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Lifecycle-Based Design Principles for Open Production Communities

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Abstract

This cumulative (publication-based) doctoral thesis aims to address different design aspects of open production communities (OPCs) and to theorize generic and life-cycle design principles based on the diverse yet valuable available literature on both theoretical and empirical findings in the pertinent fields of study. An OPC can be defined as an online community with the primary goal of accumulating, evaluating and sharing user-generated content on a specific topic of interest. OPCs can be divided into two primary categories of collaborative and creative communities. In collaborative communities, e.g. *Wikipedia*, the main body (essence) of content can developed by more than a single user. Many different types of content can nowadays be created collaboratively including text, audio, video, design, etc. The possible applications range all the way from knowledge generation (e.g. *Wikipedia*) to architectural sketching, map making, song writing and product design. In creative communities, on the other hand, content and its various components are generated by a single user. This user is basically the "owner" of the pertinent piece of content. Other members may only contribute in the form of comments (discussions), ratings, recommendations, etc. OPCs exclude competitive communities, also known as open production or open innovation communities. These communities, as the name suggests, consist of short-lived competitions with specific topics (e.g. product design or innovative ideas). Here, by focusing on long-term public content development, the scope of this thesis encompasses collaborative and creative communities under the general term of open production communities. OPCs also exclude service-based communities (e.g. game communities or e-commerce platforms). Nor do they include social networks, since the primary goal of OPCs is content development rather than socialization.

The existing research gap that is addressed in this thesis is the lack of generic principles for designing OPCs. A "generic" principle here means that it may and should apply to an OPC, regardless of the category to which the target community belongs. Successful design and development of OPCs is a delicate and complicated matter due to their dynamic nature and constant evolution. In these sub-categories of socio-technical systems (STSs), attributes of four abstract layers of technology (features), content, user and community are in perpetual interaction with each other. Each of these attributes has

its own intricate, dynamic and often context-dependent nature. Their interdependencies also vary through the lifecycle of a community. All these complex dynamics make successful design of such systems a non-trivial matter.

Despite a large body of literature devoted to OPCs and – more generally – online communities, few attempts have been made to conceptualize clear, generic and yet at the same time applicable principles to provide for their design. The majority of the existing studies elaborate on specific design aspects of online communities, or focus solely on one particular type or category. In this dissertation, the goal is to accumulate knowledge on design complications and aspects of OPCs and synthesize this knowledge into various papers. The final paper aims at theorizing a set of design principles. These principles are based on the characteristics and common patterns of OPCs that were reflected in empirical studies. By using the Delphi method to evaluate the results, these principles were refined and reformulated in various rounds of evaluations (via an online survey). As a result, precious insight, gained from a comprehensive literature review and studying the recent theoretical and empirical discoveries, was combined with and confirmed by the wisdom of practitioners and scholars.

Acknowledging the existence of a lifecycle model for online communities, the final principles were categorized into three groups to address one or both of the two general stages of every OPCs, namely pre-establishment and post-establishment. These principles provide conceptual guidelines for community designers in each stage of the lifecycle. The distinction was made since success factors and priorities of every community vary depending on in which stage it happens to be. These lifecycle-based principles shall help community designers and operators select, customize and prioritize features. The provided theories in the attached papers, including but not limited to the last paper on design principles, can serve as a well-founded theoretical ground upon which to base future scientific endeavors and empirical analysis.

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Part A: Summary of Contributions and Results

1 Introduction

1.1 Overview

1.1.1 Research Scope

As a well-known subset of technology-mediated social participation (TMSP) systems (Preece/Shneiderman 2009), open production communities (OPCs) are online communities with the primary goal of developing, structuring and sharing public user-generated content.

OPCs provide necessary tools and regulations for participants to generate, evaluate, extend, discuss, follow and share content. They benefit vastly from the Internet and Web 2.0 to channel the diverse information and immense manpower of heterogeneous and often international participants into open and usable knowledge in specific areas of interest.

Based on the type, function or collectivity (Olsson 2009) of content, these communities can be divided into two broad categories: collaborative and creative (McKenzie et al. 2012; Ziaie/Krcmar 2013c). Each of these categories represent different types of community. Creative communities include open media (Bruns 2005), open file sharing (e.g. *YouTube* or *Flickr*), open discussion (e.g. *Yahoo Answers*) (Butler/Wang 2012) and creative knowledge accumulation communities (e.g. *Wikipedia* and *Urban Dictionary*). Collaborative communities may include open source software communities (O'Mahony/Bechky 2008; von Krogh et al. 2012), open artifact (Maher 2010) or collaborative knowledge accumulation communities (e.g. *Wikipedia*).

What all these divergent communities have in common is their openness of content, possibility for long-term engagement and a user-oriented approach towards creating and managing open content. In other terms, their goal is to exploit the "Long Tail" of knowledge (Anderson 2006) by relying on users (participants) to produce open content (Leung 2009) in a sustainable manner. OPCs exclude service-based communities (e.g. e-commerce or gaming communities) and social networks, since the primary goal in these communities is not necessarily developing content, but offering a specific service for goals such as socialization, organization, business, etc.

In Section 3.1 and Paper 1 (Part B), detailed explanations on different categories and types of OPCs are provided.

1.1.2 Complications

Having a free work-force at one's disposal to create, evaluate and sometimes structure content and, in some cases, to even perform administrative and governance-related tasks may seem enticing at first; however, there are crucial design challenges and complications that inevitably induce a lower

success-rate for such communities. For example, *Wikipedia*'s success might be considered more an exception than the rule (Kraut et al. 2010). Of more than 6,000 wikis using the *MediaWiki* platform, hardly fewer than half have attracted more than eight contributors (Kittur/Kraut 2010). The median number of editors who have ever contributed to such platforms has been a mere seven. The situation is not much better in other types of OPCs. Most open source software (OSS) projects end up in failure based on lack of developers and visitors, sometimes even despite attracting sufficient initial interest (Crowston et al. 2006). Many creative communities have also proved unsustainable due to factors such as lack of proper incentives or not paying ample attention to boundary conditions (Chesbrough 2012).

In general, online communities have a dynamic and complex nature. They go through constant changes based on contextual, interpersonal, individual and technological factors (Whitworth 2009). Therefore, different aspects of them including technology (features), content, users and the community itself should be addressed in the course of their lifecycle (Ziaie 2014). In order to secure sustainability, community designers have to provide a delicate balance between technical features and individual desires, and to motivate individuals with multiple collaboration patterns to act constructively and collectively. They should also provide mechanisms to guide the community within the defined and agreed boundaries and objectives, facilitate socialization, and appropriately direct the flow of information (Dorn et al. 2012).

Faraj et al. (2011) refer to the fluidity of online communities as a design complexity, meaning wthat user-based resources such as passion, time or identity present a dynamic flow in and out of the community and structural mechanisms including community size and rules, content type and topic and user roles and needs vary constantly. All these factors contribute to making the parameterization and quantification of pertinent theories a non-trivial task (Ling et al. 2005). This is why several calls have been made to investigate mechanisms and guidelines in such a dynamic and multi-disciplinary landscape (Forte/Lampe 2013). This means various theories, concepts and frameworks are required for both researchers and practitioners to help them better understand these systems, attract visitors and motivate participants (Dannecker et al. 2007). Community designers must acknowledge the inextricably intertwined natures of the technical, individual and social elements of an online community (Gurzick/Lutters 2009). For example, with regard to participants, they have to study the interaction between visitors, contributors, sub-communities and the community as a whole from a multi-level perspective (Brass et al. 2004). Here a tension exists between the impact of community context on users and vice versa. On the one hand, individual behavior creates the atmosphere and provides the formal and informal structures of an online community (Faraj 2011). On the other hand, certain constraints and governance mechanisms shape the behavior and collective action of users within a community (Faraj/Johnson 2011).

1.1.3 Solution

Calls for further advancements in scientific theorizations, models and methodologies have been made to expand our knowledge of social, economic and behavioral phenomena in online communities.
In this thesis, the focus of the published papers is on studying and synthesizing the literature and theorizing models and concepts to help community designers and operators move from ad-hoc design approaches to predictable, and theoretically and empirically founded, design measures. This starts with defining the research focus (Ziaie/Krcmar 2013c), studying and modeling different subsystems (e.g. reputation or incentive systems) (Ziaie/Krcmar 2012, 2014), addressing design patterns with regard to the lifecycle of communities (Ziaie/Imamovic 2013), suggesting theories on "de-contextualization" of empirical findings (Ziaie 2014), and finally theorizing high-level design principles that can provide clear yet generic instructions that can be applied to all different types of OPCs (Ziaie/Krcmar 2016).
The main challenge here was to process and codify essential information on different aspects and design dimensions of OPCs and translate them into interpretable and applicable models and theories acknowledging the tension between general and context-free prescriptions and the fundamentally goal-driven and contextual nature of OPCs. The results shall serve as a first step towards design-oriented view of accumulated knowledge in this complex and multidisciplinary field of study.
In the first part of this dissertation, the eight publications are introduced and a summary of their contributions is presented. Then, the findings are concluded with an agenda for future research and a discussion of the relating implications. In the second part, the full text of the papers, all prepared with the author of this dissertation as the first and main author will be provided. I believe the findings can shed light to various design aspects and complications of OPCs and help designers and operator to build up communities more sustainably.

1.2 Abbreviations

Various abbreviations will be mentioned throughout the following sections and the attached papers. To help readers better follow the topics and discussions, here a set of commonly used abbreviations is provided.

Table 1 List of abbreviations

AI	Artificial Intelligence	OSS	Open Source Software
CPR	Common-Pool Resource	P2P	Peer-to-Peer
CSCW	Computer-Supported Collaborative Work	Q&A	Questions and Answers

GI	Group Identity	QA	Quality Assurance
GUI	Graphical User Interface	SMTP	Technology-Mediated Social Participation
HCI	Human-Computer Interaction	STS	Socio-Technical System
KM	Knowledge Management	UGC	User-Generated Content
MPC	Multi-tier Production Community	UI	User Interface
OC	Online Community	VC	Virtual Community
OPC	Open Production Community		

In addition to these abbreviations, in Section 3.2 (Paper 2: Content in OPCs: taxonomy and design construct) and Section 3.4 (Paper 4: Introducing a design framework for reputation systems in multi-tier production communities) taxonomies for commonly used terms in the context of OPCs are provided. These taxonomies help interested readers understand and distinguish between different topics and concepts in a rapidly developing research area, where the terminology has not yet been adequately standardized.

2 Research Agenda

2.1 Research timeline

In the middle of 2010, the general research goal of this thesis was clear: to study OPCs with a context-free approach and provide generic and holistic models, dimensions, guidelines and principles for their design. For this purpose, a timeline was prepared, laying out the necessary steps and outputs to achieve this goal. Figure 1 shows the defined phases and their pertinent research questions and expected results.

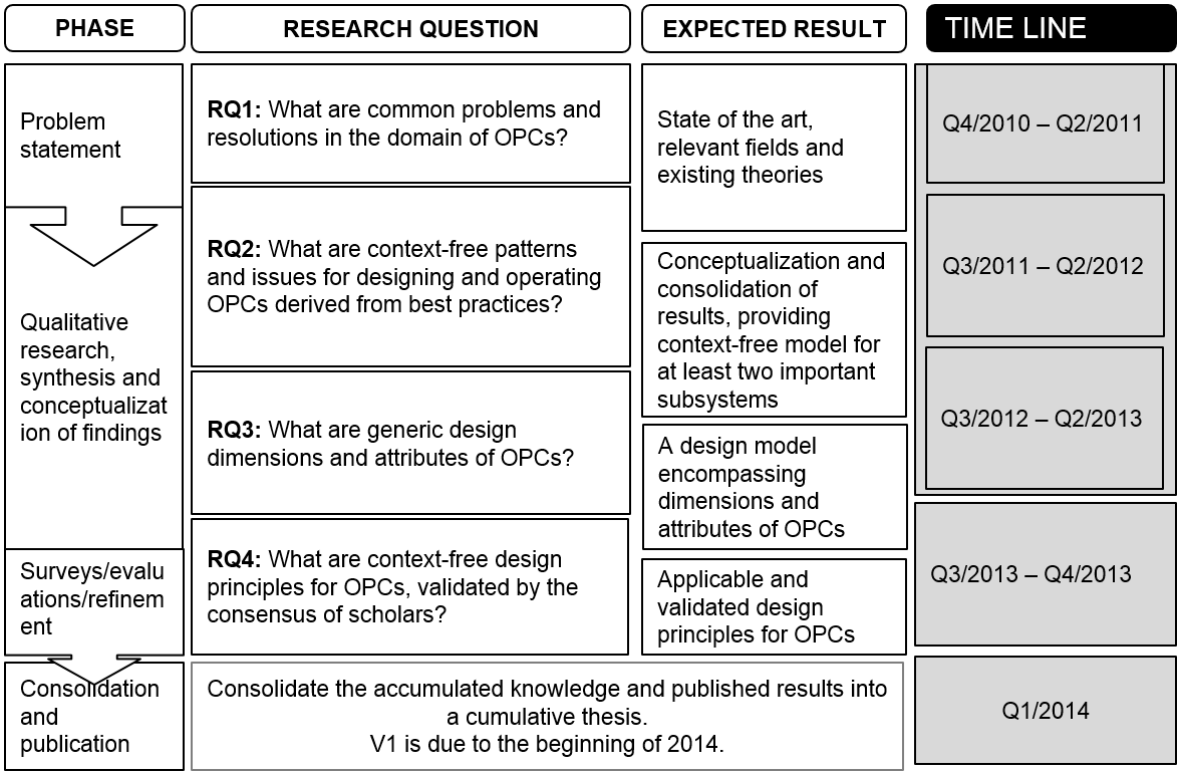

Figure 1 The devised research timeline of this thesis

For each of the expected results, sometimes different research methods were employed. In the next section these methods and the underlying reason for their selection is explained and discussed.

2.2 Research Methods

All the published paper were primarily conducted with a qualitative approach. This was due to several reasons, all stemming from the complex, dynamic and interdependent nature of OPCs. For example, hypothesizing analyses with correlational nature in an interactive context was not suitable, as it may often leave open the possibility of reverse causation (Kittur/Kraut 2008). Quantitative approaches

for mutual reinforcement processes in these cases (e.g. good questions attracts good answers and vice versa) is, therefore, questionable. Also, measuring the behavior of certain users within a specific context cannot be easily generalized to the whole lifecycle of the same community, let alone to other types of community. Moreover, laboratory observation was avoided, since the pool of participants and their participation behavior could not be easily generalized to online communities. Participants that join a lab experiment are often from a specific and limited group (e.g. students at a university), which is in contrast to the heterogeneous nature of online communities. Also, many studies have shown the change in the behavior of users during the lifecycle of a community and tenure of users (see for example (Preece/Shneiderman 2009)). The simulation of lifecycle and inevitable changes in a community's needs and priorities, as well as those of the users is not viable in a confined and short-term laboratorial environment.

During the conducted studies, we (the author of this thesis and the co-authors of the corresponding papers) tried to refrain from the so called "tendency to tilt" to either voluntarism or determinism (Leonardi/Barley 2008) as constructivist approach may suggest. Moreover, in the papers where a model was conceptualized, an *interactionist approach* (Buss 1977) was pursued, since it emphasizes both the individual needs and behavior of users and the relating factors to explain, shape, and predict their behavior within certain contexts.

The three major research methods that were employed in the publications were literature review, constructivist Grounded Theory and the Delphi Method. These methods will be explained next.

2.2.1 Literature Review

In order to address, structure and conceptualize the essential aspects of OPCs, the approach of critical literature review (Watson 2002) was selected as the starting point of all the publications. The data collection process was instantiated by searching relevant journals and conference proceedings (see Table 2) by using relevant combinations of pertinent terms. These terms included, but were not limited to, "online community," "design," "participation," "socio-technical," "collective action," "collaboration," "governance," "social media" or "crowdsourcing" depending on the topic of paper and the research questions. These terms were searched either in the title, the abstract or the keywords by using general search engines like Google Scholar or within a certain journal or conference proceedings of interest. Table 2 shows a list of journals and conferences that were mostly referred to during the review process.

The literature review was usually performed by using a chain referral sampling (Penrod et al. 2003). To avoid problems afflicting chain referral sampling (Erickson 1979), multiple networks and resources, such as community experts and renowned academic scholars, were invited to help with expanding the literature so that the scope of investigation could be sufficiently extended.

Table 2 Selected journals and conference proceedings to instantiate and complete the review process

Source (Journal)	**Acronym**	**Source (Conference Proceedings)**	**Acronym**
MIS Quarterly	MISQ	International Conference on Information Systems	ICIS
ACM Computing Surveys	CSUR	International Conference on Supporting Group Work	ACM GROUP
Journal of Information Science	JIS	European Conference on Information Systems	ECIS
Information Systems Research	ISR	International Conference on Human Factors in Computing Systems	CHI/ SIGCHI
Journal of the American Society for Information Science and Technology	JASIST	International Conference on Design Science Research in Information Systems and Technology	DESRIST
Journal of Computer Mediated Communication	JCMC	Journal of Information Technology Theory and Application	JITTA
International Journal of Web Based Communities	IJWBC	Hawaii International Conference on System Sciences	HICSS
Computers in Human Behavior	CHB	International Conference on Peer-to-Peer Computing	P2P
Academy of Management Review	AMR	Americas Conference on Information Systems	AMCIS
Organization Science	OrgSci	ACM Conference on Computer Supported Cooperative Work	ACM CSCW
User Modeling and User-Adapted Interaction Journal	UMUAI	International Conferences on Communities and Technologies	C&T

It should be noted that the reviews were not merely limited to those scientific areas that pertain to information and technology management. Mining social science theory as a source of principles for design innovation has been shown to be a useful strategy for the design of socio-technical systems (STSs) like online communities (Kraut 2003). Many theoretically sound economic mechanisms are not psychologically valid and fail when tried with real participants (Ariely 2009).

2.2.2 Grounded Theory

The collected information from the literature, was mostly categorized and conceptualized by using Grounded Theory (Glaser/Strauss 1967). Grounded theory is a powerful methodology to study and conceptualize online communities, since it not only avoids determinism, but also roots in pragmatism and relies on symbolic interactionism (Corbin/Strauss 1990), which are essential when it comes to complicated socio-technical constructs like OPCs.

Depending on the aspect or topic that were being investigated, we tried to apply *open coding* to structure the findings with similar properties and coinciding interrelations into corresponding categories. There are three basic types of coding: open, axial, and selective (Corbin/Strauss 1990). Unlike axial and selective coding where relationship of subcategories are tested against data or a central core category is sought, the purpose of open coding is to help the analyst gain new insights into the data by breaking through standard ways of thinking about (interpreting) phenomena reflected in the data. This helped us make sense of common issues and patterns despite a vast and scattered body of literature. We could then trace the underlying causes of these problems and conceptualize models or guidelines to resolve them.

Of course every method has its own pros and cons. Findings based on grounded theory are reproducible in the limited sense that they are verifiable (Corbin/Strauss 1990). This is a common problem in most research investigating social phenomenon. The generalizability of findings can be partially achieved through the process of abstraction that took place over the entire course of the research. To address this issue in the final paper (see Section 3.7.4), the Delphi method was employed to assure an acceptable level of validity and generalizability for the findings.

2.2.3 Delphi Method

Delphi method is a structured method to qualitatively evaluate findings whose quantitative evaluation is either costly, invalid or simply not viable. It lets experts reach consensus on a certain theory or hypothesis in an iterative manner. The Delphi method was deemed appropriate for evaluating and revising the design principles in the last paper (Paper 8) for variety of reasons: first, a quantitative evaluation of such principles for all types and categories of OPCs was not viable within an acceptable period. Second, for a dynamic and multi-dimensional subject, group decision analysis methods often prove more reliable that their quantitative counterparts (Denzin 2009). Third, Delphi method has high validity in social science (Landeta 2006). Lastly, it does not require the physical presence and interaction of the selected experts (Okoli/Pawlowski 2004).

In Delphi method, a meticulous procedure for finding experts is needed to ensure the the validity and reliability of the results stemming from the final consensus (Delbecq et al. 1975). For this purpose, experts with sufficient academic background were searched who –at the time of

preparing the last paper- had more than ten publications in areas relating to the design and operation of online communities.

2.3 Publication Roadmap

Figure 2 demonstrates the published papers and their relation to the theorization process that lead to the introduction of the design principles in the final paper.

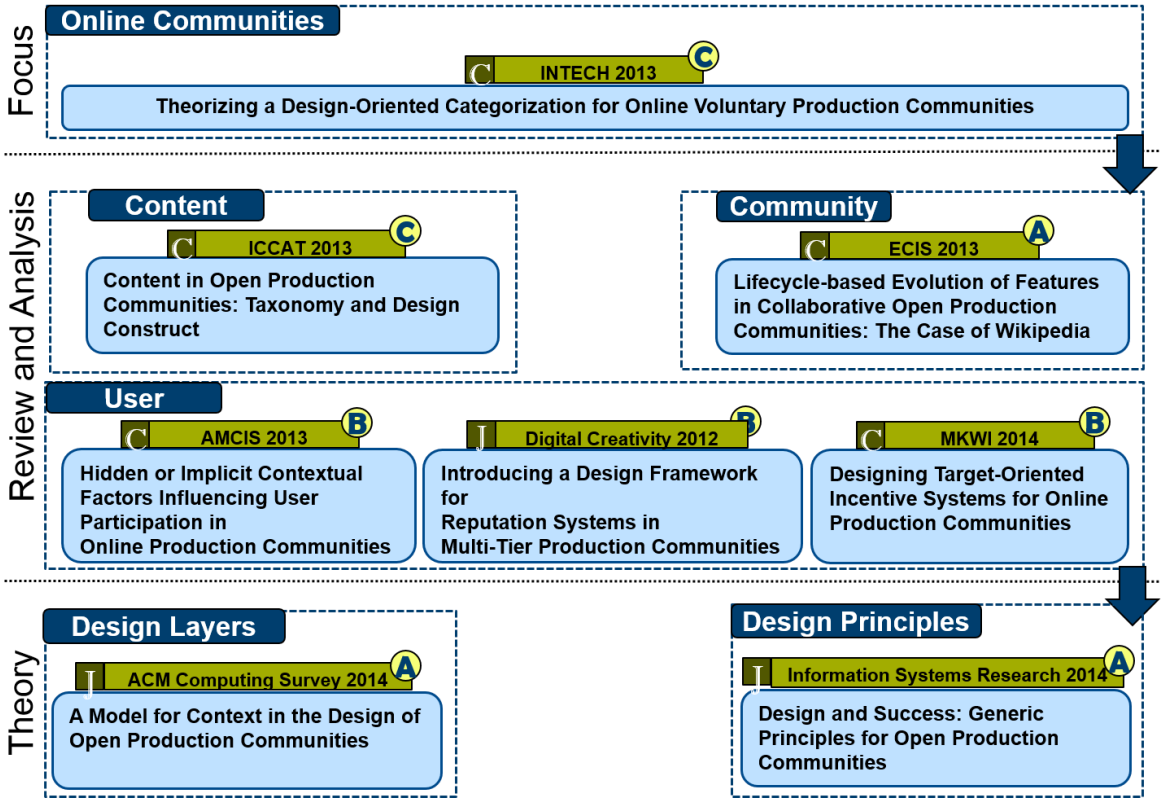

Figure 2 Publication roadmap

The paper published in INTECH 2013 (Ziaie/Krcmar 2013c) draws the general boundaries and scope of the research. Five papers focus primarily on review and analysis of current literature in order to find interesting patterns within certain aspects of OPCs including content, user and community. The paper published in ECIS 2013 (Ziaie/Imamovic 2013) addresses, for example, the role of community lifecycle in identifying needs and priorities of users and the community in order to introduce and/or implement suitable features. Another set of three papers published in AMCIS 2013 (Ziaie/Krcmar 2013b), Digital Creativity 2012 (Ziaie/Krcmar 2012) and MKWI 2014 (Ziaie/Krcmar 2014) focus on users' desires and characteristics in order to sustain participation. Content-related issues and aspects are also conceptualized and discussed in the paper published in ICCAT 2013 (Ziaie/Krcmar

2013a). All these paper contribute to the next two important papers on the design dimensions (Ziaie 2014) and design principles (Ziaie/Krcmar 2016) of OPCs.

In the first seven papers literature review and Grounded Theory were employed as primary research methodologies whereas the last paper also used Delphi Method to evaluate and revise the theorized design principles.

3 Overview and Summary of Publications

The theoretical background and theorization process that are provided in the following sections are based on the accumulated knowledge gained from comprehensive literature reviews, interviews and surveys. Depending on the addressed design aspect or dimension, this knowledge was synthesized and conceptualized in the form of scientific papers (see Table 3).

