How Can Large Collectives Solve Problems Using the Internet? (Breaking down Creative Tasks into Modular Crowdsourcing Tasks)

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Abstract (12 font)

Crowdsourcing is popular for two reasons. It draws from a global pool of talent and it is where people are acknowledged for the quality of their ideas rather than for their formal academic qualifications. All that matters is the final product, not the backgrounds of those who contributed to it (Howe, 2006). However, in order to make the tasks be able to be carried out by the crowds, the tasks should be modularized. In order to to reduce problem-solving inter-dependence among tasks, the tasks themselves need to be specified. The more independent or disconnected a component/task is, the more modular it is.

Keywords (12 font)
Crowdsourcing tasks, online business, digital economy

1. Background

Crowdsourcing is an upcoming trend where tasks that are traditionally performed by employees of companies are now increasingly performed by people who use their spare time for these tasks (Geerts, 2009).

The name ‘crowdsourcing’ first appeared in Wired Magazine in June 2006 in an article by Jeff Howe who defines it 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. So crowdsourcing stands literally for outsourcing to a crowd.

The main idea is to outsource tasks to undefined public rather than to official organization or expert group. It departed from the intriguing question: ‘What if the solutions to our greatest problems weren’t waiting to be conceived, but already existed somewhere, just waiting to be found, in the warp and weave of this vibrant human network?’ (Howe, 2006)

As the tasks are carried out to public, Howe put this situation into terms that ‘new breed of amateurs has arisen’. This new kind of amateurs are people who are knowledgeable, educated, committed and networked (Howe, 2006). Crowdsourcing directly attracts this new breed of amateurs who dedicate their leisure time to work

on something they feel passionate about. They invest their time in doing something they love to do rather than have to do.

Still according to Howe (2006), crowdsourcing is popular for two reasons. It draws from a global pool of talent and it is where people are acknowledged for the quality of their ideas rather than for their formal academic qualifications. All that matters is the final product, not the backgrounds of those who contributed to it. In fact, Howe (2006) put it in a punchline, 'Crowdsourcing is outsourcing on steroids'.

According to Brabham (2008), the concept of crowdsourcing enables individuals to excel at singular, sometimes highly complex problems when traditional problem-solving teams cannot solve. Surowiecki (2004), in his book 'The Wisdom of Crowds', called this phenomenon as 'the wisdom of crowds'. The very success of a solution is dependent on its emergence from a large body of solvers. In the case of iStockPhoto and Threadless.com, for example, the task-givers gather crowds with photography and photo design skills to finish visual design related tasks. Thus, under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them. This 'wisdom of crowds' is derived not from averaging solutions, but from aggregating them (Surowiecki, 2004).

According to Terranova (2004), a variety of cultural backgrounds on the the web increases the possibility to facilitate the exchange of diverse opinions independent of each other, in a decentralized way. The web is the aggregator of this open system, this diversity of thought.

The immense nature of the web, the grand network of networks and its ability to facilitate idea exchange makes the aggregating of disparate flows of ideas in one stream possible (Terranova, 2004).

Problem Description

Once we understand the importance of crowdsourcing in the business world nowadays, it is intriguing to know what are the kinds of problems that can be solved by outsourcing them to the crowds? When is the right time to crowdsource? Then what task types can be carried out by the crowd? By what mechanisms of coordination should these tasks be supported?

Also, it is also interesting to find out how business players use crowdsourcing. What are possible application scenarios for companies?

2. Aim of the Paper

This paper aims to give further information about crowdsourcing and how this concept grows within the last several years. Also, as several questions were raised in the section above, we would like to review some related literatures and expert comments on the possible tasks that can be carried out by crowdsourcing.

In order to be able to explain about tasks in Information Processing (IP), the discussion about modularization should be brought up. The concept of modularity refers to the degree to which the system is in fact decomposable into modules and later recombined (Alexander et al., 1964)

Modularity can be seen as a general set of principles for managing complexity that is now being applied not only to technological design but also to organizational design. (Parente, 2005). Thus, we believe that we need to talk about

modularization in order to explain what mechanisms of coordination should these tasks be supported.

