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16 Technology, Innovation and Supply Chain Management
Competitive

A systematic review of the current theory base in the crowdsourcing literature

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16 Technology, Innovation and Supply Chain Management Competitive

A systematic review of the current theory base in the crowdsourcing literature

Abstract: *Crowdsourcing literature has been grown up to an important field of research in recent years. Many studies in different areas have paid attention to the field and various theories have been utilised in these studies. The aim of the current study is developing a big picture of the theories which have been used in this area. By reviewing 887 papers in most important scientific databases, we identified 9 theory development and 50 theory based studies in the literature and categorised them based on the focus of the study (motivation, evaluation, organization, technology, and application) and the discipline from which the used theory came from (psychology, information systems, organization studies, sociology, economics, decision science, engineering, and journalism).*

Keywords: Crowdsourcing, Theory, Systematic literature review.

INTRODUCTION

The use of collective intelligence of large number of people for solving business and academic problems has been largely subject of attention throughout history (Leimeister, 2010; Pedersen et al., 2013). Crowdsourcing has been introduced as an innovative approach of problem solving and attracted much attention from both academia and research after introduction of the term by Howe (2006b) as a new sourcing approach.

Various businesses have leveraged this approach and similar classifications such as: crowdfunding and crowdvoting. Seltzer and Mahmoudi (2013) have reviewed 24 crowdsourcing platforms for a variety of application such as: business, city planning, policy development, and event outreach. A famous website in this area (Crowdsourcing.org) has also indexed 2749 sites in 45 languages. The number of websites have also been doubled between 2011 and 2013 (Tarrell et al., 2013) which shows an increasing attention to this area in practice.

The Amazon Mechanical Turk ("Amazon Mechanical Turk ") which is one of the most famous sites in the world, has more than 571,000 tasks on April 2014. iStock ("Stock photos, royalty-free images, video & music clips - iStock,") is another successful platform which is dedicated to photography industry. This platform is purchased by Getty Images for \$50 million in 2006 (Howe, 2006b) and its revenue in 2008 was approximately \$163 million (Pickerell, 2012). Many businesses also have used the model to improve their products and services. "Idea storm" of Dell for example is used for

submission of ideas about new products (Poetz & Schreier, 2012) and already contains more than 20,000 ideas.

Along with advances in use of the crowdsourcing model in practice, researchers have also paid a great attention to the field. An analysis of the 15 top IS journals and conferences by Tarrell et al. (2013) resulted in 135 articles which paid attention to different aspects of this model after 2006. These studies root in different areas and various theories from different disciplines have been used as their basis. Although few reviews on the crowdsourcing literature currently exist, we did not find any systematic review of theories which have been used in crowdsourcing studies.

The current study is aimed at tackling this shortcoming by a comprehensive and systematic review of theory based studies in the crowdsourcing area and providing a classification on the used theories.

The main research questions for the current study are:

RQ. Which theories have been used in the crowdsourcing studies?

SIMILAR WORKS

The term crowdsourcing is first defined by (Howe, 2006a) 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 an open call”. Pedersen et al. (2013, p. 585) also defined crowdsourcing as: “A collaboration model enabled by people-centric web technologies to solve individual, organisational, and societal problems using a dynamically formed crowd of interested people who respond to an open call for participation”.

The research on different aspects of crowdsourcing has been started before development of the term. For example Brändle (2005) and Lin (2004) studied the effect of increase in the number of contributors on the quality of Wikipedia articles, or Bryant, Forte, and Bruckman (2005) used activity theory to describe a new paradigm for collaborative systems in which many people collaborate with each other to produce the final product. However after 2006, the attention to this area has been overwhelmingly increased. The study of elite publications by Tarrell et al. (2013) indicates that number of publications in the area in 2012 has been 5 times more than this number in 2007.

There are also few reviews on the crowdsourcing literature and related areas such as human centric computation systems. Das and Vukovic (2011) have studied theories and models of human

computation systems. Their study ended in three groups of research: role of incentives, quality control and verification schemes, and evaluation frameworks. Another classification of human computing systems is work of Malone, Laubacher, and Dellarocas (2009) who mentioned four building blocks: the goal, process, staffing, and incentives.

Another classification of human computation systems is provided by Quinn and Bederson (2011) which mentioned six groups of: motivation, quality control, aggregation, human skill, process order, and task-request cardinality. T. Erickson (2011) classified the crowdsourcing systems in three groups: global crowdsourcing, co-located crowd forms, and audience centric crowdsourcing. The most recent classification work in this area is work of Pedersen et al. (2013) who classified the current body of research in crowdsourcing in to six group of: problem, process, technology, governance, people, and outcome.