Table 3 List of publications relevant to the design of OPCs

#	**Title**	**Journal/Conference**	**Reference**
1	Theorizing a Design-oriented **Categorization** of Online Voluntary Production Communities	The 3rd International Conference on Innovative Computing Technology (INTECH)	(Ziaie/Krcmar 2013c)
2	**Content** in Open Production Communities: Taxonomy and Design Construct	The International Conference on Computer Applications Technology (ICCAT)	(Ziaie/Krcmar 2013a)
3	Hidden or **Implicit Contextual Factors** Influencing **User Participation** in Online Production Communities	The Nineteenth Americas Conference on Information Systems (AMCIS)	(Ziaie/Krcmar 2013b)
4	Introducing a Design Framework for **Reputation Systems** in Multi-tier Production Communities	The Digital Creativity Journal, Special Issue on Collaboration and Community	(Ziaie/Krcmar 2012)
5	Designing **Target-Oriented Incentive Systems** for Online Production Communities	Die Multikonferenz Wirtschaftsinformatik (MKWI)	(Ziaie/Krcmar 2014)
6	**Lifecycle-based Evolution** of Features in Collaborative Open Production Communities: The Case of Wikipedia	the 21st European Conference on Information Systems (ECIS)	(Ziaie/Imamovic 2013)
7	A **Model for Context** in the Design of Open Production Communities	ACM Computing Survey (ACM CSUR)	(Ziaie 2014)
8	Design and succeed: Lifecycle-oriented **Design Principles** for Open Production Communities	Under review at the Information Systems Research (ISR) Journal	(Ziaie/Krcmar 2016)

These were published in various international journals and conference proceedings. The majority of the papers provide new concepts, theories or frameworks for particular design aspects of OPCs including user participation, content management and community governance. Table 3 provides a list of these papers and their corresponding publication venue. The full texts of these papers are provided in Part B. In this section, a summary is provided for each paper along with an explanation of how they contribute to the overall purpose of this thesis.

3.1 Paper 1: A design-oriented categorization of production communities

The paper "*Introducing a Design-oriented Categorization of Online Voluntary Production Communities*", published in the 3rd International Conference on Innovative Computing Technology (INTECH 2013) provides a design-oriented categorization of voluntary production communities. Voluntary production communities include competitive communities in addition to collaborative and creative communities (as in OPCs). The proposed categorization prepares a structured context for online production communities so that generalizing the findings and theories can be performed in a consistent and cohesive way. Existing theories, approaches and models were drawn upon to categorize relevant communities based on their characteristic similarities. In particular, theoretical and empirical findings in the fields of collective intelligence (Malone et al. 2010) and socio-technical systems (Whitworth 2009) are harvested and extended to address different aspects of production communities. This way, by using attributes including the collectivity and timeliness of content, communities are divided into three primary categories, namely collaborative, creative and competitive.

3.1.1 Categorization

The selected terms for the general categories represent the way content is generated by users (McKenzie et al. 2012). In collaborative communities, content can be developed collaboratively and by more than one user. The type of content that can nowadays be created collaboratively is not limited to text and ranges all the way from knowledge generation (e.g. Wikipedia) to architectural sketching, product design, movie making and geographical maps (De Alfaro et al. 2011). In creative communities however, each user is basically the "owner" of his generated content and the other members may only contribute in the form of comment (discussion), ratings, recommendations, and other auxiliary forms. In competitive communities, unlike in the other two categories, consists of short-lived competitions with specific topics. Therefore, content generation is not necessarily a constant process with perpetual improvements. Figure 3 provides a list of the nine identified types with their respective category.

Collaborative communities can be divided into knowledge (e.g. Wikipedia), source (e.g. OSS communities) and product (e.g. Quirky.com) development. In creative communities, users can create content individually and then have others discuss, distribute and evaluate it. Four subcategories can be distinguished here: open discussions (e.g. Yahoo Answers), knowledge (e.g. Urbandictionary.com), news (e.g. Digg.com) and digital file sharing (e.g. Flickr or YouTube). Centering on short-term competitions, competitive communities can be categorized into open innovations/ideas (e.g. IBM's IdeaJam) and digital artifacts (e.g. Threadless). Figure 3 demonstrates this categorization as a tree-diagram.

3.1.2 Contribution

Following this categorization, a new baseline can be founded on which future research can be built. By including collaborative and creative communities and excluding competitive communities, where goals are short-term and participation is ad-hoc, open production communities (OPCs) were defined as the primary research area.

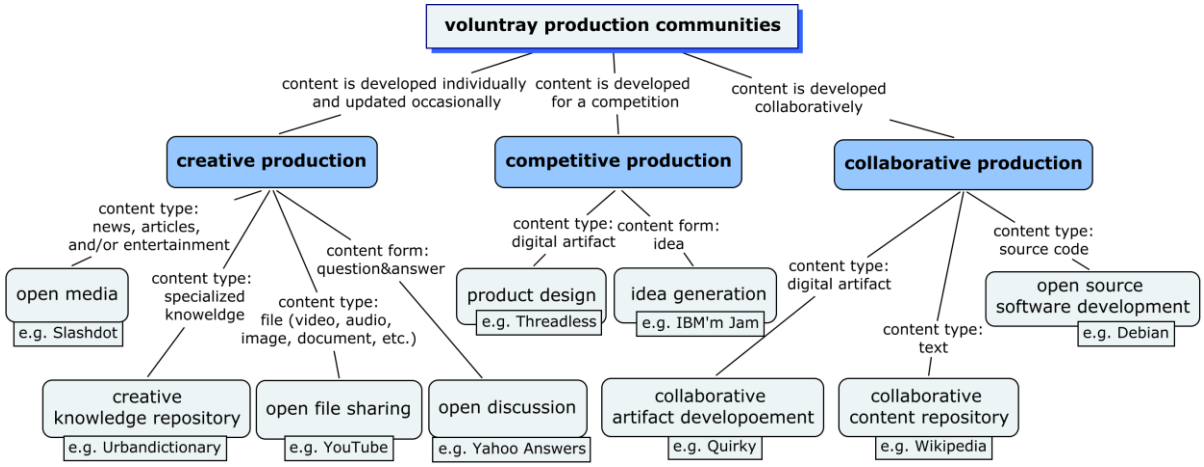

Figure 3 Categorization of online voluntary production communities (Ziaie/Krcmar 2013c)

3.2 Paper 2: Taxonomy and design construct for content

Content is the end product of OPCs, since the main objective of every OPC is to develop or accumulate high quality and open user-generated content. The concept of user-generated content is rather new and has inevitably changed our perception of many notions including collaboration, ownership, privacy, and quality (Fischer 2009). The major difference between two main categories of OPCs (collaborative and creative) is how the essence or main body of content is being developed. Furthermore, not only content generation but also content evaluation and qualification processes have been transferred from experts to the information-seeking public (Metzger 2007). This emphasizes the need for a deeper study of content-related processes in OPCs. Also, despite the prominent role of

content, its variety, and the paramount importance of quality assurance processes, no generic model had been conceptualized to address the major elements of content. Nor had any concrete taxonomy been suggested or established to facilitate the communication between experts and to support a smooth accumulation of knowledge.

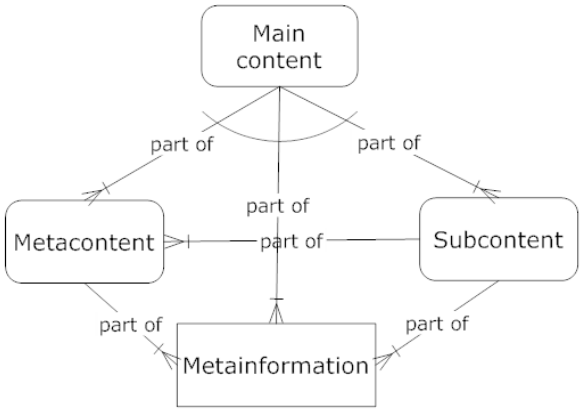

Figure 4 A model to represent the major elements of content (Ziaie/Krcmar 2013a)

The aim of this paper, therefore, was to provide taxonomy for content-related terms on the one hand and conceptualize a suitable model for content in the context of OPCs on the other.

3.2.1 A novel model for content

Based on the conceptualized model (see Figure 4), content as a whole encompasses four major components: *content essence* or *main content* (main body of content), *metacontent* (additional descriptive or evaluative information such as tags, categories, ratings, etc.), *subcontent* (discussions pertaining to the content), and *metainformation* (statistical and context-dependent information such as location of generators, number of viewers, etc.). The first three components are created and modified primarily by users, whereas the last part (metainformation) is generated automatically by the system or platform.

3.2.2 Applications for content quality assessment

This model can also be employed to structure the current quality assurance/assessment methods in OPCs. A fitting combination of content elements (main content, subcontent, metacontent and metainformation), user characteristics (e.g. user profile and reputation), and contextual factors (e.g. time) can be leveraged to address and cover the necessary qualitative and quantitative quality dimensions. This was used as a foundation to construct a model for context in paper 7 (Section 3.7). The relationships between users and their interactions with content has been shown to be an invaluable source information from which one can infer the quality of content (Agichtein et al. 2008). In creative OPCs, automatic quality assessment algorithms make extensive use of main content and subcontent to estimate the quality of content. This is due to the fact that updating main content or subcontent is not open to every user as in collaborative communities. Therefore, main content gets updated less frequently and to prevent the accumulation of low quality content, its quality plays a more significant role in estimating the quality of content.

Table 4 provides a list of few popular algorithms in different types of creative OPCs. For successful design of OPCs a deep understanding of these algorithms is essential. Algorithms provide necessary and valuable tools for community designers to secure an acceptable level for content quality. Moreover, they sometimes employ user-related attributes and aspects (e.g. user reputation) to influence or assess the quality of content. These interdependencies are further discussed and addressed in Paper 7.

Table 4 Example of practiced methods for automatic hybrid content quality assessment in creative content generation

Metrics	**Main Cont.**	**Meta Cont.**	**Meta Info**	**User Info**	**Description**	**Source**
User reputation, content feature (syntactic complexity, grammaticality, etc.) and usage statistics per category (number of clicks, etc.)	X		X	X	A binary classification (high quality or not) of answers (on Yahoo! Answers platform) based on user, content, and usage.	(Agichtein et al. 2008)
Number of answers and the reputation (expertise) of questioners			X	X	A combination of number of answers and PageRank to assess the quality of answers.	(Zhang et al. 2007)
Content characteristics (number of words), post usage data including total number of views or average dwell time	X		X		Identifying low quality posts based on post usage data and the characteristics of the post (e.g. number of words, etc.)	(Chai et al. 2010)
User reputation, typo errors, POS entropy, length of content, space density, etc.	X			X	Predicting the quality of questions via a AI-based algorithm on user (asker) and content (question)	(Li et al. 2012)
13 non-textual features such as Answerer's Acceptance Ratio, Answer Length, Answerer's Category Specialty, Copy Counts, Number of Answers, etc.	X		X		AI-based approaches are used to handle different types of non-textual features and to build a stochastic process to predict the quality of an answer.	(Jeon et al. 2006)
User reputation, meta-content characteristics (length, number of verbs and nouns, entropy)	X	X		X	Predicting the quality of comments in *Digg.com* based on a learning-based approach	(Khabiri et al. 2009)

Content (tweet content), user (type, friend's location) and the distance of his/her location to the reported events		X	X	X	Searching filtering and assessing news sources based on the credibility of users, their location, and the characteristics of content (tweets)	(Diakopoulos et al. 2012)
Content (photo data) and selection of users (best pictures)	X	X			automatically identifying similar images and rating them based on sharpness and exposure quality of the images, together with users' votes on images	(Hilliges et al. 2007)

Also, supplementing additional information to existing items is believed to be in part a personal act (e.g. to structure a user's own collected content) and in part a social activity targeting other users (Ames/Naaman 2007). These findings were later used in Paper 7 in the dimension pertaining to content. In Paper 8, few principles were addressing content-related issues and the provided taxonomy was drawn upon to elaborate on these underlying issues.

3.2.3 Contribution

The result of this paper provides a framework to address relevant issues in the context of OPCs. For example, the distinction between content and metacontent is of great importance. Many studies show that not only is the significance of each of them different with regards to the stage and objective of a community (Jones/Rafaeli 1999), but also that users show diverse attitudes and priorities toward contributing content or metacontent (Oreg/Nov 2008; Sen et al. 2006). The paper also provides a useful taxonomy for content-related topics. Also, it lays the foundation for Paper 7 (Section 3.7), where four design dimensions of OPCs are conceptualized, one specifically on "content".

3.3 Paper 3: Contextual and hidden factors of user participation

Active and goal-oriented user participation is a critical success factor in OPCs, since these communities rely mostly on voluntary user participation and user-generated content. In this paper the literature on user participation in OPCs was synthesized and a model for participation was hypothesized with regard to the identified contextual and/or hidden factors. The research was organized around a perspective with the voluntary users as the cornerstone of OPCs.

3.3.1 Implicit contextual factors

Two general types of implicit contextual factors were identified: fixed and dynamic. While fixed factors are mostly related to the structure and objectives of a community and stay rather unaltered over time, dynamic factors change with respect to community position, content pool, environment or external factors including the emergence of new phenomena and/or disruptive technologies.
By investigating the antecedents of user participation in OPCs from the perspective of user- and community-related factors, these factors were modeled as implicit or hidden motivators. This perspective states that increasing user participation can be enhanced by paying ample attention to implicit contextual factors in addition to providing explicit incentives (via incentive systems).

3.3.2 Contribution

Discussion of the participation from the angle of hidden and contextual factors was an innovative step and a contribution to the area of virtual community. Furthermore, several hypotheses were proposed as the result of this study, particularly a positive feedback loop for increasing user participation was used in the theorization process for the final design principles. The feedback loops is depicted in Figure 5.

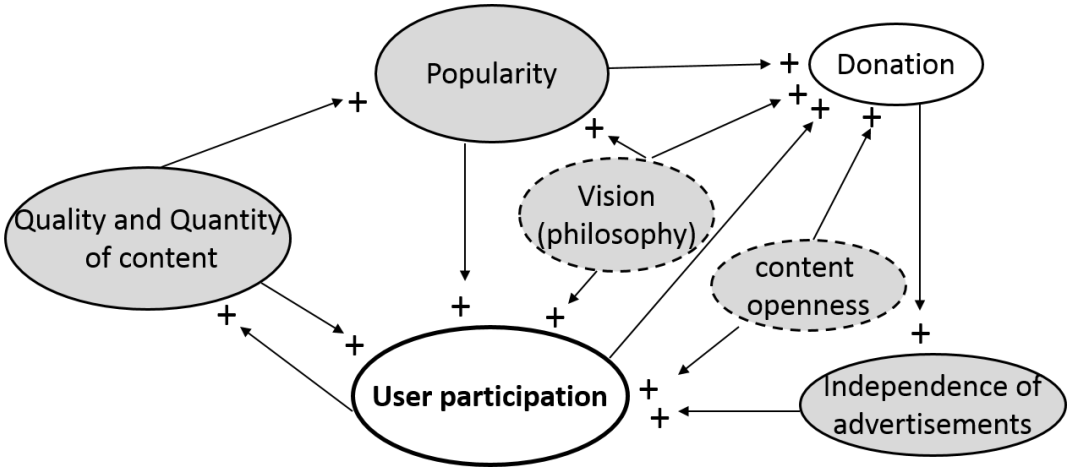

Figure 5 Correlations and interdependencies of contextual factors with regard to user participation (Ziaie/Krcmar 2013b)

This feedback loop suggests that there is mutual and reinforcing positive effect between user participation and the quality and quantity of content. This pool of high quality content in turn increases the popularity of a community, which has a positive effect on the received donations. Finally, reduced commercial advertisements (resulting from the received donations) enhances the perceived reliability of a community (Kelly et al. 2010). This often culminates in an increase in participation.

3.4 Paper 4: A design framework for reputation systems

Reputation systems are deemed an essential element of OPCs. Particularly in multi-tier production communities (MPCs), where at least two different tiers (ranks) of users exist, these systems are of utmost importance to help the community monitor, evaluate and gauge users' performance and commitment. In MPCs, users can be promoted to a higher tier or rank or demoted to a lower one. In other types of OPCs, reputation systems can also serve as an incentive. They reflect users' participation and contributions in qualitative and quantitative forms. This information, if collected and interpreted properly, can help a community from two major aspects: 1) to evaluate both content and users and 2) to provide a capturing mechanism for users as a measure of appreciation (so that they know that their endeavors do not go unnoticed).

3.4.1 A holistic design framework

Written with term definitions, key aspects and properties of the reputation system, this publication provides a design framework for reputation systems. The framework is depicted in Figure 6.

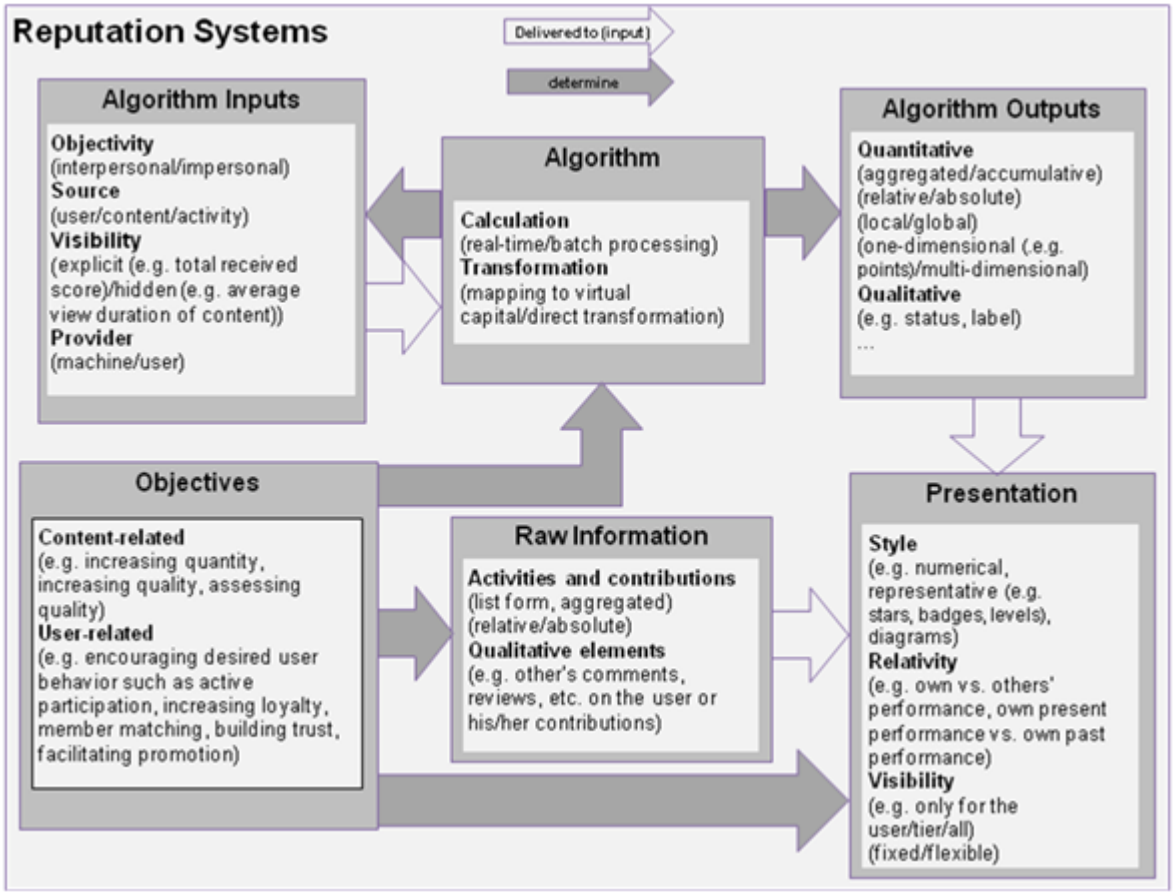

Figure 6 A comceptualized design framework for reputation systems in MPCs

This framework shows the essential elements of reputation system in the context of MPCs, including objectives, collected information, processing algorithm(s), output and presentation. The framework draws on the works of Cruz et al. (2009), Dellarocas (2010) and De Alfaro et al. (2011) and adds "increasing participation" and "facilitating promotion" as two previously understated dimensions for reputation systems.

3.4.2 Contribution

Synthesizing available literature on user participation and reputation systems into a context-free design framework helps community designers focus on crucial elements and refrains from harmful side-effects of implementing a reputation system. Considering the ultimate goal of providing context-free design guidelines and principles for OPCs, investigating reputation systems helped us gain valuable insight into design complications of an important subsystem and the dynamisms of user intrinsic and extrinsic motivations for participation in and commitment to an online community. Also, as one of the first papers addressing reputation systems from a generic design-oriented point of view, a taxonomy was provided to consolidate the terminology in this context. This taxonomy was later used in other papers as a standard to make sure the language stays consistent throughout the publications. Finally, promotion approaches were summarized into a simple model based on a combination of three primary approaches of "selection", "election" and "detection".

3.5 Paper 5: A design model for incentive systems

While Paper 3 (p. 3.324) addresses the hidden or implicit factors influencing user participation, this paper, titled "*Designing Target-Oriented Incentive Systems for Online Production Communities*", encompasses explicit factors on participation, or the so called incentives. Exchange theory suggests that although every individual may have potential conflicting interests to act selfishly, when confronted with uniform structural constraints and conditions, people tend to behave in a predictable collective manner (Faraj/Johnson 2011). Incentive systems are complementary measures to contextual (hidden) factors (Paper 3) that are carried out in order to increase participation. Participation can be reflected in the forms of commitments or contributions. Designing incentive systems is a vital part of designing online communities, since an incentive system aims at sustaining user participation (in either previously mentioned forms). It is true that many users may behave based on intrinsic motivations. Still, many others require clear incentives to commit and contribute to a community. Also, even those users acting merely based on intrinsic motivations need recognition and/or excitement. Moreover, some measures and features may act as anti-incentive for intrinsically motivated users. As a result, in designing such systems, various dimensions should be taken into

account including participants (their characteristics and activity pattern) and community (its goals, characteristics and lifecycle). The goal(s), target(s) and customization of each incentive should also be pondered with greatest attention.

In this work the literature on user participation and incentive mechanisms were synthesized and a generalized design model for incentive systems for OPCs was theorized by following a constructivist Grounded Theory approach (Mills et al. 2008). Similar to other papers, the theorization process was performed with a design-oriented and context-independent perspective.

3.5.1 The significance of user desires

Based on the findings, incentives are not always general measures to increase participation, but sometimes ad-hoc and target-oriented practices followed to motivate participant to carry on specific activities in line with the objective(s) of the community. According to the findings of this work, each and every offered incentive should address at least one of the desires of self-importance, self-development, fun, vindication, socialization, group identity and uniqueness. Figure 7 shows these desires and their orientation.

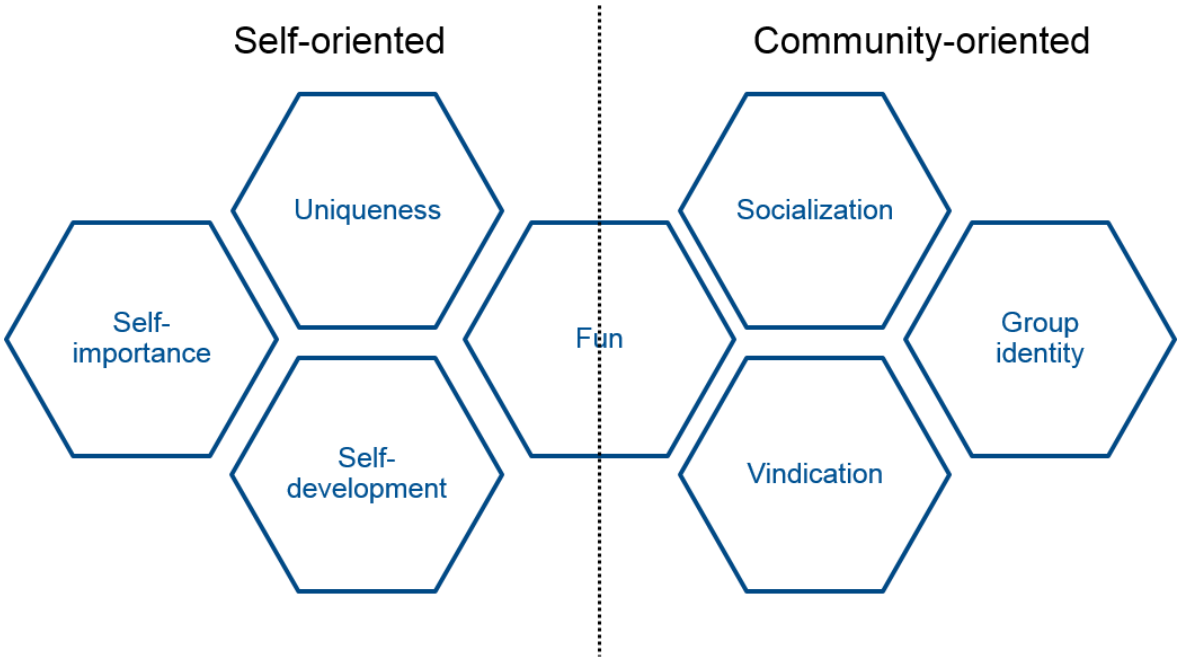

Figure 7 User desires in the context of OPCs

These were the identified relevant basic desires in the context of OPCs (for more information see Table 1 of Paper 5 in Part B). Based on these desires, an integrative framework was proposed that lays the focus on user desires, characteristics and activity pattern as well as community characteristics, lifecycle and goals.

