New Forms of Collaborative Innovation and Production on the Internet
An Interdisciplinary Perspective

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The Internet has enabled new forms of large-scale collaboration. Voluntary contributions by large numbers of users and co-producers lead to new forms of production and innovation, as seen in Wikipedia, open source software development, in social networks or on user-generated content platforms as well as in many firm-driven Web 2.0 services. Large-scale collaboration on the Internet is an intriguing phenomenon for scholarly debate because it challenges well established insights into the governance of economic action, the sources of innovation, the possibilities of collective action and the social, legal and technical preconditions for successful collaboration. Although contributions to the debate from various disciplines and fine-grained empirical studies already exist, there still is a lack of an interdisciplinary approach.

Contents

1

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Large-scale collaboration on the Internet: The intriguing phenomenon

Enabled by Internet and Web 2.0 technologies, a growing number of products and services are being developed with large numbers of autonomous actors participating in the production process. The participating actors, many of whom are themselves users of the products they co-produce, make their contributions voluntarily, without contract or salary, and are free to decide which tasks to undertake. The organization of co-production is highly decentralized and collaboration is undertaken on a large scale. Although the contributors are autonomous and their activities are decentralized, they produce complex, sophisticated and competitive products and services, employing an elaborate division of labor in a highly efficient process. Many scholars take these phenomena as evidence for the emergence of new forms of production and innovation (Chesbrough, Vanhaverbeke and West 2006, von Hippel 2005, Tapscott 2006, Benkler 2002 and 2006, Weber 2004). The key distinguishing feature of these new forms of production and innovation is the governance mechanism that coordinates the contributions of numerous actors. Collaboration among co-producers is coordinated neither by markets nor by hierarchies. Evidently, the governance of collaborative production and innovation does not

follow traditional mechanisms of market exchange. Contributions are made without recompense, and goods and services produced in joint efforts are freely accessible as public goods on the Internet (Bessen 2005). Nor does the way in which actors organize their contributions correspond to the hierarchical, planned production and assignment of tasks within firms.

The earliest, best-known and most studied examples of these new forms of production are open source software development and Wikipedia. Today, however, there is a much broader spectrum of collaboratively developed products and services. The wide variety of cases of collaborative production includes products and services such as YouTube, Spreadshirt, Crytec, Lego factory and MyParfuem as well as Facebook and other social networks. A closer look reveals considerable differences between these cases of collaborative production, in particular with respect to the roles that firms play. Generally speaking, collaborative production works without the participation of firms, as in the pure cases of Wikipedia and many OSS projects, which are the predominant sources of evidence for new forms production and innovation. But collaborative production also works when firms are involved (Reichwald and Piller 2006). In these cases firm-driven production and innovation processes are open to contributions from external actors, although the degree of openness to external participation varies significantly. In some cases, such as YouTube, social networks and other media platforms, the content is created entirely by external actors, while firms provide the platform, infrastructure or services. In other cases, firms open only some tasks to external actors, who are often users of the same products. Such tasks typically include product feedback, tests, design, or product development and innovations. In such firm-driven forms of collaborative production the governance is hybrid: value creation by firms is coordinated by markets and/or hierarchies, while the collaboration of external actors who are not members of the firms is governed by these actors' online community (West, J. and S. O'Mahony 2008).

Empirical case studies of OSS and Wikipedia have shown how collaborative production with large numbers of actors can work (Gosh 2002, O'Mahony 2006, Weber 2004, Pentzold 2007, Scacchi 2006, Prasarnphanich and Wagner 2008). Explanations of basic cooperation patterns and governance mechanisms are offered by approaches such as "commons-based peer production" (Benkler 2002 and 2006) and "community-managed" governance e.g. of OSS projects (O'Mahony 2006, 2007), alongside more sociological explanations based on social network theories and the emergence of a specific social order of production communities (Gläser 2007, Stegbauer 2009 and chapter 6 in this volume).

However, it is not yet clear whether these explanations apply to other cases, in particular to those in which firms play an important or even dominant role. On the one hand, firms are eager to involve large numbers of external actors whose willingness to contribute is stimulated by their own intrinsic motives and the success of collective action. This is because firms are considering the advantages of inte-

grating external actors and customers, and the new business models of open innovation and customer co-creation (see also chapter 2 in this volume) are increasingly pushing firms to involve externals. On the other hand, production and business models of firms basically rely on hierarchical and market coordination. Therefore for firms, it is questionable whether it makes sense to adapt coordination mechanisms from the "pure" collaborative projects (i.e. Wikipedia and OSS). And if the adaptation seems advantageous, further questions arise about the impact on firm's business strategies and production models. How does the insertion of elements of collaborative production and innovation work, and how does it affect firm's established strategies and practices? The interpenetration of different forms of production is less understood than the "pure cases", although it is gaining importance.