RESEARCH METHODOLOGY

We used the systematic literature review method for the current study. This is a methodical way to identify, evaluate, and interpret the available empirical studies conducted on a topic, research question, or a phenomenon of interest (B. Kitchenham, 2004). In order to do this systematic literature review, we used guidelines provided by B. Kitchenham (2004) and B. A. Kitchenham and Charters (2007) which suggest five different steps for review: (1) identify resources; (2) study selection; (3) data extraction; (4) data synthesis; and (5) write-up study as a report.

As mentioned above the current study is aimed at identification and classification of the theories which have been used in the crowdsourcing literature. To do this we first investigated the papers which have used these theories with an identified set of keywords and then performed another search for reference theories (set 2). Both sets of paper later have been studied in the depth and a classification of them is provided in the following sections. Figure 1 illustrates the research framework for the current study.

<Insert figure 1 about here>

In order to create the first set of papers the method used by Amrollahi, Ghapanchi, and Talaei-Khoei (2013) was adopted which starts the review by searching the keywords in five scientific databases. This initial search resulted in 887 research papers. We then started to exclude irrelevant papers when

reviewing titles, abstracts and full-text papers. After in-depth study of the papers we arrived to final list of 59 papers and performed our analysis and classification based on those papers.

Sources and keywords

According to the interdisciplinary nature of research in the crowdsourcing literature, we tried to form a set of scientific databases which potentially can cover most of these areas. For this reason we selected five scientific data bases which were recommended in similar studies (Falagas, Pitsouni, Malietzis, & Pappas, 2008; Ghanbarzadeh, Ghapanchi, Blumenstein, & Talaei-Khoei, 2014; A. H. Ghapanchi & Aurum, 2011; Amir Hossein Ghapanchi & Aurum, 2012a, 2012b; Amir Hossein Ghapanchi, Jafarzadeh, & Khakbaz, 2008; Meho & Yang, 2007; Najaforkaman, Ghapanchi, Talaei-Khoei, & Ray, 2013; Najaforkaman, Ghapanchi, Talaei-Khoei, & Ray, 2014). We also searched with our identified set of keywords (see appendix 1). Table 1 shows the number of retrieved research papers form each database in each stage.

<Insert table 1 about here>

Inclusion / exclusion criteria

The initial search for the above phrases resulted in 887 papers. By reading the titles and abstracts of those papers and excluding irrelevant ones the research pool decreased to 150 papers. Finally in another round referred to the full texts and remove the duplicated papers to formulate a first list of 59 papers. During the exclusion process, we first excluded those papers that were not related to the topic of our research (crowdsourcing). In the next step, while reviewing the papers in full-text, we excluded papers which were not developing a theory or based on a theory. Figure 2 illustrates the process of inclusion / exclusion.

<Insert figure 2 about here>

Data Analysis

We started analysis of the paper based on the remaining 59 papers. First of all we categorised the papers in our final pool in to two categories of *theory development* and *theory application*. We analysed the theory development papers separately (see section 0) and then classified the theory application papers with several criteria:

1. General aim of the paper and its possible focus based on previous research classifications (Amrollahi & Ghapanchi, 2014; Pedersen et al., 2013)
2. The used theory (or theories) and the discipline to which they belong. Figure 3 illustrates the process for data analysis.

<Insert figure 3 about here>

RESULT

As explained before our final set of papers contained 9 papers which developed theories and 50 papers which used theories from various disciplines in the crowdsourcing area. Following subsections show the result in each group of papers.

Theory development in the crowdsourcing literature

We found 9 papers that developed various theories for crowdsourcing. Silva and Ramos (2012) used grounded theory to identify and analyse eight main functions that can be performed by a crowdsourcing process. L. B. Erickson, Trauth, and Petrick (2012) used the same approach to identify four common uses of crowdsourcing in organizations. Saxton, Oh, and Kishore (2013) also developed a taxonomic theory of crowdsourcing which identified nine models of crowdsourcing.

