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Developing a Framework towards Design Understanding for Crowdsourcing Research: A Content Analysis

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Abstract

Whilst IS academics have increasingly recognised the essence of Crowdsourcing systems for producing information from a large group of people, relevant knowledge of such solution design is still underdeveloped. Existing studies on the Crowdsourcing literature reveal that of the further research directions outlined, none discuss the investigation of Crowdsourcing from an IS design perspective. Through a systematic literature review of over 14 premier IS journals (2010-2017), we found 255 articles of which 63 were suitable for our analysis. From these papers, we identified the gaps in application areas and design issues. We suggest that IS research techniques will demonstrate models, issues, approaches and gaps to inform future research. We identify five application purposes and ten design issues, from the stakeholders and development techniques involved. The analysis suggests Crowdsourcing is an emerging field to which design science could be particularly appropriate.

Keywords Crowdsourcing, Crowdsourcing systems, Crowdsourcing model of business, information systems design.

1 Introduction

Crowdsourcing has been defined as a type of online activity “in which an individual, an institution, a non-profit organization, or company proposes an idea to a group of individuals of varying knowledge, heterogeneity, and number, via a flexible open call” (Estellés-Arolas et al., 2012, p. 9). Over the past few years, many studies have been promoted various importance of Crowdsourcing studies in information systems field (Majchrzak and Malhotra, 2013). Information and communication technologies play a vital role in making the Crowdsourcing activity possible by providing an appropriate platform, network and software for such knowledge or ideas exchange (Bingham and Spradlin, 2012; Doan, Ramakrishnan, & Halevy, 2011; Majchrzak, 2013).

Requirements for developing Crowdsourcing information systems have increased rapidly over the past decade for organisational innovation. Research highlighted various demands of Crowdsourcing studies such as: for improving the technical platform for Crowdsourcing using effective programming (Morishima et al. 2016), collecting public views and translating them to actions by Crowdsourcing (Hu et al. 2014), and organisational capacity development using Crowdsourcing (Majchrzak and Malhotra, 2013). However, the current studies suggested that IS studies are limited to only engaging with Crowdsourcing research as a broader phenomenon (Ebner, Leimeister, & Krcmar, 2009) Most of the systematic literature reviews in this domain are focused in identifying issues for further research (Deng and Joshi, 2016), and forming categories of outcomes (Liang et al. 2016) and technological improvements (Morishima et al. 2016). Systematic literature reviews from an IS point of view may reveal design issues with respect to the application, methodologies, and practices. Optimising the Crowdsourcing process, is of paramount importance for the growth of the field (Feller et al., 2012 and Majchrzak, 2013). To address this call, our paper intends to focus on the IS research view. Using a view of the tradition of IS design research (Hevner et al., 2004), this paper establishes insights of Crowdsourcing studies in the context of application design. Our focus is not on the short term use of IS platforms to satisfy the current needs of the Crowdsourcing trend, rather to find issues and existing methodologies, so we can offer new research for the growth of the field.

Much of the literature describes organisational, project-based application developments which do not offer generalised knowledge contributions. For instance, mostly aiming for data collections and pilot studies or further studies (Liang et al. 2016). Previous reviews of the Crowdsourcing literature have also typically used top-down categorisations (e.g. Buettner, 2015) from the issues to identify research directions for specific areas. From the viewpoint of IS, understanding related to the solution themes, the development methods of Crowdsourcing application and the associated design issues are poorly developed and lacking a theoretical framework. Previous Crowdsourcing literature are summarised in table 1 and briefly discussed below.

<i>Existing studies</i>	<i>Literature review methodologies</i>	<i>Outcomes of the analysis</i>
Deng and Joshi (2016)	27 articles, Thematic Analysis	Number of issues identified for further research related to personalized task recommendation in Crowdsourcing information systems.
Gleasure and Feller (2016)	120 articles on crowdfunding, Narrative synthesis	Investigated whether crowdfunding presents genuinely new ideas and behaviours for social and individual approaches.
Zuchowski, Posegga, Schlagwein, and Fischbach (2016)	74 Papers, iterative review process and thematic analysis	Identifies three categories of outcome for IT-enabled internal Crowdsourcing, i.e. integration, innovation, and choice.