In our introduction to this book, which is based on an interdisciplinary workshop in Göttingen in 2010, we aim to specify the challenges that collaborative production and innovation provide for the further interdisciplinary research. We will argue in three steps to emphasize the issues that we think are critical to understand the new phenomenon of large-scale collaboration and its varieties. We start with the less controversial issue and end up with the less analyzed and more controversial. The first question is about the motivation of actors. What motivates large numbers of autonomous actors to voluntarily contribute to the development of products and services, and is it possible to foster sustained motivation for external actors to voluntarily contribute to this development? It has received great attention in the scholarly debate, and a large body of literature exists. The second issue is about the governance of collaborative production. How can autonomous, highly decentralized activities of large numbers of actors be coordinated and integrated into the highly divided production of sophisticated products and services? The critical point here is that collaborative production is a new kind of collective action that is socially embedded in Internet communities. The specifics of this social embeddedness have received less attention in the debate. The third issue, finally, is about firm-driven collaborative models of production and innovation. The critical question here is how can collective action of autonomous actors be successfully combined with the value-creation activities of companies? This is a controversial issue in the current debate.

This is also reflected in the following chapters of this volume, four of which specifically address firm-driven collaborative production and innovation models. There is a wide range of examples in which collaborative production intertwines with company activities. Still, the relationship between the companies involved and the external actors and their community is rife with conflicts and demands, which is another point addressed in various chapters of this book. In the following three sections we will take a closer look at each of these three questions. In the final section of this introduction we give an overview of the subsequent chapters in the volume, where these questions are also referred to.

Why do autonomous actors participate in collaborative production and innovation?

New forms of collaborative production and innovation are based on voluntary and uncompensated participation of autonomous actors rather than on contracts. The specifics of participation differ fundamentally from the way employees participate in intra-firm production or innovation processes, even when the external actors take on tasks that previously had been handled by employees (Voss and Rieder 2005). Autonomous actors that contribute to collaborative production processes are outside companies' hierarchies, and they are not subject to their instructions or assignment of tasks, nor are they under any obligation to perform or provide a particular service. In fact it is assumed to be unlikely that they would voluntarily subject themselves to hierarchical controls or central coordination. Rather, the actors themselves choose what contribution to make, based on their own interests and intrinsic motives (Lakhani and Wolf 2005).

Contributions to collaborative production processes are not driven by market exchange either. Usually the products created from the voluntary contributions of external actors are public goods, available free of charge over the Web, rather than commodities. Contributions to the production of these products are not stimulated by financial rewards, neither by sharing of product sales, nor by direct payments for the underlying work or reciprocal contributions by others.

In new forms of collaborative production, in cases such as Wikipedia, open source software, YouTube, and social media, large numbers of actors are involved. Thus voluntary contributions here are not on a small scale, nor sporadic or exceptional, but on a very large scale, systematic, and with lasting returns. Moreover, they produce core components of highly knowledge-intensive products that originate in sophisticated, innovative and creative activities of professional quality. The fact that products compete successfully with products from leading commercial firms is emphasizing the high professional standard of the volunteers.

But who are these actors and why do they make voluntary contributions? As empirical studies show, motives include fun, gratification, self-fulfillment, an interest in the specific issue or activity, and the enhancement of knowledge and abilities (Ghosh and Glott 2002, Glott et. al. 2010, Lakhany and Wolf 2005, Bitzer, Schrettl and Schröder 2007). Such motives are most likely to be answered by creative, innovative and challenging activities; in other words, tasks with these characteristics are most likely to stimulate contributions of this kind. If the aim is to attract as many participants as possible and gain a large number of contributions, providing a wide selection of possible activities would be an advantage, especially as the interests and abilities of the contributors are quite heterogeneous.

Furthermore, as Benkler notes (Benkler 2006:8), it is the Internet that has enabled individuals to do more for and by themselves[1]. The means of production required for innovations and knowledge-based production processes (computers, Internet access, software) are widely available today. Many tasks that formerly required a lot of cost-intensive equipment – generally only available within companies – can now be carried out easily by individuals thanks to the Internet and inexpensive information technology. As a result, distributed production and extensive division of labor are no longer restricted to bureaucratic organizations.