Grounded theory approach has also been used in crowdfunding area to study the qualitative case studies and understand the phenomenon (Ordanini, Miceli, Pizzetti, & Parasuraman, 2011). Chawla, Hartline, and Sivan (2012) have extended the theory of optimal auction design (Myerson, 1981) to the crowdsourcing area and developed “the theory of optimal Crowdsourcing Contests” which provides a virtual valuation optimizer based on the distribution of contestant skills and the number of contestants. The theory of crowd capital (Prpic & Shukla, 2013) is another theory in the crowdsourcing literature which indicates that “the Crowd Capability of an organization engages the dispersed knowledge of individuals (through structure and content), and then generates (through internal organizational processes) a heterogeneous Crowd Capital resource (p. 3506).”

Theory of effective news is another theory we found in the crowdsourcing area which attempt to explain characters of the content by networked public in economic crisis (Papacharissi & de Fatima Oliveira, 2012). Based on an study of political events in Egypt, and the news which broadcasted by people in Twitter, they suggested attributes such as Instantaneity, Crowdsourced elites, Solidarity, and

Ambience for affective news which have been reported through citizen journalism. Finally grounded theory of motivation (Gerber & Hui, 2013) explains motivations for participation in crowdfunding projects. The study suggested three design principles for such projects and the motivations for each. Table 2 illustrates the developed theories in the crowdsourcing literature.

<Insert table 2 about here>

Theory application in the crowdsourcing literature

We found 50 papers in our final pool of papers which used theories from 8 different disciplines namely psychology, information systems, organization studies, sociology, economics, decision science, engineering, and journalism.

Motivation

Studies in this category try to answer the question: *why people participate in the crowdsourcing projects?* by using various theories from disciplines such as psychology, organizational studies, and economics. Zhao and Zhu (2012a, 2012b) for example used *self-determination theory* from psychology to study motivation factors in crowdsourcing contest. The study identifies five groups of motivations for crowdsourcing: external, introjected, identified, integrated, and intrinsic. The other psychological theory which is used in this area is *cognitive evaluation theory* (Deci & Ryan, 1985) which is used to study “how linguistic cues known to affect underlying motivation can frame entrepreneurial narratives either as a business opportunity or as an opportunity to help others (Allison, Davis, Short, & Webb, 2014, p. 1)”.

Expectancy theory (Lawler, 1969) which could be classified as one of the organization theories has also been studied in the motivation area to study extrinsic reward, perceived characteristics of the task, trust, and self-efficacy as motivation factors in crowdsourcing (Moussawi & Koufaris, 2013; Sun, Wang, Yin, & Che, 2012). Alam and Campbell (2012) has also used a number of intrinsic motivation (*enjoyment based motivation* (Hackman & Oldham, 1980), *community based motivation* (Lakhani & Wolf, 2005)) and extrinsic motivation (*Immediate payoffs, Delayed payoffs* (Lakhani & Wolf, 2005), and *Social Motivation* (Deci & Ryan, 1985)) theories to develop a general model for motivation in crowdsourcing.

The only study we found which used sociological theories for study of motivations in crowdsourcing is work of Preist, Massung, and Coyle (2014) which studied *The Focus Theory of Normative Conduct* (Cialdini, Reno, & Kallgren, 1990), *The Theory of Normative Social Behaviour* (Rimal & Real, 2005), and *The Norm Activation Model* (Harland, Staats, & Wilke, 1999) to study effect of social norms.

Transaction cost theory (Frauendorf, 2006) from economics has been subject of attention in this area. This theory is used by Li and Hongjuan (2011) to conceptualize monetary motivations for businesses to perform crowdsourcing projects including: cost saving, increase efficiency, and globalization of workforce. The last theory-based study that we found in this category is use of game theory in developing a reputation mechanism in crowdsourcing (Xiao, Zhang, & van der Schaar, 2013).

Organization

These studies attempt to use theories from various disciplines to answer the question: *how crowdsourcing projects should be organized?* The first study we found in this category is work of Kittur et al. (2013) who used organizational behaviour theories to develop a framework for crowd work. *Cognitive theory* from psychology discipline has also been subject of attention in this area and has been used to study the effect of re-presenting data on the effectiveness of the work in crowdsourcing platforms (André, Kittur, & Dow, 2014). Five different theories from sociology have also been implemented in this area. *Complex adaptive system* for example has been used to understand the patterns for participation in political platforms. *Self-organizing social theory* has been also used to provide insight about features of coordination within a setting of massive interaction.

Homophily theory and *social identity theory* (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) have been subject of attention in crowdfunding context to study the influence of interpersonal attributes-in-common on collaborations (Muller, Geyer, Soule, & Wafer, 2014). *Innovation theory* also attracted attention of researchers in the same context. Gambardella (2012) used this theory to help managers of crowdfunding projects in managing the intellectual rights.

