Please quote as: Zogaj, S. (2015): Conceiving the basic Principles of Crowdsourcing in Light of the Commons-based Peer Production Model. In: Working Paper Series, Nr. 13, Kassel, Germany.

Fachgebiet Wirtschaftsinformatik

UNIKASSEL VERSITÄT

Working Paper Series

Kassel University
Chair for Information Systems
Prof. Dr. Jan Marco Leimeister

Nr. 13

Shkodran Zogaj

CONCEIVING THE BASIC PRINCIPLES OF CROWDSOURCING IN LIGHT OF THE COMMONS-BASED PEER PRODUCTION MODEL

Kassel, November 2015

Series Editor:

Prof. Dr. Jan Marco Leimeister, Kassel University
Chair for Information Systems

Pfannkuchstr. 1, 34121 Kassel, Germany
Tel. +49 561 804-6068, Fax: +49 561 804-6067

leimeister@uni-kassel.de

http://www.wi-kassel.de

Abstract

Crowdsourcing initiatives are considerably growing in quantity and scope and can be considered to be on the verge of changing the way how value creation and organizational coordination takes place as we know it from today's business. The need for all involved stakeholders to understand crowdsourcing at its core and with its underlying principles becomes obvious and is not addressed yet. This paper shows that previously used attempts to explain crowdsourcing, i.e. the Transaction Costs Theory as well as the Knowledge-Based Theory, fall short for this purpose as they involve an unsuitable perspective of either hierarchy or market. Based on this, the paper argues that the basic principles of crowdsourcing can be understood if it is viewed through the lens of the Commons-Based Peer Production Model and, thus, considered as a special form peer production. As a result, the paper outlines that (1) the broadcasting of tasks via an open call, (2) the self-selection of contributors, (3) the specification of tasks, and (4) the IT-platform for coordination and collaboration are the necessary characteristics of any crowdsourcing endeavor. These core principles are further outlined and illustrated using salient crowdsourcing examples. In this context, this study emphasizes the importance of the crowdsourcing platform as the main infrastructure for all crowdsourcing projects. It is identified as the main tool for steering, coordinating and controlling the distributed work of the crowd.

The paper contributes by providing a solid theoretical foundation that assists in understanding, illuminating and explicating crowdsourcing as well as its corresponding principles and mechanisms. Thus, it sets the basis for the development of appropriate management methods and mechanisms and helps crowdsourcing stakeholders in rethinking their current crowdsourcing understanding. Furthermore, the paper also provides an agenda for future crowdsourcing research.

Keywords: crowdsourcing, commons-based peer production, value creation

1 Introduction

Faced with an increasingly dynamic environment primarily due to advancing competitiveness, shorter product and innovation cycles (Ernst 2002), increasing complexity of problems as well as customers' desire to participate in the product design and development process (Füller and Matzler 2007), more and more organizations are increasingly on the lookout for new ways of acquiring and sourcing knowledge from outside the boundaries of their units, functions, or even outside their organization (Walmsley 2009; Jain 2010). In this connection, new information technologies, particularly the Internet as an immersive and multimedia-rich technology with low costs of mass communication, come to the fore as they allow companies to reach and interact with a large number of external sources in a more (cost) effective as well as interactive manner. Thereby, it is now possible for companies to reach out to the masses (Vukovic 2009), and open tasks and functions "once performed by employees and outsourcing [these] to an undefined (…) network of people in the form of an open call" (Howe 2006). This form of sourcing is referred to as 'crowdsourcing' and was first coined in 2006 by Jeff Howe in the Wired magazine (Howe 2006).

Based on the concept of outsourcing, the term crowdsourcing emerged, referring to the outsourcing of corporate activities to an independent mass of people ("crowd") (Howe 2010). The crowd collectively takes over tasks – such as generating innovation ideas, solving research questions or pattern recognition – that it can complete in a cheaper or better way than machines or experts. In the frame of crowdsourcing, companies can either directly interact with the crowd or they can use crowdsourcing intermediaries (e.g., InnoCentive, Top Coder, oDesk) that mediate between the crowd and the company. Due to the pervasiveness of the Internet and its nearly ubiquitous presence in the recent past, this concept has gained great popularity. For instance, software companies, such as Fujitsu-Siemens (Füller, Hutter et al. 2011), IBM (Bjelland and Wood 2008) or SAP (Leimeister, Huber et al. 2009), have leveraged the wisdom of crowds for *innovation development* by using ideas competitions. In these cases, hundreds of people submitted innovative ideas and solutions regarding the underlying issue, whereas the best ideas and solutions were then rewarded afterwards. Crowdsourcing initiatives are also used for *software development* (e.g., via Top Coder) and *software testing* (e.g., via Testbirds), for consumer *product development* (e.g., vie CrowdWorx), for *marketing and sales* (e.g., via LeadVine), or for *logistics* (e.g., via CrowdLogistics). Yet other companies use Amazon's Mechanical Turk and

Clickworker to crowdsource incidental *supporting tasks* (i.e. micro tasks such as labeling images, classifying websites, spellchecking, etc.). Recently, the information technology and consulting company IBM has initiated the so called "Liquid Program," in the frame of which internal workers and projects managers are able to outsource various arising tasks to the 'internal crowd' (i.e., the whole IBM staff around the world) or to an external crowd by using crowdsourcing intermediaries.

Despite its popularity, there is still comparatively little well-founded knowledge on crowdsourcing, particularly with regard to its theoretical underpinning. Emerging articles about preliminary taxonomies, typologies and categorizations of crowdsourcing (Rouse 2010; Yuen, King et al. 2011; Brabham 2012), about basic characteristics of crowdsourcing initiatives (Vukovic and Bartolini 2008; Schenk and Guittard 2011) or about the definition of crowdsourcing (Oliveira, Ramos et al. 2010; Estellés-Arolas and González-Ladrón-de-Guevara 2012) highlight the novelty-character of this concept. Further, most research activities related to crowdsourcing have solely focused on specific spheres of this concept such as crowdsourcing for innovation development – i.e., the realm of "open innovation" (see e.g., Franke and Piller 2004; Gassmann and Enkel 2004; Chesbrough 2006; West and Lakhani 2008; Bullinger, Neyer et al. 2010). However, current research lacks of theoretical foundations with respect to crowdsourcing as a generic method that goes beyond specific applications (Geiger, Seedorf et al. 2011). The previously shown examples outline that numerous companies have used this concept for performing *various* tasks and *value creation activities*. Due to the fact that the information involved can be transported anywhere nearly instantaneously and at almost no cost, by implementing crowdsourcing, companies have access to a vast pool of potential workers across the world that they can call on to perform different operations (Malone, Laubacher et al. 2011); thereby crossing firm boundaries and utilizing the capabilities of crowds for the actual production. Along with this arises the necessity to consider crowdsourcing not just as an alternative way of performing single tasks, but rather as an innovative form of value creation. Eventually, a form of value creation implying new forms of coordination and communication within a company and also one that cannot fully be reached by the dominant perspectives of production within hierarchal settings or based on market transactions. Consequently, research has to address the following question: *How can crowdsourcing be theoretically substantiated and what are its underlying principles and core mechanisms?*

I investigate this issue by drawing on the Commons-Based Peer Production Model (CBPPM) proposed by Benkler (2002), which implies an alternative model of production observed in the Open Source Software (OSS) development emerging alongside market-based and managerial-based production. Commons-Based Peer Production (CBPP) is a model of social production that explains coordination as well as motivation mechanisms arising and subsisting within OSS development projects. Although only analyzed with respect to the OSS development and within the context of distributed computing projects (e.g., Wikipedia), Benkler (2002) suggests that the CBPPM can be used to explain other phenomena that imply a collective effort of individuals within an online setting in a "more-or-less informal and loosely structured way." Hilgers et al. (2010) have argued that this model is a viable framework for investigating also open innovation projects in non-software related domains. Accordingly, I argue that the CBPPM constitutes an appropriate theoretical framework for the explanation of the collective production within crowdsourcing projects. In this conceptual paper, I outline that the insights provided by the CBPPM help in understanding the production and coordination processes of crowdsourcing. By taking into account several examples from practice as well as the showcase project of IBM – i.e., the Liquid Program – I elaborate the core mechanisms of crowdsourcing and justify its position as a form of production settled between hierarchy and market.

The remainder of this paper is structured as follows: In section two, the paper first provides the terminological and theoretical background by briefly approaching the concept of crowdsourcing. Within this section, I also present theories that are currently used in the context of crowdsourcing, namely the Transaction Cost Theory as well as the Knowledge-based Theory, and further outline the CBPPM. I subsequently describe the methodology in section three, before reporting the analyzed cases in section four. Based on these deliberations, the paper elaborates the basic principles and mechanisms of crowdsourcing endeavors. Afterwards, I discuss arising implications and present a research agenda for exploring crowdsourcing based on the previously generated insights before I conclude the paper in section seven.

2 Theoretical and Conceptual Background

2.1 The Background of Crowdsourcing

Crowdsourcing describes a new form of outsourcing tasks, or more accurately, a novel mode of value creation (Afuah and Tucci 2012). The term itself is a neologism that combines crowd and outsourcing (Zhao and Zhu 2014). The fundamental idea of crowdsourcing is that a *crowdsourcer* (i.e., a company, an institution, a non-profit organization) proposes to an undefined group of *crowdsourcees* (also referred to as *crowd workers* – i.e., individuals, formal or informal teams, other organizations) the voluntary undertaking of a task presented in an open call (Blohm et al. 2013; Leimeister 2015). The ensuing interaction process unfolds over *IT-based crowdsourcing platforms*. Such platforms are either run by a crowdsourcer or provided by a third party that acts as *crowdsourcing intermediary* (e.g., TopCoder, InnoCentive). Such intermediaries offer professional crowdsourcing services by enabling crowdsourcers to present their tasks to specific crowdsourcees for a fee (Zogaj et al. 2014).