3.5.2 A context-free design cycle for incentive systems

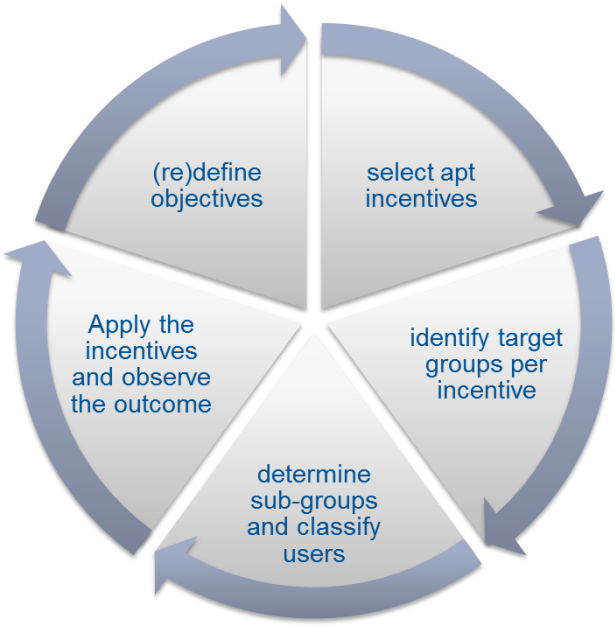

Figure 8 The design cycle of a target-oriented incentive system (Ziaie/Krcmar 2014)

Our findings suggested a never-ending cycle for refining and redefining incentives, since user desires and community goals and priorities change over time. In such cycle, the objectives of an incentive system should be defined and redefined according to the confronted challenges and needs of community and users. Then, based on these objectives, suitable incentives are to be selected and prioritized. Correspondingly, target groups should be defined, into which users are classified. Ultimately, incentives should be customized and presented individually in accordance with a user's characteristics to be more effective. This design cycle is demonstrated in Figure 8.

3.5.3 Contribution

According to the proposed design cycle, designers of incentive systems are presented with few questions for which they should seek proper answers: what is the type of community we are dealing with? Or, at what stage of its lifecycle is this community currently? Also, the model suggests that the main objectives of the incentive mechanisms should be defined and redefined with regard to the community- and user-related factors. The primary desires and motivations of users should also be laid out and the characteristics of the target group to which the selected incentive(s) are applied to should also be pondered carefully.

An apt incentive system combined with ample attention to implicit factors lays the necessary ground for a successful community. It also pinpoints the inevitability of change in many aspects including user desires and community objective(s) and the importance of a lifecycle mode. Therefore, the next paper will discuss lifecycle models as an essential fact for designing OPCs.

3.6 Paper 6: Community lifecycle and evolution of features

Incentive and reputation systems address vital design intricacies to sustain and/or increase user participation. There are few other systems (or subsystems) that contribute to user participation and experience including recommendation systems, socialization systems, etc. In order to gain a better insight into the complex world of OPCs, however, discernable patterns should also be detected in difference aspects of OPCs (e.g. participation, as elaborated on in Paper 3, p.24) and also in the course of their lifecycle. With respect to their design and operation, the lifecycle (or lifespan) of a community is deemed an essential aspect (Iriberri/Leroy 2009). This is because the focus of communities as well as the attitude, desires and motivations of users change during the their lifecycle (Preece/Shneiderman 2009).

3.6.1 Lifecycle stages for collaborative OPCs

Focusing on collaborative OPCs (the case of *Wikipedia*), this paper studies the evolution of features and mechanisms on Wikipedia as a well-known and successful community. To identify the overall orientation of Wikipedia with regard to its features, all features were divided into four main categories that can be generalized to almost every collaborative OPC: (1) user motivation and content generation (quantity), (2) user coordination and conflict management, (3) community governance (roles and policies), and (4) content quality assurance. Then these features were mapped into the timeline representing the lifecycle of Wikipedia with different colors/texture for each category so that the density of each category in different stages can be observed.

As a result, a three-stage lifecycle model was conceptualize to address similar patterns, issues and feature-based orientations. The result was consistent with the corresponding models of Aaltonen and Lanzaa (2011) and Iriberri and Leroy (2009). The identified stages are: *Rising*, in which infrastructure and content extension occur, followed by *Organizing* after reaching the tipping point of a critical mass of content and active users, where the emphasis is mostly on facilitating the coordination between users and structuring the content to enhance navigation and visibility. Finally, upon successful handling of the inevitable conflicts and the flowing load of new content, communities enter the *Stabilizing* stage, in which a certain level of self-organized coordination and structuring of content prevails. At this final stage, the community has to deal primarily with scalability issues and the focus shifts from content quantity and versatility to assuring a certain level of quality for content. Table 5 summarizes the different models with the pertinent goals and focuses at each stage.

Table 5 Community lifecycle models, the respective success factors and focus of attention (Ziaie/Imamovic 2013)

Stage	Stage (Aaltonen/Lanzara 2011)	Stage (Iriberri/Leroy 2009)	Success Factor	Community Focus
Rising	exploiting and tapping distributed individual capabilities	Inception	Purpose, codes of conduct, trademark, funding/revenue sources	Financing the project, defining viable and narrow objectives
		Creation	User-centered design, security, reliability and performance	Communicating the vision, building trust, acquiring new users
		Growth	Growth management, integration of new members, up-to-date content, reaching critical mass, transparency	responding to users' needs with agility, facilitating content generation
Organizing	take off and the building of collective capability	Maturity	Permeated management and control, recognition of contributions, subgroup management, recognition of loyalty, member satisfaction management, content quality, scalability	Facilitating coordination and effectively handling conflicts, providing visibility and interconnection between content
Stabilizing	consolidating collective capability			Enhancing quality of content, managing scalability

3.6.2 Contribution

This model sheds light on a significant aspect to the design complexities of OPCs. It can help explaining and predicting the changes in user behavior, content situation and community expectations as a community grows and matures. The model can be modified to be applicable to creative OPCs as well. Since the main body of content is generated and maintained by one user, the coordination between users does not seem to have the same importance as in collaborative communities. Therefore, a more general lifecycle model can be constructed by merging the second stage into the third one and establish a simple yet effective two-stage model for OPCs. The new more general stages was later called *pre-establishment* and *post-establishment* in the last paper on design principles (see Paper 8, p.36) and were employed to categorize the theorized design principles. The

pre-establishment stage corresponds to the Inception and Creation stages in Iriberri and Leroy's model (2009) and Rising stage in the proposed model.

Another contribution of this paper is a holistic observation of the development and evolution of features. This provides a diagnosis tool for designing communities and instills awareness of expected changes and incidents.

3.7 Paper 7: A theory for "de-contextualizing" findings

The last published paper[1] before submitting this thesis, titled "*A Model for Context in the Design of Open Production Communities*", addresses the vital yet hitherto unaddressed issue of knowledge transfer in OPCs. Different types of OPC have different characteristics, users and form of content, let alone different collaboration methods. Designers should be aware of these differences, and their effect on different features. In order to draw an applicable decision making process for choosing and prioritizing features for a community based on the best practices of another (or others), this paper introduces a new model of abstraction based on four design dimensions (features, content, user and community). It then draws on this model to point out design attributes and their interdependencies in different types of communities. Based on these dichotomies, designers can follow a specific path for deciding whether to choose a (successful) feature from another community.

3.7.1 Design dimensions

OPCs can be studied as a subset of socio-technical systems (STSs), where individual activities or interactions are enabled by technical features in a social context (Trist 1981). This implies that a holistic view of the system is required so that its design can be successful and sustainable.

In this paper, the abstraction level theorized by Whitworth (2009) was extended to conceptualize a four-dimensional model for OPCs. By merging hardware and software layer of Whitworth's model into a broader dimension of "technology" and adding a new layer representing "content" (as the pivotal information object in OPCs), a four-layer model was deduced that is suitable for addressing the pertinent high-level design aspects in this particular context.

Here it should be noted that the focus of the technology dimension is on the features of the software platform. The specification of other layers, including hardware and software infrastructures and databases, can be deduced from the platform requirements and is therefore outside the scope of high-level design of online communities.

[1] The next paper (Paper 8) is under review for the special issue of the special issue on collaboration and value creation in online communities and has not been published at the time of writing this thesis.

The conceptualized model is depicted in Figure 9 accompanied by the known terms and concepts stemming from mutual interaction between each dimension.

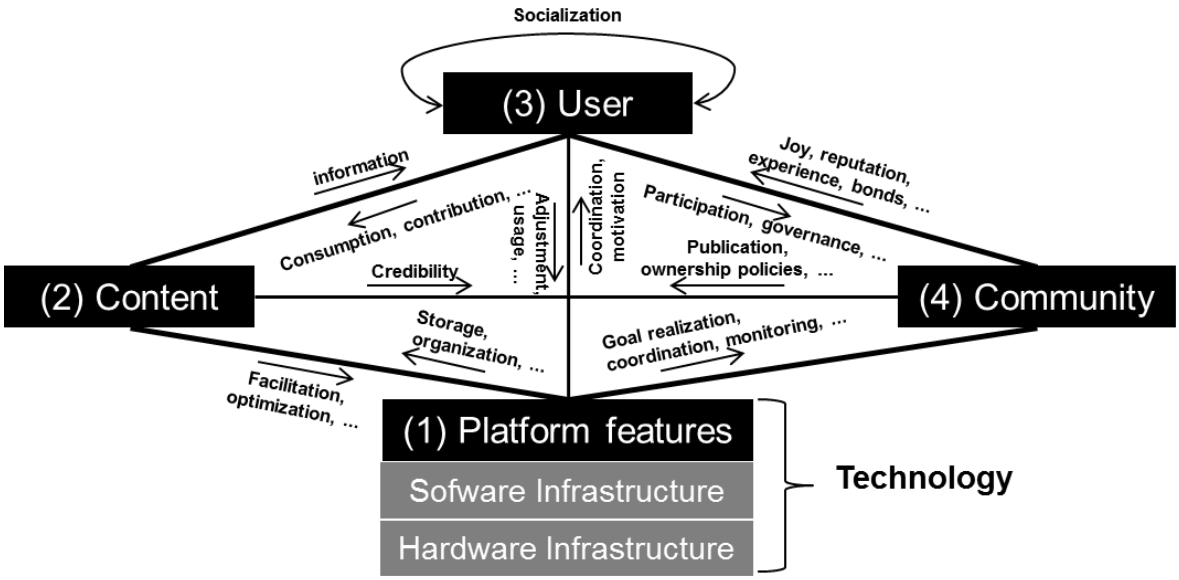

Figure 9 Theoretical framing: abstraction layers of OPCs (Ziaie 2014)

For each layer, the pertinent attributes and interdependencies with those of other layers were identified. Here a summary of each dimension is provided and the essential attributes are listed.

3.7.1.1 Platform features (Technology)

A community's platform provides the necessary tools for the community to support and enable its activities and achieve its goals. Users can employ platform features to perform relevant activities including, but not limited to, communicating with one another, generating content in a structured and coordinated way and participating in the governance process. Features can also work in background and support users indirectly (e.g. recommendation or reputation systems).
Essential attributes of platform features include Purpose, visibility, autonomy and mobile-suitability.

3.7.1.2 Content

Content is the end product of OPCs. The main objective of OPCs, as stated before, is to accumulate and offer high quality and open user-generated content. In many OPCs, not only content development but also content evaluation and qualification have been transferred to the public (Metzger 2007). Several content-related attributes were identified that should be pondered and taken into account throughout the design process of OPCs. These include Type (format), function (form), subjectivity of quality, quality criteria, timeliness, layerability (interdependencies) and interactivity.

3.7.1.3 User

Users are the main actors of online communities. In OPCs, the role of users is more prominent, since the community lives off the contributions of participants to grow and advance. Users bring various skills, experiences, knowledge, ideas and biases into the community (Fulk/Gould 2009).
Several inherent attributes of users have significant influence in their behavior to each other and the community. These include internet efficacy, basic desires, gender and age. The values of some of these attributes are strongly dependent on each other. For example, the primary desires of a user within a community can be predicted by his or her entrenched values and beliefs (Kraut/Resnick 2011). Also, the age of a user might indicate his or her internet efficacy or vice versa.

3.7.1.4 Community

Community, as a design dimension, encompasses different characteristics, requisites, and contextual factors. For example, community *ownership*, *sponsorship* (business model), *vision* (philosophy of existence) and *objectives* all have direct or indirect influence on its success (Kim/Han 2009). Community *lifecycle* has an impact on its *goals*, priorities and users' behavior and the *condition* of a community indicates the validity of its data. Standalone attributes of the community dimension include vision, goal(s), ownership, sponsorships, the stages of lifecycle, condition and size.
Similar to other dimensions, there exist some correlations between these community-related attributes as well. For example, the weight and priority of goals may depend on the lifecycle of the community and its popularity (Ziaie/Imamovic 2013). Also, the condition of a community may influence the desires of users.

3.7.2 Interdependencies of dimensions and attributes

Obtaining insight into the existing interdependencies between the above-mentioned dimensions and the corresponding attributes can contribute to a better design. These are extensively elaborated on in the paper. Here we list the attribute matrix, showing what attributes are the result of the interaction or interdependencies between two dimensions. Studying the possible values of these attributes can elucidate some of the dynamisms and complexities in designing OPCs.

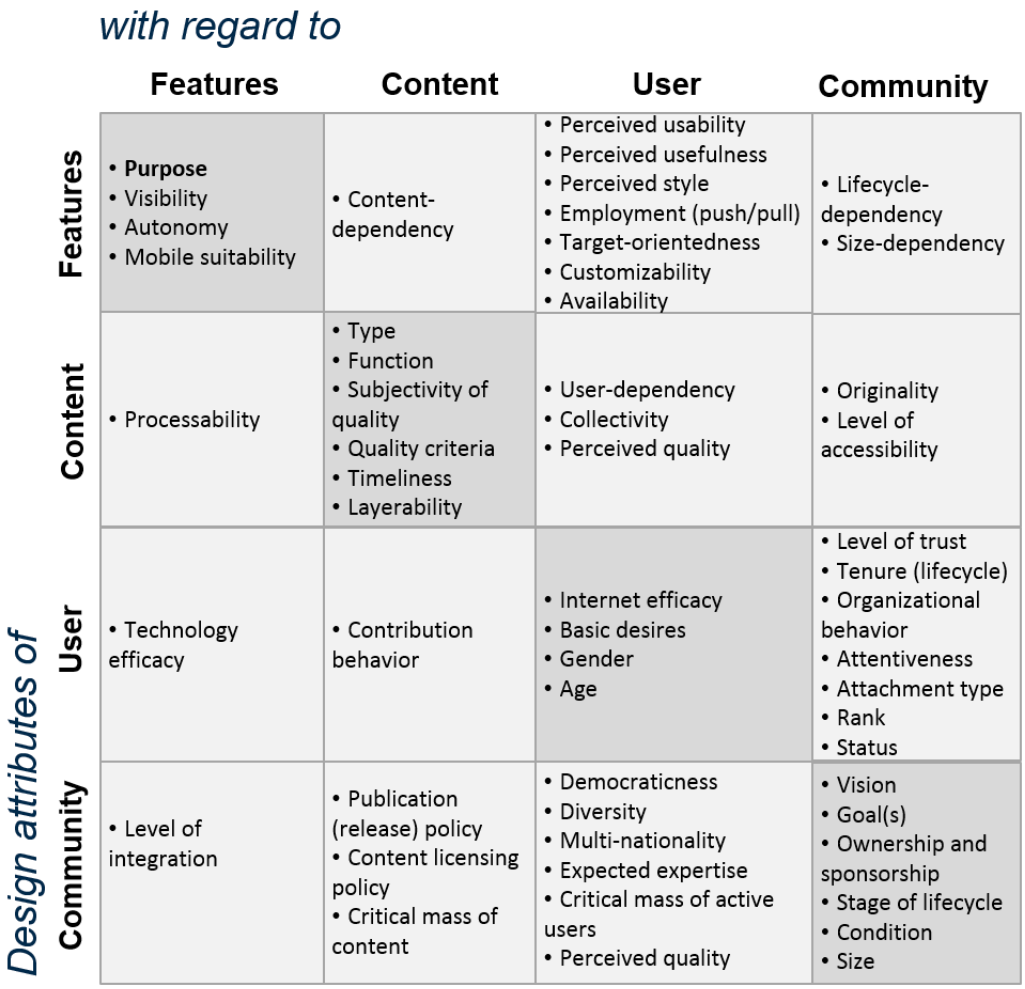

Figure 10 Design attributes stemming from mutual interdependencies (Ziaie 2014)

3.7.3 De-Contextualization

It is of great value to be able to have a context-free perspective over designing OPCs (and online communities in general). This approach will be addressed in Paper 8 (next section). In this paper, as a theoretical foundation for the next one, a "de-contextualization" method is theorized. Learning from other contexts (other types and categories of OPCs) and knowing how to apply their findings can increase the design success of a community significantly. De-contextualization refers to this process. For example, how should a designer know, whether an incentive in a social media community would work in his open source software development community? An important contribution of this paper is to propose a decision process that can give a fair answer to such questions.

In order to do so, first, the attributes of the two communities (the source and the target community) that pertain to a specific feature are identified. Then, their values is compared. If the dichotomy between these influential attributes is considerable, then the application of that certain feature should

be discarded, or at the very least the feature should be altered respectively so that the difference in values are reduced. Otherwise, a feature can be applied from another context with an ease of mind. Figure 11 shows a simplified version of this decision making process.

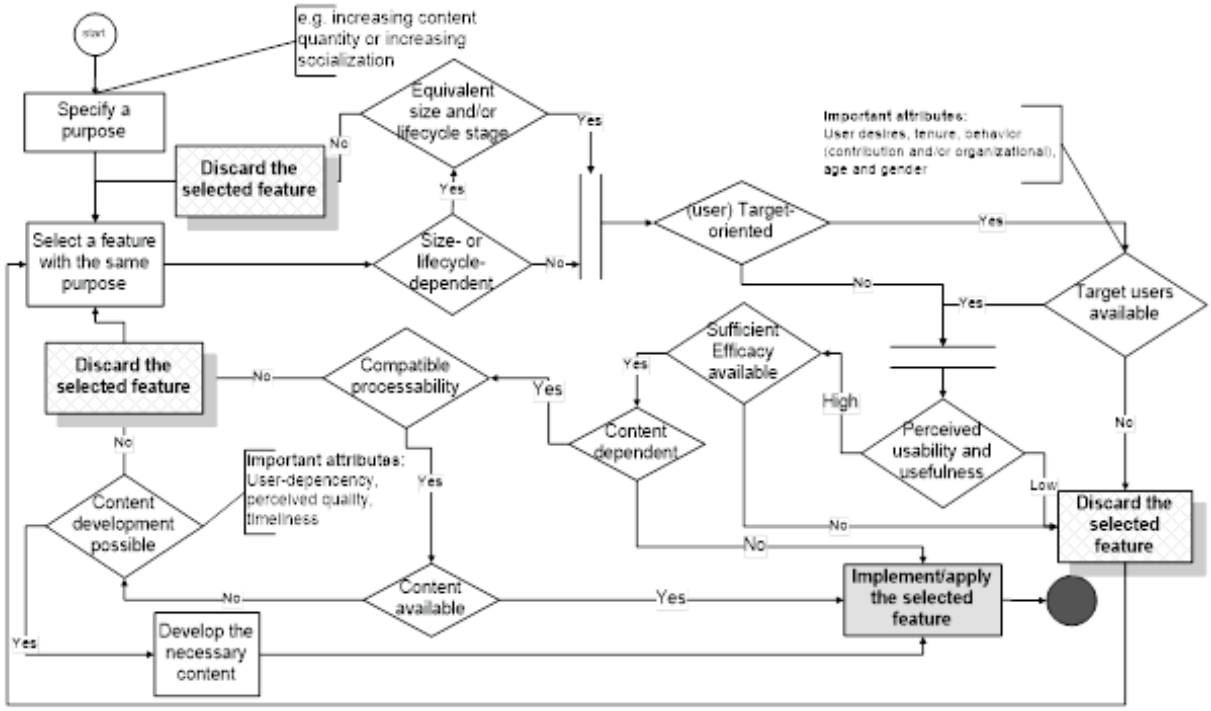

Figure 11 A simplified decision making process for purpose-oriented selection of features (Ziaie 2014)

3.7.4 Contribution

One important contribution of this paper is the synthesis of the large body of literature into specific design dimensions with clear and measurable attributes. An even more significant contribution is employing these conceptualized design dimensions to propose a selection process for estimate the suitability of successful features from another context (another type of community) to be introduced in own community. This novel decision diagram (see Figure 11 a simplified version) helps community designers avail themselves of the accumulated knowledge of experience in other communities without ignoring their own context-specific requirements and characteristics.

3.8 Paper 8: Context-free design principles for OPCs

The final paper that is under review at the time of writing this thesis theorizes context-free or generic design principles for OPCs with regard to the stage of their lifecycle. Here, the findings of other papers has been drawn upon, either directly or indirectly. Also, unlike other papers that were mainly based on comprehensive literature review and Grounded Theory, the findings of this paper are based on qualitative evaluation of experts through the Delphi method.

The goal of the paper is to introduce applicable design principles for OPCs, regardless of their type and category. This means that the principles should be valid for all types of OPC. More importantly, the generalization should be performed in a way that they don't lose their applicability.

3.8.1 Design principles

The final set includes 12 design principles. The principles were put into three categories based on the stage of the lifecycle: pre-establishment principles, post-establishment principles and all-time principles (valid for both stages). They were evaluated by online community scholars in four rounds via an online survey. Figure 12 shows a sample question in the online survey.

In the course of this recursive evaluation process, some preliminary design principles were excluded from the list, since they were specific to only one of the major categories of OPCs. For example, the *Principle of Content Rewindability*, stipulating that "any change on a piece of content should be logged, versioned and, if necessary, rewindable," is a necessity for collaborative OPCs, yet not essential for creative communities. The same is true for the principle of costly vandalism which states that "it should take more effort to vandalize a piece of content than to revert it back to an acceptable version".

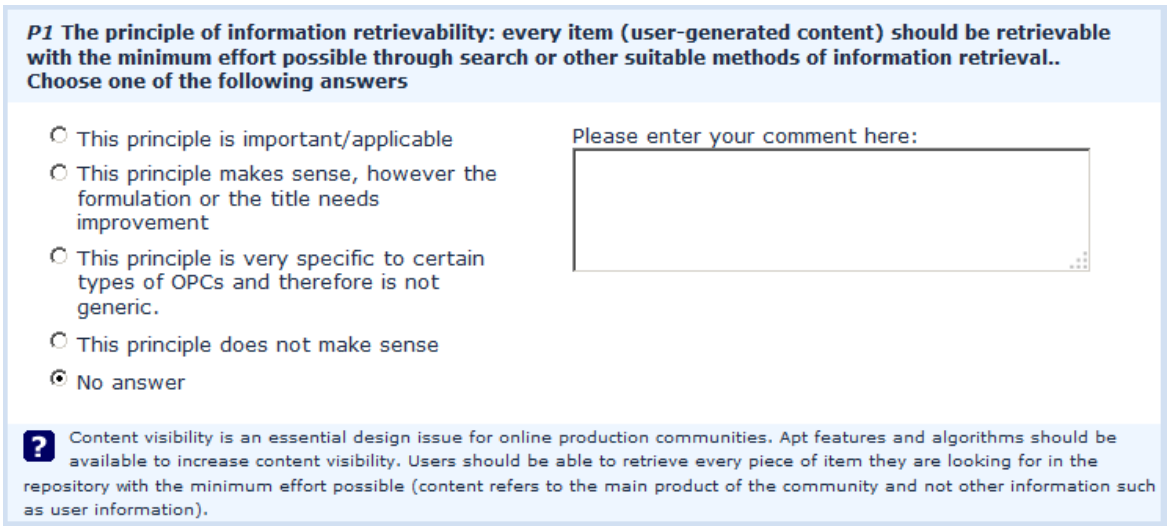

Figure 12 A sample question in the online survey to evaluate the preliminary design principles

Table 6 summarized all-time design principles. These principles address ongoing issues and needs including sustained participation, learning and communication of norms, acceptance of features, cognitive burden on users, security and reliability, privacy and accountability. They should be followed at all time, regardless of the lifecycle stage.