Table 1: Previous Crowdsourcing literature reviews

Buettner (2015) conducted a systematic literature analysis over the HRM related Crowdsourcing studies to develop a framework that may guide future research in the sub-field. Buettner’s review included the published articles from best peer-reviewed journals and conferences. Similar research done by Ranard et al. (2013) focused on finding scope of Crowdsourcing in advancement of health and medicine research. Hetmank (2014) produced a synopsis on Crowdsourcing literature that reveals how the term enterprise Crowdsourcing was interpreted by different scholars. Beyond this work, Hetmank (2013) conducted a systematic literature review to gather understanding of various Crowdsourcing systems and typical design aspects about them. The motivational study by Hetmank (2013) have come up with a

result of 17 definitions of Crowdsourcing systems and 4 perspectives for design, these relate to organizational, technical, functional, and human centric areas. We extend this framework to achieve a better understanding of the Crowdsourcing research. Moreover our attempt is to overcome the lack of “Systematic research by IS scholars on the design of the software, user interface, and practices to facilitate the Crowdsourcing process” (Majchrzak and Malhotra, 2013, p. 257). The scarcity of reports of this this approach has motivated Majchrzak and Malhotra, 2013 to undertake their own study in this area.

The paper is structured as follows. The next section gives an overview of Crowdsourcing research and aspects that are of significant use in IS research. The section after that provides methodological details followed by the findings of the study. The discussion section describes the overall contributions of the study followed by a conclusion section in which we summarised and discuss limitations and further directions for Crowdsourcing research.

2 STUDY BACKGROUND

2.1 Crowdsourcing definitions

Jeff Howe and Mark Robinson first coined the term “Crowdsourcing” in a Wired magazine article (Howe, 2006). The term was defined 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” (Hetmank 2014). Over the recent years business organisations adopt increasingly Crowdsourcing activities as an essential act of taking a challenge to collect ideas for solving problems. Howe (2006) suggested that business organisations rely on Crowdsourcing, instead of asking internal research to solve the challenge or other matters that can be solved by an open call to individuals with relevant expertise outside of the organisation.

Crowdsourcing is an umbrella term for a set of tools, approaches and concepts that deal with the process of outsourcing work (including seeking ideas) to a large and possibly unknown group of people (the crowd) usually external to the organization. Estellés-Arolas and González-Ladrón-deGuevara (2012) outlined forty definitions and provided eight characteristics that includes the use of a crowd for problem solving. It is suggested that a diverse expertise can be derived from differences in knowledge domains, contexts, product usage, discipline or specialty work areas (Erickson, 2011). Key benefits as noted in the literature are as below:

- Managerial decision making (Estellés-Arolas and González-Ladrón-deGuevara, 2012)
- Problem solving (Estellés-Arolas and González-Ladrón-deGuevara, 2012)
- Decision making about cost reductions (Majchrzak, 2013)
- Idea generation (Boudreau, 2012)
- Company value constellation (Lee et al. 2010)

2.2 IS research views

Design Science Research (DSR) elaborates the central ideas of solution development to embody an explicit consideration of relevance, and a rigorous method. DSR represents development, implementation, evaluation, and adaptation of artefacts for problem solving (Hevner et al. 2004) and exemplifies efforts in the design and construction of solution artefacts that might have utility for any applications design such as Crowdsourcing. Because other areas of application design have already applied DSR effectively, it is therefore imperative to emphasise using an appropriate design methodology for quality innovation or design practice improvement in the Crowdsourcing field.

DSR offers improvements over traditional methodologies in designing IS artefacts, so understanding DSR is of significance for Crowdsourcing design. DSR provides methodologies that have roots in engineering and the artificial sciences (Simon, 1996). DSR “seeks to create innovations that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, management, and use of information systems can be effectively and efficiently accomplished” (p. 76). DSR is particularly relevant for innovative Crowdsourcing solution designs because it better supports designers/researchers in establishing grounding knowledge and in embedding behavioural or human aspects into the design of artefacts to solve real world problems.