Research suggests different forms of crowdsourcing depending on the origin of the crowdsourcees and whether or not a crowdsourcing intermediary is used (cf. Figure 4). In the scope of external crowdsourcing, the crowd consists of Internet users that self-select themselves to a task. External crowdsourcing can be performed by, or without, the use of crowdsourcing intermediaries. In case organizations do not use crowdsourcing intermediaries, own crowdsourcing platforms are built up. Dell IdeaStorm is an example where the crowdsourcer (i.e., Dell) operates a crowdsourcing platform on its own account, which was licensed from specialized providers (Di Gangi & Wasko, 2009). In the case that an organization uses a crowdsourcing intermediary, crowdsourcers do broadcast their task to a crowd installed by the intermediary. For instance, TopCoder built up a crowd of software developers to which crowdsourcers can present their task (Lakhani et al, 2013). In terms of internal crowdsourcing, the crowd consists of employees who are addressed via in-house crowdsourcing platforms (i.e., an intranet platform) (Neyer et al, 2009). In this context, a firm aims at using the potential of internal staff for performing different corporate activities (Wagner & Back, 2008). For instance, Google operated an internal prediction market for involving its employees in collective decision-making (Cowgill et al, 2009).

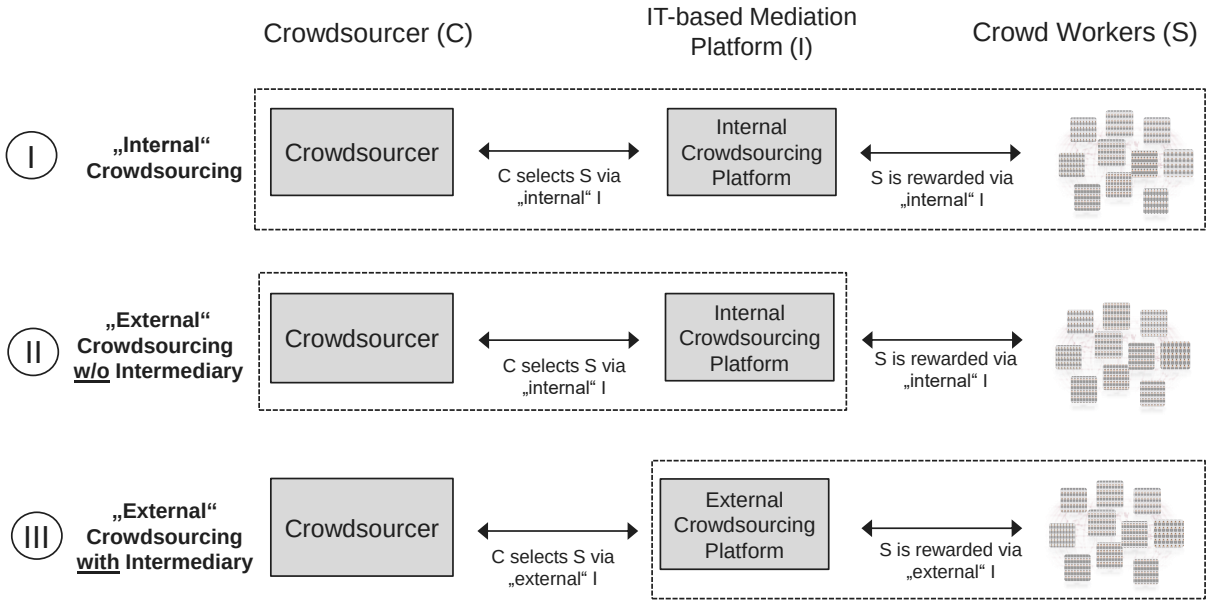


Figure 1: Three Means of Crowdsourcing
Source: Own illustration

Outsourcing describes the approach of assigning an internal task or project to a *designated* third-party contractor or a certain institution. By comparison, within crowdsourcing, the tasks or projects are allocated to an *undefined* mass of people (the "crowd") who, in turn, will be rewarded for their effort of performing the tasks. Therefore, outsourcing and crowdsourcing have basic similarities as well as differences: the outsourcing of internal tasks is a common issue, whereas the actual performing agents are crucially different. Within crowdsourcing, participation is non-discriminatory – i.e., instead of relying on only one or a small number of designated suppliers, in the case of crowdsourcing, any individual can theoretically perform the tasks or projects (Pénin 2008). This is a prerequisite that enables a "crowd" to emerge, which is then (most often) characterized by a strong heterogeneity and anonymity.

Despite these differences, for understanding the phenomenon of crowdsourcing, it is necessary to consider and reconstruct the theoretical foundations of outsourcing. From a theoretical viewpoint, outsourcing an internal task – be it to a designated supplier or to a crowd – delineates the decision between "make" or "buy," i.e. either producing a solution internally or acquiring a ready-made solution on the market (see e.g., Cheon, Grover et al. 1995). In case of internal production, *hierarchical* decision processes determine the production, whereas buying a solution on the *market* is associated with crossing firm boundaries and sourcing external knowledge. There is a well-established literature basis of exploring such make-or-buy decisions and firm boundary questions with respect to outsourcing using the Transaction Cost Theory or the Knowledge-

Based Theory (descended from the Resource-Based Theory) (see e.g., Apte 1990; Teng, Cheon et al. 1995; Poppo and Zenger 1998; Lee 2001). Belonging to the stream of economic theories, the Transaction Cost Theory stresses efficiency, cost, and benefits of outsourcing, whereas strategic management theories (Resource-Based Theory and Knowledge-Based Theory) consider outsourcing as an optional way of improving a firm's competitive advantage (Meyer 1994; Leimeister 2010). Subsequently, the paper provides an overview of the theories used for explaining crowdsourcing so far. Here, I first introduce the Transaction Cost Theory and the Knowledge-Based Theory (descended from the Resource-Based Theory) before shedding light on their consequent interpretations and implications for crowdsourcing in order to assess their suitability in the context of crowdsourcing.

2.2 Review of Current Theoretical Lens on Crowdsourcing

First coined by Coase (1937) and then further developed by Williamson (1975; 1985), the *Transaction Cost Theory (TCT)* specifically addresses make-or-buy decisions by comparing the incurring transaction costs of each option (i.e., costs in terms of time and effort that arise for initiating, planning, adapting, and controlling task completion) for accomplishing an economic activity (Williamson 1981). In this context, firms can perform a task either by using the governance structure of intra-organizational hierarchy (i.e., firm production) or by using the external market-based governance structure (i.e., crowd-/outsourcing the economic activity). According to TCT, the alternative with lower transaction costs constitutes the preferable governance structure (Apte 1990; Crook, Combs et al. 2012). Transaction costs are determined by the nature of the transactions, which – in turn – is characterized by *specificity*, *frequency* and *uncertainty*. The higher these factors the more effort has to be undertaken to settle a transaction – meaning that transaction costs are higher (Lacity and Hirschheim 1993). Williamson (1981) points out that hierarchy-based solutions are predominantly superior since actors usually face imperfect markets with information asymmetries. In this context, the costs for controlling and monitoring market transactions (because of high uncertainty, frequency and specificity due to information asymmetries) with the counterparts are (usually) higher. Therefore, the market (i.e., crowd-/outsourcing) is only preferable in cases where frequency, specificity and uncertainty are low. Thus, the following question arises: What are the peculiarities of transactions in the frame of crowdsourcing and what are the corresponding implications of the TCT?

Within crowdsourcing projects, frequency strongly varies depending on the crowdsourced activity. For instance, in the context of crowdsourcing for innovation activities (e.g., open innovation communities), the crowdsourcer frequently interacts with the crowdsourcees (Brabham 2008), whereas in case of micro tasks, the intensity of such interactions is rather low (Kittur, Chi et al. 2008). In most cases, however, the crowdsourcer has to interact several times with the crowdsourcees until a finished solution is produced. In case of such 'not-instantaneous' and 'not-unique' transactions, the possibility of opportunistic behaviors by some actors rises, which leads to higher transaction costs due to required controlling mechanisms (Burger-Helmchen and Penin 2010). Accordingly, hierarchy-based production is to be preferred over crowdsourcing. Frequency is especially high when the task is very specific because multiple transactions are required to transfer and exchange the underlying knowledge. Most often this becomes obvious in crowdsourcing projects where the task is very knowledge-intensive and not easy to codify, such as crowdsourcing for the development of software applications, products or designs (e.g. via Top Coder, 99Designs or Threadless). In cases where the task and the corresponding solutions are easy to codify, possible opportunistic behavior by the crowdsourcer disfavors the market solution, according to Burger-Helmchen & Penin (2010). For instance, the crowdsourcer might not remunerate crowdsourcees for their solutions if intellectual property rights are not enforced. If the protection of intellectual property rights is not guaranteed, costs in terms of time and effort for initiating transactions do arise. Consequently, crowdsourcing includes more transaction costs than a hierarchy-based solution, irrespective of whether a task is highly specific or not. Opportunistic behavior also raises issues related to uncertainty: Since the crowdsourcing organization is not able to control each submitted solution, some crowdsourcees might attempt submitting inappropriate solutions. Further, the crowdsourcing of internal value creation activities includes the risk of revealing valuable knowledge, since crowdsourcees are not (or can hardly be) obligated to keep their work within the crowd confidential [disclosure dilemma: Arrow's information paradoxon (Arrow 1962)]. Implementing secrecy agreements and submission control mechanisms lead to high transaction costs so that crowdsourcing is (again) inferior to the internal firm production.

