have actually deployed a crowdsourcing strategy. If crowdsourcing is such a promising strategy, then why has it not been widely adopted by organizations? One of the possible answers to this question has been suggested by Malone et al. [6], who state that "[organizations] do not know how" to utilize crowdsourcing and advocate more investigation into the "how to" question. In the same vein, Vukovic and Bartolini [4] and Khazankin et al. [7] also suggest further research on this question, especially focusing on how to integrate crowdsourcing with existing organizations' business processes.

The literature addressing this problem shows that integration can be addressed from two different angles: the manager's view, which is responsible for coordinating

the tasks; and the designer's view, which is responsible for implementing and configuring the crowdsourcing strategy on a particular platform. While many studies [8, 9] have focused on the design issues, currently there is little research focusing on the manager's perspective, including analysis of the multiple issues that managers have to consider when adopting a crowdsourcing strategy [10]. This paper focuses on one of the management issues, which is the "decision to crowdsource or not". This decision requires managers to determine whether crowdsourcing is a suitable strategy for a particular organizational context, rather than with the actual implementation of this crowdsourcing strategy. The "decision to crowdsource or not" is challenging because multiple factors need to be considered and evaluated in order to make an informed decision [11]. This leads to the research question, what factors influence an organizations' decision to crowdsource?

To address the question, this study conducted a structured literature review to analyse the factors influencing the decision to crowdsource. Since crowdsourcing can be seen as a socio-technical system [10], these identified factors will be synthesized to a decision framework including different layers of a socio-technical system. The study contributes to current knowledge by answering the question raised in the literature, "to crowdsource or not to crowdsource" [12]. From the practitioner's perspective, it provides practical recommendations for making the crowdsourcing decision in an organizational context. The recommendations will be presented using decision tables.

2 Literature Review

2.1 Concepts and Terminology

Since crowdsourcing is an emerging research area, different terms were used for this concept, including crowdsourcing, collective intelligence, human computation, mass collaboration and peer production [13, 14]. As a result, researchers have proposed different definitions for crowdsourcing. Some researchers, such as Doan et al. [14], define crowdsourcing as a system, in which the problem owner asks the crowd to solve a problem. Others, such as Howe [1] and Schenk and Guittard [15], have seen crowdsourcing as a form of outsourcing, in which tasks traditionally performed by organizational employees or other companies were sent to the members of the crowd. In some cases a single researcher, such as Brabham [3, 16] and Vukovic [17, 18] may provide more than one definition. In order to conceptualize a definition that captures "any given crowdsourcing activity" [19], Estellés-Arolas and González-Ladrón-de-Guevara [19] recently analysed the existing definitions extracted from literature. A selection of 209 articles was examined and 40 of them, which present original definitions of crowdsourcing, were analysed. As a result, eight common characteristics of crowdsourcing have been identified: clearly defined crowd, a task with a clear goal, a clear recompense for the crowd, the identified crowdsourcer, defined compensation for the crowdsourcer, online process, open call, and internet usage. The authors [19] then integrate these characteristics into a single comprehensive definition.

Although the definition proposed in [19] is comprehensive, it is wordy [20]. Thus the current study simplifies and adapts it for an organizational context. As a result, crowdsourcing is defined as *an online strategy, in which an organization proposes defined task(s) to the members of the crowd via a flexible open call. By undertaking the task(s), the members contribute their work, knowledge, skills and/or experience and receive reward, including economic reward, social recognition, self-esteem, or the development of individual skills. The organization will obtain these contributions and utilize the results for the defined goals*. In the following part, two examples to clarify the definition are introduced.

First, Amazon Mechanical Turk (AMT) is a profit platform [21] that allows organizations to crowdsource their simple tasks. After defining tasks and deciding to choose crowdsourcing, an organization creates and publishes these tasks on the platform using the predefined templates. Members (or workers) on the AMT platform browse information of available tasks, including requirements and payments, and may decide to perform these tasks. These tasks are usually performed individually and the results are submitted back to the organization. If these results' are sufficient quality, the organization will pay the compensation to the members who perform the tasks. Second, different from AMT, Brabham [22] introduced a non-profit crowdsourcing competition in the case of NextStopDesign, where the members participate to solve a design task without any concrete award. In this project, the task is published on its own website where anyone who has design skill can submit their design solution. The design solution then was evaluated based on the crowd members' vote. As a result, the three designs, which receive the highest vote, win the competition.

Although these examples show that crowdsourcing activities can be different, ranging from micro tasks to problem solving, from individual to competition, from profit to non-profit projects, the typical process of crowdsourcing can be presented in the following way.