Table 6 All-time design principles

Stage	Principle	Short definition
●	aligned and evolutionary feature development	Features should have a clear and comprehensible purpose and be developed progressively in line with the goals and needs of both community and users.
●	training and socialization	Opportunities and relevant information should exist for new members to familiarize themselves with the codes of conduct, protocols, routines and tasks.
●	deliberation support and community memory	Features should exist to enable users to openly discuss items and issues, capture these discussions and provide visibility for the essential relevant information.
●	authorship transparency	Rights including the ownership and/or authorship of content, if any, should be transparently communicated.
●	privacy transparency	The level of disclosure for any user-related data, whether personal data or transaction records, should be transparent to users.
●	do-ocracy	Users should be empowered to perform and be credited for any community-related activities they wish for, as long as the failure of these activities does not jeopardize a community's credibility or very existence.

In Table 7, lifecycle-dependent design principles are provided. Principles for the pre-establishment stage (circles with left filled half-side) address early issues including vision recognition, content quantity, financing, attracting and acquiring new users, community credibility and user motivation. Post-establishment principles, as the name suggests, focus primarily on issues that arise mostly in the post-establishment stage. These include content quality, information overload, task coordination, conflicts handling, rapid growth, and integration of new members, diversity, legal complications and member attrition. For more information on these two general stages see section 3.6.1 or the corresponding paper in Section B.

Table 7 Design principles for one of the pre- or post-establishment stages

◐	low barrier entry and exit	The process to join the community (registration process) and the procedure to unsubscribe should be enabled with the minimum efforts possible.
◐	vision comprehensibility	A comprehensible vision should be formulated and communicated and publicized effectively.
◑	clear rating criteria	The criteria for assessing the quality of content, if available, should be stated and communicated clearly.
◑	active monitoring	Features should exist to capture and share insightful information including relevant user activities, content situation, achievements and occurring incidents within the community.
◑	organization by disaggregation	It should **be** possible for users to form or join formal or informal sub-communities or groups to share information, performing certain tasks or represent a group of specific interest or expertise.

3.8.2 Contribution

The theorized principles provide a conceptual guideline and frame of action for community designers and operators. They basically act as a 'rule of thumb' or blueprint for designing such fluid and complex systems. Translating the vast, heterogeneous, scattered and sometimes contradicting findings in the context of OPCs is the primary contribution of this paper.

It should be noted that although these principles were well-founded based on theory and expert evaluation, they still need to be tested empirically in different contexts. They may serve as a first step towards design-oriented and context-free interpretation of accumulated knowledge in the complex field of OPC design. The results may also be examined in other types of online communities, since many of the principles may be valid for outside the relatively limited context of OPCs (e.g. open innovation or service-based communities).

In the next section (Part B), the full text of the discussed papers is provided. The thesis is concluded with a discussion and suggestions for future work in Part C.

Part B: Publications

1 Theorizing a Design-oriented Categorization of Online Voluntary Production Communities

Conference Paper

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Contribution of first author: problem definition, research design, literature review, data analysis, theorization

Abstract: as well-known socio-technical systems that aim at accumulating and sharing content by facilitating aligned coordination and collaboration of voluntary participant, online voluntary production communities have been the focus of academic scrutiny in the last decade. Considering their popularity and the increasing theories and models for addressing their various design intricacies and governance methods, there is still no systematic categorization available based on their characteristics to make the existing descriptive or prescriptive approaches more specific or generalizable. In this paper, we address pertinent attributes of such communities and divide them into three major categories, each further divided into few distinct types. Existing theories and frameworks are drawn upon with a design-oriented approach for the sake of this categorization, so that more transparent statements can be made with regard to their design and operation. This refined contextualization helps community designers aptly select features from successful communities only when the underlying theory and characteristic are in line with their own.

Theorizing a Design-Oriented Categorization for Online Voluntary Production Communities

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***Abstract*— As well-known socio-technical systems that aim at accumulating and sharing content by facilitating aligned coordination and collaboration of voluntary participant, online voluntary production communities have been the focus of academic scrutiny in the last decade. Considering their popularity and the increasing theories and models for addressing their various design intricacies and governance methods, there is still no systematic categorization available based on their characteristics to make the existing descriptive or prescriptive approaches more specific or generalizable. In this paper, we address pertinent attributes of such communities and divide them into three major categories, each further divided into few distinct types. Existing theories and frameworks are drawn upon with a design-oriented approach for the sake of this categorization, so that more transparent statements can be made with regard to their design and operation. This refined contextualization helps community designers aptly select features from successful communities only when the underlying theory and characteristic are in line with their own.**

***Index Terms*— Online communities; user-generated content; socio-technical systems, knowledge sharing; collaboration; crowdsourcing**

I. INTRODUCTION

Online communities and social networks are an inextricable part of today's modern society. Voluntary production communities[1] provide a cost-efficient platform to accumulate and structure user-generated content in a systematic way. If designed and operated wisely, production communities can turn the potential creativity, manpower and knowledge of a vast and diverse crowd into well-structured knowledge or pool of digital artifacts. The concept of collaborative generation of content by voluntary members started in the field of software development by the open source movement and soon was applied to other areas including, for example, open media (e.g. citizen journalism [1]), innovation crowdsourcing for products (also called co-creation communities [2] or open innovation platforms [3]) and most importantly, knowledge sharing [4]. Depending on the context and objective, voluntary production communities have been given different terms including open content projects [5], social computing systems [6], peer production communities [7], community-driven knowledge sites [8], or social media [9]. The concept of user-generated content (UGC) together with web-enabled collective intelligence systems [10] has induced an increased interest among scholars and practitioners and, as a result, a vast body of literature has been devoted to investigating certain aspects of these communities. These aspects include, for example, user behavior [11, 12], community governance [13], content quality assessment [14], community lifecycle [15], constructive collaboration [16] and design guidelines [17]. Most of these studies have focused on one particular community (e.g. OSS[2] communities, social media, *Wikipedia* or open innovation platforms) or module (e.g. incentive or recommendation systems).

Generally, online communities are deemed as socio-technical systems, with human beings as their quintessential element. Such systems should therefore be studied from different overlapping perspectives of engineering, computing, psychology and sociology to successfully bridge the gap between technical features and individual characteristics [18]. Moreover, the contextual and individual factors change and evolve perpetually in production communities, giving them a vibrant nature under constant flux [19]. All these factors make the design and operation of online communities a dynamic and challenging task. Correspondingly, communities have different focuses and priorities in different stages of their lifecycle [15]. In such complex systems, learning from past experience and similar environment is inevitable. In order to apply existing practices, however, one should first know how generalizable the findings in other communities are. If the goal of a community, or the attitude and motivation of its users or the type of its content differs drastically from another community, there is no guarantee that a successfully applied

[1] In this paper, the term "production community" is used for voluntary production communities, unless stated otherwise.

[2] Open source software

solution or feature in one community can be positively employed in another.

This paper aims at providing a design-oriented categorization of production communities, so that generalizing the findings and theories can be performed in a structured and constructive way. We draw upon existing theories, approaches and models to categorize relevant communities based on their characteristic similarities. Particularly findings in the fields of collective intelligence [10] and socio-technical [18, 20] systems are harvested and extended to address different aspects of production communities. The results of our comprehensive study show that by using the collectivity and timeliness of content, communities can be divided into three primary categories, namely *collaborative*, *creative* and *competitive*. Collaborative communities can be divided into knowledge (e.g. Wikipedia), source (e.g. OSS communities) and product (e.g. Quirky.com) development. In creative communities, users can create content individually and then have others discuss, distribute and evaluate it. Four subcategories can be distinguished here: open discussions (e.g. Yahoo Answers), knowledge (e.g. Urbandictionary.com), news (e.g. Digg.com) and digital file sharing (e.g. Flickr or YouTube). Centering on short-term competitions, competitive communities can be categorized into open innovations/ideas (e.g. IBM's IdeaJam) and digital artifacts (e.g. Threadless). Following this categorization, a new baseline can be founded on which future research can be built. Furthermore, more distinguished and precise models and mechanisms can be theorized for a more successful design and governance of production communities.

This paper is structured as follows: First, the focused area of study, namely online production communities is defined and the knowledge framework that was used as a theoretical frame to categorize existing production communities is explained. Then, the suggested categorization will be introduced and elaborated upon. Ultimately, we conclude the paper and discuss the pertinent implications.

I. Online Voluntary Production Communities

A. Definition and Distinction

Howard Rheingold, who coined the term "virtual community," described virtual communities from a social perspective as, "social aggregations that emerge from the Net when enough people carry on public discussions long enough, with sufficient human feeling to form webs of personal relationships in cyberspace" [21]. Others gave a looser definition and characterize them as, for example, "a community in which the primary mode of interaction is electronic and not face-to-face" [22]. Today, the terms "online" and "virtual" may be used interchangeably for communities. Although online communities are a rather new phenomenon, they have many similarities with real-world communities and many agree that they can be linked to the sociological definition of "community" [23, 24]. This enables researchers to draw on theories and practices that pertain to real communities and modify, extend and apply these theories and practices to the virtual world.

There are several types of online communities based on different criteria such as their objectives, activities, or users' needs. For example, they have been categorized based on their objective (areas of interest) into types related to spirituality, health, work, politics, transaction and education [25]. Some researchers have classified communities according to different dimensions, such as attributes, supporting software, relation to physical communities, boundedness, supporting software possibilities [26], or source of revenue [27]. Communities of interest to this paper are online platforms in which voluntary users create and share content either through collaboration with others or individually. This is in line with the definition of open production communities (OPCs) [28], except that the created content is not necessarily open.

From a social perspective, primary group focus and social structure [29] or users' affection toward a community [30] have also been used as criteria to classify communities. In the next section, we propose a categorization based on content development approach and content type.

B. Generic Design Dimensions of OPCs

Based on generic design dimensions for online communities proposed by [20], attributes of the three dimensions of user, content and community can be used to cluster communities into three groups with distinct characteristics. *Table 1* shows a list of these attributes.

Some of these attributes are of great importance for categorizing production communities, and some are only meaningful in specific systems including, incentive systems and quality assurance. Borrowing from this framework, the relevant attributes for the purpose of categorization are: user desires, level of collaboration, content type, content function, content timeliness, licensing policy (content ownership) and the philosophy of the community.

In the next section, we use content timeliness, licensing policy, level of collaboration and philosophy of the community to categorize communities into three distinct and general categories. Then, we use content type and function to further divide them into different subcategories.

II. Voluntary Production Communities: Categorization

Development (generation and improvement) of content can be performed either collaboratively or individually (creatively). The *level of collaboration* indicates this fundamental distinction. Collaboratively developed content means that the main body of content (its essence) can be developed by more than one user. In creative content development, however, each user is considered to be the "owner" of his or her generated content and the other users may only contribute *metacontent* in the form of comments, ratings, recommendations and so forth (see [31] for a

comprehensive taxonomy on content). McKenzie et al. [16] termed the generated digital artifacts in the first case "*collaborative content"* and in the latter "*creative content*". We call the general categories of community collaborative and creative. It is helpful to use the level of collaboration as an essential factor to categorize communities since the resulting two general community types often practice different governance mechanisms and approaches [32, 33].

If we include timeliness of content and the philosophy of the community, a new category emerges that also differs from the other two in several matters including, for example, incentive mechanisms. For this new category we introduce the term "competitive community". Competitive communities differ from the other two types in that the primary motivation behind generating content is often, but not always, extrinsic; the time frame for contributions is limited; and the produced content is not necessarily open (it cannot be considered as public good). Our categorization aligns well with the categorization introduced by [10], where they consider three options of *collection*, *contest* and *collaboration* for creating content.

A. Collaborative Communities

Communities that opt for a collaborative approach to generating content can be grouped into three major categories according to the type of content: source (*open source software* development), text (*collaborative content repository*) and digital artifacts (*collaborative artifact development*). This distinction is primarily based on the necessary skill level of users and distinguished nature of the end products of the community. Also, publication policy is often different. While there is a closed-gate policy in almost all open source software communities, such strict quality assurance mechanisms are rarely practiced in the other two types. The dominant desires of users differ as well. In collaborative content repositories fun and self-importance are primary desires, whereas in OSS communities self-development and group identity are prevalent [34]. Moreover, OSS communities show notably different success factors than the other two types [35]. Collaborative content repositories (e.g. *Wikipedia*) are distinguished from collaborative artifact development (e.g. *Quirky*) by the level of expertise of users and the desire for self-development. A cross-comparison of user desires is shown in Table 2.

B. Creative Communities

Creative communities are the majority of production communities in which users generate content individually and then evaluate or discuss each other's contributions. Four major sub-categories have been identified in literature, each focusing on a specific content type or form (see *TABLE 1*) for the corresponding definitions): *open media* communities facilitate citizen journalism [36] and deal mostly with user-generated news and other forms of articles (e.g. reports, , interviews, personal opinion, etc.) [37]. Users in these communities either generate content or refer to items on other websites. In c*reative knowledge repositories*, users generate or accumulate information on a certain topic. Depending on how critical the published information may be, open-gate or closed-gate policies will be observed for publishing content. For example, in urbandictionary.com, where users enter trendy expressions and colloquial words, the contributions need to be approved by privileged users before they can be made public. *Open file-sharing communities* are digital platforms for users to create and share files. The type of file can be document, image (e.g. *Flickr*), audio or video (e.g. *YouTube*). Finally, *open discussion communities* are one of the oldest types of communities where users can discuss certain topics or ask questions and receive answers from other members of the community (e.g. *Yahoo Answers* [38]).

TABLE 1 RELEVANT DESIGN DIMENSIONS AND ATTRIBUTES TO CATEGORIZE PRODUCTION COMMUNITIES (BASED ON [20])

Dimensions	Attributes	Description
User	Desires	Users' desires are a decisive predictor of their intrinsic or extrinsic motivations [39]. Determining desires in the context of production communities are: *self-importance*, *self-development*, *fun*, *vindication*, *socialization*, *group identity* and *uniqueness (based on* [40]*).*
Content	Timeliness	Timeliness indicates whether the value or quality of content alters with time [41].
	Collectivity or the level of collaboration	Collectivity of content [42] corresponds to the depth of user collaboration with one another to develop content. The highest level of collaboration takes place in wiki-based knowledge repositories or OSS communities [43], also known as collaborative communities, since any eligible user can alter and update the main body of content.
	Type	Types of content include text, image, audio, video, code or digital artefact including, for example, design sketches and 3D models [44].
	Form (function)	Refers to the purpose and application of content. Examples: news, essays, entertainment, maps, designs, products or ideas (innovations).
Community	Philosophy of existence (vision)	The purpose of existence of a community [45]. The more attractive this purpose is, the stronger the commitment and intrinsic motivations of users will be to help the community thrive[46].
	Content ownership	Who the content belongs to, who is responsible for the content and how to reuse, distribute or extend it.

Each of these categories has its own unique characteristics or features. In open media communities, for example, timeliness of content is of great importance. In open file-sharing communities, altering the generated or uploaded content is either not possible or difficult, which is in sharp contrast to the so-called permanently "unfinished" nature of the content in open media or creative knowledge repositories [47]. In open discussion communities self-importance and uniqueness are highly desirable [48]. These different desires and motivations should be carefully considered when making decisions regarding incentives. Moreover, the theoretical construct of findings in each of these categories should be consistent with another type before the statements and hypothesis can be extended or applied to another type.

C. Competitive Communities

Competitive communities, also known as open innovation communities [49], are communities in which the generation of ideas or designs is crowdsourced to users. These communities run short-term and topic-oriented projects with specific problems to tackle. They are often used for commercial, political or social purposes. Considering this limited scope and the pertinent issues of content ownership [50], extrinsic motivations such as winning prizes or bolstering reputation play a more significant role in these communities than intrinsic motivations such as altruism or reciprocity. For this reason, unlike other communities, monetary rewards do not have a "crowding out" effect and have proven effective [51].

The two most widespread forms of content in competitive communities are ideas and designs. Dell's *IdeaStorm* or IBM's *IdeaJam* are two examples of idea-generating competitive communities. The end result can also be a design (or product). *Threadless* is an example of a design-oriented competitive community in which users submit their T-shirt designs and evaluate the submissions of others, with the winning designs being produced at regular intervals. The primary difference between these two sub-categories is the skill level of the users. Any user can submit an idea for various topics of interest; however, to design a product, a certain level of expertise is needed. Accordingly, while vindication and uniqueness are two primary desires for both community types, self-development is of greater importance in design-oriented competitive communities. Companies often need to contemplate thoroughly when deciding between a competitive market and a collaborative community, since this decision will determine the types of external participating innovators [52].

A tree diagram illustrates the proposed three categories and their sub-categories in Fig. 1. Next, we study these categories from the perspective of user desires to elucidate their design similarities and differences.

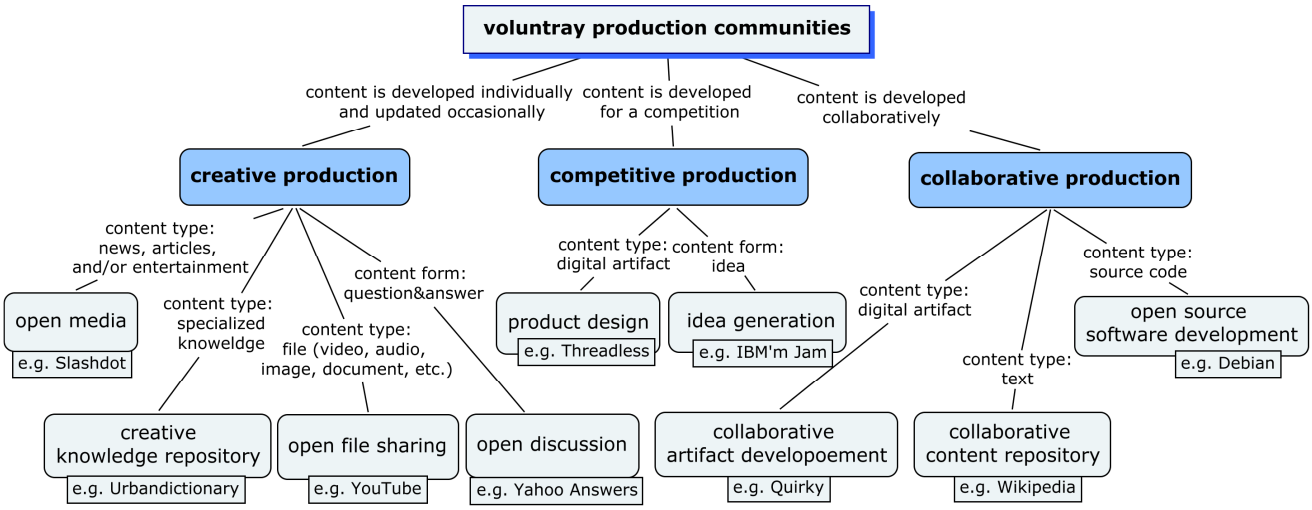

Fig. 1. Three major categories and their sub-categories for open production communities

III. Categorization Applicability: The Example of User Desires

Constant, constructive and consistent participation is a critical success factor for voluntary production communities. This is why designing apt incentive systems to encourage user commitment to the community and its activities is one of the most important and most challenging tasks for community designers and operators. Motivating users is more of an art than a science [53], because the context (community) and the actors (users) are perpetually changing. Many researchers have tried to study and explain new ways of motivating users with different theories based on theories pertaining to intrinsic and extrinsic motivations [54]. There are also researchers who question a fine distinction between intrinsic and extrinsic motivations and consider everything to be a matter of individual difference.

For example, Reiss [40] proposes the theory of 16 basic desires based on psychometric research. His theory suggests that all fundamental desires can exist with different strengths at different times in different individuals. Here, we cross compare our categorization with seven user desires in Reiss's theory that are relevant to the context of production communities and look for similar patterns. The salient user desires in every type of voluntary production community has been drawn from existing empirical studies. The result is shown in Table 2.

TABLE 2 CROSS-COMPARISON BETWEEN DIFFERENT COMMUNITY CATEGORIES AND THE SALIENT USER DESIRES

Category	Community Type	SI	SD	F	V	S	GI	U	Selected Reference(s)
Collaborative	Open source software development		X			X	X		[12, 55]
	Collaborative artifact development	X	X	X					[56]
	Collaborative content repository	X		X				X	[57-59]
Creative	Open media	X				X	X		[1, 37]
	Open (creative) knowledge		X	X				X	[60, 61]
	Open file sharing	X				X		X	[34, 53, 62, 63]
	Open discussion	X				X	X		[64-66]
Competitive	Competitive idea generation	X			X			X	[49, 67, 68]
	Competitive product design		X		X			X	[69, 70]
SI: self-importance, **SD**: self-development, **F**: fun, **V**: vindication, **S**: socialization, **GI**: group identity, **U**: uniqueness									

As noted before, the critical question for every community designer or operator is: what kinds of incentives would be most likely to have a positive effect on users' contribution and commitment? For example, open media and open discussion communities present the same patterns regarding the salient desires of their users. This suggests that theories or solutions that have proven successful in one of these two communities may be applied to the other. Table 2 provides a reference for community designers to know what features are more likely to work in the incentive system of their communities based on the best practices of other communities. The same table can be made for other input variables including user behavior, governance mechanisms and quality assessment approaches. In a sense, the categorization outlined here provides a new baseline for comparing the findings in one specific type of community to those of another in the context of voluntary production communities.

IV. CONCLUSION

Designing production communities as socio-technical systems requires meticulous attention to all technical, individual and social levels. This makes their design a dynamic and interactive process that needs to be constantly adapted to the needs of the users and the community. Numerous studies in online communities have put a range of different design areas under scrutiny, including incentive systems, community governance and content quality assessment. Taking different characteristics of these communities into account, it is essential to know to what extent the findings and hypotheses of one particular community type can be generalized and applied to another.

In this paper, we center on the characteristics of voluntary production communities with regard to three dimensions: user, content and community (see *TABLE 1*). Based on the different attributes of these dimensions [20], we partitioned these communities into three general categories: *collaborative*, *creative* and *competitive* communities. We further divided these categories into sub-categories based on different types and forms of content. With the perspective that we have outlined in this paper, one can integrate prior research of one particular community type and reconcile contradictory findings for another type by specifying how different the distinguishing factors are in both communities.

As an example, we applied our categorization to relevant user desires proposed by Reiss [40] and studied the similarities. For the purpose of designing incentive systems that are based on users' desires, this construct can suggest how likely the consistency between the solutions and hypotheses in different types of communities may be. This helps with so-called "decontextualization" [71], where ideas and solutions can become detached from their creators and from the context in which they were originally created [72]. Moreover, the proposed categorization can be used to fine-grain further theoretical development by narrowing the focus of study.

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2 Content in Open Production Communities: Taxonomy and Design Construct

Conference Paper

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Authors: Pujan Ziaie and Helmut Krcmar

Contribution of first author: problem definition, research design, literature review, data analysis, information coding and synthesizing, conceptualization

Abstract: open production communities (OPCs) are online communities in which content is solely generated by users and is publicly available for everyone. By leveraging the manpower and collective intelligence of a vast crowd, these communities facilitate gleaning, structuring, evaluating and sharing information from different perspectives and in different areas of interest. Content, as "the king" in OPCs, has been loosely modeled and defined in the literature. Observing the lack of a standard and generalized terminology in the field of production communities in general and in content-related activities in particular, this paper introduces a fine-grained taxonomy for OPCs and a novel representational construct to resolve inconsistencies based on the existing theories and approaches. The results will establish a standard vocabulary and a unified construct for content to be used by researchers and community designers in this growing field of study.