Last but not least, one other aim of this paper is to figure out how companies nowadays use crowdsourcing to support their activities.

3. Structure of the Paper, Methodological Approach

This paper is structured as conceptual paper. The discussions are built up through understanding the concepts that are already brought up in the already published academic papers.

The first chapter contains the basic information about the paper.

The second chapter is more or less the discussion about crowdsourcing. We are trying to give a comprehensive picture on why and how crowdsourcing offers such a brand new attractive way of outsourcing and why it is becoming a popular concept.

The third chapter goes straight into the discussion about types of tasks explained by previously published papers. For this purpose, we are reviewing several experts' task theories, most notably from the paper 'A Theory of Task/Technology Fit and Group Support Systems Effectiveness' by Zigurs and Buckland (1998). We are trying to see how they break down tasks according to the level of complexity and technology dimensions. Afterwards, we discuss about modularization concept offered by Gomes and Joglekar (2008) to link up between task designs and organizational structure of companies.

Finally, in the fourth chapter we discuss about the most probable options run by companies in order to conduct their businesses as well as the conclusions and suggestions for further research.

4. Discussion

Crowdsourcing is often seen as the collaboration between the computers and groups of human. According to Howe (2006), 'crowdsourcing' is the act of taking a task traditionally performed by a designated agent (such as an employee or a contractor) and outsourcing it by making an open call to an undefined but large group of people. Crowdsourcing allows the power of the crowd to accomplish tasks that were once the province of just a specialized few. Or to put it another way, crowdsourcing is to take the principles which have worked for open source software projects and apply them right across the entire spectrum of the business world.

Nowadays, it is done by making an open call to an undefined but large group of people (Howe, 2006). Notable examples of the crowdsourcing model include Wikipedia, Threadless, iStockphoto, Innocentive, the Goldcorp Challenge, and user-generated advertising contests (Brabham 2008).

According to Geerts (2009), in crowdsourcing, three aspects should be highlighted:

- The first aspect is that the crowdsourced activities should be traditionally performed by a designated agent, which represents the outsourcing part of the definition. However, this does not mean that the activity should be initiated by the organization that would traditionally perform the activity. The opportunity for the crowd to get involved in the activity can also be provided by an entrepreneur providing a platform and building a business model around it, or it can be initiated by the crowd itself.
- Second, the crowd should be undefined, which illustrates the difference between outsourcing to a known party such as a company or to a much wider audience of private individuals. The issue of who actually forms this crowd will be discussed extensively in this report.
- The final important aspect of the definition is the open call, which emphasizes the more active role of the crowd, which is traditionally seen as passive and merely consuming, in that the individual members can decide for themselves if, how and when they want to participate. (Geerts, 2009)

4.1. Crowdsourcing in the 21st Century

Howe (2006) believes that this is at least part of the reason why YouTube has more than 80 million videos. Even a web site like HarryPotterFanFiction.com can boast more than 45,000 stories written by Harry Potter fans.

Some examples of crowdsourcing as listed in Brabham (2008):

- *InnoCentive*, a Web-based network of more than 140,000 scientists from more than 170 countries. If companies such as DuPont, Procter & Gamble and BASF have problems their in-house researchers cannot solve, they post the problems on InnoCentive and offer rewards that range from $10,000 to $100,000.

- *Amazon Mechanical Turk*, a platform of crowdsourcing where task-givers, which is called 'The Requesters' can post their tasks to offer to public. The tasks, which is known as HIT (Human Intelligence Tasks), can be browsed by the workers, which is also known as 'Turkers' (Ross et al., 2010).
- *Wikipedia*, in which uses user input to generate, edit and fine-tune its online encyclopedia entries.
- *YouTube*, a vast collection of video clips submitted by users.
- *Threadless.com*, a website which allows people to submit T-shirt design ideas which others can then vote on. Threadless generated more than $17 million in revenue in 2006 using this design by democracy approach. The company pays prize money to its most successful contributors which exceeds $1 million a year and in return keeps all intellectual property.
- iStockphoto, the website which has a vast collection of photographic images which have been contributed by more than fifty thousand part-time photographers and graphic artists. iStockphoto then, in turn, sells these images for much less than its competitors. iStockphoto was acquired by Getty Images in late 2005 for around $50 million. iStockphoto is now launching separate Web sites in France, Japan, Spain and Germany to better serve these local markets. The company projects its revenues will exceed $262 million by 2012.