In many cases, independent producers are simultaneously users of the products and vice versa. Open source software production is a typical and frequently cited example. Here, the initiators and main producers are generally developers who feel the need of a particular software product that does not yet exist, or to which they have no access (Raymond 1998, Weber 2004). They first develop an idea for a product, and then begin with the initial programming steps. If other developers find the idea useful, a project emerges and eventually leads to a software product that is available free of charge; one that specifically targets the need of the users, who are simultaneously the producers. Eric von Hippel has generalized this model of "user-centered" or "user-driven" innovation and production processes (von Hippel 2005). He argues that users' roles are unique because they "expect to benefit from using a product or service, while manufacturers, by contrast, expect to benefit from selling it" (von Hippel 2005:3). Users are thus to a certain extent the "better", more competent product developers because they know from their own experience exactly what features the product should have. Returning to our initial question as to why these external actors are voluntarily involved in production, in these cases the answer is: Because they want to use the products. Von Hippel expands this argument further by pointing out that mass products do not satisfy individual needs. Their manufacturers, he states, "tend to follow a strategy of developing products that are designed to meet the needs of a large market segment. But users' needs for products are highly heterogeneous in many fields" (von Hippel 2005: 5). That is why users often do not get exactly what they want and, according to von Hippel, why they are so willing to develop, modify or otherwise customize products for their own use. In this respect the active participation in the manufacture of products can be seen as rational, purposeful behavior on the part of these actors. According to this view, the incentive for participation is that users want a certain product that serves their individual needs, and their specific competence to make such contributions is based on their knowledge of the required

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[1] Benkler 2006, p 6: "The networked information economy improves the practical capacities of individuals along three dimensions: (1) it improves their capacity to do more for and by themselves; (2) it enhances their capacity to do more in loose commonality with others, without being constrained to organize their relationship through a price system or in traditional hierarchical models of social and economic organization; and (3) it improves the capacity of individuals to do more in formal organizations that operate outside the market sphere."

product features ("stickiness of need information;" this topic is dealt with in detail in chapter 2).

However, in all these cases co-producers work for the benefit of others. The products are for direct use (as opposed to production for the market), not only by the producers, but are also intended for the use of others. Unlike the typical "do-it-yourself" cases, these goods are produced and used by large numbers of people (Hanekop/ Wittke 2010). Just as single contributions to knowledge-intensive digital goods typically are not made toward one's own use, but for the use of others, the converse applies as well: Meeting one's own needs is at most only a partial incentive for contributing. Thus even when one wishes to use a particular product, the question of why one should contribute remains unanswered. In point of fact, in widely-observed projects such as open source software development or in Wikipedia it is evident that most users make only small contributions or none at all, while just a few users create large portions of the product (Hanekop/ Wittke 2008). Since individuals are making contributions for others without ensuring that they will gain any reciprocal benefit from corresponding contributions made by those others, rational benefit calculations apparently cannot satisfactorily explain the motive for action. Efficient collective action and steadily growing products seem to be necessary to stimulate these contributions. But how are these collective action problems solved? And how can the activities of so many autonomous actors be coordinated so that large-scale, sophisticated, competitive products are created? Production models that are based on voluntary contributions from autonomous actors must mobilize individual interests, and at the same time promote collective behaviors and enable coordination of highly divided work processes without hierarchical planning and control.

Collective action by large numbers of actors in highly distributed production

While the autonomous actors participating in the production of Wikipedia, the development of open source software, in user-generated media, or in social networks are pursuing their own interests, their actions are embedded in a process of collective action. Large numbers of contributors are successfully integrated in global, highly divided production and innovation processes. Weak ties and a broad base of participants facilitate highly efficient production and innovation processes. This new way of organizing production includes self-selected individual action as part of collective self-organization – this is what we call collaborative production. But what kinds of mechanisms are used to coordinate these activities? How are these activities embedded and governed by the community?

As a starting point for the discussion we would like to refer to Ostrom's influential work on "Governing the Commons" (Ostrom 1990). This reference can clarify similarities as well as differences of the way in which collective action prob-

lems are solved. Very much in line with Ostrom's argument, one could assume collaborative production as a form of collective self-organization. Ostrom's examples—the sustainable preservation of common pool resources—deal with a specific kind of collective self-organization and a specific way in which self-organization is enabled. Although common pool resources can be better managed through collective action, opportunistic behavior and free riding are common problems threatening the sustainability of these resources. In the communities studied by Ostrom, these problems are solved and the commons are governed by institutionalizing rules and norms for sustainable use of resources, to restrict individual overuse of the limited natural resources and define obligations for preserving and regenerating collective resources (Ostrom 1990). It is essential that the ensuing usage rights and obligations are to be accepted by and applied equally to all members. Collective self-organization is possible, as Ostrom argues, when rules for governance of the commons are institutionalized and collective self-control and sanctions ensure that these rules are followed. Mechanisms of social control are based on the fact that physical proximity, personal relationships and shared everyday experience make the behavior of community members transparent for the others, and thus controllable. Institutionalized rules can also curtail opportunistic behavior and free riding.

But collective action on the Internet also differs from collective action as studied by Ostrom. Ostrom analyzed natural common pool resources, where the main problem is to avoid overuse and to preserve the commons. By contrast, digital information products are non-rival goods. There is no problem of over-usage and no need to restrict the use of the (digital) products. The potential for use by those who actively participate in production is not reduced through use by non-contributors. Large groups of users are not a disadvantage with digital goods, but an advantage due to network effects.

