COMPUTER-SUPPORTED CROWDSOURCING

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Abstract: *The paper presents a new paradigm regarding the crowdsourcing in multi-participant decision-making process. Multi-participant decision-making techniques, based on consensus building models frequently assume there are not really many decision participants in the group (appropriate operations can be done by complete enumeration). The consensus building and crowdsourcing in decision-making process are described. The most attractive crowdsourcing platforms are analyzed and a comparison between them is made, in order to reveal existing and partially supported features.*

1. Introduction

In [1, p. 19], the following definition of decision was adopted:

> "The decision is the result of human conscious activities aiming at choosing a course of action for attaining a certain objective (or a set of objectives). It normally implies allocating the necessary resources and it is the result of processing information and knowledge that is performed by a person (or a group of persons) who is empowered to make the choice and is accountable for the quality of the solution adopted to solve a particular problem or situation."

The individual or multi-person empowered and accountable decision-taker can be supported by a human support team and/or a digital (computer-based) support system. All people involved in making and taking a decision perform their tasks in various forms of collaboration. As pointed out in [2], two or more entities collaborate, as each one working individually cannot deliver the expected output, such as a product, a service or a decision solution One can identify the following forms: a) *close collaboration* established among the members of the decision group, b) *asymmetric* or *skew collaboration* is a particular form of the previous one and it is established among the decision-takers and their own human support team of assistants and hired consultants, and c) *soft collaboration* of the decision-taker with commonly anonymous members of a crowd. At present all collaboration forms are enabled and stimulated by modern ICT (Information and Communication Technology) tools, systems and platforms. In the rest of the paper we will analyze the forms of collaboration and their supporting ICT means.

The group decision-making based on consensus is a collaborative process where the voters initiate and consent to maintain a decision in the greatest interest of the entire group. The group discover this minimal feasible decision by debating and insisting equally as a lot of options as possible until all group members agree to "the final" solution even if it is not the preferred of each member. The classic "democratic" voting might enhance conflict and suspicion, because the "losers" are perceived less powerful by the decision-making process. [3].

In [4] it is described a mobile crowdsourcing platform that allows users of mobile devices to post and work on decision-making processes using the most popular crowdsourcing services. The convergence of crowdsourcing and distributed mobile systems enables developing a new paradigm for universal sensing and data processing.

2. Consensus Building and Crowdsourcing

The close collaboration is carried out by a *collaborative group* of humans. Such a group is characterized by the following attributes: a) *congruence* of methods used by members with agreed common goals, b) group *effectiveness* in attaining the common goals, c) group *efficiency* in saving member resources consumed, d) group *cohesion,* viewed as preserving members' willingness to collaborate in the future [5].

2.1 Consensus building: Basic Aspects

The common approach in the close collaboration of the components of a collaborative group is composed of two main processes: a) consensus building, and b) a selection of a recommended solution [6]. In consensus building, the participants might need to tune their opinions by making them more similar or closer to one another in an interactive process, so that, eventually, an acceptable level of consensus is reached. In [7] it is described the consensus reaching process as composed of several activities, such as: a) individual preference representations of the participants, b) aggregating individual preferences by using various methods, c) measuring the *consensus level* as a distance of individual preferences either to the calculated collective one or as the result of comparing pairs of preferences, d) implementing a correction scheme designed to increase the consensus level based either on identifying the participants whose contribution to consensus reaching is negligible or aiming to minimize the number preference revisions. The process of consensus building and selection for complex problems is commonly facilitated by multi-participant / Group DSS (Decision Support Systems) [8].

There is an implicit basic assumption in multi-person approaches based on consensus building, namely the number of participants must be limited, so that various methods proposed would be technically applicable. Sometimes, the expertise of the components of the participants might not be sufficient and the problems could be too complex and persistent and a larger number of people could bring in the necessary knowledge and help.

2.2. Crowdsourcing in Decision-Making

At present, *crowdsourcing* is ever more frequently used in various domains including collaborative decision-making [9]. In [10] it is articulated the term and viewed crowdsourcing as "the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call". Therefore, the need for supporting platforms becomes obvious.