When an organization has tasks to be accomplished, the first step is to decide whether to use crowdsourcing to perform these tasks [23]. Then, if the decision to choose crowdsourcing is made, the organization creates an open call and releases the tasks to the crowd. This step can be done through a platform developed either by the organization (e.g. NextStopDesign) or by a third party (e.g. AMT). Through the platform, the organization can approach members of the crowd. Depending on the organization's requirements, the members can be specific to a particular community, such as designers in NextStopDesign, or anyone willing to perform the task. Accomplishing these tasks individually or collaboratively, the members then submit the results back to the organization which assesses the quality of the results. The payment or other incentives will be given to the members if the organization is satisfied with the results [2, 10]. In practice, this process can vary. For example, a big task can be divided into many smaller tasks with a defined workflow before delivering to the crowd, and thus the results need to be aggregated to achieve the original task [24].

Currently, this process has been used in varied contexts with different applications. Because of this broad area of applications, terminology is not always consistent. For example, the term "task" can prefer to a problem, human intelligence task, micro task, or crowd work while the crowd member is called a solver, worker, labourer, user, or participant depending on the applications. This paper uses "task" and "member" since

these terms can be used in a broad sense and are more consistent with the above described process.

2.2 Types of Crowdsourcing

Existing literature has introduced several ways to categorize crowdsourcing. Some researchers choose one dimension to classify crowdsourcing activities, while others suggest multi-dimensional classification. In the former approach, Whitla [2] classified crowdsourcing applied to marketing into three areas based on the purpose of the activity, including product development, advertising and promotion, and marketing research. Similarly, Brabham [25] proposed a crowdsourcing typology for problem solving based on four functions: knowledge discovery and management, broadcast search, peer-vetted creative production, and distributed human intelligence tasking.

In the latter approach, Rouse [11] presented her taxonomy of crowdsourcing with three dimensions: nature of the task, distribution of benefits, and forms of motivation. Geiger el al. [26] identified four dimensions: preselection of contributions, accessibility of peer contributions, aggregation of contributions, and remuneration for contributions. Malone et al. [6] based their classification around four basic questions: what is being crowdsource, who is performing the task, why people do this, and how the task is being done.

According to Nickerson et al. [27], a taxonomy and its dimensions should be evaluated according to its "usefulness". In this study, the main purpose is to support managers making crowdsourcing decision. Zhao and Zhu [10] suggest the complexity of tasks should be clarified before making this decision, and we believe that the nature to achieve tasks individually or competitively can also influence this decision. Consequently, this study employs two dimensions proposed by Schenk and Guittard's [15]: task complexity and the difference between integration and selection based crowdsourcing for categorizing crowdsourcing.

Table 1. Examples of crowdsourcing task types

Participation mode / **Complexity**	Individual (Integrative)	Competitive (Selective)
Simple	**Market place** - AMT - Taskcn	**Simple contest** - Yahoo Answers - Ask Ville by Amazon
Skilled	**Collective intelligence** - Wikipedia - Writing academic papers [28]	**Problem solving contest** - NextStopDesign - Innocentive - Threadless - IStockPhoto

By examining the characteristics of crowdsourcing in practice, Schenk and Guittard's [15] stressed task complexity as the first important dimension. Crowdsourcing tasks can be classified as simple, complex or creative. Simple tasks are jobs that can be accomplished with generic skills. Complex tasks require expertise

and problem solving skills. Creative tasks relate to individual creativity such as logo design. It is worth to note that most of the complex tasks also require certain level of creativity while creative tasks' purposes are normally to find solutions for problems. Consequently, the difference between complex tasks and creative tasks is not large, and we combined them to "skilled" tasks in this study. Secondly, the authors [15] suggest the difference between the integrative and selective nature of the process as another dimension, which we named here as the participation mode that represents how tasks can be performed individually or competitively. Table 1 presents examples of different types of crowdsourcing, based on task properties.

2.3 Decision to Crowdsource

The decision to crowdsource has to be made before an organization chooses a crowdsourcing strategy. According to Rouse [11], this decision is significant for the organization since a failed crowdsourcing project can waste the organization's resources. With this in mind, researchers have started to examine closely the factors related to this decision.

Ranade and Varshney [12] propose the question "to crowdsource or not to crowdsource?", but their study was confined to crowdsourcing contests, also known as problem solving contests. Also focusing on a particular type of crowdsourcing, Buecheler et al. [29] examined collective intelligence in scientific method. Using the "three constituents principle" from Artificial Intelligence, they suggested a framework of three factors (environment, agent, and task) to determine the viability of crowdsourcing. Although each constituent principle has detailed variables, the authors did not specify how these variables influence the crowdsourcing decision. More importantly, the framework cannot be fully validated as the authors themselves stated "the data collection was not thorough enough to analyse all the variables mentioned in our framework".