Hevner et al’s. (2004) guidelines are intended to be supportive to designing IS artefacts in form of constructs, models, methods, and instantiations (March and Smith, 1995). Crowdsourcing solutions are composed of adaptable network, platform, software, and human interfaces and presents unique and

challenging design problems that can be seen as a call for creative methodological ideas, to which DSR is relevant. However, although the design steps commonly used for developing and evaluating in many IS solutions may be similar to design guidance of DSR methodologies, none of the Crowdsourcing design studies reviewed previously explicitly utilised DSR.

There is a need to assess how DSR could be used in Crowdsourcing design and how DSR may better address future application design needs. A comprehensive content analysis on the current literature of Crowdsourcing application design and associated issues would be of importance, not only for theoretical progression but more importantly for guiding more real-world application developments for meeting the future business demand. Our first aim is to identify major recent Crowdsourcing studies, their contributions, and the methods used by the developers.

3 Research methodology

3.1 Procedure

The main purpose of the study is to analyse recent Crowdsourcing studies, to find emerging insights related to IS design and to explore the use of design methodologies in designing Crowdsourcing applications. We consider to find Crowdsourcing research on design or development issues, application design, theory design, literature review and evaluation studies. In this paper, two main types of sample articles are analysed. Type 1 includes articles on issues of Crowdsourcing application design (e.g. research methods, key issues, study areas, factors or relationship findings studies). Type 2 includes articles on Crowdsourcing application design (e.g. a particular type of application artefacts, design theories, target user groups, and the development or evaluation methods used).

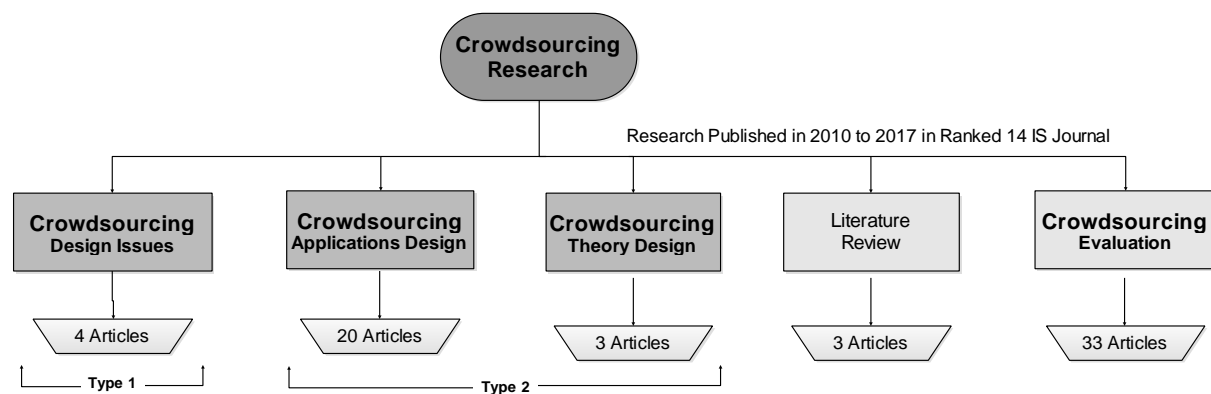


Figure 1: Sub-areas of existing Crowdsourcing research

The search procedure was performed in the 14 Journal database (Table 1) related to information systems between 2010 to 2017. This included articles in the press. The intention was to identify significant documents of importance to this study. A search string was defined subjectively to compose the following terms ('Crowdsourcing' or 'Crowd sourcing' or 'crowd source' or 'crowdsource') AND (apps OR apps design OR design research OR design issues or system or platform or innovation). After scrutinizing the results, we considered only articles that were written in English and were available in full-text. Consequently, 255 articles were found, as summarised in Table 1.