Agency theory (Bolton & Scharfstein, 1990) has been also used for organization of crowdfunding projects and study of the factors which affect the adoption of this model (Ley & Weaven, 2011). Moreover *theory-driven design* and *design oriented approach* which are usually used in information systems discipline have been also used for designing crowdsourcing systems (Leimeister, Huber,

Bretschneider, & Krcmar, 2009; Ziaie & Krcmar, 2013). Finally *co-creation theory* (Prahalad & Ramaswamy, 2000) from economics has been used for comparing how different organizations organize and manage their co-creation ventures (Roser, DeFillippi, & Samson, 2013).

Evaluation

The main question in this category of papers is: *how effective has the crowdsourcing approach been?*

To answer this question, many studies have used information systems theories. *Technology acceptance model* (TAM) (Davis, 1989) for instance is employed to examine the consistency of survey results across crowdsourcing markets and other groups of respondents (Steelman, Hammer, & Limayem, 2014) and evaluate the quality of generated ideas in crowdsourcing platforms (Lichtner, 2012).

Information theory (Shannon, 2001) is another theory with its roots in engineering which is used in the crowdsourcing area to evaluate the performance of human contributors in answering questions (Waterhouse, 2013). Wu, Tsai, and Li (2013) have also suggested an evaluation framework for software crowdsourcing based on the principles of *game theory*.

Schulze, Nordheimer, and Schader (2013) used theories from labour psychology to study workers' perception of quality assurance mechanisms in crowdsourcing. This study identified five mechanisms namely qualification test, qualification restriction, gold standard, majority vote, and validating review.

Cognitive load theory (Sweller, 1988) is another theory which is used for evaluation of accuracy and satisfaction in crowdsourcing (Blohm, Riedl, Leimeister, & Krcmar, 2011).

Application

Four studies which we found in our final set of papers suggested new applications for crowdsourcing based on various theories. *Theory of alternative journalism* (Atton, 2003) for example has been used to study appropriation of social media for journalism (Poell & Borra, 2012). *Post-panoptic theories* (Albrechtslund, 2008) have also been used to study how crowdsourcing sites and the knowledge they produce can improve the health care (Adams, 2013). *Planning theory* have also been utilized to study the challenges and opportunities of planning with crowdsourcing approach (Seltzer & Mahmoudi, 2013). Finally we found use of *systems theory* (Ackoff, 1971) in this area to identify four main applications of the crowdsourcing approach (Geiger, Rosemann, & Fielt, 2011).

Technology

We finally identified two studies which used theories for technological purposes in the crowdsourcing literature. Prpic and Shukla (2013) which used *the theory of crowd capital* to “compare and contrast a number of IS tools currently in use by organizations for crowd-engagement purposes (p.3461)” and Mäntylä and Itkonen (2013) who used *the group productivity theory* (Steiner, 1972) to characterize the type of software testing tasks which could be performed by crowdsourcing. Table 3 summarizes the results of the current study.

<Insert table 3 about here>

DISCUSSION AND CONCLUSION

This paper presents an investigation of theories in the crowdsourcing research. The study ended in 9 theories which have developed the theory in the field and 50 studies which used theories from different disciplines in this area. We categorised theory based research in five different categories. Moreover, we paid attention to the discipline in which the used theory rooted. Figure 4 illustrates the number of papers in each category. Most of the theories are used for motivation and organization purpose in the crowdsourcing research. As illustrated in Figure 4, most of the used theories are from Psychology and Organization disciplines. However, it should be noted that there are overlaps between different disciplines and sometimes it is difficult to assign one theory to one specific discipline.

<Insert figure 4 about here>

Future studies can benefit from the current study to pay more attention to theories in other fields such as technology and application. Also, in regards to the addressed disciplines, theories in engineering, economics, and decision science could be subject of more attention in future studies. Moreover adaptive studies of fields and disciplines seem to be required to develop a better picture about the theory base in this area. For example: in the motivation field, theories from psychology and sociology disciplines can be utilised and how. The categorisation of papers in the current study, could be compared to previous reviews studies (Pedersen et al., 2013). Table 4 compares the developed framework with reviews in the literature.