Different from TCT, the *Knowledge-Based Theory (KBT)* is independent of transaction cost logic and the associated behavioral assumption of opportunism (Nickerson and Zenger 2004). The KBT is based on the Resource-Based Theory (RBT), which was initially introduced by Penrose (1959) and further developed by Wernerfelt (1984) as

well as Barney (1991). In general, the RBT understands an organization as a bundle of firm-specific resources and capabilities upon which competitive advantages are based. The KBT, in turn, distinguishes *knowledge* as the most valuable resource of an organization (Spender and Grant 1996). In this context, a competitive advantage can be achieved by growing and maintaining organizational knowledge. The work around the KBT "seeks to explain how the choice of organization – particularly the choice of whether to integrate [i.e., hierarchy] or outsource [i.e., market] an activity – influences the efficient production and protection of valuable knowledge" (Nickerson and Zenger 2004). Associated with the rise of the knowledge-based economy (e.g., digitalization, internetworking, virtualization, the role of online networks and services), the KBT has gained importance for explaining organizational production (Bogers 2012). Therefore, I subsequently consider crowdsourcing in the light of the KBT.

According to Kogut and Zander (1992), as well as Nonaka (1994), transferring knowledge from one entity to another is costly, slow and requires frequent exchange processes – in particular, the more the knowledge is tacit (i.e., specific know-how, skills and contextual knowledge) (Cowan, David et al. 2000). Therefore, hierarchy is usually the preferable option; however, the market solution becomes superior if (1) an outsourcing vendor offers valuable knowledge *and* (2) the corresponding process of knowledge-exchange can be accomplished at low cost. Hence, outsourcing is often an attractive solution because the effort of exchanging and also processing knowledge with a single – or only a couple – designated agents is low.

As opposed to this, within crowdsourcing, frequent exchange processes with a mass of individuals are required for production. Further, learning processes – that are important within the KBT for developing similar mindsets – cannot occur since the crowdsourcees performing the tasks might be different for each crowdsourcing initiative. Consequently, hierarchy is superior to crowdsourcing. This becomes also apparent considering the amount of information and knowledge acquired during a crowdsourcing project: by sourcing knowledge from a crowd, an organization is provided a vast pool of diverse knowledge; however, processing that mass of knowledge and selecting the most appropriate variations might push organizations to their cognitive limits. Moreover, the disclosure dilemma gives problems in market transactions for explicit knowledge via crowdsourcing (Bogers 2012). Hence, firms try to avoid the risk of revealing any knowledge (which is crucial within KBT) by interacting with a large mass of crowdsourcees. Since protection mechanisms are onerous, hierarchy is preferred over crowdsourcing.

The previous argumentation stresses that – according to both TCT *and* KBT– performing tasks within firm boundaries is superior to crowdsourcing. In crowdsourcing initiatives, high specificity, frequency and uncertainty raise transaction costs that can be avoided when a firm elaborates the solution using hierarchal governance. From KBT's perspective, internal firm production dominates the crowdsourcing approach due to high efforts for processing knowledge-transfer between many different agents (i.e., the crowd), for integrating the knowledge received from the crowd, as well as for establishing disclosure. Despite these implications, practice shows that the crowdsourcing approach persists and that it has found a widespread acceptance. This suggests that the classical approaches of the TCT and the KBT are not sufficient for explaining crowdsourcing. However, a solid theoretical foundation is needed for being able to understand, illuminate and explicate crowdsourcing as well as the corresponding principles and mechanisms. This sets the basis for the development of appropriate management methods and mechanisms and assists crowdsourcing stakeholders in making informed decisions and taking reasonable actions.

I suggest that TCT and KBT fall short for explaining crowdsourcing because, in their original form, these theories assume only two production mechanisms: hierarchy *or* market. However, literature has consistently argues that hybrid forms of productions are more realistic. Likewise, I argue that crowdsourcing is a form of production that features hierarchy as wells as market governance mechanisms at the same time. For instance, by broadcasting a task on a crowdsourcing platform and collecting the corresponding solutions, a firm makes use of the market mechanism. However, the production is not finished until the firm assembles the solutions into (a) product(s) – which can be regarded as a hierarchal mechanism.

Other scholars have evoked different theories to explain governance modes that fall between pure market exchanges and hierarchies – such as joint ventures, strategic alliances and networks, open collaborative innovation and other kinds of partnerships (see e.g., Heide and John 1990; Alter and Hage 1993; Ring and Van de Ven 1994; Kern and Willcocks 2000; Goles 2001; Bogers 2012). This approach seems promising. However, in contrast to these modes, crowdsourcing focuses on the distributed knowledge production on the Internet; therefore, it implies specific characteristics that are different from off-line production. Analyzing the OSS development and various distributed computing projects (e.g., Wikipedia), Benkler (2002) developed the Commons-Based Peer Production Model (CBPPM) which can be used to explain other

phenomena that imply a collective effort of individuals within an online setting. Accordingly, I argue that the CBPPM constitutes an appropriate theoretical framework for the explanation of the collective production within crowdsourcing initiatives. Using salient crowdsourcing examples, especially the IBM Liquid Program, I will subsequently illustrate the CBPPM principles and their meaning for crowdsourcing.

2.3 Commons-based Peer Production Model

The Internet as an immersive and multimedia-rich technology with low costs of mass communication has engendered powerful emergent phenomena because every individual or group with a shared interest can interact, collaborate, and create intellectual value through the Internet (Milson and Krowne 2005). Over the last decade, a growing proportion of production and value creation has turned to Internet-based collaborations, thereby increasing the need for more fundamental understanding of the operation and organization of these enterprises (Haythornthwaite 2009). As early as 2002, Benkler (2002) recognized an increasing distributed knowledge production on the Internet that, apparently, did not appear to be compatible with the classical coordination mechanisms known from TCT or RBT (Reichwald and Piller 2009). Particularly spurred by the OSS development – as one of these distinctive phenomena – he established the CBPPM, which represents an alternative mode for organizing production without relying on managerial hierarchies, markets, property, and contracts (Benkler 2002). OSS is the most well-established example of peer-production; however, peer-production is also manifested in collaborative authorship projects (such as Wikipedia), distributed computing projects (such as SETI@home), and various forms of "open innovation" (e.g., Local Motors) (Feller, Finnegan et al. 2008). All these approaches have certain characteristics in common: contributors' self-motivation to be part of a project, a distinct attachment to community, a larger community of interest around the topic and (4) a purpose of production (Haythornthwaite 2009). The CBPPM explains the motivation and coordination mechanisms behind these collective production purposes, where input is generated from many unknown and unconnected contributors. According to Benkler and Nissenbaum (2002), CBPPs are typified by two core characteristics: (1) decentralization and (2) use of social cues and motivation. The first aspect relates to authority issues. Rather than in the hands of a central organizer, the authors state that the decision-power to be active resides with individuals agents, who – in turn – make their decisions based on their personal needs. Accordingly, the central organizers use social cues and motives to incentivize and coordinate the contributors. These two

characteristics account for crowdsourcing as well. According to Bauwens (2009), by implementing crowdsourcing, existing firm structures attempt to integrate partial peer-to-peer dynamics in their own value chains. Therefore, I suggest that the CBPPM helps in explaining as well as better understanding crowdsourcing and its changed way of organizational design and value creation.

However, before I can further analyze crowdsourcing against the backdrop of the CBPPM, we must take a closer look at the essential features that describe peer-production and its manifestations. These are: *information commons*, *broadcasting of tasks*, *voluntarism and self-selection*, *granularity of tasks*, and the use of an *online platform for coordination and task-processing* (see Benkler and Nissenbaum 2006). First, the information produced in CBPP settings is available for all contributors – i.e., information is regarded as a commons good. Thus, all contributors may use and further elaborate the information produced in such settings. Second, CBPPs require an open task or project to be broadcasted by an individual, an institution or an organization. This may be realized by public announcements inviting contributors to participate in the tasks (Hilgers et al. 2010). Based on this, contributors self-select themselves for participation. Motivated by different intrinsic and extrinsic motives, individuals decide themselves whether they want to contribute to the tasks or not. Fourth, for the contributors to able to perform the tasks, the objects of peer-production must display certain characteristics: The tasks should be modular or, more precisely, divisible into components, so that multiple individuals can perform the tasks asynchronously. This includes several procedures for dividing the tasks intro granular sub-tasks. the solutions of these granular tasks can then be reintegrated into a condensed solution. Finally, every CBPP requires an online platform which, basically, makes the peer-production feasible. The online platform is used for various coordination issues and, most importantly, for processing the tasks.

3 Research Approach

Given the lack of empirical and theoretical research on crowdsourcing, my primary objective was to achieve better understanding of the basic principles of crowdsourcing based on the underlying idea of the CBPPM. The case study methodology is particularly useful for exploring new phenomena for which existing approaches do not provide definite explanations (Yin 2009). Meanwhile, multiple case studies can often shed useful light on, and provide a deeper understanding of, important issues when the available data are limited, since they allow observing, exploring and explaining new phenomena within their real-life setting (Steinfield et al. 2011, Yin 2009). According to Eisenhardt (1989) and Yin (2009), case studies are useful when the phenomenon has not yet received appropriate ascertainment within the existing literature, and when theoretical knowledge lacks clearness and certainty with respect to the underlying issue. The analysis of the core principles of crowdsourcing exhibits the above-mentioned features. Therefore, I suggest the case study approach to be suitable for this research endeavor.

In terms of data collection and analysis, I followed the guidelines presented by Dubé and Paré (2003) on how to approach, conduct and report cases studies, and therefore deployed a four-stage analysis process. The first step was to determine appropriate and expedient cases. As stressed above, there are three forms of crowdsourcing – i.e., internal crowdsourcing, external crowdsourcing including an intermediary, and external crowdsourcing without an intermediary. It is imperative to include all three forms in order to obtain basic principles valid for any kind of crowdsourcing project. Hence, I aligned the selection of cases based on the three forms of crowdsourcing displayed in Figure 4. In this vein, I studied six cases, thereby covering all the crowdsourcing manifestations with at least two cases. Table 6 provides an overview of the cases I approached for this study.