4.2. The Reasons Behind Crowdsourcing

Why is crowdsourcing such a popular method to conduct? Some experts have tried to elaborate the reasons. According to Doan (2011), the reasons can be divided into the degree of manual effort and role of human users.

- *Degree of manual effort*.

When building a CS system, we must decide how much manual effort is required to solve each of the four CS challenges. This can range from relatively little (for example, combining ratings) to substantial (for example, combining code), and clearly also depends on how much the system is automated. We must decide how to divide the manual effort between the users and the system owners. Some systems ask the users to do relatively little and the owners a great deal. For example, most of the manual burden of merging Wikipedia edits falls on the users (who are currently editing), not the owners.

- *Role of human users*.

According to Doan (2011), there are four basic roles of humans in a CS system.

1. *Slaves*: humans help solve the problem in a divide-and-conquer fashion, to minimize the resources (for example, time, effort) of the owners. Examples are ESP and finding a missing boat in satellite images using Mechanical Turk.
2. *Perspective providers*: humans contribute different perspectives, which when combined often produce a better solution (than with a single human). Examples are reviewing books and aggregating user bets to make predictions.
3. *Content providers*: humans contribute self-generated content (for example, videos on YouTube, images on Flickr).
4. *Component providers*: humans function as components in the target artifact, such as a social network, or simply just a community of users (so that the owner can, say, sell ads).

Humans often play multiple roles within a single CS system (for example, all at once as slaves, perspective providers, and content providers in Wikipedia).

As workers in crowdsourcing, Kauffmann (2011) concludes that there are two types of motivation to human.

1. *Intrinsic Motivation*
   There are two differentiations to intrinsic motivation: *Enjoyment Based* and *Community Based Motivation*. The category of *Enjoyment Based Motivation* contains factors that lead to that lead to the sensation of 'fun' that might be perceived by the workers. These factors are measured by the constructs *Skill Variety*, *Task Identity*, *Task Autonomy*, *Direct Feedback from the Job* and *Pastime*. *The category of Community Based Motivation* covers the acting of workers guided by the platform community. Relevant constructs are the *Community Identification* and *Social Contact*.
2. *Extrinsic Motivation*
   Three motivational categories are counted to the extrinsic motivation: *Immediate Payoffs*, *Delayed Payoffs* and *Social Motivation*. The category of *Immediate Payoffs* covers all kinds of immediately received compensations for the work on crowdsourcing tasks. Possible direct payoffs in the case of paid crowdsourcing are payments received for completing a task or winning a contest. *Delayed Payoffs* address all kind of benefits that can be used strategically to generate future material advantages. The category of *Social Motivation* is the extrinsic counterpart of intrinsic motivation by community identification. It covers socially motivated extrinsic motivation out of values, norms and obligations from outside the platform community as well as *indirect feedback from the job* and *the need for social contact*.

It can be seen in the figure 1 below:

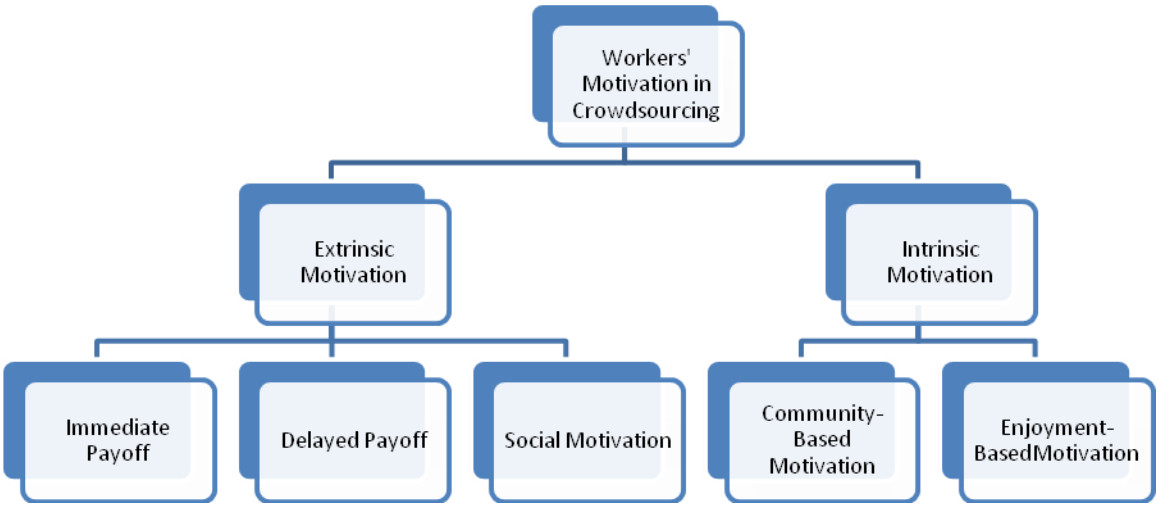

Figure 1: Crowd Motivation in Crowdsourcing[1]

[1] Source: Taken from Kaufmann (2011): More than Fun and Money: Worker Motivation in Crowdsourcing – A Study on Mechanical Turk, p. 4-5

Geerts (2009) divides crowdsourcing into four types, according to its attributes. These types all represent different business models that can be used for different purposes.

1. The first type is *crowdcasting*, in which a particular challenge is broadcasted to a crowd, generally organized as a competition with a financial reward.
2. The second type is *crowdstorming*, which involves an online brainstorming session, where interaction between participants is important. In many cases, this involves a company asking the crowd for new product or service ideas.
3. The third type is *crowd production*, in which the crowd creates a product or database together or creates a market of individual contributions.
4. The fourth type is *crowdfunding*, where instead of the spare time, abilities and knowledge of the crowd, their spare money is used. The crowd is for example used to fund artists, companies or each other.

Afterwards, Geerts (2009) also offers ten attributes that represent design choices that organizations in the cases have made, consciously or unconsciously. These attributes are the main source of information to answer the first research question and to develop a typology for crowdsourcing.

Some organizations act as mediator between the crowd and other parties. Sometimes, crowdsourcing is used for the company's own purposes. In the case of a mediator, the case represents an organization that connects the crowd to another organization.

Types of participation are voting; rating; commenting; forum; weblog; social network; wiki upload; or financial.

To explain the options of this attribute, it is necessary to explain something about the technologies that make crowdsourcing possible and more efficient. it 'emphasizes the construction of common, open, and friendly spaces for collective intelligence'.

The easiest types of participation are voting and rating, which have become increasingly commonplace online. They are used to get people's opinion about certain topics and to structure content according to these opinions.

Another easy way to participate is commenting on existing content, either from other participants or from the organization. Voting, rating and commenting are often used in combination with more complex forms of participation, like weblogs, forums and social networks. There is also one type of contribution that is not related to the others, which is a financial contribution. In these cases, instead of contributing time or knowledge, the crowd is asked to contribute their money (Geerts, 2009).

This attribute shows the distinction between a company initiative and a crowd initiative. In a company initiative, the company must provide a specific request or challenge for the crowd to work on. The crowd is allowed to work on this task until a specific deadline, and then has to wait for the company to provide another task. This results in the crowd working in batches. In a crowd initiative, the activity is much more continuous. For example, the crowd is allowed to create their own topics on a forum or wiki, and start their own tasks and discussions, giving the crowd much more control over the process (Geerts, 2009).

This attribute shows whether there are financial rewards involved for the participants or not. This attribute has to do with the motivation of participants. In these cases, participants generally receive no financial reward (Nambisan 2002), which has challenged researchers to find other sources of motivation.