<Insert table 4 about here>

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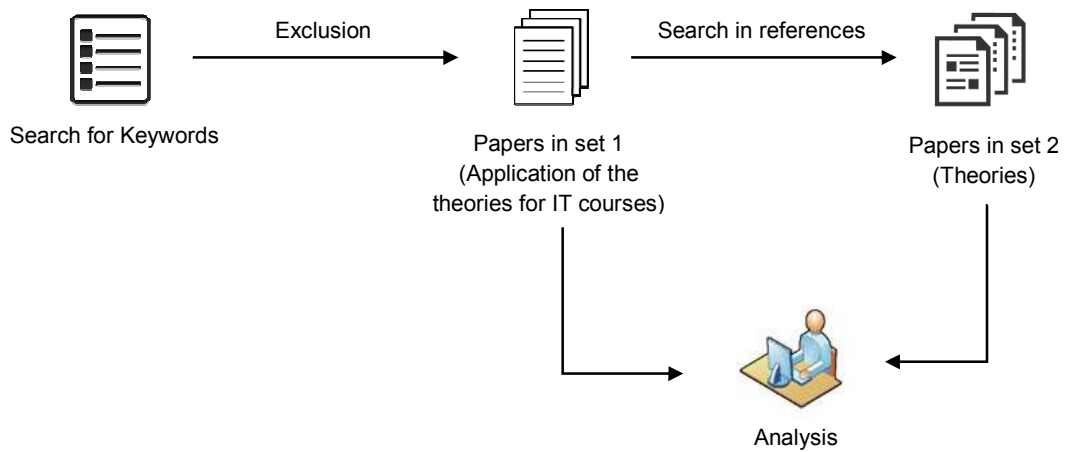