Content in Open Production Communities: Taxonomy and Design Construct

Providing a Taxonomy and Conceptualizing a Construct to Address Content and Content-related Activites

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Abstract: Open production communities (OPCs) are online communities in which content is solely generated by users and is publicly available for everyone. By leveraging the manpower and collective intelligence of a vast crowd, these communities facilitate gleaning, structuring, evaluating and sharing information from different perspectives and in different areas of interest. Content, as "the king" in OPCs, has been loosely modeled and defined in the literature. Observing the lack of a standard and generalized terminology in the field of production communities in general and in content-related activities in particular, this paper introduces a fine-grained taxonomy for OPCs and a novel representational construct to resolve inconsistencies based on the existing theories and approaches. The results will establish a standard vocabulary and a unified construct for content to be used by researchers and community designers in this growing field of study.

Keywords: online communities, user-generated content (UGC), open production communities (OPC), content quality, collaboration

I. INTRODUCTION (HEADING 1)

The increasing number of internet users and the interactive features of Web2.0 have significantly facilitated content generation and sharing in the last decade. As a result, an enormous amount of content is being produced every second of every day in the Internet, a virtual network that lacks distinguishable voices of authority [1]. Many websites try to accumulate and structure user-generated content in a systematic way to turn the potential creativity, manpower, and knowledge of a vast crowd into reusable knowledge. This potential of a large number of people has been used in many areas such as in providing news (citizen journalism), idea generation (e.g. open innovation communities [2]), software development, or knowledge sharing.

Open production communities are public communities with two or more layers (tiers) of users, in which the generation of content is performed by users and this user-generated content (UGC) is considered as a public good. These online communities have been built around the idea of providing an environment for users to generate, update, evaluate, and share content. They are characterized as gift economies where members are non-competing, have a common objective, and the resources (content) are not scarce, but abundant [3]. In many such communities, in addition to content generation, the information qualification process has also been transferred from experts to the information-seeking and information-generating public [4]. *Wikipedia*, *Slashdot, Flickr* or *Yahoo Answers* are some prominent examples of OPCs, each focusing on a different domain or form of knowledge. Production communities, in general, differ from service-based communities (e.g. for gaming), social networks, and common-bond communities [5] in which the main objective is not necessarily to accumulate high-quality public user-generated content. This "new world" of user-driven production communities have inevitably created a new understanding of many aspects such as collaboration, motivation, ownership, and quality [6]. What all these communities have in common is the salient role of content and users as the sole generator (and sometime evaluator) of content. In other words, content is "the king" in open production communities[1].

Despite the prominent role of content, its variety, and the paramount importance of quality assurance processes, no generic model has been conceptualized to address the major elements of content and no terminology standards have yet been suggested or established to facilitate the communication and accumulation of knowledge in this field.

In this paper, we focus on the following research questions:

RQ1: How can the content, as a construct, be represented in the context of open production communities?

RQ2: What types of OPCs can be distinguished based on the approaches to generate and publish content?

RQ3: What taxonomy can address and standardize content-related entities and activities?

To answer these questions, we address the relevant practices and frequently used terminologies in the context of OPCs based on a critical literature review. Here, the focus is on the content in the information layer rather than in the data layer. In

[1] "content in virtual communities is the king" is a quote by Jay Marathe, the head of consulting at Durlacher Research Ltd.

order to conceptualize a generic construct for content, a constructive grounded theory approach [7] was used to glean all relevant elements of content in different types of OPCs and sort them into a number of categories according to their characteristic similarities.

This paper is structured as follows: First, the accumulated knowledge is provided in a structured form in two major domains: content as an entity and content generation as a process. In the first domain, content as an entity is studied and a new construct for content is introduced. In the second part, open production communities are classified into four different domains based on two dimensions: how the content is developed (collaborative vs. creative) and how the content is published (open-gate vs. closed-gate). Then, taxonomy to consolidate and standardize the frequently used terms pertaining to content and content generation is suggested. Finally, the conclusion including a summary of the discussions, important issues and future works will be provided.

II. User-Generated Content: Conceptualization

To conceptualize different aspects and elements of user-generated content, the literature and best practices were reviewed and studied from an engineering perspective with a focus on two main domains: content as an abstract entity and content qualification processes. This section entails content characteristics in production communities and the relevant features of content that may be leveraged to enhance content quality. Based on the gleaned information, a new construct (model) is introduced to represent content in open production communities. The proposed model can explain different behaviors and approaches in various content production contexts.

The term "content" has been used in the literature with different connotations depending on the context and application. Generally, content refers to a piece of information that can be accessed on demand or is available at certain times within the system (in this case, within an online community). Content can be altered, transmitted, viewed, and traded in parts or as a whole [8]. In the context of production communities, however, a common terminology is missing and more sophisticated and refined definitions are needed to address content and its inextricable elements. In many production communities, content is generated by one user, and then extended (by means of comments, tags, ratings, etc.) or edited (in case of collaborative content generation) by others. Regarding the construct of content, four elements can be distinguished for each content: The main body of content (*main content*), separate contents that are categorized under or are related to the main content (*subcontent*), the additional information that is added by users to enrich the main content (*metacontent*), and the additional information that is added by the system[2] to enrich both the main content and its pertinent subcontents (*metainformation*) (see Fig. 1).

1) Main content

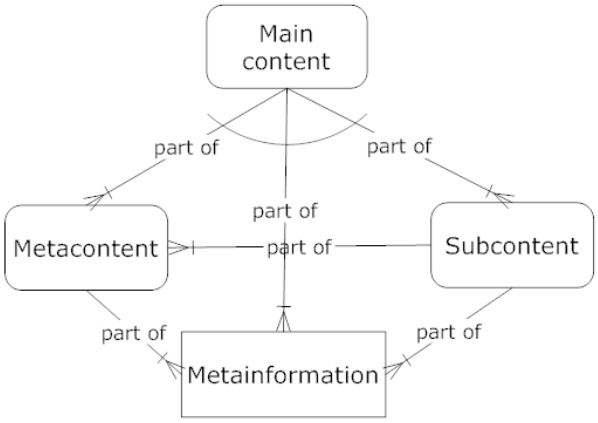

Figure 1. Relationship diagrams of content elements

Each generated content has a main part, which has sometimes been referred to as the *essence* of content [9]. For example, the main body of articles in an encyclopedia, the text, picture, or video that represents an article or some news in a media website, content of the files in file sharing sites, or blog posts in weblogs can all be considered as "main content". In open collaboration communities [10], where the main content is being generated *collaboratively*, this main content can be edited by other users as well (e.g. in Wikipedia or open source projects). In *creative* production communities, on the other hand, only the user that has generated or publicized[3] [11] the content in the first place is able to update it if necessary [12].

2) Subcontent

Allowing Discussions and reviews over generated content, whether news, an article, a blog post, or an uploaded video or picture allows other members to supplement them with new information from different angles [13]. Nowadays, the discussion (commenting) feature is available in almost every production community for any generated or publicized piece of content. Particularly in the context of open media, it is believed that any news report is per se "*unfinished*" [14] and needs to be extended and enriched from other angels and views. Additional files that are attached to provide additional information can also be considered as subcontent. These subcontents have, in fact, all the features of the main content, with the exception that they are categorized or located as a subsection of a main content. In other words, their existence is based or dependent on another piece of content.

3) Metacontent

Metacontent refers to the user-generated supplementary information that can be added to a piece of content (main content as well as subcontent) in order to subjectively specify its value (evaluative) or to enrich its characteristics and scope (descriptive). In the literature, human-generated metadata [15], socially-generated metadata[4] [16], metadata [17] or metainformation [18] are commonly used terms to address this socially-

[2] This additional information can be added periodically, event-based, or at the time of generation

[3] Publicizing is defined as creating pointers to reports or news that have been generated elsewhere. Publicizing is a common action in social bookmarking websites.

[4] Socially-generated metadata has been used to address both metacontent and subcontent

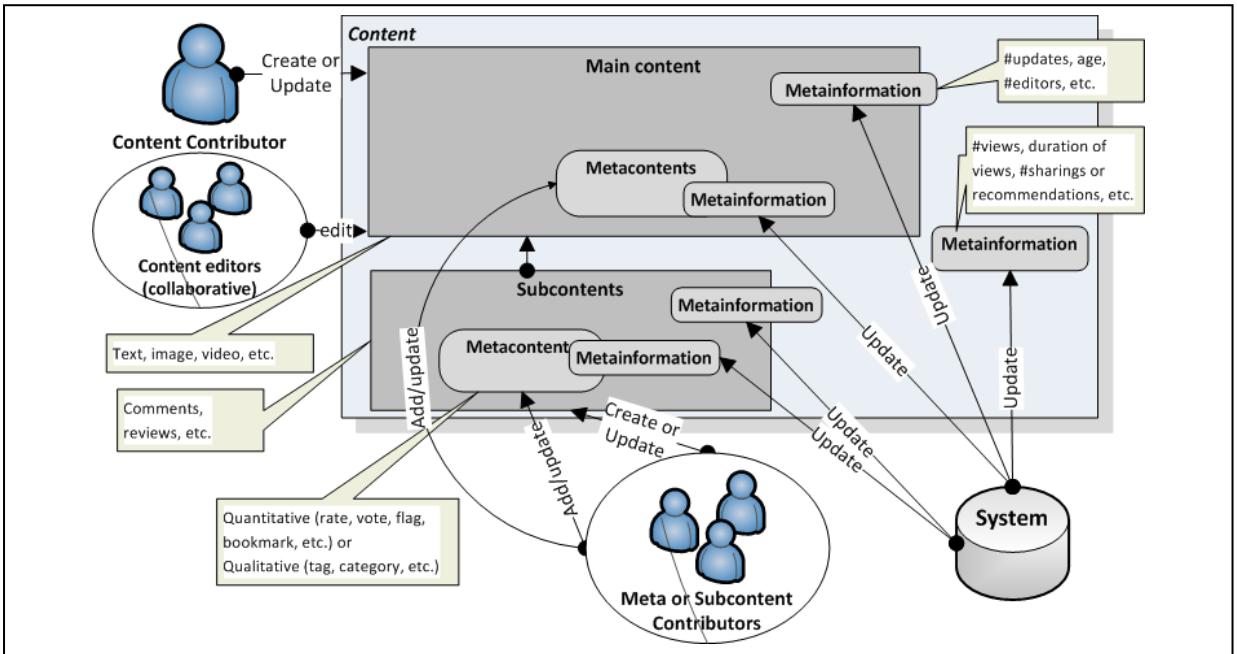

Figure 2. Content construct and the relating actors in open production communities

generated constituents of content. Metacontent is with no doubt one of the key features driving the growth and success of Social Web [19]. The quality of metacontent (especially its accuracy and consistency) is of great importance, since it is frequently used to assess the quality of content [17].

Contributing metacontent is in part a personal act (for organizing content for own use) and in part a social activity to help others (and also the system) with finding, interpreting, evaluating, and understanding the essential message of a piece of content [20]. The most known types of metacontent are tags (labels), categories, and ratings; nevertheless, any other socially-generated information such as votes, flags, favorites, notes (when editing or updating the main content for example), or other user-generated supplementary information can also be considered as metacontent.

4) Metainformation

The term metainformation is chosen to address any type of supplementary information that is extracted, detected, or derived from the *context*, the *content*, and the transacting *users* by the system. Davis et al. [21] refer to this process as the "*context-to-content*" paradigm. Although "*metadata*" has also been used in the literature to address additional information for content (e.g. in [22]), we deliberately refrained from using "data" and "metadata" in this particular context, so that we can draw a distinct line between the data layer (relating to database and data storages) and the information layer (any piece of information that can be processed by human-beings). Metainformation is, therefore, useful pieces of information that can be gathered or calculated by the system from the context (e.g. the origin of content, the location or IP address of the contributing user or viewing users), the content (e.g. currency of content, its size and richness, or the number of edits) [23], and the user (e.g. his or her reputation within the community, age, origin, background, etc.).

When designing a community, depending on the context, possible (inter)actions and the corresponding implications should be identified in advance as relevant metainformation. Metainformation can encompass relevant information about all user-generated elements of content, including the main content, its subcontents and metacontents. It should also contain pertinent information on different combinations of or interrelations between these elements (see Fig. 2). The information that pertains to these interactions should then be gathered either at the point of generation, or at the time of occurrence of relevant transactions, or periodically (via batch-processing for example). Similar to metacontent, metainformation is of great value to the system to assess or predict content quality [24]. It also provides valuable data for clustering algorithms (e.g. to identify similar segments of content or groups of users), search engines (to index and filter information and optimize their results) [25], and recommendation systems (e.g. to suggest relevant content to be viewed or updated) [26]. Moreover, it has been suggested that the values of metainformation be normalized by the category of content so that the possible future evaluations would be more accurate [27].

Fig. 2 demonstrates the construct of content as a whole and its constituents as well as the contributing actors. As depicted in this figure, users can create, update and edit the main content, subcontents, and their corresponding metacontents. The system, then, provides metainformation on all these three elements and the relevant combinations of them (e.g. the versatility of editors or the number of clicks on the links in the main content). In the next section, different approach towards content generation will be discussed.

III. Content Generation and Approval Approaches

The second domain of our study emphasizes content qualification and publication processes and suggests a categorization of OPCs based on two dimensions: the approach to generate and update content (collaborative vs. creative) and the publica-

tion process of the content (open-gate vs. closed-gate). Based on the culled knowledge from these two domains, at the end of this section, we ultimately suggest a standard and consistent taxonomy that can be used by the scientific community to address features and mechanisms related to content and content generation processes and activities.

In open production communities, two main approaches towards content generation and improvement can be distinguished: *collaborative* and *creative*. The major difference between these two approaches is how they deal with content modifications. What is, however, similar in both approaches, is accepting the fact that content is "*unfinished*" [14]. In the first approach users collaborate mainly in improving the main content, while in the second approach they collaborate in extending the content by adding descriptive and evaluative metacontent.

A. Collaborative content generation

In the context of knowledge development, collaborative content generation not only helps to keep the knowledge pool up-to-date, but also provides an opportunity to add multiperspectivality to matters where no objective quality standards can be achieved. In other contexts such as collaborative architectural sketching, video editing, or geographical maps [10], providing editing features helps improving the content based on a set of agreed objective criteria. Despite all these advantages, however, it should be noted that editing features also open up the door to vandalism [28]. This concern has led to some skepticism over the credibility and quality of the generated content [29], which in return magnifies the need for apt mechanisms to assure content quality in such communities.

The contribution patter in collaborative OPCs differs even in active members. Some members are considered main content contributors (who generate main content and instantiate the edition/revision process), while others are either metacontent contributors or merely main content *editors*[5] [30, 31].

The most salient issues and challenges in designing and governing a platform for collaborative content generation are generally lack of contribution, duplicity or redundancy of data, conflict management between users with differing ideologies or perspectives [32], dealing with vandals [29] such as trolls [33] or spammers [34], and the development of a common ground by training users and familiarizing them with the norms, philosophy and objective of the community [35]. Next, we review the characteristics of *creative* communities.

B. Creative content generation

In creative open production communities, the main content is either not easily updatable (e.g. videos and photos) or can be modified merely by the creator of the content and not by other ordinary users [12]. The collaborations and interactions, therefore, take place mainly in the subcontent and metacontent layers. Weblogs, review portals, open file sharing platforms, questions and answers portals, public discussion forums and open media sites are prominent examples of creative content generation [36]. Subcontent is usually in the form of comments/discussions, reviews, answers, or file attachments. Metacontent mainly consists of tags, categories, and any possible means of evaluation (ratings, votes, bookmarks, etc.). Since filtering and sorting content is largely based on user evaluation, finding apt evaluation criteria and quantitative measures for quality is of great importance in creative communities.

Similar to collaborative communities, the contribution behavior in communities with semicollaborative content is also different. Some users tend to contribute main content, some merely generate subcontent or metacontent [30]. This behavior might change with regard to the member lifespan [37]. Moreover, because of the significance of users' evaluation, encouraging metacontent contribution is sometimes more important than encouraging main content contribution, especially after a community has reached its critical mass of active users or content [38].

Issues and challenges in creative communities are slightly different from those of collaborative ones. While in collaborative communities the focus is on constructive coordination and quick reversion of vandalism, achieving a practical and effective way of evaluating the quality of content is of great importance in creative communities. Ill-intended or dishonest users who try to game the system or build up gangs to pimp content to the top (or the first page in open media sites for example) are common issues to deal with. This is due to the fact that here, unlike collaborative communities, user evaluation plays a vital role in assessing the value of content and filtering/sorting it. Designing proper criteria for content evaluation to combine the subjective judgment of users with respect to objective criteria is another challenging task that requires delicate attention. Moreover, the criteria should be comprehensive enough to adequately address quality measures of content, yet these criteria shall not be too complicated, lest they impose high cognitive burden on users [39].

Finally, it should be noted that user interaction still exists in creative communities; however, it is merely taking place on the metacontent and subcontent elements.

C. Content Approval/Publication Approaches: Open-gate vs. Closed-gate

Some researchers have divided production communities into two general categories [11, 40]: open-gate (or open) and closed-gate (or gated). This categorization is with regard to quality approval process and lies on the basic principles of production. In manufacturing, quality can be assured or improved by either introducing quality enhancement processes (as in open-gate communities) or by applying stricter quality approval procedures for the ready products (as in closed-gate communities) [41].

In open-gate communities, content will be published (meaning made available to the public) at the same instant it is produced or delivered. The evaluation and quality enhancement procedures follow the publication. In (open-gate) collaborative communities, this quality enhancement is performed by other users in forms of discussions and editions. In (open-gate) creative communities, the content is enriched by other users through their metacontent and subcontent contributions (dis-

[5] Content editors wait for others to generate content and then extend or revise it.

cussion for example). The creator of the content can also update the content based on contextual changes or others' suggestions (through discussions and other possible feedback mechanisms). This way, in many cases, there is no "final" or "perfect" version of content, but content is being improved in a continuous process. One disadvantage of open-gate communities is the possibility of them getting filled out with garbage. Therefore, apt mechanisms to filter and sort content should be practiced in addition to quality enhancement methods in order to encourage high quality of content and exclude content with low quality.

In closed-gate communities, content should go through an approval process before being published and made visible to the public. Closed-gate approach is often practiced in communities with sensible or critical content. Open source communities and critical knowledge platforms (scientific forums reference repositories) are two well-known communities that have a closed-gate system of content publication. The Gene Ontology is a popular example of this approach. The aim of this platform is to use crowdsourcing to standardize the representation of gene and gene product attributes across species and databases. To secure a certain level of credibility, however, contributions (provided vocabularies) go through a control process. The output of open source communities should be controlled and approved as well, since too many faults in the published product (software) can oppose serious threat to the credibility of the product and the community.

IV. Community Categorization and a Standard Taxonomy

We propose a framework to categorize current open production communities based on two dimensions: The collaborativeness of content generation (whether the content is generated collaboratively or creatively), and the openness of content publication processes (whether it is closed-gate or open-gate). As a result, four categories of OPCs can be distinguished: creative open-gate communities, creative closed-gate communities, collaborative open-gate communities and collaborative closed-gate communities. The corresponding matrix including some examples for each category is depicted in Fig. 3.

This categorization provides a framework and narrows the focus for studies on pertinent design concepts and operational mechanisms such as incentive systems, recommendation systems, quality assurance mechanisms, and community governance. Because of similar approaches towards content generation and quality assurance, one can hypothesize that the procedures, guidelines, and practices of each of these concepts show some level of similarity for each of these categories. Moreover, this categorization establishes a common ground to study the impact of the type of content (text, image, software code, videos, etc.) for specific concepts and systems (e.g. recommendation systems).

Finally, based on the conceptualized construct for content and the existing approaches for content generation and publication, a list of common terms is provided. Table I. summarizes this standard terminology (taxonomy) for the context of open content production communities.

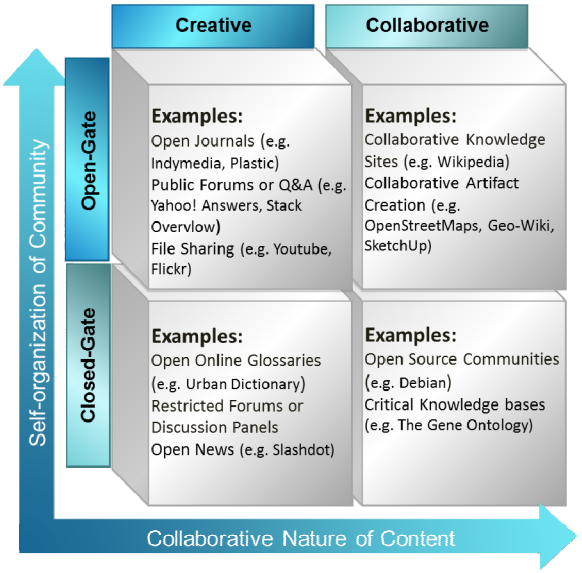

Figure 3. Communities and user-generated content: Collaboration level and publication policy

V. Conclusion

Open production communities (OPCs) and user-generated content (UGC) are rather new phenomena that were initiated by the popularity of open source communities. The concept of crowdsourcing a wide range of activities from content generation to content evaluation and approval, quality enhancement and community governance has been rapidly growing and been applied in other contexts since the introduction of Web2.0. Although there is a large body of literature in this research area, standards and common models and frameworks are not yet widely established. In this paper, we conceptualized a new construct for content to be used in the context of OPCs. The proposed construct consists of four elements: main content, subcontent, metacontent, and metainformation. The first three elements are often contributed by users (with an exception of bots or some techniques to import information from other repositories) and the last one automatically by the system. This construct helps scholars to have a common model to use and address when conducting research in content-related areas of study. Furthermore, two approaches where distinguished in the process of content generation and publication. Content generation can be performed either collaboratively or creatively. In collaborative content generation every user has the right to edit and improve the main content, whereas in creative content generation only the creator of content may alter the main content and the other users may only contribute metacontent and subcontent. Regarding content publication, two major approaches were identified: closed-gate and open-gate. In closed-gate approach, content should be approved by privileged users based on specific quality criteria before being published. In open-gate approach, content is published right after being generated and the quality enhancement follows the publication by all users, whether collaboratively, or by suggesting amendments or enriching the content by contributing subcontent and metacontent.

TABLE I. A TAXONOMY OF CONTENT-RELATED ACTIONS AND ENTITIES IN OPEN PRODUCTION COMMUNITIES

Term	Definition	Example(s)
Main Content	Main body (the essence) of content that has been generated (or initiated) by one user.	Articles of an encyclopedia, News or articles of open news websites, videos and music files in file sharing websites, etc.
Metacontent	The additional piece of information that is attached to a piece of content mainly by users in order to enrich its essence.	tags, categories, edition note, votes, ratings, flags, recommendations, etc.
Subcontent	The additional stand-alone content which has interdependencies with the main content, however, it can yet be considered as a separate piece of content with its own set of meta-contents.	Comments and discussions, answers to questions (in Q&A or discussion-based websites), reviews of an item, etc.
Metainformation	Any information pertaining to the main content, subcontent, or both that is extracted or captured by the system. Metainformation mostly relates to contributors (main, sub, or meta) and their transactions, and also statistics regarding the usage of content and its elements.	Date of creation, number of views, format, number of edits, time of evaluation, duration of views, location, number and diversity of subcontent or metacontent contributors (e.g. commenters), etc.
Content generation	The act of generating main content and if necessary the additional elements of content (e.g. metacontent). In collaborative communities, generating content is equal to initiating it, for every other user may update (edit or extend) the generated content (see the descriptions below).	Adding a new article to Wikipedia, adding a piece of news on open media website (e.g. Slashdot), adding source code in Open source software (OSS) communities, uploading a video on file sharing websites (e.g. YouTube), etc.
Metacontribution and metacontributors	Metacontribution is the act of contributing metacontent instead of generating a whole piece of content (content generation). Metacontribution can be *descriptive* (e.g. tagging an item) or *evaluative* (e.g. rating an item).	Tagging content (items) in open file sharing websites (e.g. Flickr), evaluating content (e.g. like/dislike or Likert-scale evaluations), bookmarking an item, etc.
Collaborative (community or content generation)	Collaborative content generation is a system in which all users who have the right to generate content, may edit and extend the content that has been generated (initiated) by others	Wikipedia and OSS communities are prominent examples of collaborative content generation. Open sketching and open map development websites are other important applications of this type.
Creative (community or content generation)	Creative content generation is when only users who generate a specific piece of content (an item) may update the main content (with an exception of administrators or other privileged users). In these communities, feedback mechanisms such as discussion (comments) or directly contacting the creator are essential means to improve the quality of content by adding new perspectives and suggesting improvements.	Open file sharing websites (e.g. YouTube or Flickr), open (creative) knowledge sharing communities (e.g. *urbandictionary.com*), discussion-based or Q&A communities (e.g. Yahoo Answers or online discussion forums) and open media (e.g. *Slashdot* or *Digg*) websites are the four prominent types of creative communities.
Content publication	Publishing content is the act of making it available to other users or the public.	Confirming the submitted source code in OSS communities or accepting a new entry in closed knowledge sharing websites (e.g. *geneontology.org)*
Closed-gate communities	Communities, in which the content should first be confirmed or admitted by privileged users (experts or admins) to be publicly available to others.	In open source communities, usually the owner(s) keep the right of "gatewatching" the public edition/revision of the software to assure an acceptable quality of source code.
Open-gate communities	In open-gate communities, the generated content is published (made available to other users or everyone) at the time of generation, without any other further steps to confirm the content. Inappropriate or harmful content can later be removed automatically by the system (e.g. upon receiving too many negative ratings) or manually by privileged users.	Many open file sharing websites (e.g. YouTube or Flickr) or open media (e.g. Digg.com) have an open-gate system. In such systems, fitting algorithms is applied at the point of content generation to prevent users from generating redundant or inappropriate content (e.g. publishing copyright-protected content)
Editing vs. updating	To draw a fine line between editing content in collaborative communities and updating (own) content in creative ones, *editing* is used to any form of changing or extending content in collaborative communities. Updating content is performed solely by the content owner in creative communities.	Changing or extending the text of an article in Wikipedia or modifying the source code in OSS communities are examples of "editing". Updating is either changing the whole main content (changing an image or video in open file sharing websites) or updating the main content in creative communities.