Also focused on problem solving contests, Afuah and Tucci [30] recently suggested circumstances where crowdsourcing could be used. They evaluated the likelihood of crowdsourcing by comparing three alternative ways to solve a problem: internal sourcing, outsourcing and crowdsourcing. Based on behavioural and evolutionary theories of organizations, they identified four organizational factors and one environmental factor that need to be considered before the decision to crowdsource can be made. Four organizational factors that positively influence the probability of crowdsourcing are: characteristics of the problem (ease of delineation and transmission, and modularizability), characteristics of knowledge required for the solution (effective distance, and tacitness and complexity), characteristics of the crowd (pervasiveness of problem solving know-how, and motivation), and characteristics of solutions to be evaluated and of evaluators (experience-good orientation, and number of solution evaluators required). The external factor includes the pervasiveness and low cost of IT, which positively moderate the relationship between aforementioned variables and the probability of crowdsourcing.

Adopting a broader perspective, Sharma [31] provided a framework of several success factors associated with crowdsourcing initiatives, which are necessarily involved in the decision to crowdsource. In this framework, motive alignment of the

crowd is the central factor influencing crowdsourcing success since it is "aligned to long term objectives of the crowdsourcing initiative" [31]. This factor is affected by five peripheral factors: vision and strategy, human capital, infrastructure, linkages and trust, and the external environment. However, many factors in this framework need to be detailed [10] before the framework can be used to support managers to make informed decision.

In summary, making an informed decision whether to crowdsource or not requires a comprehensive analysis in which multiple factors should be examined in a systematic way [10, 11]. Although studies highlighted the importance of the decision to crowdsource, most of them have focused on a particular type of task. Therefore, the overall picture of the crowdsourcing decision is still missing. Moreover, these studies offer different lists of factors that should be considered in this decision, and none of them proposes a comprehensive framework to support the decision to crowdsource. Taking that in consideration, this study addresses this gap by synthesizing the accumulated knowledge in the literature to clarify the factors related to crowdsourcing decision for general types of task.

3 Method

Selecting Articles. A structured literature review was chosen as the research method for this study. Following the approach introduced by Webster and Watson [32], this review is concept-centric without being limited by selected journals. In addition, since crowdsourcing is an emerging research field [10], many findings were presented in conference papers which are also included in this study. Consequently, six online bibliographic databases were selected: ACM, IEEE, Science Direct, SAGE, Springer Link and Emerald (as identified by Estellés-Arolas and González-Ladrón-de-Guevara [19]). These databases were searched, using 'crowdsourcing' as the keyword, between February and March 2013. Only English publications available in full text were selected. The results are shown in Table 2.

Table 2. Search results

Document types	ACM	IEEE	Science Direct	Sage	Emerald	Springer Link	Total
Conference paper	274	110					**384**
Journal		33	33	16	8	137	**227**
Total	274	143	33	16	8	137	**611**

After removing duplicates, editorial introductions, conference posters, letters, tutorials, and publications that contain the searching keyword but focus on other issues, the total of 500 papers were left in the initial pool.

Filtering Articles. In an effort to filter the papers which are not related to the focus of this study (the decision to crowdsource), we first eliminated the articles related to crowdsourcing design issues based on the paper' title and their keywords. This elimination is performed based on the work of Kittur et al. [13], who suggests key topics in designing complex crowdsourcing processes, such as workflow design, task assignment, designing real-time crowdsourcing, collaboration and quality control. 112 articles, which have the titles and keywords related to these topics, were mapped to the design theme. This step also filtered out articles focused on crowdfunding (3 articles) and legal discussion (1 article). As a result, the pool reduced to 384 articles.

Classifying Articles. Since, in our knowledge, there is currently no classification frame or keyword schema that can distinguish the papers related to crowdsourcing decision from the unrelated ones, a classifying procedure is needed. Consequently, we defined the following iterative procedure for classifying the remaining 384 papers.

First, some papers, whose titles are clearly related to the decision to crowdsource, were classified to the crowdsourcing decision group of papers. Examples of these articles are "*to crowdsource or not to crowdsource?*" [12] and "*crowdsourcing critical success factor model: strategies to harness the collective intelligence of the crowd*" [31]. Second, by reading these classified articles, a list of important terms which relate to the decision to crowdsource was identified. Third, unclassified papers were examined, focusing on the papers' abstracts, introductions and conclusions. If a paper has term(s) in the list (or phases that have the equivalent meaning with terms in the list), it was added to the crowdsourcing decision group of chosen papers. Fourth, by examining the new added paper, new term(s) may be added to the list. Steps three and four were performed iteratively until no new term could be found. As a result, the list includes the following key terms: crowdsource or not to crowdsource, crowdsourcing circumstances, crowdsourcing success factors, crowdsourcing success, crowdsourcing decision, feasibility of using crowdsourcing, crowdsource ability, crowdsourcing viability, crowdsourcing alternatives, probability of crowdsourcing, crowdsourcing framework, crowdsourcing factors, and potential risks of crowdsourcing. In the final step, we engaged in detailed reading of the unclassified papers' abstracts, introductions and conclusions, and classified them based on the terms list related to crowdsourcing decision.