Howe (2008) concludes that crowdsourcing participants are not primarily motivated by money. However, many crowdsourcing cases use financial rewards. This financial reward can be a prize in a competition, a reward for being active, or a profit share.

This attribute shows whether it is possible for the participants to interact with each other, and therefore shows whether the crowd can be seen as a community. Chiu (2006) found that community-related outcome expectations are positively related to both the quantity and quality of contributions.

Motivation can for example be related to reputation systems (Antikainen and Väätäjä 2008). By providing meaningful contributions to the community, the participants can enhance their reputation, which is often presented on the website in the form of a ranking. Although reputation systems are sometimes also used in cases without interaction, the effect is likely to be larger when participants feel that they are part of a community. (Geerts, 2009)

4.3 Input and Output control (company / crowd)

This attribute represents the extent to which the organization actually gives the crowd the possibility to influence the organization (Geerts, 2009). In the simple case of voting or rating, the organization can choose to follow the crowd's opinion or decide to disagree with it. This attribute can also be important for the motivation of the crowd, as (the feeling of) control, or at least influence, can increase the motivation of participants, as this gives meaning to their actions (Howe, 2008). An organization can show its trust and commitment towards the crowd by following its opinion.

However, it is important to know in which cases there is really an online community or just a crowd (Geerts, 2009).

This attribute shows the control that the organization has over the input of the contributions of the crowd. There are several ways to apply this control (Geerts, 2009):

First, the contributions can be shown on the website, where everyone can see them, or the company can choose to let the crowd submit their contributions in a more private way while only the company has access to it.

Or second, the type of participation also influences the need for control, as voting, rating or financial participation needs less control than more open contributions.

Third, the organization can choose to screen the contributions before posting them on the site. This shows important information about the extent to which the crowdsourcing organization is willing to give up some of its control. It must be said here that many cases do not perform screening before posting, but do allow moderation by removing posts that contain inappropriate content.

This last design choice shows the distribution of intellectual property rights, whether the rights belong to the participants, the company (or to a third party in case of a mediator), or the public (Geerts, 2009).

Although crowdsourcing is often compared to open source software cases, there are some important differences, including possible financial rewards and the IP issue. Although some crowdsourcing cases show many similarities with open source software, in many cases the participants give up the IP rights to the organization, which makes money from it (Brabham 2008).

The relationship between crowdsourcing types and its attributes result in the options or possible choices that can be seen in table 1 below.

Type		**Role of the company**	**Type of participation**	**Party that takes initiative**	**Whose contiburions are used**	**Financial Rewards**	**Interaction**	**Input control**	**Output control**	**IP**
Crowdcasting		mediator / own initiative	upload	company initiative	individual	yes	yes / no	contibutions not public ; registration	company	company
Crowdstorming		own initiative	Forum	crowd initiative	combination	no	yes	registration	company	Company / public
Crowd production	**product**	own initiative	weblog / wiki	crowd initiative	Crowd	no	yes / no	registration	crowd	public
	market	mediator	upload forum	crowd initiative	p2p	yes	yes / no	registration	crowd	crowd
Crowd funding	**product**	Mediator / own initiative	financial	company initiative	Crowd	yes	no	registration / type of participation	crowd	not relevant
	market	mediator	financial	crowd initiative	P2p	yes	no	registration / type of participation	crowd	not relevant

Table 1: Characteristics of Crowdsourcing Types[2]

We need to discuss about tasks since many scholars and experts believe that task is important. As one type of Group Support Systems (GSS), we need to know what type of tasks can be carried out by crowds in crowdsourcing because the nature of the task plays an important role in a group's interaction process and performance (Shaw 1981).