1.1 Sample articles and their sources

We used a bottom-up approach for collecting our sample articles. That is, we didn't initially select the specific outlets for selecting the sample articles but rather conducted an independent search across various databases such as Sciencedirect, NCBI, and Google scholar. Using the terms {"design science (research)" or "information systems"} and "Crowdsourcing" as initial filters on the ACM digital library, Sciencedirect. We identified only a handful of peer reviewed articles since 2004, where most of the articles were irrelevant to design science and/or information systems research domain. We expanded the search strategy in the top information systems journal databases ensuring better coverage of relevant articles. From 2010 to 2017, including article in the press, for type 1, we identified 4 articles and for type 2, 23 articles. The articles are from published journals (excluding conference papers and book chapters). We purposively searched into top high-impact journals (such as DSS, EJIS, JAIS (ranked as A* IS journals by ACPHIS). The process used to identify and select articles is shown in figure 1. We followed three steps to select articles; first- the word ('Crowdsourcing' or 'Crowd sourcing' or 'crowd source' or 'crowdsource') found in the "Title" (30 articles), second- the above subjective word(s) were in the

“Abstract” (19 articles) and finally in “Keywords” (14 articles). This also indicates there is no particular upward trend in the number of publications. With small numbers this is not significant, but is consistent with a nascent field of study. We now look more specifically at the content of the identified articles (Journals and number of samples for type 1 and Journals for type 2).