There are several issues that should be dealt with attention in the context of OPCs. For example, user-generated content forces some redefinitions and rethinking of what content is, who owns it [42], or who has responsibility for it [43]. Especially in collaborative communities, new notions of authorship should be pondered and defined [44]. Moreover, a practical implication is what kinds of metainformation to define for content. When designing a community, depending on the context, helpful information based on possible interactions should be identified as relevant metainformation and be collected/calculated and added to the content (for example the versatility of evaluators can be calculated and considered as a quality factor).

As for future work, distinct characteristics of the four general types of OPCs will be studies for different design features such as incentive systems, quality assurance processes, recommendation systems or governance mechanisms. For example, it is not yet clear whether the design or implications of content qualification measures or incentive practices are significantly different in the four distinguished types of communities. The impact of the type of content (text, source code, image, etc.) should also be studied to deepen our understandings towards open production communities and their characteristics.

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3 Hidden or Implicit Contextual Factors Influencing User Participation in Online Production Communities

Conference Paper

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Contribution of first author: problem definition, research design, literature review, data analysis, theorization

Abstract: user participation is an inextricable part of online communities that live off user-generated content. Since these communities depend on sustained participation, they often employ various incentives to maximize the contributions and collective intelligence of users. Most prior research on user participation is focused on one specific type of production community (e.g. open source or Wikipedia) or on explicit incentives. However, despite the large body of literature devoted to this area, few systematic attempts have yet been made to identify common hidden or implicit factors. These factors sometimes have considerable impact on user commitment and participation. In this paper, we review and organize the pertinent literature and provide a generic list of implicit factors that account for a sustained flow of contributions. We also hypothesize a model that represents the interdependencies of some of these factors. The outcome provides community designers with a fine-grained knowledge framework and the corresponding design guidelines.

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ABSTRACT

User participation is an inextricable part of online communities that live off user-generated content. Since these communities depend on sustained participation, they often employ various incentives to maximize the contributions and collective intelligence of users. Most prior research on user participation is focused on one specific type of production community (e.g. open source or Wikipedia) or on explicit incentives. However, despite the large body of literature devoted to this area, few systematic attempts have yet been made to identify common hidden or implicit factors. These factors sometimes have considerable impact on user commitment and participation. In this paper, we review and organize the pertinent literature and provide a generic list of implicit factors that account for a sustained flow of contributions. We also hypothesize a model that represents the interdependencies of some of these factors. The outcome provides community designers with a fine-grained knowledge framework and the corresponding design guidelines.

Keywords

Virtual communities, socio-technical systems, open production, user-generated content, participation, motivation, design

INTRODUCTION

With widespread adoption of the Internet, a vast infrastructure is available that enables people to connect with others, express his or her feelings, generate content, discuss issues and freely share knowledge worldwide. The emerged communities of practice and social networks and the possibility of location-independent interactions and collaborations have brought up the new phenomenon of online socio-technical systems (STSs). Scholars have adopted two different approaches to study STSs. While some researchers such as Coiera (2007) look at them as sociological principles applied to technical features, others take this notion one step further and envision these systems as an integration of social and technical aspects into a higher-level system with unique and dynamic properties (Whitworth, 2009). Online communities are well-known forms of STSs, where technical feature are introduced to facilitate activities toward a common goal by bridging the gap between technical features, individual motivations and social norms. Designing a successful online community is, however, a complicated and intricate process, for human behavior is a multi-dimensional, interactive and dynamic factor, especially when put in a social context.

A thorough understanding of the interdisciplinary nature of online communities, contextual factors, heterogeneity of users, and different varieties of content is a quintessential prerequisite for designing such complex systems. There are numerous online communities with different purposes including, for example, socialization, networking, gaming or content generation. Regarding content generation, an online or virtual community can provide an easy-to-access platform with proper mechanisms for creating and sharing knowledge, fostering innovations and solving problems (Hargadon and Bechky, 2006). The focus of this study is on open production communities (OPCs) as a particular and well-known type of online communities (Ziaie and Krcmar, 2012). The primary objective of OPCs is producing and publicly publishing content, with users as the main explicit[1] producer of content. There are various types and terms in literature including open content projects (Bryant, Forte and Bruckman, 2005), technology mediated social participation (Chi, Munson, Fischer, Vieweg and Parr, 2010), web-enabled collective intelligence systems (Malone, Laubacher and Dellarocas, 2010), social computing systems (Parameswaran and Whinston, 2007), peer production communities (Wilkinson, 2008) or open source content projects (Oreg and Nov, 2008). OPCs are deemed increasingly important to a knowledge-based economy (Powell and Snellman, 2004;

[1] This is in contrast with implicit content production, where activities of users is captured and used as content, sometimes without them being aware of the process (e.g. in searching algorithms).

Williams and Cothrel, 2000) since they facilitate and encourage easy and cost-friendly creation and distribution of knowledge.

Because OPCs depend on user contributions as the main source of content generation and development, sustained participation is a crucial factor for their success (Koh, Kim, Butler and Bock, 2007). Sustained participation means a continuous and uninterrupted flow of contribution (and not necessarily a certain group of users). Incentive systems are often introduced to provide proper mechanisms to guide users' behavior with regard to their core desires and characteristics aligned with the objective of the community (Jeon, Kim and Koh, 2011; Vassileva, 2012). There are, however, implicit or hidden factors in the design and operation of communities that have considerable impact on user participation and commitment. Furthermore, online communities have a dynamic nature and change direction and set different goals and objectives in the different stages of their lifecycle (see for example (Ziaie and Imamovic, 2013) for the case of Wikipedia). If these hidden factors are recognized and acknowledged, there is a better chance of securing a sustained participation and contribution (Hoegg, Meckel, Stanoevska-Slabeva and Martignoni, 2006).

Numerous research and studies have been conducted on user participation for different types of communities including discussion forums (Butler and Wang, 2012), open innovation communities (Gebauer, Füller and Pezzei, 2012), open source communities (von Krogh, Haefliger, Spaeth and Wallin, 2012) and Wikipedia (Nov, 2007; Zhu, Kraut and Kittur, 2012b). There is, however, no organized accumulation of knowledge to identify and address general hidden or implicit factors that have considerable impact on user commitment and participation. Taking different characteristics of these communities into account, the question is to what extent can the facts and hypotheses of one particular community type, regarding implicit motivational factors, be generalized and applied to one another? This paper is dedicated to providing a generalized list of such implicit or hidden factors by organizing pertinent aspects of established theories on user participation and community design and governance. Moreover, based on the theories and empirical findings in the literature, we hypothesize a feedback loop model that represents the interdependencies of some of these factors.

The two key research questions that will be addressed by this study are:

RQ1: What are the salient implicit or hidden contextual factors that influence user participation?

RQ2: How can the interdependencies or mutual reinforcements between these implicit factors be hypothesized as a model?

In order to find appropriate and clear answers to these questions, we conduct a thorough literature review and try to conceptualize existing relevant theories, approaches, and features from the vast but disperse available practices and concepts into a comprehensible list of factors for community designers. We hope that conceptualizing the recent findings in a fine-grained format will shed light on recent discoveries in designing incentive systems and can help explain the interdependencies and complexities in this area. From a practical perspective, by providing an intellectual basis, this organized accumulation of knowledge helps community designers to address pertinent dimensions of their communities when designing various systems and tools or providing policies and regulations. It also helps community operators to refrain from harmful practices by paying ample attention to hidden factors that may influence user behavior.

The work is structured as follows: first, we focus on fixed contextual factors that do not necessarily change over time. Then, we determine dynamic implicit factors. These are the factors that evolve and change in the course of a community's lifecycle. Next, we hypothesize a model on the interdependencies between these factors based on recent findings in the literature. The paper concludes with a discussion of our findings, suggestions for future works and the possible practical implications.

USER PARTICIPATION AND IMPLICIT CONTEXTUAL FACTORS

There are certain built-in features and characteristics in online communities that may motivate (or demotivate) users to be more attached and committed to a community and its objective(s). These are not explicit incentives or, as Tedjamulia el al. (2005) put it, interventions, but rather prerequisites of a dynamic, passionate and successful community. These factors have an indirect effect on user participation by increasing the overall trust and attachment (Ren, Kraut, Kiesler and Resnick, 2011; Wu and Tsang, 2007) of users or enhancing the credibility of a community (Kim and Han, 2009; Leimeister, Sidiras and Krcmar, 2006). In knowledge-based communities, trust has been shown to be a significant predictor of users' willingness to exchange information and any factor that can increase the level of trust can indirectly increase members' participation. Moreover, the absence or malpractice of some of these implicit factors can impose unnecessary costs (e.g. cognitive or communicational) and, therefore, bestow a negative effect on participation. For example, a poor infrastructure (low site quality) increases communication costs and, as a result, constrains user participation (Koh et al., 2007).

Previous research suggests a link between contributions and several community-related as well as user-related factors including individual motivations, personal characteristics and outcome expectations (Wasko and Faraj, 2005). Here, we

narrow our focus to contextual factors and organize them into two broad categories of *fixed* and *dynamic*. Fixed factors (e.g. philosophy of existence), once established, do not change much over time. Dynamic factors, on the other hand, may change and evolve during the lifecycle of a community (e.g. quality or quantity of content).

Fixed Contextual Factors

Fixed factors are mostly related to the structure and governance (policies and regulations) of a community. These include vision (philosophy of existence), reciprocal culture, community ownership, leadership, privacy, content ownership (licensing) and low entrance and exit barriers. Descriptions of these factors are provided in Table 1.

Fixed factors	**Description and references**
Vision or Philosophy of existence	The novelty of the vision (philosophy of existence) a community can act as a strong motivator. As in the case of Wikipedia or Linux, a tantalizing vision and a noble objective creates strong passion and commitment among users to spend time and other resources to help a community flourish (Kane, 2009).
Reciprocal culture	The type of bond and respect between the users of a community may stimulate contributions by increasing users' confidence in being reciprocated. This anticipated reciprocal relationship reduces users' perceived costs of participation (Quigley, Tesluk, Locke and Bartol, 2007), culminating in more frequent or higher quality contributions (Bock, Zmud, Kim and Lee, 2005).
Community ownership	The ownership of a community, whether by natural person or by a Legal personality, can considerably influence its credibility. Two attributes that are frequently addressed in accordance with ownership are *expertise* and *trustworthiness* (Flanagin and Metzger, 2007).
Leadership	Leadership can be summarized in encouraging and appreciating activities of users and guiding their contribution in line with the objective and vision of the community (Luther, Fiesler and Bruckman, 2013). Identifying key players (committed active users) and keeping them satisfied is another important tasks of the leadership (Jeppesen and Laursen, 2009), for without such core participants a community is very likely to dissolve (Bruckman and Jensen, 2002). Leadership has also a moderating role between user conflicts and content quality (Arazy, Nov, Patterson and Yeo, 2011).
Privacy	Handling user data sensitively is deemed an essential success factor for online communities (Leimeister et al., 2006). There is not sufficient literature to address the possible differences in the level of privacy awareness and sensitiveness of users in different types of online communities; regardless, *perceived privacy protection* (Paine, Reips, Stieger, Joinson and Buchanan, 2007) is deemed an important criterion to establish trust within a community.
Content ownership (licensing)	Attitudes regarding information ownership and propensity to share influence people's use of collaborative media (Jarvenpaa and Staples, 2000). In open production communities, content ownership (also known as authorship or licensing) is a non-trivial issue, particularly in collaborative communities (Hunter, 2011). In OSS communities, for example, the form of licensing the software (code) is of great importance for the contributing users (von Krogh et al., 2012). The more users are confident that their contribution is open and utilized for a greater cause, the more willing they would be in voluntarily contributions.
Transparency of content validation	Users should be aware of how their contributions are being validated and evaluated (Cuel, Morozova, Rohde, Simperl, Siorpaes, Tokarchuk, Wiedenhoefer, Yetim and Zamarian, 2011). Durcikova and Gray (Durcikova and Gray, 2009) show that perceived transparency of knowledge validation process can have a significant impact on the flow of contribution, especially in knowledge-based communities.
Low entrance and exit barriers	Less complicated and time-consuming registration processes are recommended, especially in the early stages of a community. Also, interestingly, a minimum amount of barriers to exit shows a great deal of respect for users and their freedom of choice sends the signal that there is a vibrant community available to join (Dabbish, Farzan, Kraut and Postmes, 2012).

Table 1 Fixed implicit factors with an impact on user participation

Dynamic Contextual Factors

There are contextual factors in online communities that may change over time with regard to changes in user behavior, community position, content pool, environment or external factors such as the emergence of new phenomena or competitors. These include community quality, content quality, content quantity, popularity, sponsorship and stage of the lifecycle. Table 2 provides a description of these dynamic implicit motivators in the context of production communities.

Dynamic factors	Description and references
Community quality	Quality of a community can be divided into two categories: *system* quality and *site* quality (Belanger, Fan, Schaupp, Krishen, Everhart, Poteet and Nakamoto, 2006). System quality refers to technical qualities (both hardware and software) such as bug-free functionalities, security, reliability and responsiveness. Site quality represents the quality of user interface or aesthetic quality (Fogg, Soohoo, Danielson, Marable, Stanford and Tauber, 2003), usability (ease of us and navigability), searching features, customizability or "integratability" with other websites (Barnes and Vidgen, 2003). The importance of these features depends largely on variables including community size, personality of users, characteristics of topics and the objective of the community (Lampe, Wash, Velasquez and Ozkaya, 2010; Schoberth, Heinzl and Preece, 2006).
Content quality	Content quality corresponds to issues including accuracy, novelty, relevance, and other information quality attributes depending on the type of content and the objective of the community (Yaari, Baruchson-Arbib and Bar-Ilan, 2011). Offering high quality of content and services (community quality as mentioned above) has a positive impact on users' willingness to commit to a community and participate in its activities (Zheng, Zhao and Stylianou, 2010).
Content quantity	A critical mass of content (Rainie and Tancer, 2007) helps a community establish its audience and, as a result, become more attractive for potential new users. Ample content also provides a template and guide for current users to know the direction and scope of the community to contribute accordingly.
Popularity	Empirical data suggest that when users believe that their contributions can reach a wider audience, they tend to be more contributive (Raban, Moldovan and Jones, 2010). That is why having secured an acceptable number of visiting users can implicitly encourage users to be more participative.
Democratic structure or governance	Delegating power to users, especially in collaborative communities (where content is developed collaboratively), is not only recommended, but sometimes necessary for a cost-efficient expansion (see (Zhu, Kraut and Kittur, 2012a) for an example in the context of Wikipedia). In some OPCs, members feel a sense of ownership toward the community (O'Keefe, 2008), for the community practically lives off their contributions. Thus, if this feeling or perception is not respected and violated by, for example, not discussing the changes in advance or by ignoring their feedback, their commitment may gradually fade (Mustonen, 2009). A democratic kind of governance may therefore help the community to keep users satisfied, stay dynamic and secure a sustainable growth.
Sponsorship	Reputation of the sponsors of a site affects the perception of users toward its trustworthiness (Rifon, Choi, Trimble and Li, 2004). Commercial information are shown to reflect low credibility (Flanagin and Metzger, 2000), although this impact differs depending on the type of community and content (Flanagin and Metzger, 2007). Trustworthiness may be communicated through policy statements or absence of commercial content (Poorisat, Detenber, Viswanathan and Nofrina, 2009). Especially in younger audiences, there is a distrust towards explicit advertising (Kelly, Kerr and Drennan, 2010). For this reason, some open production communities (e.g. OSS communities) rely solely on donations.
Stage of the lifecycle	Communities have certain distinguished stages/phases during their lifecycle (Iriberri and Leroy, 2009; Ziaie and Imamovic, 2013). Regardless of the number of distinct stages within the lifecycle of a community (that depends on the context), what is apparent is that user perception of the community, their motivation to participate, contribution behavior and preferences as well as community needs and goals may differ in each of these stages (Jones and Rafaeli, 1999).

Table 2. Dynamic implicit factors with an impact on user participation

Theorizing a model of Interdependencies

The weight of each of the addressed implicit factors, whether fixed or dynamic, may vary in different types of community. Moreover, interdependencies and correlations may exist between some of these factors. Based on the literature, we hypothesize a model that represents a positive feedback loop on some of the factors on user participation (Figure 1) and the correlation and interdependencies of these factors on each other as well as user participation. According to this model, user participation improves the quantity and quality of content, which in turn increases the popularity of a community. The more popular a community becomes and the stronger and more noble its vision (philosophy), the more donations will flow into the community, which decreases its dependency on commercial sponsorships and advertisements. This financial independency joined by the increased popularity and enhanced pool of content account for more user participation. Also, how open the content is (content ownership) has a positive effect on user participation and indirectly decreases the community's dependence on advertisement by increasing the stream of donations. This positive feedback loop can play a major role in the success of a community along its lifecycle. How to deal with and manage the overwhelming amount of content and number of users is an important issue after a community takes off. It should be remarked that mishandling such situations can quickly turn this positive cycle into a vicious negative loop.

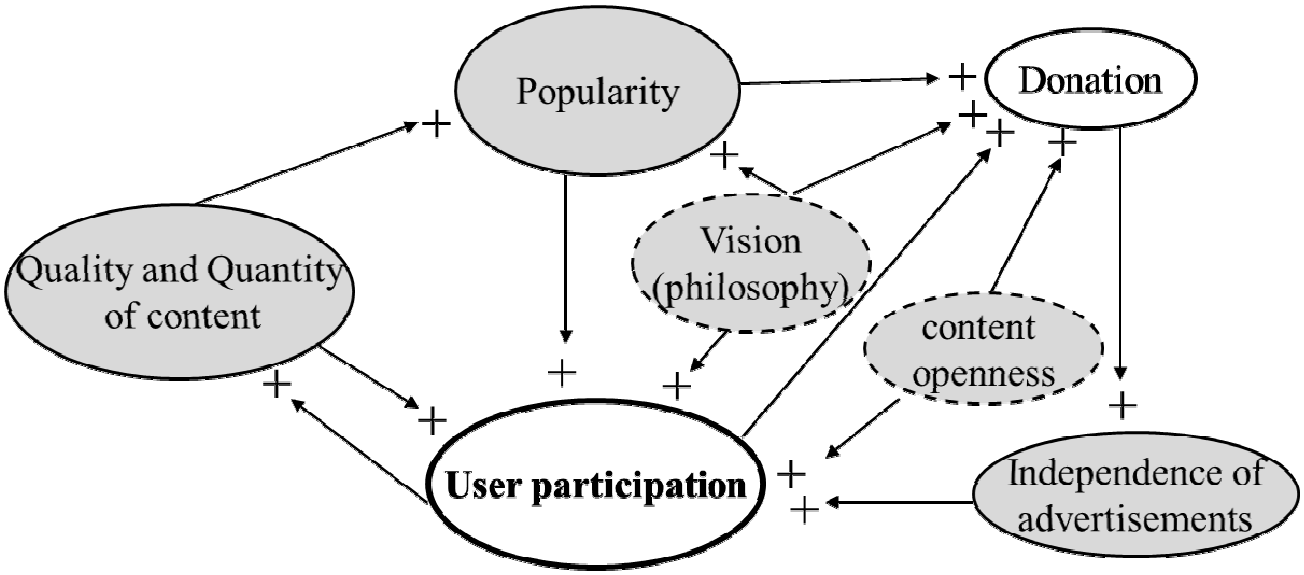

Figure 1 Hypothesizing a positive feedback loop: interdependencies of factors and their impact on participation

CONCLUSION

This paper set forth to review and synthesize the literature on user participation in open production communities from the angle of hidden and implicit contextual factors. With the perspective that we have outlined in this paper, increasing user participation can be enhanced by paying attention to implicit contextual factors in addition to providing explicit incentives. We focused on open production communities (OPCs) as an increasingly popular type of socio-technical systems (Whitworth, 2009). The main objective of OPCs is to produce high-quality user-generated content (e.g. text, source, audio or video files, designs, etc.) by maximizing user participation in the community-related processes including content generation and evaluation, user-management and, in some cases, governance and policy making (Ziaie and Krcmar, 2012). We made extensive use of recent studies in the field of open source communities (Oreg and Nov, 2008; von Krogh et al., 2012), open innovation and knowledge platforms (Vassileva, 2012), open file sharing websites (Nov, Naaman and Ye, 2010), creative and collaborative user-generated content (McKenzie, Burkell, Wong, Whippey, Trosow and McNally, 2012) and design of online communities (Kraut and Resnick, 2011). The extant interdisciplinary research was organized around a perspective that lays the focus on users as the cornerstone of production communities and contextual factors as implicit motivators.

Our study shows that there are two general types of implicit contextual factors: fixed and dynamic. While fixed factors are mostly related to the structure and objectives of a community and stay rather untouched over time; dynamic factors change with regard to community position, content pool, environment or external factors such as the emergence of new phenomena or competitors. Furthermore, our review reveals that there exists a feedback loop between some of the implicit factors and, if managed aptly, they can reinforce each other and increase user participation iteratively. This approach points the way for

researchers to give further consideration to hidden contextual factors as they study user participation and incentive systems. As for future work, the correlations and directions of causality that are theorized by this model can be empirically tested in different community types.

The results of this study may be used by online community designers and operators as a knowledge framework and a set of pertinent design guidelines to overcome design intricacies and boost users' motivation to participate. These implicit motivators may contribute independently or in combination with explicit incentives to enable a community keep users committed and active. Exploring the interdependencies of these implicit factors with explicit incentives is another interesting topic that requires further investigations. Another limitation of the current research concerns the weight or importance of each of the addressed factors in different types of OPCs. For example, content quantity might be an essential factor in some communities (e.g. open source communities), whilst not so important in other types (e.g. open file sharing). Desires and perceptions of users vary in different contexts as well and a prioritization of these factors might prove helpful, especially when no sufficient resources are available to be invested in the early stages of a community.

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4 Introducing a Design Framework for Reputation Systems in Multi-tier Production Communities

Journal Paper

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Authors: Pujan Ziaie and Helmut Krcmar

Contribution of first author: problem definition, research design, literature review, data analysis, information coding and synthesizing, conceptualization

Abstract: reputation systems are an important part of online production communities, for they provide both users and machine with proper metrics to assess the truthfulness and reliability of users, and their generated content. In multi-tier communities, in which users can be promoted to higher ranks, reputation systems are given a new role, which is helping the community to have a more meritocratic promotion process. This paper provides a design framework for reputation systems and promotion processes in the context of multi-tier production communities (MPCs). An apt promotion process based on a well-designed reputation system can be deemed as a valid practice to motivate users, enhance their level of trust and satisfaction, and increase the quantity and quality of contributions. We address different aspects and design elements of reputation systems and their association with and their impact on user participation in production communities, particularly those with a multi-tier structure.

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Introducing a design framework for reputation systems in multi-tier production communities

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Abstract

Reputation systems are an important part of online production communities, for they provide both users and machine with proper metrics to assess the truthfulness and reliability of users, and their generated content. In multi-tier communities, in which users can be promoted to higher ranks, reputation systems are given a new role, which is helping the community to have a more meritocratic promotion process. This paper provides a design framework for reputation systems and promotion processes in the context of multi-tier production communities (MPCs). An apt promotion process based on a well-designed reputation system can be deemed as a valid practice to motivate users, enhance their level of trust and satisfaction, and increase the quantity and quality of contributions. We address different aspects and design elements of reputation systems and their association with and their impact on user participation in production communities, particularly those with a multi-tier structure.