Previous papers such as Zigurs and Buckland (1998) and Campbell (1988) have suggested theories which focus on the kinds of tasks that are typically encountered in organizational decision making groups

Campbell (1988) divide dimensions of tasks into four, each of which is important in defining unique task environments:

1. *Outcome multiplicity*.
   Outcome multiplicity means that there is more than one desired outcome of a task. This is important because it increases information load and information diversity. Each outcome requires a separate information processing stream and is essentially a criterion against which a potential solution is evaluated. An example of a task with outcome multiplicity is one where there is more than one stakeholder and each stakeholder has different explicit expectations about what the objectives of the task are.
2. *Solution scheme multiplicity*.
   Solution scheme multiplicity means that there is more than one possible course of action to attain a goal. This dimension of the task increases information load. This

[2] Taken from Geerts (2009): Discovering Crowdsourcing Theory, Classification and Directions for Use

shows the presence of multiple solution schemes in that many configurations of a final solution are possible, depending on which decisions are chosen.

3. *Conflicting interdependence*.
   Conflicting interdependence may exist among solution schemes where adopting one scheme conflicts with adopting another possible solution scheme. In this case, the adoption of any one scheme substantially alters the situation such that the decision makers cannot simply change their minds, undo that adoption, and return to essentially the same conditions presented in the original task to make a new decision. Conflicting interdependence also exists in cases where outcomes are in conflict with one another.
4. *Solution scheme/outcome uncertainty*.
   It is the extent to which there is uncertainty about whether a given solution scheme will lead to a desired outcome. Solution scheme/outcome uncertainty can range from low to high, where high means that the relationship between a solution scheme and the desired outcome is uncertain or highly probabilistic (Campbell 1988).

4.4. Task Theory

Campbell (1998) and Zigurs and Buckland (1988) have defined different combinations of the four basic dimensions of complexity, which result in 16 distinct task environments.

However, the discussion is then simplified into five task categories based on similarities in the presence or absence of the four basic complexity attributes (Campbell, 1988).

1. *Simple tasks*
   Simple tasks have a single desired outcome, a single solution scheme, and no conflicting interdependence or solution scheme/outcome uncertainty. Therefore, a GSS should provide primarily communication support so that group members can communicate their ideas about the solution to one another (Zigurs and Buckland, 1998).

2. *Problem tasks*
   For problem tasks, the main focus is on finding the best solution scheme from among multiple possible schemes, which satisfies a single, well-defined desired outcome. The presence of multiple solution schemes increases the information processing requirements for the task (Campbell 1988). Group members have to be able to configure the problem in various ways in order to achieve the best outcome. Increased information load can be handled by a GSS with elements of information processing. Problem tasks should result in the best group performance (as defined for the specific task) when done using a GSS configuration that emphasizes information processing (Zigurs and Buckland, 1998).

3. *Decision tasks*
   The focus for decision tasks is on crafting a solution that best satisfies multiple (and potentially conflicting) outcomes. Each desired outcome involves a separate information processing stream, implying both high information load and high information diversity (Campbell 1988). Each desired outcome is a criterion against which the proposed solution is evaluated. This type of task requires heavy information processing support and, in particular, support for evaluating

information. Process structuring is also important to ensure that the group carries out all the steps of criteria identification and evaluation against alternatives (Zigurs and Buckland, 1998). Decision tasks should result in the best group performance (as defined for the specific task) when done using a GSS configuration that emphasizes information processing and process structuring (Zigurs and Buckland, 1998).

4. Judgment tasks
   For judgment tasks, the emphasis is on resolving the conflict and uncertainty in information associated with the task. Communication support is as important as information processing. Therefore, the focus for judgment tasks should be on the communication support and information processing dimensions. Judgment tasks should result In the best group performance (as defined for the specific task) when done using a GSS configuration that emphasizes communication support and information processing (Zigurs and Buckland, 1998).
5. *Fuzzy tasks*
   Fuzzy tasks have very little focus, and group members expend most of their effort on understanding and structuring the problem. Information load, information diversity, conflict, and uncertainty are all part of fuzzy tasks (Campbell 1988). Where complexity is high, enhanced information processing is important (Rana et al. 1997). The greatest emphasis, therefore, should be on communication among group members, gathering of information relative to the problem, and using problem structuring templates to understand the problem (Zigurs and Buckland, 1998). Process structuring is also important to the extent that it helps groups structure the process by which they accomplish their work.