However, the products or services must first be collectively produced before they can be used. Thus the collective action aims not at *governing the commons*, but at *producing the commons*. The collective action problem here is that people can use it without any contribution in reverse, but these public goods are not feasible without any producer.

In spite of the difference of the collective action problem, there are similarities in the way in which this problem can be solved by the social embeddedness of actors. As Ostrom argues, action necessary to preserve common pool resources is ensured by socially constituted rules and norms. New forms of collaborative production and innovation on the Internet, as has been argued frequently, rely on shared goals, norms and institutionalized rules of behavior, too. (Benkler 2002 and 2006, Gläser 2007, Pentzold 2010, Reagle 2010). These goals, norms and rules are accepted within the communities. Shared goals are mainly related to the product, its usefulness, design and functionality. A shared vision of the product (which Lepsius 1995 calls "Leitidee") stimulates people to invest time and collective effort. In

the case of open source software, the goal is to develop free and open software and in many cases to provide an alternative to Microsoft; or with Wikipedia, to create a free encyclopedia that makes the world's knowledge available to all.

Rules and guidelines for participation that correspond to the goals and behavioral norms of the community are defined and institutionalized within the collaborative processes. Such norms also include that behavior has to be fair and participants have to take care of each other. Furthermore, decision rules have to be meritocratic. Finally, the openness of products and contributions on web platforms makes the collaboration process transparent for everybody, enables self-coordination by the contributors and social self-control of adherence to those rules and norms by the community. Shared goals, norms and institutionalized rules can be seen as common principles of collective action in both cases – Ostrom's common pool resources as well as collaborative production on the Internet.

However, Internet communities are not of the same breed as communities governing the commons or embedding other forms of economic action (Granovetter 1985; Powell 1990; Hollingsworth/Boyer 1997). Traditionally, communities are based on long-term relationships of a comparatively small number of members with strong ties of relationship and personal trust. The emergence of common goals and the establishing of norms and rules are typically based on physical proximity that allows for co-presence of action and face-to-face interaction. Non-compliance with norms, rules and obligations is strictly sanctioned. Furthermore, conventional communities establish defined obligations and strong norms of reciprocity within the boundaries of a defined membership. Access to and use of collective goods is restricted to members of the community only.

In this, Internet communities differ basically from conventional communities (Brint 2001, Gläser 2007b). Here, short term or often one time contacts, weak ties, the absence of proximity, face-to-face co-presence and defined memberships with clear external boundaries are characteristic for collaborative production communities on the Internet. These are large, globally distributed communities without defined rights and obligations of members. Anyone can participate, but no-one is obligated to do so – contributions are indeed voluntary. Finally, social control is hard to imagine with large numbers of frequently changing actors. In such volatile, globally distributed Internet communities the production of the commons must operate without all these conventional means of social embeddedness.

The question therefore is, how producing the commons can be ensured. Benkler (Benkler 2006) and many others (e.g. Raymond 1999, von Hippel 2005, Weber 2004, Gläser 2007, Tapscott 2006, Pentzold 2007, Osterloh and Rota 2007) argue that the Internet offers radically new options for collective production and innovation. The economic effects of the digital "networked information economy" enable the spread of non-market production, a broad culture of "sharing" and the involvement of very large numbers of contributors (Benkler 2006:29, see also above). The Internet facilitates necessary collective action and makes it much easier

to produce common goods in a joint effort. New opportunities for collective action grow out of the fact that "the networked environment makes possible a new modality of organizing production: radically decentralized, collaborative, and non-proprietary; based on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other without relying on either market signals or managerial commands. This is what I call 'commons-based peer production'." (Benkler 2006:60). And a broad base of participants facilitate highly efficient production and innovation processes. Previous limitations on large-scale collective action are eliminated and the means of production (PC + Internet access) are widely available. Furthermore, the specifics of the products developed collaboratively on the Internet allow a very high and global division of tasks due to a very granular task structure, the aggregation of many small-scale contributions and easy-to-change product releases (Weber 2004, Raymond 1999).

The openness and transparency of the product is a central prerequisite for the ability of these actors to self-coordinate their actions. They integrate their contributions in a common product, by "mutual adjustment of individual actions. OSS communities solve this problem by mediated adjustment, that is, by all producers adjusting to the common subject matter of work, which they observe and from which they derive their tasks. … Thus, the shared subject matter of work mediates the adjustment of producers' actions by providing them with a common point of reference" (Gläser 2007:171). Transparency of the product and the rules for contributing are implemented on web platforms, as well as in collaboration tools such as Wikis or CMS, that provide a workspace in which numerous, widely distributed actors can coordinate their tasks as if they were watching each other work. While all information relevant for participation is available to everyone at any time on the Web, cooperation and self-coordination among actors is possible without physical proximity and without the actors knowing one another personally.