Figure 1 research framework

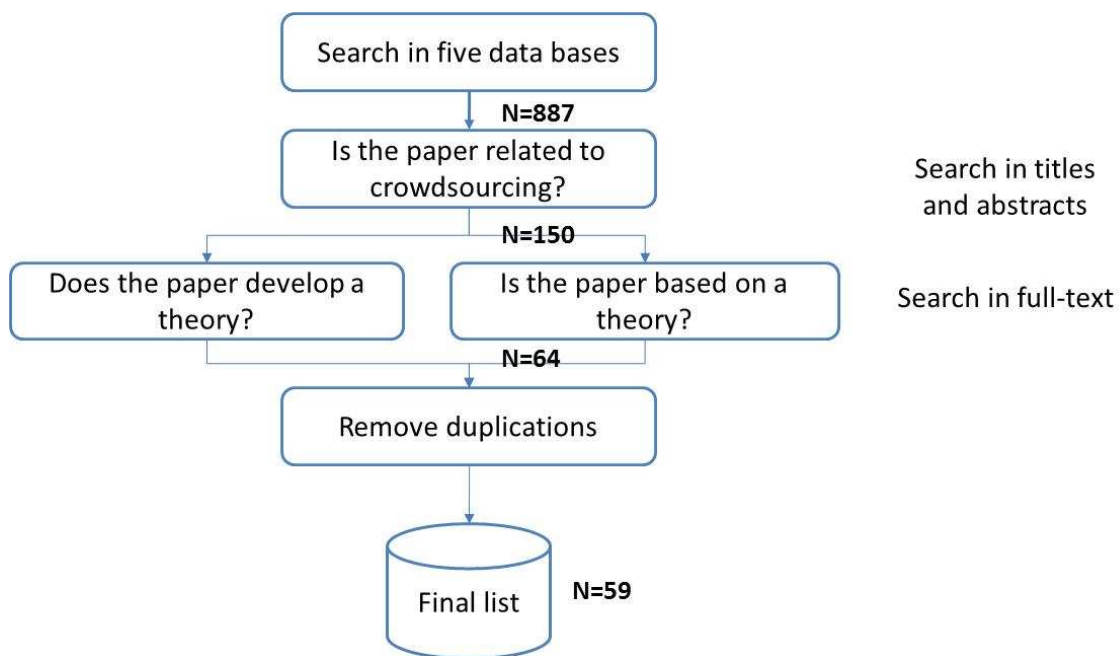


Figure 2 Exclusion process

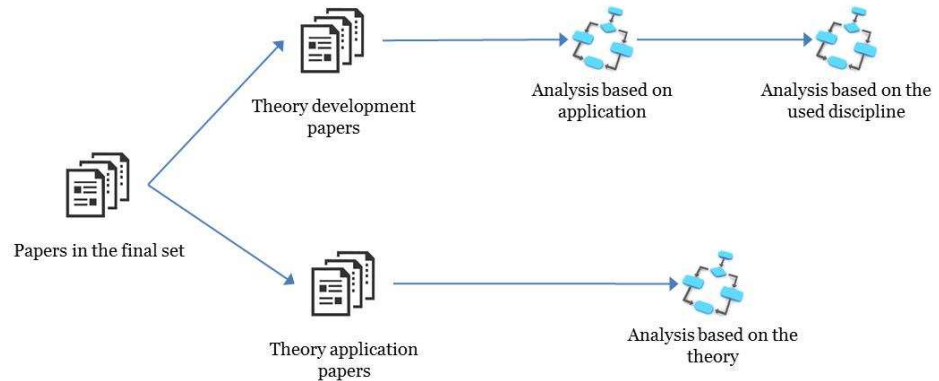


Figure 3 Analysis process



Figure 4 the number of papers in each category

Table 1 Number of papers from each database

	Database	First search	Remaining papers after title review	Remaining papers after abstract review	Remaining papers after Full-text Review
1	Scopus	271	134	66	38
2	IEEE Xplore	286	43	43	6
3	ProQuest	175	65	15	7
4	Association for Information Systems electronic library	123	89	10	4
5	Business Source Premier	32	28	16	4
Total		887	359	150	59

Table 2 theories in the crowdsourcing literature

Reference	Theory	Purpose	Theory development approach
Silva and Ramos (2012)	-	Eight main functions of crowdsourcing	Grounded theory
(L. B. Erickson, Petrick, & Trauth, 2012); L. B. Erickson, Trauth, et al. (2012)	-	Four common uses of crowdsourcing in organizations	Grounded theory
Saxton et al. (2013)	Taxonomic theory of crowdsourcing	Nine models of crowdsourcing	Literature review
Ordanini et al. (2011)	-	Analyse the crowdfunding phenomenon	Grounded theory
Chawla et al. (2012)	The theory of optimal Crowdsourcing Contests	Virtual valuation optimizer	Extending previous theory
Prpic and Shukla (2013)	Crowd capital	Crowd Capital generation in organizations	Grounded theory
Papacharissi and de Fatima Oliveira (2012)	Theory of effective news	Explain the distinctive character of content produced by networked publics in times of political crisis	Grounded theory
Gerber and Hui (2013)	Grounded theory of motivation	explains motivations for participation in crowdfunding projects	Grounded theory

Table 3 findings of the current study

Category of theories	Sub-category of theories	Main research question in the category	Used theories
Theories in crowdsourcing	-	Understand, use, and typology of crowdsourcing	
Theories for crowdsourcing	Motivation	Why people participate in the crowdsourcing projects?	Self-determination theory Cognitive evaluation theory Expectancy theory

Category of theories	Sub-category of theories	Main research question in the category	Used theories
			Community based motivation Social Motivation The Focus Theory of Normative Conduct The Theory of Normative Social Behaviour The Norm Activation Model Transaction cost theory
	Organization	How crowdsourcing projects should be organized?	Cognitive theory Complex adaptive system Self-organizing social theory Homophily theory Social identity theory Innovation theory Agency theory Theory-driven design Design oriented approach Co-creation theory
	Evaluation	How effective has the crowdsourcing approach been?	Technology acceptance model Information theory Game theory Cognitive load theory
	Application	New applications for crowdsourcing	Theory of alternative journalism Post-panoptic theories Planning theory Systems theory
	Technology	Technological design and development of crowdsourcing systems	The theory of crowd capital The group productivity theory

Table 4 comparison of the current categorisation with previous works

The current study	Motivation	Evaluation	Organization	Technology	Application	
(Pedersen et al., 2013)	Problem	People	Process	Governance	Technology	Outcome
(Amrollahi & Ghapanchi, 2014)	Promotion / Grant award	Evaluation / Process evaluation and documentation	Conceptual design / Participant selection / Monitor	Technical design	Idea or task entry / Idea or task revision / Implement	

Appendix 1

We selected the following set of keywords for the initial search:

(Crowdsourcing OR “Crowd Sourcing” OR Crowdfunding OR Crowdsearching OR Crowdsourcing OR Crowd-based OR “Collective Intelligence” OR “Participatory sensing” OR “citizen science”) AND (Theory OR Theoretical).

We also searched the following data bases:

Scopus, Business Source Premier, ProQuest, Association for IS electronic library, and IEEE Xplore