As a result, 38 articles related to the decision to crowdsource were identified. Although this number is relatively small, it is consistent with a recent literature review [10], which also reported limited publications on adopting crowdsourcing. Following the forward and backward searching proposed by Webster and Watson [32], additional 10 articles were identified, resulting in 48 papers overall.

4 A Theoretical Framework to Support the Decision to Crowdsource

By analysing the chosen articles, the factors related to the crowdsourcing decision were identified. From a system's perspective, crowdsourcing is a socio-technical system [10, 33], which involves interaction and connectivity between humans and

technology. Adopting this perspective, the study adapted the various layers of a complex sociotechnical system from Vicente's work [34] and classified the identified factors to these layers (Figure 1). There are four layers in this framework: the task that an organization wants to crowdsource, the people who perform the task, the management which plans how the task can be coordinated, and the environment. A discussion of each layer in the framework follows.

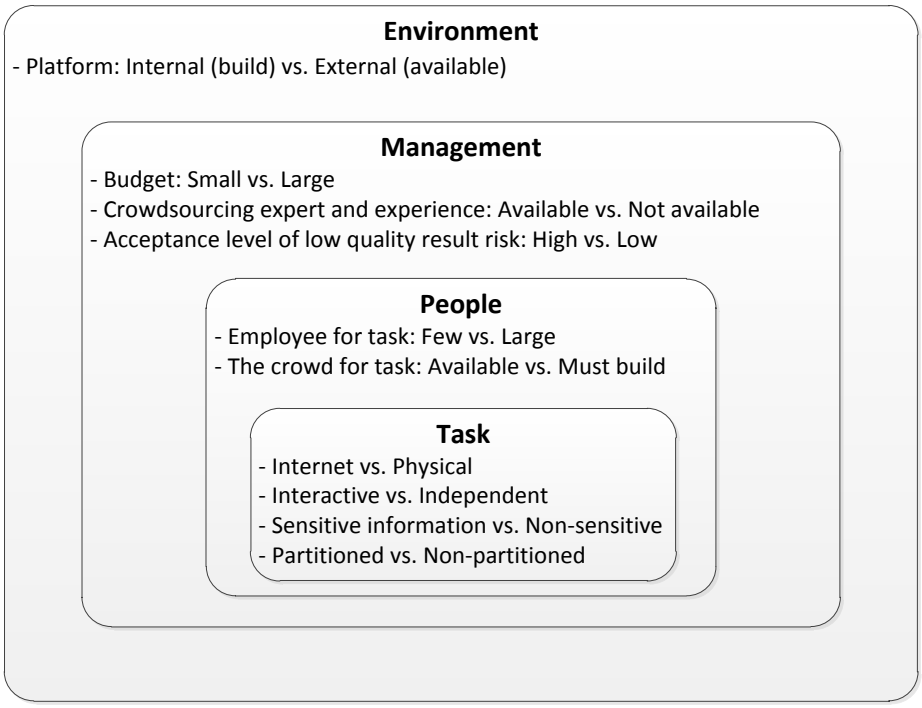

Fig. 1. A Theoretical Framework to support the decision to crowdsource (Adapted from [34])

Task Properties. Existing evidence has highlighted the nature of tasks as an important factor in the decision to crowdsource [12]. According to Kazman and Chen [35], the crowd can be good for certain tasks, but not for all kinds of tasks. Four task properties were highlighted. The first property is whether a task and its corresponding result can be delivered and collected through the internet. Most of the existing literature suggests crowdsourcing should only be used for internet activities, and some of them go further by adding this property to the crowdsourcing definition [15, 19, 36]. Only one exception [37], based on the deployment of tasks through physical kiosks, was identified in the searching papers. However, in this case, the problem solving task could easily be transferred to an online platform.

The second property is the interaction property, focusing on the nature of the relationship between the organization and the members during the crowdsourcing activities. Burger-Helmchen and Pénin [38], for example, suggest crowdsourcing

contests are not suitable for tasks that require large interaction between the organization and the members (solvers). This suggestion is logical since the crowd members are usually anonymous to the organization and consequently, it is quite hard to establish the interaction between them. This argument can also be applied to other types of crowdsourcing tasks such as tasks published on AMT and Taskcn [39].

Third, since tasks in crowdsourcing are sent to anonymous members in the crowd, Muntés-Mulero et al. [40] claim that tasks with sensitive information, including privacy, security, and intellectual property, are not suitable for crowdsourcing. However, other believe that with additional actions in defining tasks, these tasks can still be crowdsourced. An action handling sensitive information in crowdsourcing tasks is introduced by Feller et al. [41], who advise organizations to decompose a task into a number of small tasks that conceal the overall picture, thus increasing the ability to protect privacy or intellectual property. Roy et al. [42] present another case of crowdsourcing sensitive-information tasks on digitizing data from scanned images of insurance forms. In this case, the authors [42] describe a sequence of actions "overcoming the security challenges".