Form of Crowdsourcing	Background Information about the Cases
Internal Crowdsourcing	**IBM Liquid** In 2012, IBM introduced the so called "Liquid Program" which represents a partial relocation of production into the crowd. Within the Liquid Program, project managers outsource different tasks (e.g., design and programming components) to IBM employees worldwide (i.e., internal crowd) using an internal IT-based platform.
	Omega[1] Omega is a large multinational automotive corporation, which has performed several internal crowdsourcing projects. In this context, the higher management level (i.e., crowdsourcer) asked the employees (internal crowd) to elaborate solutions to various issues, such as the design of innovative infotainment systems, the development of additional safety technologies, or the improvement of existing customer services.
External Crowdsourcing without Intermediary	**Fujitsu Siemens** *Fujitsu Siemens* established a crowdsourcing initiatives called "IT Services for tomorrow‘s Data Center" in order to obtain ideas and solutions from the crowd with respect to its service offerings. The crowd consisted of customers, IT-managers, IS students, and professors.
	Dell IdeaStorm *Dell IdeaStorm* is a virtual community, in which distributed groups of individual customers focus on voluntarily sharing innovation ideas. It is used by Dell to integrate its customers into ideation for new product development. In this context, customers are seen as a key resource as they often have high product expertise as well as experiences and creativity potential gained by regular product usage.
External Crowdsourcing with Intermediary	**Clickworker** *Clickworker* is a crowdsourcing intermediary for different supporting business tasks. The intermediary helps companies (i.e., crowdsourcers) to break down business projects into smaller tasks (e.g., language translation) and distribute them to the crowd.
	HealthTap *Health Tap* is a crowdsourcing intermediary specialized in healthcare. The platform brings together private persons, who act as crowdsourcers by calling for help with respect to a certain health issue, and medical professionals, who act as crowdsourcees by providing answers and solutions to the broadcasted issues. The purpose of the platform is to provide trustworthy information and guidance in the area of healthcare.

Table 1: Analyzed Crowdsourcing Cases
Source: Own Presentation

According to Meredith, a case study typically uses “multiple methods and tools for data collection from a number of entities by a direct observer(s) in a single, natural setting that considers temporal and contextual aspects of the contemporary phenomenon under study” (Meredith 1998). Thus, in the second step, I first performed a content analysis of the websites, the documents provided by the interviewees, as well as articles related to the cases published in practitioner and scientific outlets. This

[1] For reason of confidentiality, I use the acronym "Omega", which represents a company that has performed several internal crowdsourcing projects

approach was taken in order to understand the context of the projects. The insights served as background information for the subsequent interviews as well as the analysis in the later steps. Hence, the third step included the execution of semi-structured, in-depth interviews conducted with the founders, co-founders, (former) executives, as well as company-internal managers designated to manage the crowdsourcing platform (e.g., in case of crowdsourcing without intermediary). I developed a roughly structured guideline with open questions, which addressed various issues on the content, on the characteristics, as well as on the implementation of the crowdsourcing endeavors. Each interview lasted at least from 35 to 90 minutes. In each situation, detailed notes were taken during interviews. Finally, for the fourth step (i.e., data analysis), I transcribed all recorded interviews and analyzed each case with respect to the basic dimensions of the CBPPM. The analysis was supported by scientific assistants, who read the relevant transcripts and discussed the content with the author of this paper. Here, I included only issues on which all individuals agreed upon. By this means, the overall quality of the data analysis was ensured. These procedures (i.e., the same data collection and analysis procedure for each case combined with the use of multiple data sources) consolidate the reliability of this analysis (Yin 2009).

4 Analysis of the Cases

This section presents the core insights arising from the analysis of the different cases. I will briefly describe each crowdsourcing endeavor and outline the main characteristics in the light of the CBPPM principles.

At the beginning of 2012, IBM introduced the so called *Liquid Program* (also referred to as "IBM BeLiquid" or "Liquid Challenge Program") representing a partial relocation of production into the crowd. According to IBM, the Liquid Program focused on creating a more effective and flexible organization and provide IBM staff (internal crowd) the possibility to use free capacities for alternative and lucrative work opportunities. Within the Liquid Program, IBMs project managers (i.e., crowdsourcer) could outsource different tasks (e.g., design and programming components) to the internal crowd. According to the interviewees, the crowd consisted of potentially all IBM employees worldwide. These internal crowdsourcees were referred to as 'Liquid Players.' Even though this crowdsourcing endeavor was performed internally, the crowdsourcees were not obligated to participate in the crowdsourced tasks. They could choose whether they participate or not. The interviewees reported that employees would usually contribute in case they considered the tasks interesting and challenging (i.e., voluntarism and self-selection). The tasks were broadcasts on a specific section of the IBM intranet-platform by means of an open call (i.e., broadcasting of tasks). Using that platform, crowdsourcees could apply for the written-out tasks, whereas the project managers were able to select how many and which ones of the solvers could complete a task. The crowdsourcees were chosen by the crowdsourcer based on different criteria such as their performance in prior projects, or their (technical) background. The elaborated solutions had to be submitted on the platform. If the solutions were not satisfactorily, the crowdsourcers had the possibility to further engage the crowdsourcees until an appropriate solution was developed (i.e., online platform for coordination/ task-processing).

Just as IBM, *Omega* uses an internal platform four sourcing out several projects to their employees (crowdsourcees). In this context, the higher management level (i.e., crowdsourcer) perfoms an open call asking the employees to elaborate solutions to various issues, such as the design of innovative infotainment systems, the development of additional safety technologies, or the improvement of existing customer services. One a task is broadcasted through the internal platform, employees have a chance to participate and elaborate solutions to the announced tasks. However, the initiatives are

usually organized as challenges. This means that the submitted solutions of only one or a few crowdsourcees are rewarded. Due to the competitive context, the crowdsourcees work independently from each other and (usually) do not share any information. The winning solutions are then selected from the crowdsourcer, who uses the platform to communicate the winner and to also provide any further information regarding the broadcasted tasks.

The crowdsourcing endeavors by *Fujitsu Siemens* and *Dell* are both a type of external crowdsourcing (i.e., crowdsourcees are from outside the company). However, both companies have developed a dedicated platform for coordinating the crowdsourcing initiatives. While Fujitsu Siemens initiated a crowd-based ideas competition, Dell uses its IdeaStorm platform for continuously gathering ideas and solutions from the crowd. In both cases, however, any individual who cached the announcement of the tasks could be part of the crowd. Hence, numerous customers from both companies, IT-managers, IS students, or researchers self-selected themselves to contribute to the crowdsourcing endeavors. Fujitsu Siemens used its platform to announce its competition, to provide detailed information on the competition as well as to collect the solutions by the crowdsourcees. Dell goes a step further and constinously communicates with crowdsourcees on the platform, whereas Dell managers also take part in the elaboration of solutions. The information on Dell's IdeaStorm is – in most cases – regarded as a commons good, because every crowdsource can see the solutions and contribute to these elaborations. As compared to that, contributors to Fujitsu Siemens' competition do not share any information with each other and also not able to see other contributors' solutions.

This contradistinction is also apparent if we consider *Clickworker* and *HealthTap*, which are both intermediaries and, thus, representative examples for external crowdsourcing endeavors that include a crowdsourcing intermediary. On HelathTap, information is regarded as a commons good since any crowdsource can contribute on a broadcasted task. This is, however, not the case on Clickworker, where every crowdsourcee works individually. On HealthTap, registered patients act as crowdsourcers and broadcast medical issues on the platform, whereas registered doctors (i.e., crowdsourcees) try to – sometimes collaboratively – provide appropriate advices on the issues. In some cases, the broadcasted tasks are modular, in the sense that doctors with different specializations each provide answers to a part of the modular tasks. As compared to that, the granularity of tasks is always given on Clickworker. In most cases, Clickworkers helps the crowdsourcers (i.e., mostly

companies) to break down larger tasks into small units. On both platforms, all work processes are managed on the dedicated crowdsourcing platform. In these cases, the IT-based platform provided by the intermediaries is the cardinal element of the crowdsourcing endeavors. Table 7 summarizes the findings with respect to the fit between CBPPM's principles and the analyzed cases. It further stresses the main challenges associated with the management of these crowdsourcing endeavors.

CBPPM Principles	***IBM Liquid***	***Omega***	***Fujitsu Siemens***	***Dell IdeaStorm***	***Clickworker***	***HealthTap***
Information commons	○	○	○	◐	○	●
Broadcasting of tasks	●	●	●	●	●	●
Voluntarism and self-selection	●	●	●	●	●	●
Granularity of tasks	◐	◐	◐	◐	◐	◐
Online platform for coordination/ task-processing	●	●	●	●	●	●
Main challenges	• Definition of broadcasted tasks • Selection of suitable crowd-sourcees • Control of work processes	• Definition of solution requirements • Screening & selection of solutions • Enhance motivation & participation	• Definition of solution requirements • Screening & selection of solutions	• Definition of broadcasted tasks • Behavioral control • Control of work processes	• Quality control • Definition of broad-casted tasks • Control of work processes	• Definition of broadcasted tasks • Foster collaboration • Enhance motivation & participation

Table 2: **Correspondence of Crowdsourcing Cases with CMPPM Principles**
Source: Own Presentation

5 The Core Mechanisms Behind Crowdsourcing

The multiple cases analysis stresses some relevant findings, that is: crowdsourcing endeavors do exhibit, but not the same features as peer-production initiatives. The two core characteristics are equal (i.e., decentralization, use of social cues and motives). However, firstly, crowdsourcing is not always characterized by a granularity of tasks. The granularity of tasks may be part of many crowdsourcing endeavors. However, a crowdsourcer can perform an open call for complex and not divisible as well. This was especially shown by the cases of Omega and Fujitsu Siemens. Here crowdsourcees has to provide solutions to complex issues, which had not been further broken down. Nevertheless, these tasks had to be precisely described, so that the crowd was able to provide solutions. As such, it becomes clear that crowdsourcing is not characterized by a "granularity of tasks" – the feature in hand can rather be described as "task specification."