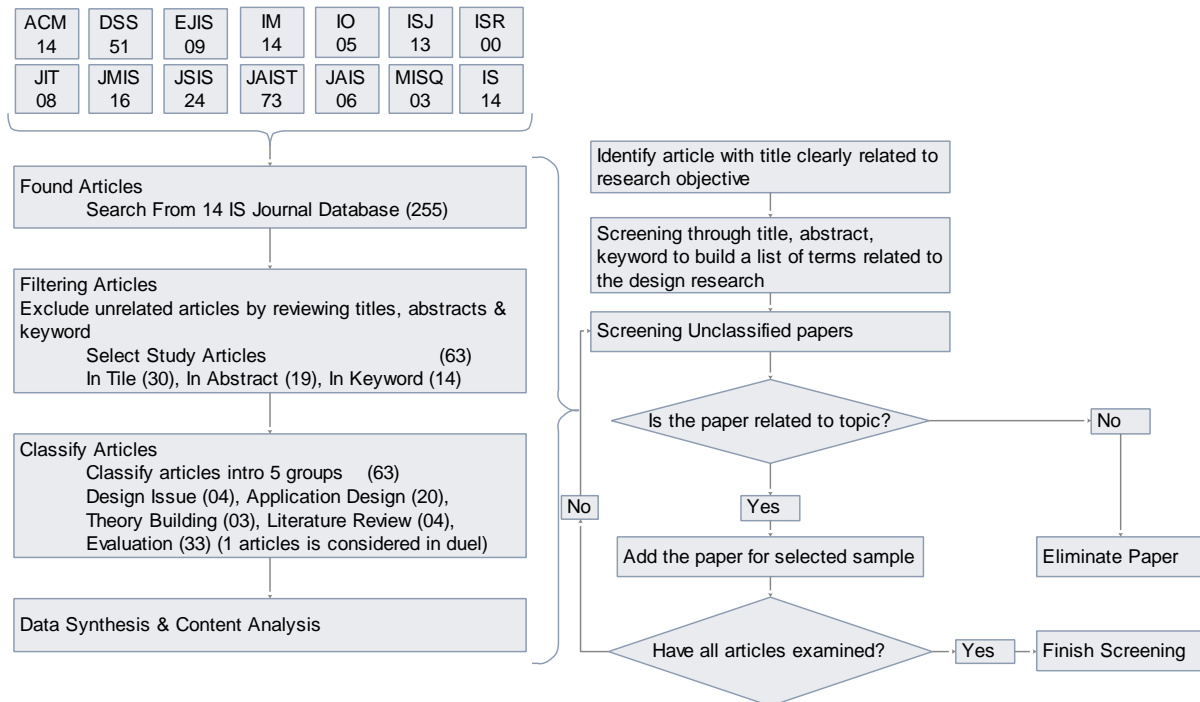


Figure 2: SLR Methodology for sample collection

1.2 Content analysis

Content analysis uses qualitative and quantitative research techniques and the method can be applied for exploring data or content directly from any human interaction process, verbal or visual, and written documents for the purpose of analysing the data (Forman, Creswell, Damschroder, Kowalski, & Krein, 2008). Using qualitative methods, this method is useful for enhancing the ability of researchers to exploit documents as important sources of information and to identify new phenomena. Many IS researchers have applied the method both for qualitative and quantitative analysis in different IS research domains. For example, Al-Debei and Avison (2010) used content analysis in their analysis of business model concepts using IS literature while Arnott and Pervan (2012) explored previous articles of DSR in relation to decision support systems design research. Indulska and Recker (2010) also conducted qualitative content analysis on DSR articles to establish the claims of these articles’ usage of DSR methods in IS research. In our research we followed the approach of Arnott and Pervan (2012) to analyse both types of articles.

For conducting effective content analysis deductive and inductive approaches are widely implemented. Inductive analysis is appropriate when “there are no previous studies dealing with the phenomenon or when it is fragmented” (Elo and Kyngäs, 2008). In our research, we analyse both types of articles using the inductive method, for classification and categorisation of the attributes; as suggested in Elo and Kyngäs (2008) the result of a qualitative content analysis provides a summary of the original information.

As mentioned earlier the Crowdsourcing articles are collected to gain insights on their issues, themes and whether they use any design methods related to DSR. For achieving our first objective the analysis focussed on revealing insights on issues, themes and other aspects while the second objective of the analysis focused on revealing insights on methodologies utilised in designing crowdsourcing application. Although Elo and Kyngäs (2008) note that no exact systematic rules are appropriate for analysing data, for producing a rigorous output we followed the three phases stated by Elo and Kyngäs (2008) as guidance; these phases are preparing, organising and reporting.

In the preparation phase, the act of categorising the collected or grouped coding or headings aims to form a categorization based on related and common characteristics (Elo and Kyngäs, 2008). Elo and

Kyngäs (2008) also describe the categorisation process as including the interpretation process that helps with the grouping of categories; the categories are used to describe the phenomenon that has been analysed. The first concern is to determine what to analyse and this naturally pertains to the research problem. As outlined above, we searched research libraries' databases sources using ('Crowdsourcing' or 'Crowd sourcing' or 'crowd source' or 'crowdsourcse') AND (apps OR application design OR design research OR design issues or system or platform or innovation).

In the organising phase, after identifying a total of 63 articles on both types of Crowdsourcing solutions, we manually went through each article to find the issues, key themes and how the design was conducted. We looked at the Crowdsourcing articles for their design process description, evaluation methodologies and rigorous processes. These components relate to the explicit DSR guidelines defined by Hevner et al. (2004).

4 Findings

The section describes the findings revealed in two separate analyses (details of analysis Type 1 and 2). First we briefly describe the issues emerging, and indicate some areas from recent papers not identified in the earlier studies reviewed, which had been based on an earlier sampling period. We then focus on the techniques and technologies used in more detail. Our content analysis (on type 1 samples) initially found a rapidly growing trends of Crowdsourcing studies that is represented in figure 3. Although we analysed samples that were collected till June 2017, it is anticipated that the total sample will be greater than the number of samples articles in last year. We also identified five key purposes of Crowdsourcing studies for organisations and stakeholders. Figure 4 below illustrates the percentages for the key purposes. It is suggested that data collection is one of the vital purposes of Crowdsourcing studies.