Finally, the ease with which a task can be partitioned into smaller pieces of work also affects the crowdsourcing decision. Malone et al. [6], when discussing crowdsourcing in terms of collective intelligence, suggest the crowd should be used for tasks that can be subdivided. Afuah and Tucci [30] noted that "modular problems are particularly conducive to collaboration-based crowdsourcing". This has been supported by other studies [24, 43].

People. An organization should consider who performs tasks in term of its available employees and the crowd members. Malone et al. [6] suggest choosing crowdsourcing when an organization does not have enough employees to deploy the tasks. With tasks, such as transcriptions and image labelling, requiring significant human resources that often exceed an organization's capability, organizations should consider crowdsourcing as an option. For example, a recent project that aimed to transcribe 41 diaries written over 21,000 days and thousands of prints found that "[they] can't do the project with existing human resources" and consequently, crowdsourcing was a good (if not the only) possibility [44]. Afuah and Tucci [30] agreed with this argument, but extended the boundary of the organization's human resources to include outsourcing contractors. Consequently, they recommend using crowdsourcing if "the knowledge required to solve the problem falls outside the focal agent's knowledge neighbourhood".

As key actors in the crowdsourcing system, the nature of the target members will influence crowdsourcing decisions [45]. Since some tasks, such as designing T-Shirts or writing academic papers [28], require the crowd members to have a certain level of skill, crowd member availability will influence the decision to crowdsource. Both Afuah and Tucci [30], examining crowdsourcing contests, and Malone et al. [6], studying collective intelligence, identify the positive influence of the available members, who know how to perform the tasks, on the crowdsourcing probability. Sharma [31] supports this argument by presenting the skills and abilities of the crowd as human capital in her crowdsourcing critical success factor model.

Management. Considering crowdsourcing as a type of outsourcing project, Rouse [11] advises the decision to crowdsource should "only be made" after examining four factors. Besides the production factor, which was discussed in the task section, the other three factors are: costs, coordination and risks. Cost saving is one main reason to choose crowdsourcing [10, 46, 47]. Consequently, the budget of the crowdsourcing project influences this decision. Crowdsourcing has been suggested when a project does not have enough money to hire employees or other companies to perform the task [6]. In other words, project with limited budget should be crowdsourced, and Wikipedia is a typical example of crowdsourcing a huge amount of writing tasks within a limited budget.

However, crowdsourcing activities can only succeed if organizations allocate appropriate expertise and experience to handle the coordination in these activities. Rouse [11] states that poor coordination can lead the project to the drain of resources and substantial delays, while other studies have stressed the importance of expertise and management in different parts of the crowdsourcing process, such as workflow management [48], members management [49], and agreement management [50].

Risk and risk management, as with any project, should be considered in crowdsourcing activities [11, 45]. Since members of the crowd perform the tasks voluntarily, organizations will not have the same level of control over member behaviours as they would have over their own employees [10], and this could lead to poor member contributions to the project. Consequently, the risk of low quality results should be considered.

Environment. The choice between internal or external platforms plays a role in the crowdsourcing decision. In terms of cost, which is one of the reasons to choose crowdsourcing [2, 10, 47], the availability of a crowdsourcing platform can decrease the development cost, which makes the decision to crowdsource become more attractive. In addition, since different platforms include different pools of members, which relates to the probability of the decision to crowdsource, the availability of the platform that is suitable for the defined task is valuable in term of the availability of its members. For example, Amazon Mechanical Turk has approximately 100,000 members [51] who can be utilized to address tasks that organizations would otherwise struggle with.

5 Discussion and Suggestions

Based on the framework, the following implications can be applied for crowdsourcing activities. In order to present these implications in a precise and compact way, the chosen presenting technique in this study is decision table. According to Huysmans et al. [52], decision table is the best presenting technique in term of interpretability compared to decision tree, propositional rule, and oblique rule. The authors [52] conducted an experiment measuring the accuracy, response time, and answer confidence when the participants using the aforementioned presenting techniques for problem solving tasks. The results from the experiment show that decision tables help the participants "answer the questions faster, more accurately and more confidently".

Consequently, recommendations for crowdsource decision-making are presented as a series of decision tables. Each layer of the framework is summarised as a decision table, except for the Environment layer, which has only one factor.