Secondly, in crowdsourcing endeavors, the produced information is not available to all contributors. In the most distinctive example of CBPP – open source projects – value arises through collaboration different programmers developing a new IT application. Such a collaborative approach is visible in crowdsourcing endeavors as well (see e.g., Dell's IdeaStorm or HealthTap); however it is not a basic feature.

Besides these exceptions, the CBPPM framework help in eliciting the core mechanisms of any crowdsourcing endeavor. These are: *broadcasting of tasks using an open call*, *self-selection to performing a task*, *task specification*, and the use of an *IT-based platform for coordination and task-processing*. As such, every crowdsourcing endeavor exhibits all of these three characteristics, independent of the application context.

5.1 Broadcasting of Tasks via an Open Call

For peer-production to commence, one or more (individual) contributor(s) or a focal coordination body has to ‘broadcast’ the tasks – i.e., make public announcements for "inviting participation in the solution to a problem that has been aired" (Hilgers, Müller-Seits et al. 2010). Any person can then participate and contribute to the solution of the underlying problem. The same applies to crowdsourcing, where a crowdsourcer performs an open call to contribution to a specific task. Hence, the broadcasting associated with the open call is a crucial feature. Only by this means it is possible to gather a large amount of contributors or a crowd, respectively. The first

implication resulting from the broadcasting is the circumvention of the "local search bias," which describes the propensity of organization to search for solutions only in their near environment (Afuah and Tucci 2012). For instance, firms search for outsourcing vendors usually only on nearby markets and thereby neglect the chance to find more appropriate contractors (with lower prices or better solutions) on distant markets. This issue is inherent to both TCT and RBV. Searching for solutions beyond the local area increases the transaction costs (in case of TCT) or the effort for transferring the knowledge from one entity to another (in case of the RBV). Broadcasting a task based on an open call, however, enables a distant search and correspondingly an efficient assignment of human capital to the underlying tasks (Benkler 2002; Afuah and Tucci 2012). This is because firms gain the possibility to reach more and distant solvers who either have the best solutions for a task, the lowest costs in solving a task, or the highest motivational stimuli to work on a task (Hilgers, Müller-Seits et al. 2010; Jeppesen and Lakhani 2010). According to Malone et al. (2011), costs are lower and quality improves "when more of the work that goes into a final product is done by people who are good at it" (Malone, Laubacher et al. 2011). In all analyzed crowdsourcing endeavors, crowdsourcers are offered the opportunity to conduct distant search that crosses internal division boundaries as well as company boundaries: For instance, a project manager from one IBM branch, or one Omega branch (e.g., in the U.S.), is not restricted to use only workers within division to complete different work packages. Instead, the manager can outsource the tasks to the while internal crowd which consists of employees from all over the world. With a crowd consisting of a large number of crowdsourcees, the project manager is likely to obtain suitable solutions over a short period of time. These same principles apply for external crowdsourcing with and without intermediaries.

5.2 Voluntarism and Self-Selection

The second implication resulting from the broadcasting is that individuals (from the crowd) can *self-identify* for tasks that attract them and for which they are suited. This aspect has a crucial implication that holds for peer-production as well as for crowdsourcing: The actions of the individuals are not directly coordinated by commands from a person in hierarchy. The individuals (or accordingly the crowdsourcees) can self-select whether they contribute to specific tasks, and how much effort they put into that. For instance, one can accomplish only several parts of a specific task, whereas the remaining parts can be seized by other contributors. In this context, crowdsourcees' motivations are a core mechanism for controlling the

participation in crowdsourcing endeavors. If implemented incentive mechanisms (e.g., monetary rewards) do not work, the crowdsources will not be able to engage a large number of contributors – thereby endangering the success of the crowdsourcing project. By comparison, appropriate incentives enhance active participation and increase the chances of finding the most suitable solutions. Meanwhile, the crowdsourcer collects, controls, and manages the solutions.

These elucidations particularly stress the character of crowdsourcing as a production mode settled between market and hierarchy: The actual solutions are obtained from the market (i.e., the crowd), whereas hierarchy decides on the incentives (i.e., pricing/remuneration). These aspects can be observed all across the presented cases. For instance, project managers at Dell, IBM or Fujitsu Siemens broadcast specific tasks and the crowdsourcees (self-) select whether they perform the broadcasted tasks – i.e., they are not ordered by the hierarchy (IBM, Dell, Fujitsu Siemens) to accomplish specific tasks. Crowdsourcees can choose to work on tasks which they feel appropriate for or which they like. The projects managers of these companies try to establish suitable incentives for enhancing participation. Benkler and Nissenbaum (2006) state that the participating individuals are motivated by various (mostly social) cues; however, monetary incentives (e.g., prices) are not used within peer-production. As opposed to this, in crowdsourcing initiatives, remunerations are used to motivate participating agents as well. For instance, Fujitsu Siemens used monetary rewards as an incentive – they offered 5000 Euros for the winning solution. As compared to that, Dell and IBM use non-monetary rewards such as badges, scores of special acknowledgements. Hence, the decision power with respect to participation is upon the crowdsourcees. However, the decision power with respect to submitted contributions is upon crowdsources as they decide whether a solution is accepted or not. For instance, Clickworker reports examples where the submitted solutions did not meet the previously defined solution requirements. Hence, these solutions were either not remunerated by the crowdsourcer or the crowdsourcees had to rework their solutions.

5.3 Task Specification

From TCT's perspective, uncertainties lead to transaction costs. Therefore, firms try to reduce uncertainties by specifying to their counterparts what actions to take by means of contracting and property – i.e., *task specification*. Both traditional governance mechanisms – firm-based hierarchies or market-based exchanges – depend on clear property rights and contracting to control resources and outputs (Benkler 2002).

However, CBPPM is free from property rights arrangements and contracts with contributors are not concluded. Benkler (2002) argues that, within CBPPM, the coordination of the production is not based upon contracts; instead, the work of the contributors is coordinated by structural elements of the tasks – i.e., modularity as well as granularity of tasks, and the cost of integration. These elements partly characterize task processing within crowdsourcing.

Modularity rests upon the basic principles of cohesion and loose coupling (Balzert 1996). It refers to possibilities of dividing objects into smaller, fine-grained modules that can be produced independently. The importance of modularity in the context of crowdsourcing is obvious. It guarantees the decomposition of projects into tasks that fulfill two main requirements: first, they can be performed independently and do not require other modular tasks to be involved and second, they are manageable by only one individual in terms of size. Further, modularity enables crowdsourcees to also work simultaneously on a project, while at the same time keeping coordination costs low (Osterloh and Rota 2007). The size mentioned here is closely related to the second structural attribute: granularity. The tasks resulting from modularization need to be at granularity levels that match the crowdsourcees' capabilities (Benkler 2002). These capabilities can be limited by factors such as the crowdsourcees availability, motivation or proficiency. The better the granularity reflects the heterogeneous crowdsourcees, the higher is the probability of adequately fulfilled tasks and the overall success of the project (or production). This is because heterogeneous granularity will allow people with different levels of motivation to contribute to larger or smaller modules, consistent with their level of motivation (Benkler and Nissenbaum 2006). The right level of granularity also facilitates the allocation of tasks since requirements for small tasks can be more easily defined and appropriate crowdsourcees identified that qualify as the needed specialist.

The third CBPPM principle for task characteristics, integration, can be considered the latter part from a lifecycle's perspective. While modularity and granularity are essential for the decomposition of a project into tasks that can be independently performed by an individual (crowdsourcee), it is integration which takes the pieces of the puzzle, i.e. the modular tasks, to make the big picture, i.e. the overall project. It must be able to merge and aggregate the produced solutions for the subtasks into a single and coherent solution for a larger problem. The integration thereby includes quality control as well as the ability to incorporate the modules into the finished project (Benkler 2002). Thus first, the quality of the submitted solutions from the

crowd must be controllable. In this context, the controlling entity must be able to determine if the previously defined outcomes are realized.

From a crowdsourcing perspective, the integration part is located on the crowdsourcer's side. Critical to subdividing knowledge tasks and merging the corresponding solutions is to understand the dependencies amongst the crowdsourced tasks. Thus, crowdsourcing must include a mechanism for integrating the competent modules into a finished product; however, the mechanisms must assure a sufficiently low cost integration (Benkler and Nissenbaum 2006). Benkler and Nissembaum (2006) propose automated integration (a software program defines the modules and integrates these back together) or iterative peer production of integration (i.e., the crowd is engaged in assembling the modules).

However, crowdsourcing does not always rely on these two features. The analyzed cases show that also non-modular and complex tasks are crowdsourced. Here, crowdsourcers tend to provide clear definitions of the tasks and the corresponding solution requirements. Thus, when tasks are not modular or in case it is too costly to break down complex tasks into fine-grained sub-tasks, crowdsourcers are obligated to provide understandable specifications – i.e., *definition of tasks and solution requirements*. The cases stress that the better the tasks and the solution requirements are defined the more valuable the submitted solutions. For instance, there are many cases on HealthTap, where crowdsourcers post an imprecise demand (e.g., "I continuously have headache. What should I do?"), and do not receive satisfactory answers. This seems logical since the crowd (i.e., doctors) is not able to provide precise answers to such questions. As compared to that, the solutions for broadcasted demands where the task is clearly specified – in terms of clear descriptions of physical complaints (e.g., body region, frequency, intensity, and duration of the pain) – are much more elaborated.

Considering all three structural attributes of tasks, namely modularity, granularity, and clear definition, it can be stated that they reflect all major activities that are crucial for the successful execution of crowdsourcing initiatives. From TCT's perspective, precise task specifications by means of clear definitions, or by means of subdividing tasks into small bits of work and controlling the integration, lowers transaction costs due to two reasons: First, the defined (sub-)tasks are of low 'specificity' and thus, the 'frequency' of solver-seeker-interaction is low. Second, 'uncertainty' is reduced to some extent as the crowdsourcing firm has mechanisms to control the quality of the contribution.