The shared Internet workspace not only offers enhanced options for ubiquitous interaction and virtual co-presence of the participants; transparent rules and standardized routines of participation also facilitate frequent changes of participants. It is not necessary to rely on a stable community in order to progress in collaborative work. By contrast, capable Internet communities can evolve even if the volatility of contributors is high and direct personal relations are lacking. Although such communities create only weak ties they can ensure a steady flow of contributions. The lack of obligations can be compensated by a large base of motivated users and co-producers who can join collaboration easily. The possibilities of compensation are facilitated by the specifics of the workspace. This can explain why weakly tied communities can ensure *producing the commons*. However, how can it be explained that some participants contribute substantially more than others?

The starting point might be once again the transparency of the collaborative production process itself. Transparency not only allows for self-coordination but also for easy monitoring of the contributions of others. Thus, differences in scale

and relevance of contributions are widely visible inside the community. Based on this visibility a social structure can emerge in the process of ongoing collaboration and interaction that defines roles and positions within communities. Stegbauer describes this emerging social structure in Wikipedia (chapter 6 in this volume and Stegbauer 2009). The same process is described for open source projects (O'Mahony 2006, Scacchi 2006, Gläser 2007, Weber 2004). Roles and positions within collaborative production communities on the Internet are primarily based on contributions. They differ heavily between core contributors or even leaders on the one side and occasional – frequently anonymous – contributors on the other side (Hanekop/Wittke 2008). Core contributors attain several non-monetary rewards, such reputation, influential positions and influence on decisions. Individual actions and motives in such communities are socially embedded and shaped by the positions, roles and relationships in the social order of the network. Membership is not formalized, but based on the commitment to the community by contribution. The volatility of membership is compensated by the openness of those communities and the large number of users and contributors. Trust and reputation are important mechanisms within Internet communities, too, though not based on personal face-to-face relations. Recognition of one's own work by peers, reputation, and positions in the social order of the community are organized by web applications. IT-based trust and reputation systems facilitate trust building even without personal relationships or face-to-face contact (see chapter 4).

The answer to the question of how "production of the commons" can work without reciprocal obligations and strong ties therefore is multidimensional. First, contributions can be easily made and in many cases it is fun to do. As there are many contributors, tasks are distributed over many shoulders. Second, the high volatility of contributors can be compensated by the large base of potential contributors, the openness of those communities and the attractiveness of the shard goals. Third, collective action is embedded in a social structure that evolves in the process of collaboration and interaction. The social structure is established in spite of weak ties, where the core contributors can expect non-monetary rewards, influential positions and reputation within the community. It-based applications facilitate the emergence of such a social structure.

However, social embeddedness and ease of collective production through the Internet works well, if there is a critical mass of the product and of actors that participate. As the number of participants grows, so does the probability that the product will be successfully created and continuously improved. Thus the success of collective action stimulates more contributions, in particular during phases of rapid dynamic diffusion and after a critical mass of the product and number of participants is reached. The growing number of participants also strengthens the expectation that one's own needs will be met.

This explains how the specific collective action problem of "producing the commons" can be solved *when* there already is a usable common good. However,

before this critical point is reached, it is doubtful whether a usable product will ever be produced. Looking at the large number of projects started (see the OSS projects registered with SourceForge), it is striking how few attain a critical mass. If the project fails, the efforts that were invested in it will have been in vain. In its initial stages, the new product is often no more than a vision. If the critical mass is not reached, it remains in a rudimentary state, because the product idea did not spark sufficient interest. In short, collective action problems on the Internet are typically problems of producing a critical mass of the product (Cominoa, Manenti and Parisi 2007). However, the issue of how to gain critical mass is still under-researched. Very little is known about the factors that are decisive for the initial and sufficiently sustaining attraction of participants by successful projects in contrast to others. In order to discuss the perspective of a further diffusion of collaborative production and innovation seriously this knowledge gap has to be addressed.

In this context it might be of interest to look at new ways of mixing self-organized collaborative production with firm-based activities. Firms may provide, for instance, critical infrastructure that enable collaborative production of autonomous co-producers. YouTube and most of the social networks are such cases in which companies operate infrastructure platforms. While operating a web platform is less complex than building a factory, large collaborative projects do require large global infrastructures, which often is expensive and difficult to organize (as seen in Wikimedia). Therefore, firms may play a critical role in particular for the emergence of forms of collaborative production that need complex and costly platforms. However, although firms can afford to continue providing an expensive infrastructure even if it is under-utilized, providing an enabling infrastructure is no guarantee for its usage by voluntary co-producers.