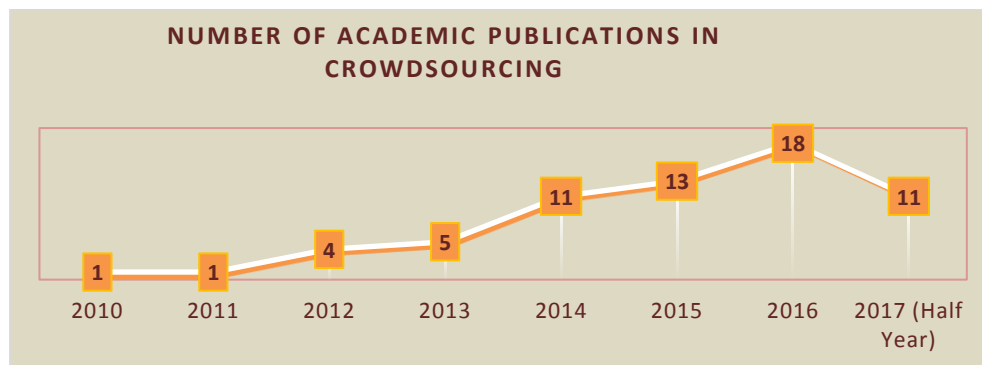


Figure 3: Progress of Crowdsourcing Research

Hetmank (2013) have come up with a result of 17 definitions of Crowdsourcing systems, 4 perspectives of design such as organizational, technical, functional, and human centric. Hetmank (2013) outlined components and functions that are implemented in a Crowdsourcing system. Consequently, Yuen et al. surveyed various Crowdsourcing literatures and allocated them into four categories: the type of application such as for voting system, information sharing system, game, or creative system, as well as the performance such as user participation and quality management.

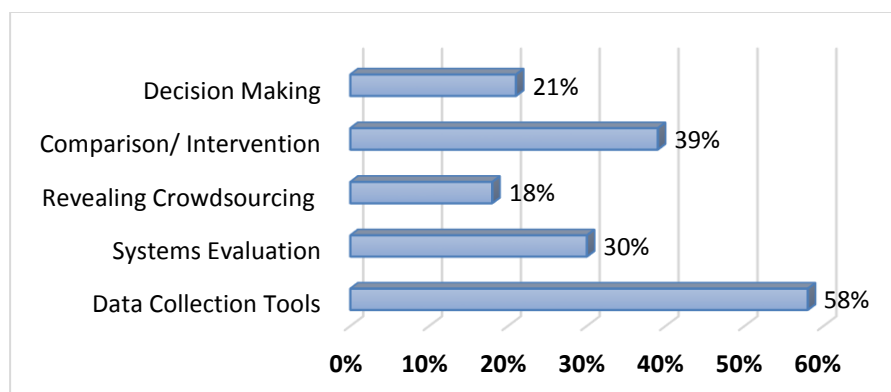


Figure 4: Five Key Broad Purposes of Crowdsourcing Studies

Our analysis on type 1 samples focus on issues of Crowdsourcing studies (summarised in table A1 in Appendix A). Figure 3 shows the rate of increasing Crowdsourcing research over the past eight and half years. Figure 5 below illustrates the number of issues found over the past studies. We then looked at the solution artefacts involved in the various studies, summarised in table B1 (Appendix B).