Keywords: online communities, multi-tier production communities, reputation systems, participation, promotion

1 Introduction

In the last decade, the success of online production communities[1] such as Wikipedia, YouTube, Slashdot, or popular open source communities have attested the power of crowd sourcing in generating content and sharing knowledge. Production communities are a certain type of communities in which the main objective of the community is to produce and evaluate content and share it with others and are considered as an increasingly important step towards a knowledge-based economy (Powell and Snellman 2004). This individually or collaboratively generated content can be anything from text and audio and video files to architecture sketches and maps (De Alfaro *et al.* 2011). The more users are actively and effectively involved in the production and evaluation process, the more valuable content will be accumulated. Moreover, involving users in the wide variety of community-related activities ranging from content generation to modification, evaluation, user moderation and even decision and policy making would provide the breadth, depth and complexity that is usually required for the sustained growth of a community (Kim 2000). This is why facilitating the knowledge, manpower, and ingenuity of a vast crowd with lower costs is an appealing objective of many companies, governments, or non-governmental organisations (NGOs). Yet, successfully motivating users or

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members to participate in the process of content production is not a trivial task.

Understanding the motivation of users to participate and planting apt incentive mechanisms respectively is no easy procedure. What seems to be the advantage of online communities, namely connecting and harnessing the power of geographically and culturally heterogeneous users of different backgrounds, is often a true challenge for community designers and operators. Such heterogeneity combined with rapidly-changing external factors constantly challenges the long-term viability of production communities. After all, the profound complexity resulting from the interrelated nature of the individual, social, technical, and environmental elements of communities (Gurzick and Lutters 2009) is not easy to deal with. Constructing a befitting reputation system and utilising it for both content generation and governance purposes can be deemed as one important stabilising factor for this non-trivial matter.

Reputation systems, in the context of online communities, are generally used to 'capitalize on the motivational power of reputation' (Dellarocas 2010, p. 33). They are also availed to gauge the credibility of others for financial or otherwise risky transactions. Considering production communities, previous empirical studies have called attention to status and status seeking along with altruism and reciprocity as the key motives behind informational gift giving (Lampel and Bhalla 2007). Depending on many factors such as the culture of a community, the type of content, or its maturity, such status sentiments are very likely to foster an ongoing participation in communities, hence their sustainable success. Availing reputation systems is an effective tactic to be used to augment awareness of status. Besides reflecting the history and status of users, reputation systems can also play a crucial role in those production communities that have a multi-tier structure. They can provide quantitative and qualitative metrics on the amount and essence of the activities of users. What is missing in the literature is how reputation systems can be employed for the sake of promoting users to the next tier in a systematic and meritocratic way. A multi-tier production community (MPC) uses different tiers to privilege active and loyal users by restricting access to allow only those in a higher tier to benefit from certain services (Saranow 2005) or be involved in more operational and strategic activities. It is believed that promotion mechanisms should be based on meritocracy in order to attract high quality contributions from voluntary users (Lee and Cole 2003). In the absence of a viable mapping function to reflect the reputation and activities of a user outside of the community (e.g. in other communities or in the society), a well-designed reputation system within the borders of a community is a valid approach to address this issue. For this reason, structuring and framing reputation systems from the perspective of production communities in general, and multi-tier production communities in particular seems necessary.

A large body of literature currently exists that pertains to participation, motivation and governance of communities with a focus on crowd sourcing (Leimeister *et al.* 2010, Schwagereit *et al.* 2011). In order to address and structure the pertinent design elements of reputation systems and the existing approaches toward user promotion, we first identified the relevant literature using a chain referral sampling (Penrod *et al.* 2003). To avoid problems afflicting chain-referral sampling (Erickson 1979), multiple networks and resources were accessed to extend the scope of investigation. We combined a snowball sampling based on the literature recommended by community experts with a snowball sampling based on keyword search in top journals and distinguished conferences. The raison d'être of this paper is, therefore, framing and highlighting those aspects and characteristics of reputation systems that can be harnessed to not only motivate users to be more participative but also facilitate their promotion in MPCs. The paper is structured as follows: first, reputation systems and one of their most essential elements, namely virtual capital, will be overviewed and a fine-grained design framework is introduced. Next, existing promotion processes in production communities and their relation to and reliance on reputation systems will be elabo-

rated upon. Finally, the findings will be concluded and open issues will be discussed.

2 Definition and distinction of terms

Unfortunately, due to the rapid developments of new concepts and approaches in the domain of online communities, the terminology has not yet been delicately standardised and, therefore, many terms have been given loose or inconsistent definitions. There is, for example, ambiguity in using terms like *user role*, *rank*, *identity* and *status*. The definitions of various terms such as *contribution, participation* or *motivation* have not been fine-grained either. In Table 1, a list of terms and definitions is provided that includes the most frequently used terms in the context of production communities and with respect to reputation and promotion systems.

3 Reputation systems: a review of research and practice

Almost half a century ago, Weber theorized tradition, law, and charisma as the three bases of authority (Weber 1968). This does not hold true in modern collective forms of production (O'Mahony and Ferraro 2007). Multi-tier production communities, as non-commercial virtual communities of interest, mostly represent a virtue-based system, where those users that are more active are bestowed with more power and responsibility (by being promoted to the next tier). The mission of a reputation system here is to secure a systematic way of keeping track of users' activities (behaviour as well as the quality of the generated content), process it into digestable and relevant results, and finally, make them visible to others. In this section, we provide a comprehensive study on the characteristics of reputation systems in the context of production communities. Then, we introduce the design elements of a generic reputation system based on a descriptive analysis of the accumulated knowledge to help community designers separate the wheat from the chaff.

3.1 Characteristics of an apt reputation system

As discussed earler, reputation systems play a vital role in production communities, for they provide the necessary foundation for users to not only know whom to trust, but also help the community promote active and reliable users to higher ranks based on their past behaviour and efforts. Users put a high value on the trustworthiness and fairness of a reputation system (De Alfaro *et al.* 2011) and it could, therefore, be considered as a major success factor of many such communities, particularly before they enter the maturity phase of their lifecycle (Iriberri and Leroy 2009).

3.1.1 Reputation systems: aspects and properties

Before addressing different design aspects and properties of reputation systems, it should be once more asserted that status, role, and rank have different meanings and should be distinguished. The status of a user is merely a label and is not necessarily correlated to his rank in the community. The status of a user might be only symbolic (such as '*junior member*,' '*power user*,' or '*expert*'), whereas a different rank (such as community moderator) guarantees accessing a different set of features. The role of a user, on the other hand, corresponds to his contribution pattern. For example, frequently mentioned roles in open source communities are *core members*, *peripheral members*, and *passive users* (Hinds and Lee 2008).

Moreira *et al.* (2009) propose three properties for every visible reputation system that is not solely based on content-driven analysis: first, the identity of users should stay persistent, whether they are pseudonyms or not. Second, there should be a feedback and rating mechanisms (mostly and preferably for the produced content rather that for the user), and the results should be visible to other members, and third, people should trust the reputation system and make their decisions based on its ratings (Rheingold 2003).

Dellarus (2010) provides a comprehensive study on the design and configuration of reputation

Term	Definition	Reference
Open Production Community (OPC)	Also known as peer production communities or community-driven knowledge sites, open production communities are communities with clear code of conduct, in which content is regarded as a public good, and at least one of the domains of content production, user moderation, or community governance is fully or partly delegated to users in a systematic way. OPCs can be divided into two general categories: open content production communities and open source production communities.	(Nov *et al.* 2010; Wilkinson 2008; Kim and Han 2009)
Multi-tier Production Community (MPC)	A multi-tier production community is a production community in which at least two different tiers (ranks) of users exist. Users can be promoted to a higher tier or rank or demoted to a lower one. (see Figure 4).	
(User) Participation	Involvement in all possible community-related activities such as content generation, discussions, evaluations, viewing, voting, flagging, etc. Every activity of users that in some way or other benefits the community can be classified as 'participation.'	(Lee and Carroll 2010; Ren *et al.* 2007)
Contribution	Activities that culminate in producing content are called contribution. Every contribution is considered participation, but not every participative activity is a contribution per se. In other terms, when participation results in content being generated, it is called contribution.	(Harper *et al.* 2007; Reiser 2008)
Motivation or Motive	Reflects personal or internal motivations to participate. Motivation shall not be confused or used as an act of encouragement (an incentive).	(Leimeister *et al.* 2010; Shah 2006)
Incentive	Incentive represents (external) motivational enticements that are practiced in communities to encourage users to be more participative.	(Farzan *et al.* 2008; Cheng and Vassileva 2006)
User Role	The perceived behavior of users. User role can range from reader (lurker), to leader (core member). It does not necessarily match the official status or rank of a user, but reflects a behavioral abstraction of user activities.	(Preece and Shneiderman 2009; Jensen and Scacchi 2007)
User Rank	The official position of a user within a community. User rank is usually associated with his or her level of access (privileges). The most basic ranks in communities are guest, normal user, and admin. However, in multi-tier or multi-rank communities users may be promoted to a higher tier and receive a higher rank.	(Saranow 2005; Shin *et al.* 2010)
User Status	User status is the label that is bestowed upon users based on their level of commitment. Unlike *user rank*, user status is symbolic and does not give them any privileges over other users. This is a common practice in many open source and game communities.	(Introne and Alterman 2006; Ganley and Lampe 2009; Lampel and Bhalla 2007)
User Identity	Identity is used to identify users either by other users or by the system (e.g. username, emails, or SSH keys). Identity is often a text (name, nickname, etc.), but can also be an image (badge or avatar).	(Castells 2009; Anthony *et al.* 2009)
Ranking	Ranking refers to listing entities (users, groups, content, activities, etc.) based on their given or received value (via explicit or implicit rating).	(Hearn 2010; Bender *et al.* 2008)

(*Continued*)

Table 1. Continued.

Term	Definition	Reference
Rating	Rating is the act of evaluating an entity (a user, a group, a piece of content, or an activity) which can be performed via thumbs up and down, Likert-type scale, like button, etc. Rating can be performed either by users (explicit) or by the system (implicit) based on pre-defined rating criteria.	(Hearn 2010; Agichtein *et al.* 2008)
Virtual Capital	Represent the abstract quantified reputation of a user within a community. It can be categorized as social, contribution, or cultural capital. Social capital is gained through socialization in a community, contribution capital is based on the amount of a user's contribution, and cultural capital refers to the amount of experience a user has within a community (knowing norms and culture).	(Zheng *et al.* 2010; Rafaeli *et al.* 2004)
(Reputation) Points	Also referred to as 'point', 'score', or 'equity', represents the building unit (currency) for estimating the virtual capital of users. This can be both input and output of a reputation system. It can be categorized into informational, personal, contribution, and participation points. Similar known terms are Karma, which is used in some communities such as Slashdot.	(Dong *et al.* 2010; Reiser 2008)

Table 1. Definition and distinction of frequently used terms in the context of production communities.

with a focus on non-production (service-providing) communities. He specifies a set of objectives and a set of key decisions to be met before designing any reputation system: why is it being designed (objective), What is being collected, computed, and shown (information), and how the information is being calculated and shown (algorithms and display). We add *contribution assessment* to his suggested set of objectives to provide a new dimension to be taken into account when studying production communities.

3.1.2 Virtual capital and the introduction of reputation points

Keeping track of the most prolific users (leaderboards),[2] making them be seen (visibility), and appreciating them (thankfulness) are believed to have a positive effect on participation (Viégas and Smith 2004). In order to empower reputation systems, spotting active users (and maybe later automatically promoting them to a higher rank), a kind of unit, or currency (Karma or *reputation points* as addressed in Table 1) should be implemented (Reiser 2008; Farzan *et al.* 2009). Based on this approach, each activity of a user that is in one way or another of benefit to the community is rewarded with a certain amount of (virtual) points. How many points are being given for which activity and how the ultimate score is being calculated are very delicate matters, for two reasons. First, users are deeply concerned about how their reputation is being calculated, and constructing any system to capitalise efforts demands a certain degree of subjectivity. And second, introducing rewarding systems might make some users try to game the system and therefore might unwillingly trigger dishonest behaviour. Reputation systems need to provide necessary mechanisms against gaming the system, whether it is actions to enhance one's own reputation or actions to diminish or undervalue that of the others (Dellarocas 2006). One approach to address this issue is to try to remove the effect of the social capital of users based on their reputation points. Certain algorithms can be used to reduce this effect (smooth the bias) and calculate the points of users solely based on the value of their contribution (Shin *et al.* 2010; Chen *et al.* 2011).

Figure 1 demonstrates the flow of a combination of three input actors and two entities that provide input data for a reputation system. This

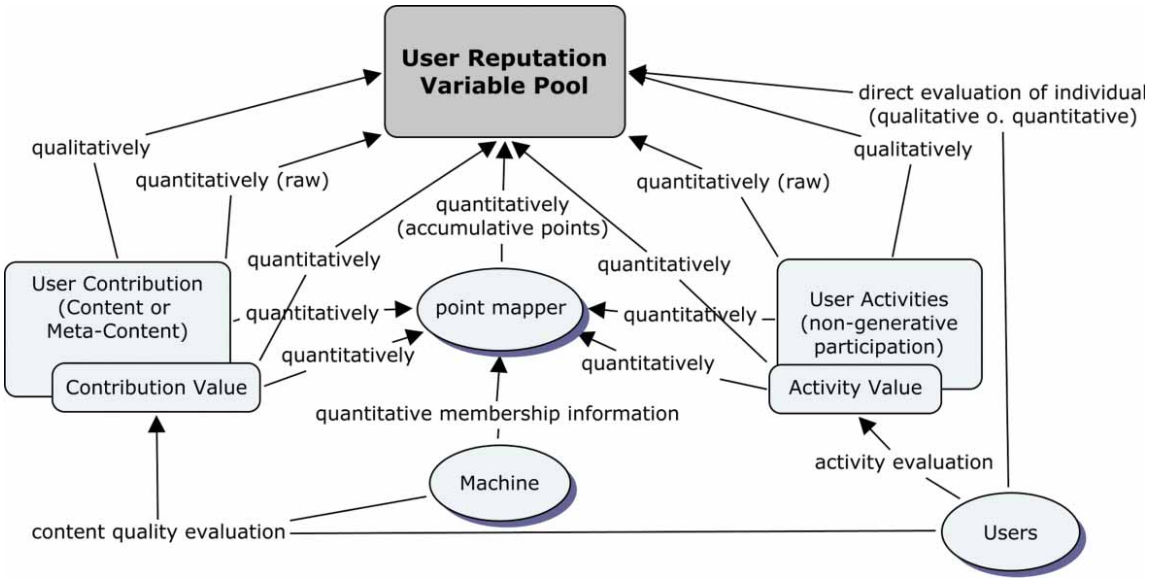

Figure 1. Generic input variables of a reputation system.

pool of variables is either presented directly (as raw information) or is processed by an algorithm when the raw data do not necessarily make sense by itself and should, therefore, either be converted or combined with other input variables. In the next section, this distinction of raw and processed data along with the necessary design elements is elaborated upon.

3.2 Design framework of reputation systems

Every reputation system has five major design elements: why is it required and what are the expectations (*objective),* what kind of information is collected (algorithm *inputs* and *raw information*), how is the reputation being calculated (*algorithm*), what is the output of the algorithm (*output*), and how is it presented (*presentation*). The objective of a reputation system is of tremendous importance, for it directly shapes the formation of algorithm, raw information, and presentation.

3.2.1 Objective(s)

The objectives of a reputation system should be aligned with the objective and culture of the community it is being facilitated for. For example, the main objective of reputation systems in commercial websites such as eBay is to enhance or assess the level of trust. On some websites, the emphasis is on the reliability of reviews. On others, it may be used to recognise similar behavioural patterns to match members or recommend further material. In the context of production communities, reputation systems can be used for a variety of reasons: they can be leveraged as incentive mechanisms to enhance the quality and quantity of produced content by increasing participation. They can also be used shed light on the credibility and trust issues pertaining to users and content. Furthermore, regardless of what the main objective of a reputation system is, in most cases, it can also be considered as a strategic mean to increase user loyalty and lessen attrition (Dellarocas 2010).

Objectives of a reputation system determine what information should be collected, how it should be collected, what part of this information may be used directly and 'unprocessed' (raw) and what part should be processed (e.g. normalised) and or combined with other factors to produce more comprehendible and sensible results (outputs), what output should be calculated based on the aggregated information, and how and for whom it should be visible. That is to say that the defined objectives directly affects three major

design elements: algorithm (input and output), raw information and presentation. It should also be noted that depending on the context and breadths of a community, combining multiple objectives of reputation systems into one system is sometimes not necessary and might culminate in misleading or irrelevant results.

3.2.2 Raw information

Collected information (as demonstrated in Figure 2) can be used either directly (raw information) or as inputs for the designed algorithm (as algorithm inputs). It has been recommended that when possible, using manipulative functions on the collected information should be avoided and only raw data should be presented as supportive information for a reputation system so that the judgment is left to the users themselves. Raw information is either qualitative (e.g. reviews on the produced content, a list of users' activities, etc.) or quantitative (e.g. total number of posts, number of views of a piece of content, or time (e.g. duration of membership or the age of the generated content).

3.2.3 Algorithm inputs

Information as input variable(s) provides the necessary material to calculate the outputs of the algorithm. The objective of a reputation system indicates what sort of information should be collected and how it should be processed. Algorithm input can be driven by contribution (content), user (activities) (De Alfaro *et al.* 2011), or a combination of both. Content-driven or, as Dellarocas (2010) puts it, *first-hand* information is preferred to user-driven or second-hand information (direct evaluation of individuals), for user-driven information increases bias and subjectivity and might also lead to undesired behaviour such as blackmailing or destructive feedback.

Also, the more dimensions that are added to the input, the more difficult it gets to calculate the right output and use that output to compare users or content. Even if a ground truth exists regarding the significance of the elements, they should nevertheless be weighted accordingly and a proper function should be sought, which might increase the subjectivity or decrease the aptness of outputs. Another important issue when collect-

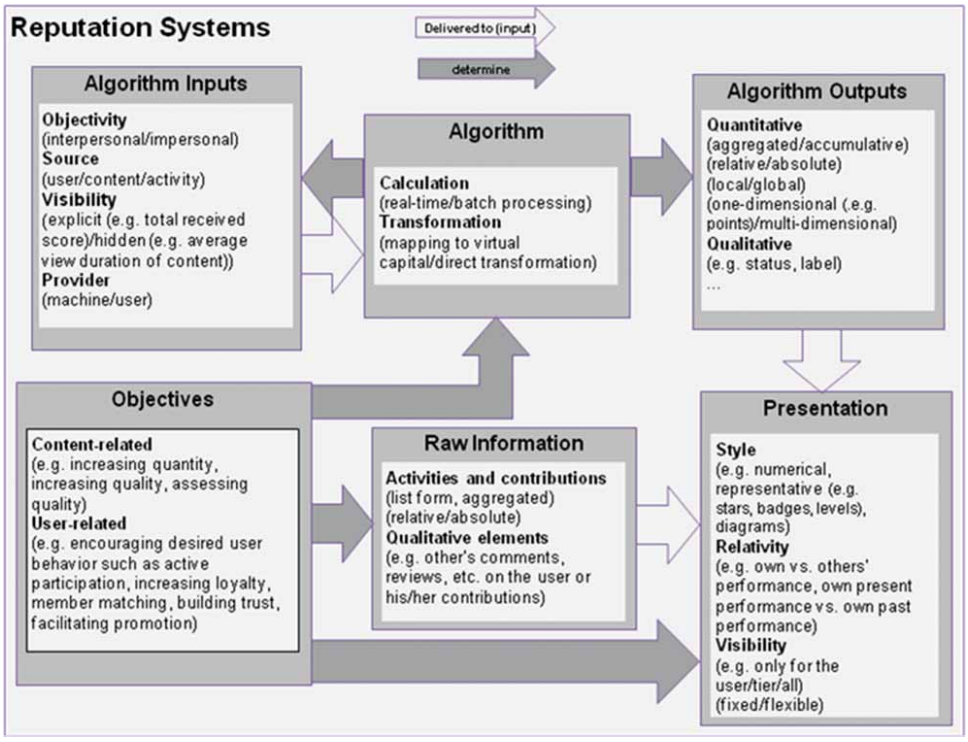

Figure 2. Generic design framework of a reputation system.

ing data is the privacy of users. It is recommended that the collected information is communicated clearly with the users, no matter if this information is visible to them or not. Regardless of the unethical nature of using unauthorised data, irresponsible collection of user data might have severe legal and organisational consequences.

3.2.4 Algorithm

Calculating the reputation of users can be based on different quantitative as well as qualitative input variables. As mentioned in the previous section, user's valuing of another user's contribution or behaviour, whether qualitative (in forms of reviews, comments etc.) or quantitative (in forms of rating, voting etc.) is a crucial source of information for such algorithms. In addition, algorithms may also take advantage of other users' actions on content such as number of views of a piece of content or the amount of time users spend viewing it. The recommendation system of eBay and Amazon's reviewing systems are two prominent examples in this regard (Bunz 2006).

A sophisticated and reliable reputation system should include all relevant input variables and weight them according to the required effort and their importance to the objectives of a community. Sizable literature deems the effect of mechanical (or statistical) method stronger compared to judgmental (subjective) methods (Stumpf and London 1981), for they are conceived as less biased. The fact is, the more manipulative operations are applied to inputs to calculate the output(s), the more subjective and judgmental a reputation system becomes.

Processing information and calculating the outputs can be performed in real-time or on a regular basis (batch-processing). Furthermore, the output can be calculated globally or chronologically (De Alfaro *et al.* 2011), and relatively (e.g. to a certain group within the community) or absolutely. If the reputation is mainly based on the amount of contribution, relative outputs are believed to be more suitable, since showing absolute outputs might scare off the newcomers (Chiu *et al.* 2006). Outputs can be calculated relative to time (recent activities) or relative to rank (within a tier).

3.2.5 Algorithm outputs

Generally, outputs of a reputation system should encompass three aspects of an individual: *trustworthiness*, *commitment* and *sociability.* Trust can be assessed by providing items that reflect an individual's belief in other members' non-opportunistic behaviour, promise keeping, behaviour consistency, and truthfulness (Chiu *et al.* 2006). The commitment aspect represents how active an individual is in community-related activities (participation), and sociability represents the amount of social interactions an individual practices with other members. In other words, reputation systems must indicate not only how much and what kind of contribution and social capital a user possesses, but also how reliable the actions and contributions of this very user are.

As discussed before, some of this information can be extracted directly (raw information), and some should be processed and combined with other factors and inputs (via an algorithm). The results of an algorithm may be aggregated (e.g. average number of posts per month) or accumulative (e.g. the total number of posts). It can also be calculated locally or globally, in case a website has more groups and objectives. The outputs of the algorithm can also be transformed into qualitative determinant such as labels or status. Moreover, in certain cases where the output primarily reflects the expertise of users (the value of their contribution), it can also be categorised and distinguished for different topics of content (Hong *et al.* 2009).

3.2.6 Presentation

The output of a reputation system consists of algorithm output and the relevant raw information. How a piece of information is being presented can have significant impact on how it is perceived. For example, sometime, merely changing the name of an online relationship can have positive or negative influence on users (Zhang *et al.* 2010). Like other aspects, displaying the reputation of users can also be both quantitative and qualitative. Quantitative display is the case where the virtual

capital of users or statistics corresponding to their contributions (e.g. number of posts in a forum) is shown. Qualitative display is showing the status or rank of a user, listing a list of his or her activities (e.g. comments or ratings), or listing other users' feedback about him or her.

To enhance understandability, users' activities and contributions can be visualised by using diagrams as well. In large communities such as Wikipedia, visualisation makes assessing the quality of content or legitimacy of edits easier (Kittur *et al.* 2006). The output can also be presented individually, or benchmarked with others. For example, the current performance of each user can be compared with his own past performance, or that of the others to instil a sense of competition into the community. It has been argued that comparing the outcome or input ratio for oneself with that of others determines an individual's perception of fairness of information exchange (Adams 1966).

The presentation of outputs can have different styles. Aggregated output can be presented by using stars and badges or be interpreted into abstract meanings such as user status. In point-based, multi-tier systems, the promotion of users to a higher rank (tier) can be performed automatically when users achieve the minimum number of reputation points required for a rank. This way, the rank of a user can also be an implicit form of presenting his reputation.