The summary of the types of task linked with their dimension can be seen in table 2 below.

	Simple Task	**Problem Task**	**Decision Task**	**Judgment Task**	**Fuzzy Task**
Outcome Multiplicity	No	no	yes	no	yes
Solution Scheme Multiplicity	No	no	no	no	yes
Confliction Interdependence	No	yes or no	yes or no	yes or no	yes or no
Solution Scheme / Outcome Uncertainty	Not applicable	low to high	low to high	low to high	low to high

Table 2: Aggregated Task Categories[3]

Tasks require significant interaction between users (Kittur, 2008). However, when talking about a complex system, the term 'modularity' will come up. Baldwin and Clark (2000) define modularity as a proven concept in different fields for handling complex systems. A complex systems can be decomposed into sub-systems or modules or tasks (Simon, 1969), which are structurally independent of another but work in a synergy. The outputs of some tasks are inputs

[3] Taken from Zigurs and Buckland (1998): A Theory of Task/Technology Fit and Group Support Systems Effectiveness

to other tasks, and iterations may occur due to recursive dependence on task outputs (Gomes and Joglekar, 2008).

Von Hippel (1990) suggested that in order to specify tasks so as to reduce problem-solving interdependence among tasks, there are three steps to be taken:

1. First, predict which tasks are likely to be the source of important new information.
2. Second, predict which other tasks in the network are likely to be affected by that new information.
3. Third, use such predictions to adjust task specifications.

These things can be done to a useful degree both in the instance of 'routine' innovation projects. Therefore, since interdependence creates requirements for information sharing and transfers, we need to know deeper about modularity and managers need to understand how uncertainty arises from the timing of information release, as well as the associated degree of information completion (Gomes and Joglekar, 2008).

The mapping of information dependencies together with the task ownership decision provides a basis for understanding the coordination requirements of distributed development projects. The task ownership decision consists in the choice of a governance structure for task execution. The task execution can be assigned to the development group, other development or functional groups within the firm, or to external suppliers (Gomes and Joglekar, 2008).

Hence, Gomes and Joglekar (2008) proposes their own model of Design structure matrix (DSM). The DSM itself is already known as a mapping methodology that captures information dependencies between development tasks through the use of a square matrix where each cell captures the dependency between two tasks (Steward, 1981).