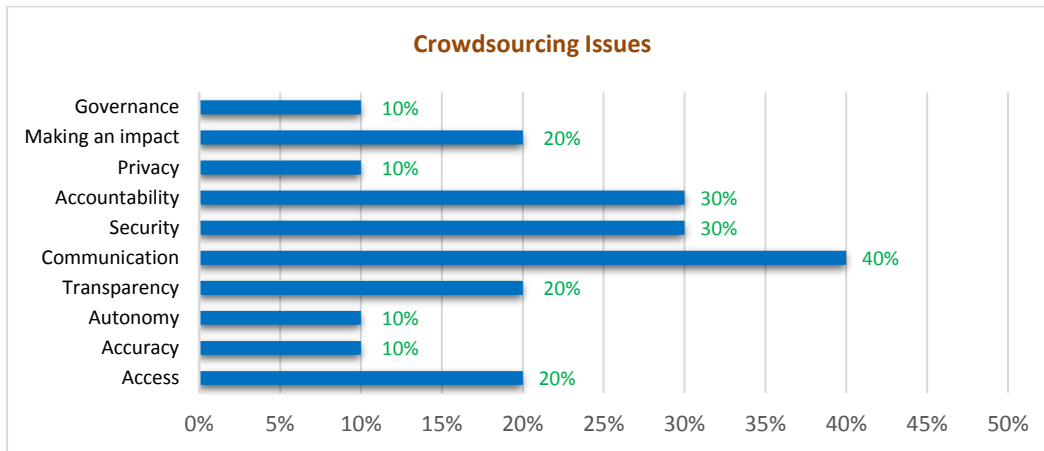


Figure 5: Issues identified in different Crowdsourcing studies

Design Science artefacts can be constructs, models, methods, or instantiations. For each article, we classified which of these was the main contribution of the research. Figure 4 shows the distribution of artefact types, which is dominated by instantiations or implementations. We also analysed the type 2 Crowdsourcing articles through the 8 themes (See Table A1 in Appendix A). Although most papers were not expressed using DSR terms the categories could be approximately mapped to the list in figure 4. The 20 papers described artefact types and purposes, their descriptions related to problem definitions and design theme details informing about problem relevance, description of design steps and components, methods and approaches used, which indicated the rigour of the process and its replicability as a search process and finally the details related to the evaluation method define how this was done, as is common with system development projects. Hevner and Gregor (2013) also described design theory as a type of artefact, we therefore added 3 more articles in which design theories were proposed.

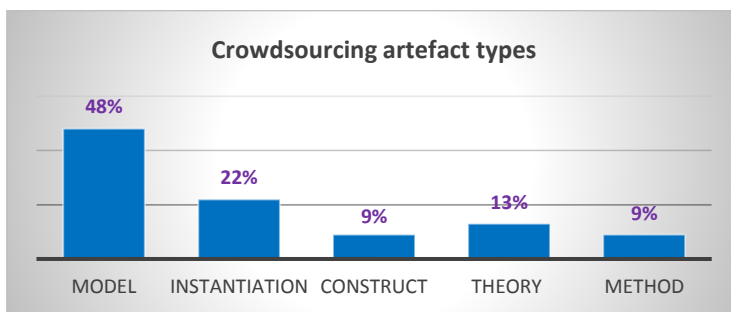


Figure 6: Crowdsourcing artefact types

5 Discussion and conclusion

The objective of this study was to gather a better understanding of what are key purposes of Crowdsourcing studies and what typical solutions in the design aspects can be considered for the use of DSR methodologies. Therefore, this study was aimed first to give an overview of issues and areas of Crowdsourcing and second, to derive typical design components so it can be comparable to DSR methodology.

Our focus was not developing on short-term use of IS platforms to satisfy the current needs of the Crowdsourcing trend. Rather, we were interested in establishing an evidence based framework on a use of theory (e.g. DSR) that can be strategically leveraged over the long term, in order to improve upon the potential of open innovation.

This literature review reveals a lack of clear methodological frameworks for artefact development in the Crowdsourcing ecosystem and we consider that much can be gained in this area through the use of tried

and true Information Systems theories such as DSR. The use of a rigorous methodology will provide a strong long-term platform for Crowdsourcing ventures well into the future and we suggest that DSR can hold the key not only for the rigour and quality of the artefact but also for the design, implementation, management, and use of the information system (Simon 1996).

It is the areas above and beyond simple artefact development that can provide improvements in the overall quality of Crowdsourcing implementations. The fact that DSR can equally represent development, implementation, evaluation, and adaptation of artefacts for problem solving means that the full lifecycle of the artefact can be catered for through the one framework. We propose that this could provide a rock-solid basis for the Crowdsourcing community to develop and grow.

We note that at present the Crowdsourcing industry is still very much in its infancy with little clarity in role and purpose and we note that there are 17 definitions of Crowdsourcing in the literature (Hetmank 2013). We consider the implementation of a DSR approach could provide a consistent framework for Crowdsourcing implementations and this should lead to a more developed understanding of the role and purpose of Crowdsourcing in today's digital environment. Perhaps this would also lead to a more focused definition of Crowdsourcing.

Future research in this area should include the development of case studies to investigate the use of DSR in the actual development and implementation of Crowdsourcing projects. The evaluation of a DSR approach could provide meaningful solutions for the Crowdsourcing community and this could be assessed through further longitudinal studies over a significant period of time.