Collaborative production and value creation by firms

Collaborative production is possible with and without companies, as the wide range of successful cases from Wikipedia and open source software to YouTube and Facebook, Spreadshirt and Crytec (see chapter 8) shows. In the previous sections we discussed how autonomous actors work together without firms, making voluntary contributions to the development of large public goods. In this final section we look at constellations with companies. As has been argued frequently, firms are interested in integrating external actors into production and innovation processes for many reasons (von Hippel 2005; Reichwald and Piller 2006; Voß and Rieder 2006; Hanekop and Wittke 2010). The critical question here is how are firms able to attract voluntary contributions from a large number of external actors. Or to put it in our line of argumentation more specifically: Can collaborative production mechanisms as we have described above be made consistent with firms' value creation strategies? This question calls for further research. In the

following we start with the discussion of these questions, while the subsequent chapters in this book address various aspects in more detail.

As a starting point we will address the most likely inconsistencies between firms business models as well as their production and innovation strategies on the one hand and mechanisms of collaborative production as described in the previous section on the other hand. (1) Value creation strategies might conflict with the provision of public goods. (2) Firm-driven hierarchically organized production strategies might conflict with the principles of autonomously defined tasks. And (3) firms strategies to control production and innovation processes might conflict with the principles of community-based collective self-organization.

First, there are good reasons for external actors to expect that their contributions are freely available for the use of others even if they collaborate within firm-driven constellations. As voluntary co-producers they intend their contributions to be used without restrictions by others within the community and *not* for the profit of the company. Furthermore, the transparency of the collaborative product, which is necessary for collective self-coordination, demands open access to the contributions made by all others. The external actors see themselves as part of a community in which the product is created through collective action. The shared goals that keep the community together are focused on the collective product, and the social structure evolves from contributions. So, without public and open goods, social embedding of the productive activities in a community could fail and uncompensated contributions from large numbers of external actors become unlikely.

Second, interests and motives of external actors may be neglected or suppressed when possible tasks are predetermined and planned by the firm. As autonomous actors voluntary co-producers are used to self-selecting the tasks they address and the contributions they make. They presumably would not wish to follow companies' instructions. However, firms' strategies for organizing production and innovation processes rely at least to some extent on firm-centered planning and predefinition of tasks. If the company does not allow the externals sufficient room to maneuver in implementing their own interests and self-organizing their voluntary activities, the company may find that no voluntary contributions are made.

Third, firms' hierarchically planned production and innovation processes with their inherent rules of decision-making conflict with basic principles of community based collective self-organization. Communities of external actors are the locus of decision in the way we have described collaborative production and innovation. Here, rules for contributions and the basic design of the collaborative product are discussed in the community according to their rules and the structure. Decisions about the selection of contributions must be widely accepted in the community and are strictly observed.

To come back to the question of how firms are able to attract voluntary contributions from a large number of external actors, one possible answer is, by miti-

gating those inconsistencies. However, as far as conventional business models of firms are assumed, it may be difficult to cope with this challenge (see Chesbrough 2006). And if we look at some of the best known cases of firm-driven collaborative production far-reaching changes in conventional business strategies and production models are made in order to attract voluntary contributions on a large scale. These adjustments can be seen as specific answers to challenges that result from inconsistencies between conventional business strategies on the one hand and the preconditions for collaboration of external actors we described above.

The perhaps most elaborated approach firms follow to combine collaborative production patterns with value creation strategies is to search for new business models and new strategies to co-create value (Chesbrough et al, 2006, Reichwald and Piller 2006, Piller et al. chapter 2). A typical model in the software industry is to create value not by selling (OS-)software, but by offering open-soure-software-based services (West 2007, Chesbrough and Appleyard 2007, West and O'Mahony 2008). In the media sector firms typically draw on advertising as a common business model that deal in public or free products. It can easily be combined with the collaborative production of free and open content on a web platform. But, in contrast to the conventional advertising models, the content here is provided by voluntary contributions of external actors (user-generated-content), while the company organizes the infrastructure services. From the perspective of the company this approach requires a (new) strategy. The offered product or service is split into two parts one remains firm-organized, but the other is self-organized by a community of external actors. Although the firms' commercial service provision relies entirely on the contributions of externals, the firm has no control over the community-managed part of the production. Therefore risks and uncertainties in this model are high, in particular in its initial stage, when there is no critical mass of content. On the other hand the initial investment of firms may be low, as long as the service is not used on a large-scale.

Furthermore, new forms of intellectual property rights (IPR) are necessary to deal with collectively created products from private acquisition (open source software licenses and Creative Commons licenses; see also chapter 3). Although the protagonists of the new IPRs are not often found in companies, companies have to make use of such regulations when they seek a relationship with external co-producers.

A slightly different strategy for combining commercial value generation with the collaborative production of public goods is to have the companies produce the core product, while external actors – primarily users of the product – collaboratively create additional services. Online recommendation services are an example of this model. The advice given by other users, based on their real experience with the firm's product, constitute a new kind of recommendation service, that cannot be given by the firm. The unique quality of the service relies on the autonomy of externals. So this specific service might better be produced collaboratively by exter-

nals – from the perspective of both, firms and users. But again, the question of how to gain contributions is still open. And additonally, from the firms' perspective, how to deal with negative assessments and excessive demands of users that are publicly available on the web (see chapter 7).