Table 3. Decision table for layer 1: Task Properties

Condition: *Task properties*						
Internet	N	Y	Y	Y	Y	Y
Interactive	-	Y	N	N	N	N
Sensitive information	-	-	N	N	Y	Y
Partitioned	-	-	Y	N	Y	N
Action						
Not to crowdsource	X	X				
Should crowdsource			X			
Crowdsource with additional action: defining tasks aiming to hide the sensitive information					X	X
Crowdsource with additional action: only crowdsource as a contest				X		X

Since task is an important factor in crowdsourcing activities, task properties related to crowdsourcing decision were presented in Table 3. On the one hand, managers should only choose to crowdsource tasks that can be performed through the internet [15, 19, 36]. On the other hand, tasks which require a significant level of communication should not be crowdsourced [38]. In addition, if tasks include sensitive information or intellectual property, additional actions to hide the sensitive information are necessary [41]. Examples of these actions can be found in [42]. Finally, crowdsourcing is more suitable for tasks, which can be partitioned into small pieces of work [6]. One can argue that many big contest tasks, which are not necessarily divisible, can still be crowdsourced using platforms such as Innocentive. However, if these tasks can be modularized, "it may be easier for the focal agent to articulate a module" [30]. In other words, the probability to accomplish divided contest tasks is higher compared to the same non-divided tasks.

Table 4. Decision table for layer 2: People

Condition: *People*			
The crowd for task: Available (A) vs. Not available (N)	N	A	A
Employee for task: Few (F) vs. Large (L)	-	F	L
Action			
Not to crowdsource	X		
Should crowdsource		X	
Crowdsource with additional action: consider other factors			X

Table 4 shows the influence of human resources on the decision to crowdsource. Crowdsourcing tasks can only be performed if the organization can approach mass and suitable members. For simple tasks, the number of crowd members is important, while for skilled tasks, the ability of the members is significant. In short, "the constant

availability of sufficient quantity and quality, of on-line workers" is a requirement for crowdsourcing [53]. From the organizational context, when an organization does not have enough appropriately skilled labours that are currently possessing by the crowd, crowdsourcing is a good option [6]. Finally, if both employees in the organization and the crowd members have the ability to perform the tasks, other factors, such as task properties, and management factors should be considered.

The factors in the Management layer were summarized in Table 5. Some organizations, such as Wikipedia, and non-profit organizations [54], show that they can employ crowdsourcing with little or no money. Consequently, crowdsourcing should be chosen when the fund allocated for tasks is not enough to perform these tasks in the traditional way [6]. However, it is worth noting that crowdsourcing also needs good expertise and experience in order to organize the activities [11]. As a result, if a project has limited budget, and limited or no crowdsourcing expert, it should not be crowdsourced.

Lack of commitment between the organization and the crowd members creates risks for crowdsourcing activities, including low quality results. In order to address the risk of low quality outcomes, organizations should crowdsource tasks where the results are easy to be evaluated [30]. In addition, different mechanisms that can be used for control quality have been suggested, including checking results by experts, using members of the crowd for evaluating, and evaluating by a third party organization [10].

Table 5. Decision table for layer 3: Management

Condition: *Management*								
Budget: Small (S) vs. Large (L)	S	S	S	S	L	L	L	L
Crowdsourcing expert: Available (A) vs. Not available (N)	A	A	N	N	A	A	N	N
Acceptance level of low quality result risk: High (H) vs. Low (L)	H	L	H	L	H	L	H	L
Action								
Not to crowdsource			X	X				
Should crowdsource	X				X			
Crowdsource with additional action: hire outside experts (due to large budget)							X	X
Crowdsource with additional action: implement mechanisms for quality control		X				X		

Finally, as the lone environmental factor, platform availability should also be evaluated. Although many crowdsourcing initiatives can be done by building their own platforms, the availability of a platform is an important factor when organizations decide to crowdsource, especially for small and medium-sized enterprises which have fewer financial resources and lower technical expertise. The availability of platforms, in some cases, has a relationship with the availability of the crowd members, which is the crucial factor in crowdsourcing decision [6, 30].

6 Conclusion and Limitations

Some studies highlighted the importance of factors that need to be considered when making a decision to crowdsource. Since most of these studies chose a particular type of crowdsourcing to explore the factors, a broader view which can be used for different types of crowdsourcing activities is necessary. Using a structured literature review method, this study developed a framework of identified factors related to the crowdsourcing decision, and proposed decision tables suggesting actions for managers when they make the decision.

There are some potential improvements that can be applied for this study. First, since crowdsourcing is a practical decision, discussion related to it can also be found from organizational presentations, reports, website and news media, such as the discussion in [44] and [55]. Consequently, future research should extend the scope in term of searching sources and keywords. Second, the current study foresees the ability to use these factors, not only in the decision to crowdsource, but also to design and implement crowdsourcing. By doing so, more factors related to each phase in crowdsourcing process should be explored. The results will enable a more comprehensive framework to be built, and provide a tool supporting the organization to decide on, design and implement crowdsourcing activities.