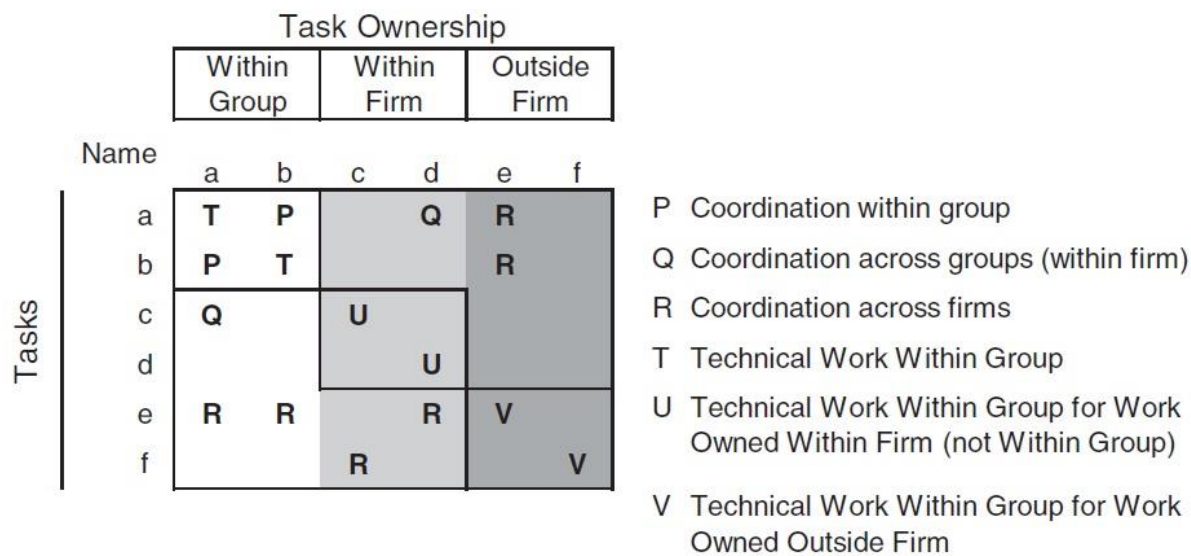

Figure 2: Stylized DSM for distributed development projects[4]

[4] Taken from Gomes, P. J., and Nitin R. Joglekar (2008): Linking Modularity with Problem Solving and Coordination Efforts

The task ownership decision consists in the choice of a governance structure for task execution. The task execution can be assigned to the development group, other development or functional groups within the firm, or to external suppliers.

The execution of a development task has associated two types of effort, which are technical problem solving and coordination effort (Gomes and Joglekar, 2008).

From figure 2 (DSM), we can see that the technical problem-solving effort required for each task (production effort) is represented in the diagonal elements of the DSM.

Given a defined task aggregation, there may be the need to perform some technical work within the development group even for tasks that are outsourced (Gomes and Joglekar, 2008). For example, a task such as specification of software system requirements can be contracted to an external supplier, while a sub-set of this task, such as defining security principles and communication protocols may still be defined internally.

The non-diagonal elements represent coordination effort associated with task execution.

Three types of coordination will result from task ownership decisions:

1. Coordination within group, such as planning the internal work execution
2. Coordination within firm but across development groups, such as negotiating agreement on standards;
3. Coordination across firms, such as resolving conflictmanaging iterations between external partners and internal team members.

When selecting a particular interface, managers have the choice to either:

- place coordination between development tasks within a production unit,
- increase modularity,

  or
- allow coordination to occur across task boundaries, decreasing modularity.

According to Transaction Cost Economics (TCE) view, the coordination across boundaries is more costly to the organization than coordination within boundaries (Gomes and Joglekar, 2008). A greater level of task modularity should result in a lower level of endogenous uncertainty. The TCE theory conceptualizes uncertainty as a key driver of transaction costs.

Task modularity is conceptualized as an architectural decision that defines how project endogenous uncertainty gets resolved. Task ownership decisions impact the distribution of coordination effort among internal versus external interfaces. The ownership decision may moderate the impact of architectural choices on coordination (Gomes and Joglekar, 2008).

The modularity requires more cross-firm sharing of design and knowledge. (Parente, 2005). The more independent or disconnected a component is, (the more degree of freedom a component has), the more modular it is (Sosa, 2007).

4. Conclusion

4.1. Findings and Implications

Crowdsourcing allows the power of the crowd to accomplish tasks that were once the province of just a specialized few. It is conducted by taking the principles which have worked for open source software projects and apply them right across the entire spectrum of the business world (Howe, 2006).

In order to send out activities to be crowdsourced, first we elaborate the types of crowdsourcing according to some experts. After that we tried to comprehend the motivation and role of human in the crowdsourcing process. Before sending out tasks to be solved by a type of crowd, it is better to understand the types of tasks based on degree of complexity (Zigurs and Buckland, 1998).

Then, in order to to reduce problem-solving interdependence among tasks, the tasks themselves need to be specified. The more independent or disconnected a component/task is, the more modular it is (Sosa, 2007).

A design of Design Structure Matrix (DSM) proposed by Gomes and Joglekar (2008) may help explaining the modularization process. The finding explained that modularization involves technical problem solving and coordination effort.

4.2. Limitations and Suggestions for Further Research

This paper is intended to conduct conceptual study about crowdsourcing, its task characteristics and modularization method. However, limited research due to limited time to further understand this broad topic has made this paper far from perfect. Our suggestion for future researchers is to be more focused in specific crowdsourcing issues, therefore any required literature study can be narrowed down and related observations can be conducted

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Biography

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