Thus, the specification of tasks within crowdsourcing reinforces the character of crowdsourcing as a production mode settled between market and hierarchy: outsourcing the act of modularizing and integrating tasks to the crowd would cause high transaction costs and require intense knowledge exchange. Hence, these activities are performed by hierarchy, whereas the crowd is required to provide solutions for the sub-tasks. Outsourcing small bits of work averts the risk of opportunistic behavior by crowdsourcees and keeps the effort for knowledge exchange low. Low transaction costs and little effort in knowledge transfer are, however, only enabled by the use of the Internet whereby crowdsourcers can connect with crowdsourcees.

5.4 IT-based Platform for Coordination and Task Processing

CBPPM is facilitated and only made possible by the technical infrastructure of the Internet. The tasks as well as the corresponding solutions have to be digitalized so that they can be conveyed between the coordination body and the contributors (Benkler 2006; Hilgers, Müller-Seits et al. 2010). This is achieved by means of an online platform. Similar to CBPPM, crowdsourcing depends on *IT-based platforms* as well. The crowdsourcing platform is the "place" where crowdsourcers and crowdsourcees come together and, accordingly, where all interactions between the crowdsourcer and the crowdsourcees occur (Vukovic 2009). It is thus the cardinal feature of any crowdsourcing endeavor: All core activities – i.e., the open call, the subsequent self-selection of contributors, and the specification of tasks – are performed using the IT-based platform. From a crowdsourcer's perspective, the entire crowdsourcing process is managed via the web-based platform – starting with the open call and ending with the transmission of final solutions by the crowdsourcees. It provides crowdsourcers the possibility to broadcast a task with the corresponding solution requirements. The crowdsourcees can then see the task and self-select whether they contribute to the offered tasks. When the tasks are completed, contributors have to upload or post the solutions on the platform.

From KBT's view, the platform provides crowdsourcers access to a large pool of knowledge. More importantly, little effort is necessary to interact with the great amount of knowledge holders. The online platform provides crowdsourcers the possibility to coordinate the knowledge transfer during the production: Information to the tasks as well as solution requirements are managed by the crowdsourcers, whereas direct communication to potential solvers is also possible via discussion forum on the platform (Jeppesen and Frederiksen 2006; West and Lakhani 2008). Regardless of

crowdsourcees' locations, the crowdsourcing process is coordinated by the crowdsourcer via the IT-based crowdsourcing platform. Table 3 illustrates the four basic principles.

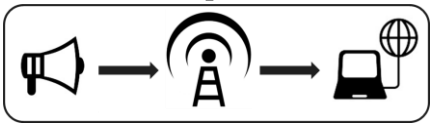
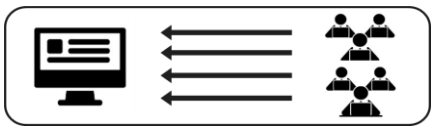
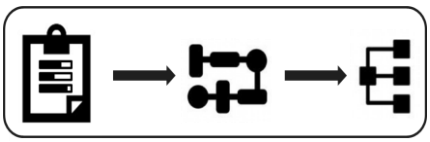
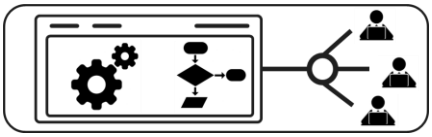
Principle	Description
(1) Broadcasting of Tasks via Open Call 	• Ask for contributions by means of an open call and by using IT • Circumvention of the local search bias enabled by IT • Potentially find distant solvers with best solutions, lowest prices, or highest motivation • Efficient assignment of human capital to the underlying tasks
(2) Self-selection of Contributors 	• Individuals self-select whether they contribute to specific tasks, and how much effort they put into that • Actions of the individuals are not directly coordinated by hierarchy • Contributors' motivations are a core mechanism for controlling the participation and actions
(3) Specification of Tasks 	• Clear definition of tasks by means of descriptions and/or decomposition • Description: ➢ Definition of tasks and solution requirements • Decomposition: ➢ Modularity: Division of tasks into smaller, fine-grained modules that can be produced independently. ➢ Granularity: Granularity levels (size of the modules) should match contributors' capabilities. ➢ Integration: Incorporation of modules into the finished solution.
(4) IT-platform for Coordination and Collaboration 	• Crowdsourcing made possible by the technical infrastructure of the Internet • Management of all crowdsourcing-related processes by means of the IT platform: ➢ Broadcasting of tasks via open call ➢ Arrangement of incentives ➢ Workflow management ➢ Task allocation and task specification ➢ Transmission and control of final solutions

Table 3: **Basic Principles of Crowdsourcing**
Source: Own presentation

6 Discussion, Implications and Future Research Directions

Throughout the years, academic literature has shown that this issue determines, and has various implications on, all organizational processes. Although various potentials are associated with outsourcing, basic economic (TCT) and strategic management (KBT) theories particularly outline the inherent pitfalls of outsourcing and thereby justify the cohesion, respectively the existence, of organizations. However, with the rise of communication technologies, the disadvantages are reduced as these technologies enable to lower the costs for transactions and knowledge transfer. Consequently, new production models emerge, with crowdsourcing as one interesting development. Crowdsourcing initiatives are considerably growing in quantity and scope and can be considered to be on the verge of changing the way how value creation and organizational coordination takes place as we know it from today's business. The example of IBM's Liquid Program stresses this issue on a conspicuous manner as it shows how IBM shifts the actual production to the crowd. For numerous tasks, IBM project managers in hierarchy do not have to face the crucial question of outsourcing projects *or* accomplishing them internally. Instead, they can decide to outsource specific tasks to the crowd *and* retain control of task processing at the same time. This is due to the character of crowdsourcing as a governance mechanism settled between hierarchy and market. Consequently, the need for all involved stakeholders to understand crowdsourcing at its core and with its underlying principles becomes obvious.

One could argue that the differences between the mode of outsourcing and that of crowdsourcing are marginal, or that crowdsourcing has been around for a long time. Either proposition might apply. For instance, Afuah and Tucci (2012) present the striking example of Sheriffs in Wild West movies who crowdsourced elements of crime solving by posting "Most Wanted" pictures in public places to highlight that crowdsourcing is not a completely new phenomenon. However, only the Internet as an immersive and multimedia-rich technology with low costs of mass communication and knowledge exchange has enabled to leverage the potentials of crowdsourcing as a mode of production. Seekers can reach potentially more (and eventually more appropriate) solvers by an open call through the Internet. In this connection, broadcasting an open call (enabled by the Internet) constitutes one of the core principles of crowdsourcing. It helps circumvent the local search bias and leads to two primary advantages from a purely economic view, these are: increased information

gain (in terms of knowledge from more resources) and variability (diverse knowledge) with relatively low transaction costs (Benkler and Nissenbaum 2006).

Using the CBPPM as a theoretical framework, this paper stresses the core principles of crowdsourcing, which – in turn – entail various implications on different levels. Subsequently, I discuss these implications and outline future research perspectives based on the main challenge identified by means of the multiple case analysis: the governance of the work processes on crowdsourcing platforms. Just as Benkler and Nissenbaum (2006), or Doan et al. (2011), this study emphasizes the importance of the crowdsourcing platform as the main infrastructure for all crowdsourcing projects. Just as in other open development ventures, its "purpose is far beyond organizing technical communication and exchange of information" (Hilgers et al. 2010). It is rather the main tool for steering, coordinating and controlling the distributed work of the crowd. All outlined principles are enabled by means of the platform. Yet research has not provided insights on how to effectively govern crowdsourcing initiatives on crowdsourcing platforms. Research on the effective governance of crowdsourcing endeavors must address the following challenges that were discernible throughout the different cases: appropriate definition of broadcasted tasks, motivation of crowdsourcees, selection of suitable crowdsourcees, screening and selection of appropriate solutions, control of behavior, and governance of work processes.

Appropriate definition of tasks: Firms can use outsourcing vendors for entire projects, whereas a crowd can presumably not be used for greater work packages without any specification. Hence, projects have to be either precisely defined, or separated into smaller bits of tasks, so that contributors are able to accomplish. Existing research shows that tasks need to be clearly defined for successful crowdsourcing projects (Blohm, Leimeister et al. 2013). However, we do not know “how precisely” tasks should be defined. Some authors suggest that a clear task description is sufficient (Vukovic 2009) – however, what are appropriate description criteria? And for which kinds of tasks is a description sufficient? Again, other authors argue that tasks have to be divided into very small units (micro tasks) (Kittur, Chi et al. 2008; Kittur, Nickerson et al. 2013). With respect to these rather opposing opinions, future research should outline which method is more suitable when considering different kinds of tasks, types, and architectures of crowdsourcing projects. On the other hand, there are various open questions with respect to the modularization of crowdsourcing tasks: What kind of tasks can be modularized and how can modularization be accomplished in these cases? These questions might be tackled by reviewing established methods on

modularization – especially within software development (Narduzzo and Rossi 2003) as well as manufacturing and service sciences (Ulrich 1995; Böhmann and Krcmar 2006) with respect to crowdsourcing. Some promising approaches with respect to so called micro tasks have already been examined within the realm of human computing (e.g., Kittur, Chi et al. 2008; Little, Chilton et al. 2010; Bernstein, Klein et al. 2012). Further, the size of the different modules is an important factor upon which the success of a crowdsourcing initiative depends on. Hence, future research might examine the correlation between the granularity and the performance of crowdsourcing initiatives. In this connection, it is also relevant to determine if the size of the modules is related to loss of knowledge. Since larger modules contain more information they might reveal crucial knowledge to competitors.

Motivation of crowdsourcees: Practice shows that various companies have problems in generating a large and diverse crowd. This may, for instance, be due to inappropriate incentive mechanisms or an insufficient implementation of crowdsourcing. Thus, further research might lay emphasis on effective incentive mechanism. These have been examined within OSS development (see e.g., Hars and Ou 2002; Lakhani and Wolf 2005); however, research on effective incentive mechanism for crowdsourcing initiatives still is scarce. Research on how to optimize broadcasting of crowdsourcing initiatives could be addressed by future research as well.