Having done an extensive analyses of existing definitions and systems which were claimed to be crowdsourcing solutions, in [11] it is proposed the following integrated definition:

> "Crowdsourcing is a type of participative online activity in which an individual, organization, or company with enough means proposes to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call, the voluntary undertaking of a task. The undertaking of the task, of variable complexity and modularity, and in which the crowd should participate bringing their work, money, knowledge and/or experience, always entails mutual benefit. The user will receive the satisfaction of a given type of need, be it economic, social recognition, self-esteem, or the development of individual skills, while the crowdsourcer will

obtain and utilize to their advantage that what the user has brought to the venture, whose form will depend on the type of activity undertaken."

The above authors also established a set of attributes a system should possess to qualify as a crowdsourcing one:

- "There is a clearly defined crowd;
- There exists a task with a clear goal;
- The recompense received by the crowd is clear;
- The crowdsourcer is clearly identified;
- The compensation to be received by the crowdsourcer is clearly defined;
- It is an online assigned process of participative type;
- It uses an open call of variable extent;
- It uses the Internet."

Having performed an analyses in accordance with the above criteria, the cited authors state that out of set of systems which were commonly viewed at the moment of the study as crowdsourcing ones, several can be qualified as crowdsourcing such as *Innocentive, Threadless, AMTurk*, and *iStockPhoto.* Also, *ModCloth* and *Fiat Mio* could be accepted even though do not satisfy all the criteria. Other systems, such as Wickipedia or Youtube, do not qualify.

There are various possible uses of crowdsourcing. In decision-making, [9] proposes the framework composed of the following phases:

- *Identification* of the problem to be solved or the opportunity to be exploited based on opinions and predictions collected from the crowd and task definition to facilitate *intelligence* phase of Simon's process model;
- *Task broadcasting* to the crowd, which is commonly carried-out as an open call. The crowd may be composed of either enterprise employees or customers and/or other outsiders;
- *Idea generation* by the crowd in the form of various action alternatives. It basically corresponds to the *design* phase of Simon's process model.
- *Evaluation of ideas* by the same members of the crowd that generated the idea or by another crowd or limited group of hired experts who may pursue the process of reaching the consensus, as described in the previous section;
- *Choosing* the solution through a voting mechanism.

As noticed by [12],"in crowdsourcing, a task is not performed by a designated outsourcing company or worker, but it is accomplished by the crowd". This means that an employer (sometimes called 'crowdsourcer' or 'initiator'), when using crowdsourcing, does not choose who will work on the task, but he will hand over the task to the crowd and an anonymous worker will complete it. Consequently, a platform is needed to make the soft collaboration of outsourcers (here the decision-takers and, possibly, their assistants) and the contributors from the crowd.

3. Platforms
3.1. A Survey of Existing Platforms
According to [13], in the current section we describe a list of top ten crowdsourcing platforms that can assist the user to design and create a product, from developing an idea, to create a 3D object or a full real product.

Some of these platforms were built to help the decision-making process in various contexts, from growing an idea to designing and creating a product or for every intermediate stage.

The following platforms are covering all of these situations [13]:

- **Idea Bounty** (https://www.crunchbase.com/organization/idea-bounty): it is a crowdsourcing platform for creative ideas and marketing solutions that assist to carry your idea from the seed stage to the end;
- **OpenIdeo** (https://www.openideo.com/): it is a platform that can speed up the impact by gathering the right people together, being mainly oriented towards philanthropic projects, growing ideas that can make the world better;
- **Innocentive** (https://www.innocentive.com/): it offers a validated and successful approach to find various ideas and solutions, being another "problem solving" platform that connect solution seekers;
- **CrowdSpring** (https://www.crowdspring.com/): it is a great tool that allow you to write down the idea and wait for submissions from the freelancers on the platform; after that you can choose the favorite and you'll only pay for that one:
- **99Designs** (https://99designs.co.uk/): it is more an artistic platform, mostly oriented on graphic design than product design, where more than 1 million professionals are working to implement the most attractive solution;
- **Cad Crowd** (https://www.cadcrowd.com/): it is a platform where you can freelance 3D CAD (Computer Aided Design), 3D modeling, but the winner can be hired in a more traditional way, for example paying for hours spent on the project;
- **DesignCrowd** (https://www.designcrowd.com/): it is a platform for the best freelance design, where you can find designers based on different filters, such as specialty, country, earnings, percentage of jobs awarded etc.;
- **MicroWorkers** (https://www.microworkers.com/): it is a crowdsourcing platform for micro-tasks, where the user can choose from any of the ready-to-use templates available on the platform;
- **Mechanical Turk / mTurk** (https://www.mturk.com/): it is a crowdsourcing platform created by Amazon to outsource different processes and jobs offered by companies to a geographical distributed workforce that can realize these tasks in a virtual manner;
- **oDesk.com / Elance** (https://www.upwork.com/): it is a platform that helps to find various profiles, such as web developers, software designers, proficient translators, and so on, and the platform enables the possibility to keep in touch with these professionals, so that one can develop a strong relationship except the freelancing;

3.2. Comparing Platforms

Based on the stages of the crowdsourcing process described in [14], we have considered the following criteria to classify the crowdsourcing platforms presented above:

- registration and specification;
- initialize crowdsourcing request;
- carry out crowdsourcing request;
- complete crowdsourcing request;

Table 1 below presents a comparison of the top ten crowdsourcing platforms available on the market, based on the four criteria defined earlier.

Table 1. Comparison between crowdsourcing platforms

No.	Platform name	Registration and specification	Initialize crowdsourcing request	Carry out crowdsourcing request	Complete crowdsourcing request
1	**Idea Bounty**	+	+	+	+
2	**OpenIdeo**	+	+/-	+/-	+/-

3	**Innocentive**	+	+/-	+/-	+/-
4	**CrowdSpring**	+	+	+/-	+/-
5	**99Designs**	+	+/-	+/-	+/-
6	**Cad Crowd**	+	+/-	+/-	+/-
7	**DesignCrowd**	+	+/-	+/-	+/-
8	**MicroWorkers**	+	+/-	+/-	+/-
9	**Mechanical Turk**	+	+	+/-	+/-
10	**oDesk.com / Elance**	+	+/-	+/-	+/-

Legend:
- + feature exists,
- **+/-** partially supported,
- **-** feature does not exist,
- NA = not applicable to use case

As seen from Table 1, all of the crowdsourcing platforms presented satisfy the criteria defined.

3.3. Selecting a platform
In selecting the service of a platform, the general *set of criteria* presented in [15] can be used;
- *Adequacy*: informational transparency, accuracy of expected results, robustness to errors and low quality uncertain input data, response time;
- *Quality of implementation*: scalability, flexibility, functional transparency, documentation completeness;
- *Delivery quality*: price, service delivery time, provider's general reputation, easy adaptation, degree of dependence on the technical assistance from the provider's specialists for implementation and usage.

In situations when more than one person are involved in choosing the service of the platform, the simple procedure for consensus building inspired by [16] and presented in section 2.3.4.2 of [1] is recommended. It is based on the *IPV* (*Intensity-Polarity-Voting*) model. In case in the selection group there is a moderator, the procedure presented in [17] could be used.

4. Conclusions
The implicit common assumption concerning the limited number of persons in multi-participant decision-making approaches based on consensus building systematic procedures, so that various methods proposed would be technically applicable was stated above in section 2.1. Moreover, the identification or design of the set of alternatives is a decision problem *per se*. If such a problem is not solved in a satisfactory way, there is the risk of applying systematic consensus building and selection procedures to an incomplete set and of eventually choosing the best one of several poor candidate alternatives. In such a situation crowdsourcing may help and the platforms enable the interaction of the crowdsourcer unit and the people of the crowd.

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