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Appendix A (Table A1: Findings in terms of Crowdsourcing issues in the literature)

Samples	Objective	Key Issue	Research Design	Study Area/Level	Key Findings
1	Rising awareness related to microtask crowdsourcing	access, autonomy, fairness, transparency, Communication, security, accountability, making an impact, and dignity	Explonatory field study by in-depth interview	Crowd workers in Amazon's Mechanical Turk	<ul style="list-style-type: none"> ✓ Issues are employed in four crowdsourcing structures: compensation, governance, technology, and microtask.
2	To investigate how concerns around impression management may impact upon entrepreneurs' resistance to crowdfunding.	Communication, Security, Impact Assessment.	Case Study among entrepreneurs	Entrepreneurs'	<ul style="list-style-type: none"> ✓ Impression management was found to play an important role in explaining entrepreneurs' resistance to crowdfunding ✓ Identified key strategic i.e. perceived costs of Crowdfunding, benefits of crowdfunding which trade-offs entrepreneurs perceived for crowdfunding
3	To estimates urgency based on citizen emotions of municipalities' activities	Accuracy, Communication, Accountability, Governance.	Narrative textual analysis using web-based service tools called SeeClickFix hackathon data	Local Govarnance	<ul style="list-style-type: none"> ✓ Enhanced local governmetn services classified peoples' emotion and estimating urgency of daily work of municipalities.
4	To understand peoples' perception and develop conceptual model to predict appropriate sharing policy in multiuser scenarios	Access, Communication, Security, Accountability, Privacy.	Survey on Amazon Mechanical Turk practitioners'	Amazon's Mechanical Turk users'	<ul style="list-style-type: none"> ✓ Contextual factors, preferences, and arguments influence the optimal sharing policy. ✓ Users' arguments help in predicting the optimal information sharing policy

Appendix B (Table B1: Findings in terms of Crowdsourcing application/artefacts design in the literature)

Sample s	Artefact	Problem domain	Purposes	Design components	Methods	Kernel theories	Design steps	Evaluations
1	Model	Urban crowd management	Develop a centralized technique that allows fast computation	Pre-processing, optimisation, bulk processing method and pruning heuristic	Design method (not defined or explained through any IS approaches)	The k Nearest Neighbors (kNN) theory	Design technique, analysis and experimental evaluation	Performance, comparison and theoretical efficiency

2	Model	Organisational context	Provide guidelines about opportunities for research in the area as well as knowledge for practitioners regarding	four major components of crowdsourcing: the task that is outsourced, the crowd which carries out the task, the crowdsourcing process, and the outcome evaluation	Analytical study	Un-defined	Problem identification, analysis, framework development and evaluation	Descriptive evaluation on the validity of the framework's components
3	Method	Street maps and transportation networks	Propose straightforward method to deduce turning restrictions for Open tree Map data	Features of the methods such as turning restrictions	Design method (not defined or explained through any IS design approaches)	Un-defined	Input data, analysis (parsing map-matched trajectories, identifying candidate and verification process), design and evaluation	extensive experimental evaluation and verification process utilizing online map-services
4	Instantiation	bidirectional communication for language speaker	<i>Propose a crowdsourced monolingual translation, a new translation system that supports collaboration for two crowds of people</i>	Features of translations approach for effective bidirectional conversation	Quantitative investigation and undefined design method	Translation method	Analysis, design, implementation and evaluation	Quality evaluation of the translation algorithm
5	Model	propose a model for learning multiple latent rankings by using pairwise comparisons for crowdsourcing platforms	Solving problem of learning to rank items, name of the artefact is termed as <i>CrowdRank-ACT</i>	Features of the solution model for pairwise comparisons in crowdsourcing	Design method (not defined or explained through any IS design approaches)	Complex mathematics	Analysis, design, implementation and evaluation	Performance Experiments

(Note: 18 Sample details are removed due to the page restrictions, but will be presented at the conference if the panel accepts the article)