Reference

1. Howe, J., *The rise of crowdsourcing*, in *Wired magazine*2006, Dorsey Press. p. 1-4.
2. Whitla, P., *Crowdsourcing and its application in marketing activities.* Contemporary Management Research, 2009. **5**(1).
3. Brabham, D.C., *Crowdsourcing as a Model for Problem Solving: An Introduction and Cases.* Convergence: The International Journal of Research into New Media Technologies, 2008. **14**(1): p. 75-90.
4. Vukovic, M. and C. Bartolini, *Towards a research agenda for enterprise crowdsourcing.* Leveraging applications of formal methods, verification, and validation, 2010: p. 425-434.
5. Andriole, S.J., *Business impact of Web 2.0 technologies.* Communications of the ACM, 2010. **53**(12): p. 67-79.
6. Malone, T.W., R. Laubacher, and C. Dellarocas, *The collective intelligence genome.* IEEE Engineering Management Review, 2010. **38**(3): p. 38.
7. Khazankin, R., B. Satzger, and S. Dustdar. *Optimized execution of business processes on crowdsourcing platforms*. in *8th International Conference on Collaborative Computing: Networking, Applications and Worksharing (CollaborateCom'12), IEEE*. 2012. Pittsburgh, PA
8. Zheng, H., D. Li, and W. Hou, *Task Design, Motivation, and Participation in Crowdsourcing Contests.* International Journal of Electronic Commerce, 2011. **15**(4): p. 57-88.
9. Khasraghi, H.J. and M.J. Tarokh, *Efficient Business Process Reengineering with Crowdsourcing.* International Journal of Applied Information Systems, 2012. **2**(7).
10. Zhao, Y. and Q. Zhu, *Evaluation on crowdsourcing research: Current status and future direction.* Information Systems Frontiers, 2012: p. 1-18.

11. Rouse, A.C. *A preliminary taxonomy of crowdsourcing*. in *ACIS 2010: Information Systems: Defining and Establishing a High Impact Discipline: Proceedings of the 21st Australasian Conference on Information Systems*. 2010. ACIS.
12. Ranade, G. and L.R. Varshney. *To Crowdsource or not to Crowdsource?* in *Workshops at the Twenty-Sixth AAAI Conference on Artificial Intelligence*. 2012.
13. Kittur, A., et al. *The Future of Crowd Work*. in *Proceedings of the 2013 conference on Computer supported cooperative work*. 2013. San Antonio, TX, USA.
14. Doan, A., R. Ramakrishnan, and A.Y. Halevy, *Crowdsourcing systems on the world-wide web.* Communications of the ACM, 2011. **54**(4): p. 86-96.
15. Schenk, E. and C. Guittard, *Towards a characterization of crowdsourcing practices.* Journal of Innovation Economics, 2011(1): p. 93-107.
16. Brabham, D.C., *Moving the crowd at threadless.* Information, Communication & Society, 2010. **13**(8): p. 1122-1145.
17. Vukovic, M. *Crowdsourcing for enterprises*. in *Services-I, 2009 World Conference on*. 2009. Los Angeles, CA: IEEE.
18. Vukovic, M., M. Lopez, and J. Laredo. *Peoplecloud for the globally integrated enterprise*. in *Service-Oriented Computing. ICSOC/ServiceWave 2009 Workshops*. 2010. Springer.
19. Estellés-Arolas, E. and F. González-Ladrón-de-Guevara, *Towards an integrated crowdsourcing definition.* Journal of Information science, 2012. **38**(2): p. 189-200.
20. Brabham, D.C., *Crowdsourcing*2013: The MIT Press.
21. Buhrmester, M., T. Kwang, and S.D. Gosling, *Amazon's Mechanical Turk A New Source of Inexpensive, Yet High-Quality, Data?* Perspectives on Psychological Science, 2011. **6**(1): p. 3-5.
22. Brabham, D.C., *Motivations for Participation in a Crowdsourcing Application to Improve Public Engagement in Transit Planning.* Journal of Applied Communication Research, 2012. **40**(3): p. 307-328.
23. Wexler, M.N., *Reconfiguring the sociology of the crowd: exploring crowdsourcing.* International Journal of Sociology and Social Policy, 2011. **31**(1/2): p. 6-20.
24. Kulkarni, A., M. Can, and B. Hartmann, *Collaboratively crowdsourcing workflows with turkomatic*, in *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*2012, ACM: Seattle, Washington, USA. p. 1003-1012.
25. Brabham, D.C., *A Model for Leveraging Online Communities.* The participatory cultures handbook, 2012: p. 120.
26. Geiger, D., et al. *Managing the crowd: towards a taxonomy of crowdsourcing processes*. in *Proceedings of the Seventeenth Americas Conference on Information Systems*. 2011. Detroit, Michigan.
27. Nickerson, R.C., U. Varshney, and J. Muntermann, *A method for taxonomy development and its application in information systems.* European Journal of Information Systems, 2012.
28. Tomlinson, B., et al., *Massively distributed authorship of academic papers*, in *CHI '12 Extended Abstracts on Human Factors in Computing Systems*2012, ACM: Austin, Texas, USA. p. 11-20.
29. Buecheler, T., et al. *Crowdsourcing, open innovation and collective intelligence in the scientific method: a research agenda and operational framework*. in *Artificial life XII. Proceedings of the twelfth international conference on the synthesis and simulation of living systems, Odense, Denmark*. 2010.
30. Afuah, A. and C.L. Tucci, *Crowdsourcing as a solution to distant search.* Academy of Management Review, 2012. **37**(3): p. 355-375.