Selection of suitable crowdsourcees: While outsourcing requires firm to put effort in finding and screening potential outsourcing vendors, the open call of a crowdsourcing initiative enables potential contributors to self-identify for tasks that attract them and for which they are suited. Nevertheless, for some tasks, firms have need of contributors with specific characteristics. To identify crowdsourcees with required qualifications is, however, very costly. Therefore, future research should examine approaches focusing on the identification of measures that ease the search for suitable solvers.

Screening and selection of appropriate solutions: In crowdsourcing projects with a large number of contributors, crowdsourcers accordingly receive numerous solutions – sometimes contributors submit more than one solution. Hence, crowdsourcers need insights on mechanisms for screening and selecting the best results. The second issue has been research in several contexts (e.g., open innovation). However, appropriate screening – or rather – quality assurance mechanisms have not been ascertained yet in the context of crowdsourcing. The open research question here is: How can results of

(complex) crowdsourcing projects be systematically evaluated? Research should investigate on methods and procedures on how to assure the quality of different kinds of solutions (i.e., for fine-grained sub-tasks as well as for complex non-granular tasks).

Control of behavior: Our cases stress that crowdsourcees can misbehave and disturb crowdsourcing initiatives by different means. For instance, some crowdsourcees disturb communications between crowdsourcees on the crowdsourcing platform. Others spread information online, even though the corresponding crowdsourcing initiative was supposed to be kept secret. Thus, measures on how to control crowdsourcees behavior, or how to prevent misbehavior, should be explored by upcoming research endeavors.

Governance of work processes: Future studies should also provide a better understanding of different activities and mechanisms that determine crowdsourcing processes. Existing studies are, to some extent, useful as they provide rough insights into the different phases of crowdsourcing projects. However, research lacks insight with respect to a number of additional mechanisms that support the different activities within the phases. The question here is: What are the concrete phases of a crowdsourcing project and what issues and activities have to be considered in each phase? Finally, all these procedures have to be coupled with the IT-based crowdsourcing platform as it serves as a mechanism for coordinating the whole crowdsourcing process.

In view of the above, this paper stresses different mechanisms of crowdsourcing that need to be further examined with respect to their relation and effect on the success of crowdsourcing initiatives. Firms implement crowdsourcing due to its advantages in terms of increased information gain and access to a large pool of resources. For instance, IBM communicated that the Liquid Program promises competitiveness by lowering personnel costs and granting worldwide access to temporary talent. However, crowdsourcing can also be related to various pitfalls, such as loss of knowledge, high cost investments for implementation, and so on. I therefore suggest future research approaches to examine approaches for the effective governance of crowdsourcing endeavors. However, due to the fact that traditional theoretical approaches fall short in appropriately explain crowdsourcing, I recommend future research approaches to consider this circumstance and approach crowdsourcing as a rather innovative form of production and value creation.

7 Conclusion

Crowdsourcing has gained much attention in practice over the last years. Numerous companies have drawn on this concept for performing different tasks and value creation activities. Nevertheless, despite its popularity, there is still comparatively little well-founded knowledge on crowdsourcing, particularly with regard to its basic mechanisms and theoretical foundations. The wide-ranging use of crowdsourcing for various tasks in practice states reasons for considering this concept not just as an alternative way of performing single tasks, but rather as an innovative form of value creation. This consideration implies that crowdsourcing evokes new forms of coordination and communication within a company. However, hitherto, research does not provide sufficient insights regarding the core mechanisms of crowdsourcing. Consequently, the need for all involved stakeholders to understand crowdsourcing at its core and with its underlying principles becomes obvious. On this basis, this conceptual paper based on an analysis of multiple crowdsourcing cases aims at shedding light on the basic principles and theoretical foundations of crowdsourcing.

First, by outlining how crowdsourcing is currently explained from the theoretical perspective by using Transaction Cost Theory and Knowledge-Based View (both incorporate typical market versus hierarchy considerations), the paper concludes that neither one of these theoretical approaches can sufficiently explain the concept of crowdsourcing. From TCT's perspective, firms would not decide to crowdsource tasks due to the high transaction costs that arise from high specificity, frequency and uncertainty. Similarly, considering KBT, firms would avoid using crowdsourcing since high effort is needed to interchange, respectively exchange knowledge, with the crowdsourcees.

I then approach crowdsourcing in the lens of Benkler's Commons-Based Peer Production Model which explains the motivation and coordination mechanisms behind collective online production purposes. Thereby I am able to outline the core mechanisms of crowdsourcing, namely: broadcasting of tasks via an open call, voluntarism and self-selection of contributors, task specification, and the IT-platform for coordination and collaboration. Broadcasting evokes the possibility to circumvent the local search bias and to thereby access a large pool of human resources. More importantly, crowdsourcees' opportunity of self-selection for tasks stresses the character of crowdsourcing a production mode settled between market and hierarchy. The specification of tasks reflects a crucial for the successful execution of

crowdsourcing initiatives. In this connection, methods and mechanisms are required for either clearly defining the tasks or for subdividing larger work packages into small bits of work (i.e., making them fine-grained) and integrating them back into a final solution. Further on, this paper lays emphasis on the IT-based crowdsourcing platform that constitutes the main tool by means of which firms coordinate and control task processing by crowdsourcees: the requirements for solutions, the number contributors as well as the evaluation of submission are all determined and controlled via the crowdsourcing platform.

In summary, building on the CBPPM, I was able to outline the core mechanisms of crowdsourcing and justify its position as a form of production settled between hierarchy and market. This perspective provides insights into the economic benefits of voluntary participation by numerous contributors – i.e., a crowd. Consequently, this paper draws various implications and discusses the argumentation of the underlying paper. In this connection, I outline further research implications as I suggest that the presented mechanisms are largely unexplored. Despite some first promising research approaches with respect to crowdsourcing, still, further research on each level – i.e., broadcasting of tasks, self-identification based on motivations, specification of tasks, and crowdsourcing platform – is needed.

Afuah, A. and C. L. Tucci (2012). "Crowdsourcing as a solution to distant search." Academy of Management Review **37**(3): 355-375.

Alter, C. and J. Hage (1993). Organizations Working Together. London, Sage Publications.

Apte, U. M. (1990). "Global Outsourcing of Information Systems and Processing Services." The Information Society **7**(4): 287-303.

Arrow, K. J. (1962). Economic welfare and the allocation of resources for invention. he Rate and Direction of Inventive Activity: Economic and Social Factors. N. B. o. E. Research. Princeton, NJ, Princeton University Press**:** 609-625.

Balzert, H. (1996). Lehrbuch der Software-Technik. Heidelberg, Berlin, Oxford, Spektrum, Akadamischer Verlag.

Barney, J. B. (1991). "Firm resources and sustained competitive advantage." Journal of Management **17**(1): 99-120.

Bauwens, M. (2009). "Class and capital in peer production." Capital and Class **33**: 121-141.

Benkler, Y. (2002). "Coase's Penguin, or, Linux and the Nature of the Firm." The Yale Law Journal **112**(3): 369-446.

Benkler, Y. (2006). The Wealth of Networks. How Social Production Transforms Markets and Freedom. New Haven, Connecticut, Yale University Press.

Benkler, Y. and H. Nissenbaum (2006). "Commons-based Peer Production and Virtue." Journal of Political Philosophy **14**(4): 394-419.

Bernstein, A., M. Klein and T. Malone (2012). "Programming the Global Brain." Communications of the ACM **55**(5): 41-43.

Bjelland, O. M. and R. C. Wood (2008). "An Inside View of IBM's Innovation Jam." MIT Sloan Manag Rev **50**(1): 31-40.

Blohm, I., J. M. Leimeister and H. Krcmar (2013). "Crowdsourcing: How to Benefit from (Too) Many Great Ideas." MIS Quarterly Executive **12**(4): 199-211.

Bogers, M. (2012). Knowledge Sharing in Open Innovation: An Overview of Theoretical Perspectives on Collaborative Innovation. Open Innovation at Firms and Public Adminitrations: technologies for Value Creation. C. De Pablos Heredero and D. López. Hershey, PA, IGI Global**:** 1-14.

Böhmann, T. and H. Krcmar (2006). Modulare Servicearchitekturen. Service Engineering. H.-J. Bullinger and A.-W. Scheer. Berlin, Heidelberg, Germany, Springer**:** 377-401.

Brabham, D. C. (2008). "Crowdsourcing as a Model for Problem Solving. An Introduction and Cases." Convergence: The International Journal of Research into New Media Technologies **14**(1): 75-90.

Brabham, D. C. (2012). Crowdsourcing: A model for leveraging online communities. The Routledge Handbook of Participatory Culture. A. Delwiche and J. Henderson. London, England**:** 120-129.

Bullinger, A. C., A. K. Neyer, M. Rass and K. M. Möslein (2010). "Community-based innovation contests: where competition meets cooperation." Creativity and Innovation Management **19**(3): 290–303.

Burger-Helmchen, T. and J. Penin (2010). The limits of crowdsourcing inventive activities: What do transaction cost theory and the evolutionary theories of the firm teach us? Workshop on Open Source Innovation. Strasbourg, France.

Cheon, M. J., V. Grover and J. T. C. Teng (1995). "Theoretical perspectives on the outsourcing of information systems." Journal of Information Technology **10**(4): 209-219.

Chesbrough, H. W. (2006). Open Innovation. The New Imperative for Creating and Profiting from Technology. Boston, MA.

Coase, R. H. (1937). "The Nature of the Firm." Economica **4**: 386-405.

Cowan, R., P. A. David and D. Foray (2000). "The explicit economics of knowledge codification and tacitness." Industrial and Corporate Change **9**(2): 211–253.