The fragmentation of the whole production process into one firm-organized part and another part that is (self-) organized by a community of external actors is discussed in the literature as hybrid form of production (von Hippel and von Krogh 2006; Lessing, L. 2008, Harhoff and Mayrhofer 2010). In such hybrid models, firms offer external co-producers those kinds of activities that correspond to their interests. They do this by removing these activities from the company's internal process in order to create the space for the actors' self-organization and collaboration. Examples are also Webplatforms, such as YouTube or other forms of user-generated content, where externals take on creative tasks, in which they experience enjoyment and self-expression, and in which at the same time there is a potential for gaining attention and recognition from others. Companies allow extensive latitude in these areas, since as a rule they are not involved in the production of content, but rather allow it to be created entirely by volunteers. In other cases, too, external actors are offered creative and innovative activities that are fun to do; for example, innovative production ideas, design, feedback, field reports, tests and requests for improvements. There are various possibilities, attractive to both the external actors and the companies. But, the challenge here is, how to design an appropriate division of labor, that attracts a critical mass of contributions.

To attract contributors might be easier in cases in which these actors are at the same time customers of the company, because users of products or services usually are interested in their performance. Motives for voluntary participation thus include possible improvements in the product, which the company may implement based on the feedback and suggestions from users. In conventional customer relationships, the customer can only wait and hope for the company to react, for example to a customer complaint. In the collaborative environment, however, criticism and suggestions are in the public eye. It is no longer a dyadic relationship between the customer and the company; in fact, the situation is different in many aspects (see also chapter 7). On the one hand, public criticism can put the company under pressure to make improvements; on the other, the interaction concerning individual experiences increases the motivation of customers to provide feedback and make suggestions. Each user has access to the information shared by others, and the exchange of knowledge and experience becomes an important impetus for participation by the customer; the public discussion changes the relationship between customer and company.

Those firm-driven strategies of collaborative production and innovation usually means partly to give up control in order to arrange their internal processes in accordance with rules that are accepted by the external actors and the community.

One model is – as the above-mentioned examples show – to clearly divide tasks and responsibilities between the company and the community. To avoid conflicts and promote the success of such interactions, it is apparently important that roles and the expectations on each side are clearly defined and consistently maintained, to prevent complicated and lengthy negotiation processes and mistrust of the company by the externals. A company that implements decisions that were not accepted in the community would risk a surge in public criticism and a drop in participation by external actors. A widespread expectation on the part of external participants is that important decisions are made transparently and serve the shared goals and values of the community (rather than unilaterally serving the economic interests of the company). Experience has shown that web platforms' "Terms of Use," usually laid out by the platform operator, are a common point of conflict (see chapter 3, the conflicts at Facebook).

To conclude, firm-driven collaborative production and innovation models may work best if firms act as far as possible in accordance with community-based norms and rules. Firms have to give leeway for principles of self-organized collaborative production by autonomous actors. The main direction firms follow in order to avoid inconsistencies between firm-driven strategies and the practices and principles of self-organized collaborative production seems to be the fragmentation of realms. By establishing and respecting a realm for the self-organization of autonomous actors firms can facilitate producing the commons even within a value-creation dominated context. However, so far the number of successful real-life examples of this approach is very limited. This indicates that its hard to define proper lines of fragmentation in order to attract contributions and to be able at the same time to reduce risks and uncertainty to allow value generation by firms. More generally speaking, it is an open question how far the fragmentation approach can help to mitigate the basic inconsistencies between firm driven strategies and self-organized collaborative production. The limited number of real-life cases indicates that so far there is no "golden road" for firm-driven collaborative production and innovation. The question of what are the prospects of collaborative production with firms, therefore is still open. Examining firm-driven collaborative production from various (inter-)disciplinary perspectives is a major focus of this book and an ongoing challenge for further research.

The structure of this book

Large scale collaboration of autonomous actors, collectively producing freely accessible goods, is an intriguing phenomenon for a variety of scientific disciplines. So, in many disciplines new approaches and models are discussed, but are still widely discipline-specific. In order to meet the requirements to further research it seems to be fruitful to apply an interdisciplinary approach to address the scientific challenges posed by the new phenomenon (Lessing 2010). This was the idea be-

hind the international workshop held in May 2010 at the Lichtenberg Kolleg of Göttingen University which led to this book. The chapters of this book are from the fields of economics, sociology, legal and political sciences and computer sciences. The chapters are organized as follows.