31. Sharma, A., *Crowdsourcing Critical Success Factor Model: Strategies to Harness the Collective Intelligence of the Crowd.* Working paper, 2010.
32. Webster, J. and R.T. Watson, *Analyzing the past to prepare for the future: writing a literature review.* MIS quarterly, 2002. **26**(2): p. xiii-xxiii.
33. Geiger, D., et al. Crowdsourcing Information Systems- Definition, Typology, and Design. in *Proceedings of the 33rd International Conference on Information Systems*. 2012. Association for Information Systems/AIS Electronic Library (AISeL).
34. Vicente, K.J., *Cognitive work analysis: Toward safe, productive, and healthy computer-based work*1999: CRC PressI Llc.
35. Kazman, R. and H.M. Chen, *The metropolis model a new logic for development of crowdsourced systems.* Communications of the ACM, 2009. **52**(7): p. 76-84.
36. Saxton, G.D., O. Oh, and R. Kishore, *Rules of crowdsourcing: Models, issues, and systems of control.* Information Systems Management, 2013. **30**(1): p. 2-20.
37. Heimerl, K., et al. *CommunitySourcing: engaging local crowds to perform expert work via physical kiosks*. in *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems*. 2012. Austin, Texas, USA: ACM.
38. Burger-Helmchen, T. and J. Pénin. *The limits of crowdsourcing inventive activities: What do transaction cost theory and the evolutionary theories of the firm teach us*. in *Workshop on Open Source Innovation, Strasbourg, France*. 2010.
39. Dow, S., et al. *Shepherding the crowd yields better work*. in *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*. 2012. Seattle, Washington, USA: ACM.
40. Muntés-Mulero, V., et al., *Crowdsourcing for industrial problems*, in *Citizen in Sensor Networks*2013, Springer. p. 6-18.
41. Feller, J., et al., *'Orchestrating'sustainable crowdsourcing: A characterisation of solver brokerages.* The Journal of Strategic Information Systems, 2012.
42. Roy, S., C. Balamurugan, and S. Gujar. *Sustainable employment in India by crowdsourcing enterprise tasks*. in *Proceedings of the 3rd ACM Symposium on Computing for Development*. 2013. ACM.
43. Kittur, A., et al. *Crowdforge: Crowdsourcing complex work*. in *Proceedings of the 24th annual ACM symposium on User interface software and technology*. 2011. ACM.
44. Kingston, A., *"Choir attempted that beautiful anthem "Oh, Radiant Morn" – made a hash of it" - Making a hash of the Adkin Diary transcriptions*, 2013, in Workshop on Crowdsourcing for the Digital Humanities and Cultural Heritage Sector.
45. Marjanovic, S., C. Fry, and J. Chataway, *Crowdsourcing based business models: In search of evidence for innovation 2.0.* Science and Public Policy, 2012. **39**(3): p. 318-332.
46. Rosen, P.A., *Crowdsourcing Lessons for Organizations.* Journal of Decision Systems, 2011. **20**(3): p. 309-324.
47. Van Pelt, C. and A. Sorokin. *Designing a scalable crowdsourcing platform*. in *Proceedings of the 2012 international conference on Management of Data*. 2012. ACM.
48. Potter, A., M. McClure, and K. Sellers. *Mass collaboration problem solving: A new approach to wicked problems*. in *Collaborative Technologies and Systems (CTS), 2010 International Symposium on*. 2010. IEEE.
49. Dow, S., et al. *Shepherding the crowd: managing and providing feedback to crowd workers*. in *Proceedings of the 2011 annual conference extended abstracts on Human factors in computing systems*. 2011. ACM.
50. Psaier, H., et al. *Resource and agreement management in dynamic crowdcomputing environments*. in *Enterprise Distributed Object Computing Conference (EDOC), 2011 15th IEEE International*. 2011. IEEE.

51. Mason, W. and S. Suri, *Conducting behavioral research on Amazon's Mechanical Turk.* Behavior research methods, 2012. **44**(1): p. 1-23.
52. Huysmans, J., et al., *An empirical evaluation of the comprehensibility of decision table, tree and rule based predictive models.* Decision Support Systems, 2011. **51**(1): p. 141-154.
53. Corney, J., et al., *Putting the crowd to work in a knowledge-based factory.* Advanced Engineering Informatics, 2010. **24**(3): p. 243-250.
54. Brabham, D.C., *Crowdsourcing the Public Participation Process for Planning Projects.* Planning Theory, 2009. **8**(3): p. 242-262.
55. Holley, R., *Crowdsourcing: How and Why Should Libraries Do It?*, in *D-Lib Magazine,* 2010.