Crook, R. T., J. G. Combs, D. J. Ketchen and H. Aguinis (2012). "Organizing around transaction costs: What have we learned and where do we go from here?" Academy of Management Perspectives (published online before print).

Dubé, L. and G. Paré (2003). "Rigor in Information Systems Positivist Case Research: Current Practices, Trends, and Recommendations." MIS Quarterly **27**(4): 597-636.

Ernst, H. (2002). "Success Factors of New Product Development: A Review of the Empirical Literature." Intern J Manag Rev **4**(1): 1-40.

Estellés-Arolas, E. and F. González-Ladrón-de-Guevara (2012). "Towards an integrated crowdsourcing definition." Journal of Information Science **38**(2): 189-200.

Feller, J., P. Finnegan, B. Fitzgerald and J. Hayes (2008). "A Study of Socially Enabled Business Exchanges in Open Source Service Networks." Information Systems Research **19**(4): 475-493.

Franke, N. and F. Piller (2004). "Value Creation by Toolkits for User Innovation and Design: The Case of the Watch Market." J Prod Innov Manag **21**: 401–415.

Füller, J., K. Hutter and R. Faullant (2011). "Why co-creation experience matters? Creative experience and its impact on the quantity and quality of creative contributions." R&D Manag **41**(3): 259-273.

Füller, J. and K. Matzler (2007). "Virtual product experience and customer participation - A chance for customer-centred, really new products." Technovation **27**(6-7): 378-387.

Gassmann, O. and E. Enkel (2004). Towards a Theory of Open Innovation: Three Core Process Archetypes. R&D Manag Conf (RADMA). Lissabon, Portugal.

Geiger, D., S. Seedorf, T. Schulze, R. Nickerson and M. Schader (2011). Managing the Crowd: Towards a Taxonomy of Crowdsourcing Processes. AMCIS 2011. Detroit, Michigan.

Goles, T. (2001). The impact of the client-vendor relationship on information systems outsourcing success. Doctoral Thesis, University of Houston.

Hars, A. and S. Ou (2002). "Working for free? Motivations for participating in open-source projects." International Journal of Electronic Commerce **6**(3): 25-39.

Haythornthwaite, C. (2009). Proceedings of the 42nd Hawaii International Conference on System Sciences. Proceedings of the 42nd Hawaii International Conference on System Sciences. Maui, Hawaii.

Heide, J. B. and G. John (1990). "Alliances in Industrial Purchasing: The Determinants of Joint Action in Buyer-Supplier Relationships." Journal of Marketing Research **27**(1): 24-36.

Hilgers, D., G. Müller-Seits and F. T. Piller (2010). Benkler Revisted - Venturing Beyond the Open Source Software Development. International Conference on Information Systems (ICIS). St. Louis, Missouri.

Howe, J. (2006). "The Rise of Crowdsourcing." Wired Magazine **14**(6): 1-4.

Howe, J. (2010) "Crowdsourcing. Why the Power of the Crowd is Driving the Future of Business."

Jain, R. (2010). Investigation of Governance Mechanisms for Crowdsourcing Initiatives. AMCIS 2010. Lima, Peru.

Jeppesen, L. B. and L. Frederiksen (2006). "Why Do Users Contribute to Firm-Hosted User Communities? The Case of Computer-Controlled Music Instruments." Organization Science **17**(1): 45-63.

Jeppesen, L. B. and K. R. Lakhani (2010). "Marginality and Problem-Solving Effectiveness in Broadcast Search." Organization Science **21**(5): 1016-1033.

Kern, T. and L. P. Willcocks (2000). "Exploring information technology outsourcing relationships: theory and practice." The Journal of Strategic Information Systems **9**(4): 321-350.

Kittur, A., E. H. Chi and B. Suh (2008). Crowdsourcing user studies with Mechanical Turk. 26th SIGCHI.

Kittur, A., E. H. Chi and B. Suh (2008). "Crowdsourcing User Studies with Mechanical Turk." CHI '08 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems **453-456**.

Kittur, A., J. V. Nickerson, et al. (2013). The Future of Crowd Work. Proceedings of the 2013 CSCW. San Antonio, USA.

Kogut, B. and U. Zander (1992). "Knowledge of the firm, combinative capabilities, and the replication of technology." Organization Science **3**(3): 383-397.

Lacity, M. C. and R. A. Hirschheim (1993). Information Systems Outsourcing - Myths, Metaphors and Realities. New York, John Wiley & Sons.

Lakhani, K. R. and B. Wolf (2005). Why Hackers Do What They Do. Understanding Motivation and Effort in Free/Open Source Software Projects. Perspectives on Free and Open Source Software. J. Feller, B. Fitzgerald, S. Hissam and K. R. Lakhani. Cambridge, MA, The MIT Press.

Lee, J. N. (2001). "The Impact of Knowledge Sharing, Organizational Capability and Partnership Quality on IS Outsourcing Success." Information & Management **38**(5): 323-335.

Leimeister, J. M., M. Huber, U. Bretschneider and H. Krcmar (2009). "Leveraging Crowdsourcing: Activation-Supporting Components for IT-Based Ideas Competition." Journal of Management Information Systems **26**(1): 197–224.

Leimeister, S. (2010). IT Outsourcing Governance: Client Types and Their Management Strategies. Wiesbaden, Gabler.

Little, G., L. Chilton, M. Goldman and R. Miller (2010). Turkit: human computation algorithms on mechanical turk. Proceedings of the 23nd annual ACM symposium on User interface software and technology**:** 57-66.

Malone, T., R. Laubacher and T. Johns (2011). "The Big Idea: The Age of Hyperspecialization." Harvard Business Review **July 2011**.

Meredith, J. (1998). "Building operations management theory through case and field research." Journal of Operation Management **16**(4): 441–454.

Meyer, N. D. (1994). "A sensible approach to outsourcing: the economic fundamentals." Information Systems Management **11**(4): 22-27.

Milson, R. and A. Krowne (2005). Adapting CBPP Platforms for Instructional Use. Free Culture and the Digital Library Symposium Proceedings, Atlanta, Georgia.

Narduzzo, A. and A. Rossi (2003). "Modularity in Action: GNU/Linux and Free/Open Source Software Development Model Unleashed." http://opensource.mit.edu/papers/narduzzorossi.pdf.

Nickerson, J. A. and T. R. Zenger (2004). "A Knowledge-Based Theory of the Firm: The Problem-Solving Perspective." Organization Science **15**(6): 617-632.

Nonaka, I. (1994). "A dynamic theory of organizational knowledge creation." Organization Science **5**: 14–37.

Oliveira, F., I. Ramos and L. Santos (2010). Definition of a crowdsourcing Innovation Service for the European SMEs. Current Trends in Web Engineering. F. Daniel and F. M. Facca. Heidelberg.

Osterloh, M. and S. Rota (2007). "Open source software development—Just another case of collective invention?" Research Policy **36**: 157-171.

Pénin, J. (2008). More open than open innovation? Rethinking the concept of openness in innovation studies. DT BETA. Strasbourg, France.

Penrose, E. (1959). The Theory of the Growth of the Firm. Oxford, Blackwell.

Poppo, L. and T. Zenger (1998). "Testing alternative theories of the firm: Transaction cost, knowledge-based, and measurement explanations for make-or-buy decisions in infomation services." Strategic Management Journal **19**: 853–877.

Reichwald, R. and F. Piller (2009). Interaktive Wertschöpfung: Open Innovation, Individualisierung und neue Formen der Arbeitsteilung. Wiesbaden.

Ring, P. S. and A. Van de Ven (1994). "Developmental Processes of cooperative interorganizational relationships." Academy of Management Review **19**(1): 90-118.

Rouse, A. C. (2010). A Preliminary Taxonomy of Crowdsourcing. Australian Conf Inform Sys (ACIS), 1-3 Dec 2010, Brisbane.

Schenk, E. and C. Guittard (2011). "Towards a characterization of crowdsourcing practices." Journal of Innovation Economics **7**(1): 93-107.

Spender, J. C. and R. M. Grant (1996). "Knowledge and the Firm: Overview." Strategic Management Journal **17**(2): 5-9.

Teng, J., M. Cheon and V. Grover (1995). "Decisions to outsource information systems functions: Testing a strategy-theoretic-discrepancy model." Decision Sciences **26**(1): 75-103.

Ulrich, K. (1995). "The role of product architecture in the manufacturing firm." Research Policy **24**(3): 419-440.

Vukovic, M. (2009). Crowdsourcing for Enterprises. World Conference on Services - I. Los Angelos, CA**:** 686-692.

Vukovic, M. and C. Bartolini (2008). Towards a Research Agenda for Enterprise crowdsourcing. Leveraging Applications of Formal Methods, Verification, and Validation. M. Tiziana and S. Bernhard. Porto Sani, Greece**:** 425-434.

Walmsley, A. (2009). "The art of delegation." Marketing: 12-12 (11 page).

Wernerfelt, B. (1984). "A resource-based view of the firm." Strategic Management Journal **5**(2): 171–180.

West, J. and K. Lakhani (2008). "Getting Clear About Communities in Open Innovation." Industry innovation **15**(2): 223-231.

Williamson, O. E. (1975). Markets and Hierarchies, Analysis and Antitrust Implications: A Study in the Economics of Internal Organization. New York, The Free Press.

Williamson, O. E. (1981). "The Economics of Organization: The Transaction Cost Approach." American Journal of Sociology **87**(3): 548-577.

Williamson, O. E. (1985). The Economic Institutions of Capitalism: Firms, Markets, and Relational Contracting. New York, London 1985, Free Press, Collier Macmillan.

Yin, R. K. (2009). Case Study Research: Design and Methods. Thousand Oaks, SAGE.

Yuen, M.-C., I. King and K.-S. Leung (2011). A Survey of Crowdsourcing Systems. 2011 IEEE Int Conf on Privacy, Security, Risk, and Trust. Boston, MA, USA.