In chapter 2 Frank Piller, Christoph Ihl and Alexander give an overview on the concept of customer co-creation in innovation processes. They present a typology of methods of co-creation along the three dimensions, "degrees of freedom" (customers' autonomy in the task), "degrees of collaboration" among customers (dyadic firm-customer interaction vs. communities) and the "stage of the innovation process" (early vs. late stage). All methods of customer co-creation involves customers actively in a company's innovation process. But companies intending to profit from co-creation need to know which of the different methods are most suited for themselves and how to use these tools best. The authors conclude, that modeling the effect of customer co-creation and the scare resource of "innovative users" could become a fascinating field for future research in economics and strategy.

In chapter 3, entitled 'Governing Social Production,' Niva Elkin-Koren examines the social dimension of content production from a legal perspective, and analyzes the consequences for the governance of content in the social web. While copyright law is primarily designed to regulate the relationships of a single owner with other non-owners and is focused on the sovereignty of the author, social production, by contrast, requires a matrix of relationships between the individual, the facilitating platform and the communities and crowds involved in social production. She claims, that a legal strategy is needed, preserves incentives for social motivation, and protects the community assets so that community members who have already made use of content shared by others can continue to use it. The interdependency between platforms and users, and the fact that social media platforms depend on the enduring livelihood of the community, makes these platforms a good candidate for implementing a "social contract" for collaborative online communities.

Chapters 4 and 5 deal with trust and reputation systems for collaborative production on the Web from the perspective of computer sciences. As trust in online-communities cannot evolve from personal relations, IT-based trust and reputation management systems are implemented as a substitute. Trust management in online communities aims at making trust reasoning more powerful and reliable by collecting, analyzing and disseminating information that is relevant for trust and trust-based decision making. In chapter 4 Audun Jøsang gives an overview of trust management concepts and methods in online communities. He describes semantic aspects of trust as well as principles and methods for building online trust and reputation systems. The problems and challenges for designing and implementing reliable trust and reputation systems are invoked and some potential solutions are

mentioned. Finally, he articulates a vision for trust management in online communities.

In chapter 5 Christian Damsgaard Jensen analyzes how a reputation system can be built, using Wikipedia as an example. The Wikipedia Recommender System (WRS) helps users determine the credibility of articles based on feedback from other Wikipedia users. A generic architecture for integrating a reputation system into existing legacy systems is developed. Both the generic architecture and the design of the WRS are outlined in the chapter. The author elucidates both the capabilities of such systems and the potential problems involved in their implementation.

In chapter 6 Christian Stegbauer presents a social network approach to explain "the mystery of participation" in Wikipedia. While neither the classic individualistic nor the collectivist approach can explain participation in Wikipedia, he presents an alternative, empirically-based rationale for this participation. Based on an empirical study Stegbauer analyzes the evolution of the positional structure in Wikipedia at the meso level, where positional allocations are negotiated. He demonstrates how social order evolves from the allocation of responsibilities, roles and positions, where positions and roles are formed dynamically during the interaction.

Sabine Hornung, Frank Kleemann and Günter Voß present findings from a sociological study on the "working consumers in Web 2.0" as a source of corporate feedback (chapter 7). Customer feedback on a collaborative web platform leads to far-reaching effects and potential loss of organizational control from a firm's perspective: a new level of communicating and negotiating with consumers is necessary and all domains of the value chain have to be reconceptualized in terms of their role for customer service. If companies disregard these challenges, new risks are entailed in using Web 2.0 for gaining feedback from customers. Further research is needed to understand how to combine organizational control with the new demands of collaborating customers in Web 2.0 constellations – or, as the authors put it, how to "manage the new consumer culture."

In chapter 8 Birgit Blättel-Mink, Raphael Menez, Dirk Dalichau and Daniel Kahnert present case studies on customer co-production, or prosuming. Their main questions are: Why do customers participate and how are these processes coordinated by the firms? The results show a considerable range of motives and forms of coordination. Whether motives are extrinsic or intrinsic in nature apparently depends on the type of co-production involved. With regard to the organizational models the authors identify a range of different strategies: from rationalization, to prosuming as a basic business model, up to interactive value creation between the company and the web community. The authors conclude that collaborative practices provide a rich field for future research. Theoretical approaches are needed that allow for a better understanding of the reciprocity of the relationship between customers and companies.

In some of the firm-driven collaborative models the collaborating users or customers are employees of the firm. In the case of OSS, the developers are frequently at the same time employees of a firm in which the OSS software is used (Henkel 2008 and Sojer and Henkel 2010). In chapter 9 an open innovation intermediary arena is analyzed by Tobias Fredberg, Maria Elmquist, Susanne Ollila, and Anna Yström. Here, the collaborating actors are employees of a firm that is a partner in the network of the intermedia arena. The authors provide insight into the tensions that these actors experience in their work in the intermediary arena. As they are embedded in two organizational structures, they constantly need to renegotiate their positions both within their firm and in the intermediary arena. Role confusions occur in four dimensions: trust, loyalty, knowledge sharing and career. To enable these actors to bring their full potential into the collaborative process, both the partner firms and the intermediary organization have to deal with these tensions.

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