What is also of great importance is to whom the output is available (visibility). Perceived identification, which is backed up and amplified by a reputation system is believed to be an important predictor of individuals' involvement in online communities (Ma and Agarwal 2007, Zhang *et al.* 2010). Similar to privacy issues when collecting information, the visibility level of output results is also of utmost importance. The visibility can be limited to oneself, on specific group of users (such as friends), or a certain tier (e.g. admin rank). Figure 2 provides a view of the general design framework of a reputation system and the interrelations between the main design elements.

Elucidating users' history of actions and contributions enables a community to use this information, either quantitatively (e.g. via reputation points) or qualitatively to promote a user to a higher rank. A fair promotion process is an important part of most multi-tier production communities (MPCs) in order to facilitate promoting users from a lower tier to a higher one (Figure 3). It not only motivates users to be more participative, but also secures the quality of content by privileging more active and experienced user to participate in content qualification, conflict management, or strategic decision making.

Defining different ranks and restricting access to certain features to those with a particular rank is a known tactic to increase awareness of status and motivate users to be more active in order to be promoted to a higher rank (Saranow 2007). Moreover, the distributed nature of communities often requires formal positions for certain administrative tasks (Butler *et al.* 2002). If we accept the positive correlation between the reputation of a user with his or her ability to perform activities such as user moderation or content quality assessment, the importance of well-designed reputation-based promotion processes becomes more obvious.

Promotion process is all about how users are designated to new ranks, which includes a bestowal of exclusive set of rights and privileges upon them within the community. The mechanism plays an important role in MPCs, for its fairness has a significant value on the users' level of trust in a community.

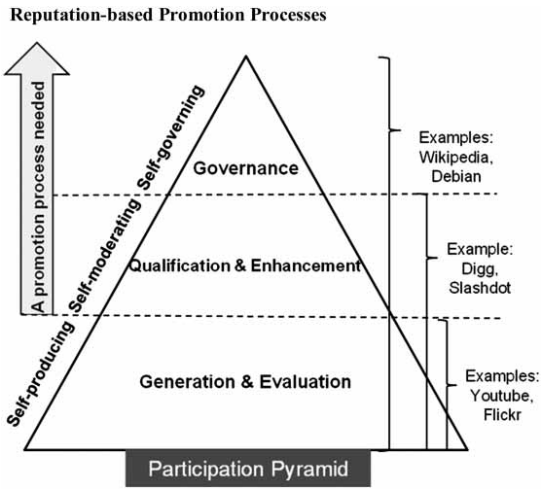

Figure 3. Different tiers of user activities in MPCs.

Promotion can be practiced in many ways. It can be practiced solely by the system (*automatic detection*), by operators (*selection*), by other users (*election*), or by a combination of two or all of them (*hybrid*) (see Figure 4). Selection is when users are designated to a new rank by administrators and operators, or by users possessing a higher rank (Rosenkranz and Feddersen 2010). This is a common practice in most communities for two main reasons: first, implementing promotion mechanisms and or organising web-based elections is a costly resolution and requires certain technical infrastructure, and second, community owners often do not want to lose control of the community. One possible downside of selection, depending on the degree of willingness of users to go to a higher tier, is that users would have little influence on the promotion process. The second method exercised in some communities, particularly open source communities, is to call an election for certain ranks (O'Mahony and Ferraro 2007). This is the most democratic form of promotion; however, with allowing every user to become a candidate, users may be confused and overloaded with data, which may eventually prevent them from making the right choice.

The third option is to elevate user's rank automatically based on detection. Intelligent algorithms to detect experts (Zhang *et al.* 2007) or simply defining a minimum number of reputation points for a certain tier are two common practices in this regard. Figure 4 demonstrates a rank pyramid, where ranks can be obtained automatically based on one's accumulated virtual capital in a community or by other methods such as election or selection. The problem with automatic promotion (detection) is that often qualitative attributes of users is not being taken into account. Furthermore, as discussed in the motivation section, users may try to trick the system to get to higher ranks (Cheng and Vassileva 2005).

None of the three promotion approaches can single-handedly fulfill the requirements of a flawless promotion process in a complex environment. It is recommended that any form of authority simultaneously preserves democracy and accountability to its members (Lee and Cole 2003). Therefore, some communities should adopt a hybrid process in which a combination of these methods is used (see Figure 4). For example, on Wikipedia, committee members are selected through a process of election by the community and appointment by Jimmy Wales (Forte and Bruckman 2008). The candidates must also have a certain amount of virtual capital, which is determined on Wikipedia by the number of posts and edits (Burke and Kraut 2008). This would not have been possible without a befitted reputation system to provide the necessary input data.

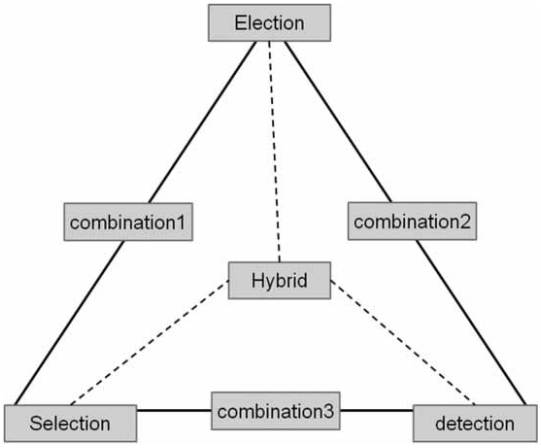

Figure 4. Promotion approaches in communities.

4 Conclusion and future work

A reputation system is an essential element of multi-tier production communities. They provide users with valuable information to assess their own performance and that of the others. They also help community owners to evaluate content and identify active users. Identification of active and committed users has two major advantages: first, their efforts are made visible to the community and this awareness of status has a positive effect on loyalty and participation. Second, particularly in multi-tier communities, this information can be used to promote users either in an automatic way, or indirectly by helping others when they have to select or elect privileged users.

While on commercial websites the focus of reputation systems has often been on building trust,

promoting quality, or facilitating member matching (Dellarocas 2010), in production communities, the emphasis is mostly on encouraging sustainable and high-quality contributions. In this paper, we studied reputation systems from the perspective of production communities. Our work was mainly based on the work of Cruz *et al.* (2009), Dellarocas (2010), and De Alfaro *et al.* (2011). We added two dimensions to the objective of reputation systems, namely increasing participation and facilitating promotion. We also accentuated the role of reputation points in assessing the virtual capital of users. Taking into account the downside of such subjective approaches toward calculating one's reputation, we argue that such systems can be used to facilitate promotion processes in multi-tier communities. We summarised the findings into a design framework that consists of generic design elements of a holistic reputation system.

There are several issues that need to be addressed in future works. One important issue is the impact of the lifecycle of a community on its reputation systems. The success of a community depends on what features are introduced when (Iriberri and Leroy 2009). The interdependence of lifecycle stages and design features holds true for reputation systems as well. For example, showing top users (leaderboards) based on their absolute virtual capital might positively influence participation in early stages of a community, but not when it has matured. Another issue that needs further scrutiny is the effect of reputation systems on different tiers (ranks) of a community. We argue that in communities with a multi-tier (multi-rank) structure, the effect of the outcome of a reputation system is distinct for each tier. If this hypothesis is valid, then thinking of a dynamic reputation system with different outputs for different tier of users is possible.

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Notes

[1] In this paper, the term 'community' is used as a short form of 'online community', unless otherwise stated.

[2] The effect of leaderboards may vary depending on the lifecycle of a community. For example, Lerman (2007) argues that eliminating user top list (leaderboard) of Digg.com in its maturity phase did not seem to have any negative effect on participation.

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5 Designing Target-Oriented Incentive Systems for Online Production Communities

Conference Paper

In: Die Multikonferenz Wirtschaftsinformatik (MKWI 2014)

Authors: Pujan Ziaie and Helmut Krcmar

Contribution of first author: problem definition, research design, literature review and synthesis, information coding, conceptualization

Abstract: online production communities aim to realize the collective intelligence and leverage the potential creativity, manpower, and knowledge of volunteer users to generate high quality, public content. Introducing appropriate incentives to sustain participation is not a trivial task for community designers due to the dynamic and multi-dimensional nature of such communities. In this paper, we review and synthesize the existing body of research pertaining to user participation and incentive systems and propose a novel approach towards incentive systems based on user desires and lifecycle-based community objectives. The identified relevant user desires drawn from Reiss's theory of basic desires are self-importance, self-development, fun, vindication, socialization, group identity and uniqueness. By using this desire-based approach, we conceptualize a generalizable and target-oriented iterative design model for developing and adapting incentive systems. The theorized model extends the current body of research by accumulating and merging the academic findings from different types of communities into a unified prescriptive model. This model also provides a practical guide for community designers to follow a systematic approach towards designing effective incentive systems.

Designing Target-Oriented Incentive Systems for Online Production Communities

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Abstract

Online production communities aim to realize the collective intelligence and leverage the potential creativity, manpower, and knowledge of volunteer users to generate high quality, public content. Introducing appropriate incentives to sustain participation is not a trivial task for community designers due to the dynamic and multi-dimensional nature of such communities. In this paper, we review and synthesize the existing body of research pertaining to user participation and incentive systems and propose a novel approach towards incentive systems based on user desires and lifecycle-based community objectives. The identified relevant user desires drawn from Reiss's theory of basic desires are self-importance, self-development, fun, vindication, socialization, group identity and uniqueness. By using this desire-based approach, we conceptualize a generalizable and target-oriented iterative design model for developing and adapting incentive systems. The theorized model extends the current body of research by accumulating and merging the academic findings from different types of communities into a unified prescriptive model. This model also provides a practical guide for community designers to follow a systematic approach towards designing effective incentive systems.

1 Introduction

Online or virtual communities provide an easy-to-access platform with valuable functions and mechanisms for various purposes including socialization, networking, gaming and content generation. Due to the voluntary nature of participation in many types of online community, social behavior complications and individual dynamism are critical factors for designers and operators to deal with. Designing a successful online community needs, therefore, meticulous and constant attention to different aspects of technical, individual and social layers [52]. Human behavior, in particular, is a multi-dimensional, interactive and sometimes irrational, especially when put into a social context. Moreover, external factors such as new technologies, paradigms and networks require a perpetual adoption of constructs and methods [4].

While early research in this area has been largely descriptive, in recent years there has been a shift toward prescriptive modeling of online communities in particular and STSs in general. The goal of these

studies has been to bring a more systematic approach for their design and operation [22; 37] by providing evidence-based and scientific guidance [33].

In this paper, we narrow our focus to (online) production communities[1] as an increasingly important type of online community. In production communities, the primary objective is collecting and/or developing content, with voluntary users as the main explicit[2] producer of content. These communities aim to accumulate, rate and share information, create digital artifacts, foster innovations and solve problems [23] by utilizing the collective intelligence of voluntary participants. Since production communities heavily depend on contributions of voluntary participants (users), sustained participation (not necessarily by the same users) plays a crucial role in their success [32]. In many production communities, incentive systems are introduced as explicit measures to attract new users, keep active users motivated and encourage passive users to become more committed (see [60] for implicit motivational factors). Taking the large number and geographic dispersion of users and the variety of their motives and characteristics into account, introducing effective incentives is a delicate and dynamic process. Also, communities change in scope and direction and set different goals and objectives in the different stages of their lifecycle [28; 57] and so do users [44]. All these factors account for the complexity and dynamism of incentive systems.

There is a large body of literature on theorizing incentive systems for different types of communities including discussion forums [10], open innovation communities [20], open source communities [50] and Wikipedia [40; 56]. The key success factor, and at the same time the major challenge for all these different types of production communities, is their ability to enhance interest and drive users to participate and contribute more frequently, consistently and in alignment with the community's goals and norms. There is, however, no conceptualized framework to theorize on general design flow of incentives that can be indiscriminately applied to all different types of production communities. This paper is dedicated to providing a comprehensive literature review on established theories and best practices for different types of production communities pertaining to user participation and incentive systems.

For this purpose, we try to conceptualize existing relevant theories, approaches, and features from the vast but disperse practices and findings into a comprehensible and concretized design model. Our intent in this exploration is to address underlying differences as well as similar patterns in different types of production communities that are relevant to user participation and the role of incentive systems. Various influential factors including user desires and community features (goals and lifecycle) are studied with a scientific canon. We hope that the theorized model and the provided approach would shed light on recent discoveries in designing successful incentive systems and help explain the interdependencies and intricacies in this area. The outcome may also pave the way for future research endeavors on other relevant aspects of production communities.

Our study is structured as follows: first we provide a generalized definition of production communities and their characteristics. Then, we outline an integrative framework that surfaces the general determinants of their incentive systems. In the next section, based on the proposed integrative framework, the implicit and explicit incentives and objective of incentive systems are discussed and drawn upon to conceptualize a design cycle for target-oriented incentive systems with clear steps and

[1] In this paper, the term "community" represents an online or virtual community, unless stated otherwise.

[2] This differs from implicit content production, where user activities are captured as content (e.g. in searching algorithms).

guidelines. We conclude the paper with a discussion of our findings, open issues and implications for future research and practice.

2 Theoretical Framing

2.1 Research Context: Production Communities

Communities can generally be distinguished by following an approach based on users' needs, such as socialization, gaming, content or knowledge sharing, activism, development and exchange [25]. The communities of interest in this study are production communities, which have the primary goal of accumulating and sharing user-generated content. There are various types and terms in the literature to refer to production communities including open content projects [8], web-enabled collective intelligence systems [37], social computing systems [43], peer production communities [53], open source content projects [42], community-driven knowledge sites [31] and social media [26]. We chose the term production communities inspired by the definition provided by Oreg and Nov [42] and Wilkinson [53], emphasizing the crowdsourcing of content.

Considering this broad definition, a few well-known community types can be distinguished based on the type, form and collectivity [41] of content. One study divides production communities into three primary categories of collaborative, creative and competitive communities [61]. In collaborative communities, content can be developed collaboratively and by more than one user. The type of content that can nowadays be created collaboratively is not limited to text and ranges all the way from knowledge generation (e.g. Wikipedia) to architectural sketching, product design, movie making and geographical maps [17]. In creative communities, however, each user is basically the "owner" of his generated content and the other members may only contribute in the form of comment (discussion), ratings, recommendations, and other auxiliary forms. Competitive communities, as the name suggests, consist of short-lived competitions with specific topics (e.g. product design, innovation ideas, etc.).

2.2 User Motivations and Basic Desires

In literature, user motivation been has primarily divided into two general types: intrinsic motivations and extrinsic motivations, although some scholars further divide extrinsic motivations into internalized extrinsic and purely extrinsic ones [50]. There is no certain verdict regarding which type of motivation is generally of more importance. What is certain is the weight or importance of each motivation with regard to the desires and behavioral characteristics of users and the goal of the community. This suggests that designers should understand personal desires of different groups of users to be able to provide suitable incentives that are aligned with each group's internal and external motivations [35]. Observing users' behavior from the perspective of motivation might be best suited for a descriptive approach to justifying their participation. However, a design-oriented view of the behavior should tap into the distinction between various motivations to be able to provide suitable incentives.

To distinguish between different kinds of motivation and address those differences to introduce the most effective incentives, individual preferences based on personal needs provide a potent theoretical ground. Accordingly, Reiss [46] proposed the theory of 16 basic desires based on psychometric research. His widespread theory suggests that all fundamental desires can exist with different strength at different times in different individuals. According to his theory, individuals behave in ways that is appealing to both reference group members (community) and their own desires of affiliation and power [51]. We derived seven primary user desires that are relevant to the context of production communities: *self-importance, self-development, fun, vindication, socialization, group identity* and *uniqueness*.

Table 1 shows how we identified these seven desires. We believe that the more desires of users an incentive system can successfully address and support, the more effectively it can motivate them to participate.

Intrinsic feeling/motive	**Pertinent desire**	**Remark**
- Efficacy/power - Freedom/ Independence	Self-development	The same. Self-development is a more common term in the literature [42].
Self-importance/ Status	Self-importance	Uniqueness is a well-known desire in online communities [14] and can be derived from self-confidence and self-importance motives. It is distinguished from self-importance, since it emphasizes the individual aspect, whereas self-importance can be achieved as part of a bigger group (e.g. via status) [27].
Self-confidence/ Acceptance	Uniqueness	
- Fun/social contact - Wonder/Curiosity	Fun Socialization	Socialization, as an important motivation in online communities [39],though not explicitly mentioned, is a part of "fun" in Reis's basic desires.
Vindication/ Vengeance	Vindication	Same. Especially important in competitive production communities [6].
Loyalty Compassion/ Idealism Love/family	group identity	Loyalty, compassion and love were merged into "group identity", a well-known desire in online communities [53].
Ownership/ saving	X	Not relevant
Stability/order	X	Not relevant
Lust/romance	X	Not relevant
Vitality/physical exercise	X	Not relevant
Satiation/eating	X	Not relevant
Safety/tranquility	X	Not relevant

Table 1 Deriving primary desires in production communities from Reis's 16 basic desires

3 Theorizing Dynamic and Target-oriented Incentive Systems

As discussed in the last section, constant observation of contextual and individual factors and appropriate reactions to inevitable changes throughout the lifecycle of a community [57] are essential for designing a successful incentive system. For this reason, the design process of incentive systems can be regarded as a never-ending cycle. In this cyclic design process, the objectives of a community should be defined and redefined according to the confronted challenges and current needs of a community and its users. Then, based on the addressed desire(s), the selected incentive for achieving these objectives should be applied to the right users in a personalized way. Incentives are then to be selected and prioritized. This design cycle is demonstrated in Figure 1.

3.1 Design Steps

3.1.1 Defining Objectives

Incentive systems can embrace certain objectives at different stages of a community's lifecycle (see [57] for an example on feature evolution during a community's lifecycle). Their objective is sometimes directly aligned with the community's objectives [13] and sometimes with a temporary goal to overcome imminent problems. For instance, while encouraging timely contributions is a persistent goal in open media communities, it can be adapted temporarily in open file sharing communities to regulate

data traffic [48]. Some general objectives are, for example, improving *user experience*, encouraging *timely contributions*, enhancing *content quality*, increasing *content quantity*, increasing *metacontent*[3] *[59] quantity*, *discouraging excessive contributions* and *promoting presence* (e.g. reading, navigating, distributing content or taking part in elections).

3.1.2 Selecting apt incentives

In this step, a list of apt incentives should be prepared and prioritized. The selection process can be carried out with regard to the defined objectives and the salient desires of users within the community (see Section 2.2). Table 2 lists a few incentives with their corresponding main objective and addressed user desires as an example of how incentives can be systematically selected in a community.

Main objective	Incentive	SI	SD	F	V	S	GI	U	Reference(s)
enhancing content quality	Providing systematic feedback mechanisms on content	X	X			X			[9; 30]
Improving user experience	Sending personal admiration messages or showing public admiration	X						X	[3; 5]
increasing content quantity	Sending invitation to contribute to a topic, in which the user has been more active (is expert)	X	X					X	[18; 36]
promoting presence	Publishing a summary of the activities of users (e.g. in newsletters or blogs)	X	X				X		[24]
increasing (meta)content quantity	Providing a list of needed contributions		X				X	X	[15; 34]
SI: self-importance, **SD**: self-development, **F**: fun, **V**: vindication, **S**: socialization, **GI**: group identity, **U**: uniqueness									

Table 2 A sample of few incentives with the pertinent objectives and addressed desire(s)

For example, in open source software development communities, self-development, socialization and group identity are primary user desires [42; 50]. This information can be used to identify and provide possible incentives (e.g. “systematic feedback mechanisms” or “self-evaluation tools”). Here the distinction between content and metacontent is of great importance. Many studies show that not only is the significance of each of them different with regards to the stage and objective of a community [29], but also that users show diverse attitudes toward contributing content or metacontent [42; 47].

3.1.3 Identifying Target Groups per Incentive

There are few incentive practices that can be effectively applied to all users in the same form and style. Many seemingly sound approaches fail when they are applied to certain groups, since they are not tailored based on user needs and preferences (reflected in their activity pattern) and therefore prove to be psychologically invalid [16]. If an incentive is focused on fulfilling one or more certain desires (e.g. self-development), it is only effective when applied to users who possess and/or value those desires.

Assigning users to the right behavioral group can, therefore, be of tremendous effect. This can be achieved through various approaches depending on the available resources, contribution context and the heterogeneity of users. One approach to classifying users is to explicitly measure user values and preferences via a questionnaire upon registration or as an optional feature in user profiles [55]. Another approach is to use software agents to implicitly gather user preferences by monitoring their activities [19] and extract certain patterns. It should be noted that although the first approach is more accurate and

[3] metacontent refers to socially-generated metadata aimed at providing supplementary information for an item (content) to enhance its quality or to add new perspectives to it (e.g. tags, ratings, votes, comments, etc.) (see [59] for further details).

transparent, it may impose a cognitive burden on the users [38]. A thorough exploration of these techniques and their advantages and disadvantages is outside the scope of this paper.

3.1.4 Determining Sub-Groups and Classifying Users

After identifying the right target-group for each incentive, it is time to determine sub-gourp in their corresponding target (pool of users). Sub-groups help designers customize and personalize each incentive based on the characteristics of its target users. Formulation and presentation of incentives is of great importance [3] and can be performed based on characteristics of users (e.g. gender [54], age, level of education [56], etc). For example, for "thank you notes", the formulation of the text or the color of the message may vary for different genders or ages. The gender of users is believed to determine their perception of features [2] or preferred form of layout [21].

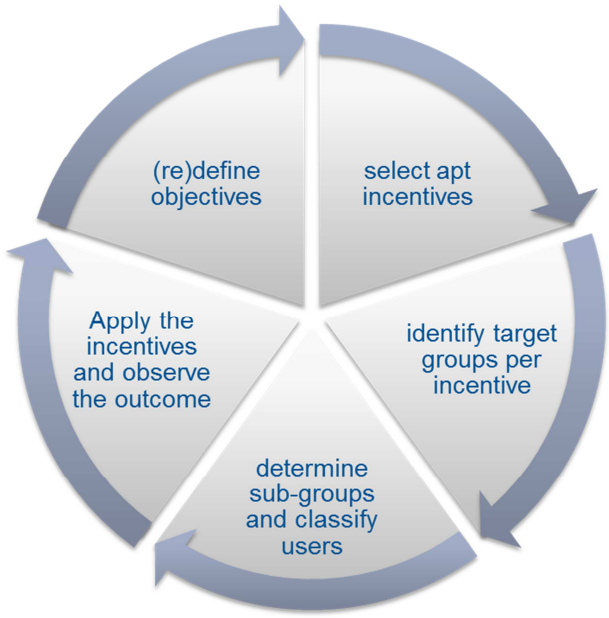

Figure 1 Designing a target-oriented incentive system

3.1.5 Applying the Incentive and Observing the Outcome

Even for the same user, there might be a need for certain incentives to be presented differently on different occasions. User salutations, invitations to contribute, "thank you" notifications, content or activity recommendations, socialization functions, etc. can all be personalized based on user characteristics and customized according to the frequency of use.

Keeping track of the activities of users after applying the incentives may also help the operators gain more insight about the effectiveness of those incentives. Moreover, if an incentive proves ineffective for a certain user or group, the target-group can be redefined in the next cycle. In case introducing an incentive does not yield the expected outcome, it can be removed or modified to decrease the cognitive burden on users.

3.2 Empirical Examples

The proposed design cycle can summarized as follows: 1) the objectives of the incentive system is defined with regard to the characteristics, goals and lifecycle of the community; 2) the target groups are determined based on the list of relevant incentives; 3) the users are classified into target-groups for those incentives; 4) for each incentive the possible customizations are determined and the target users are classified into corresponding groups; 5) The incentive(s) are ultimately customized and applied. Objectives (step 1) can then be redefined or revised based on the outcome of the applied incentives.

Taking the generic and target-oriented nature of such design cycle, some steps may be removed or adjusted depending on the context, type of users, the importance of the incentive system and the available resources. We end this section with few examples from the literature, one depicting a target-oriented incentive and the other an adaptive and personalized one.

3.2.1 Target-oriented Incentives: The Cases of MovieLens and Flickr

MovieLens: Social comparison is a well-known incentive in online communities. In this practice, users are informed about their contribution compared to other users. In *MovieLens,* a community for evaluating and recommending movies, Chen et al. [11] applied this incentive to observe its effect on increasing participation (Step 1 and 2 of the design cycle). The incentive was not initially aimed at a specific target-group and all users were notified of their contribution compared to the median of all users. When the results were studied (Step 5), only those who were below or near the median increased their contribution while the contribution of those above the median was decreased significantly (by 60%). In the next cycle, users were classified into two groups (with contributions above and below average) and the incentive was applied only to the less active users (Step 3).

Flickr: Prieur et al. [45] suggest that incentives applied to Flickr users be categorized into three groups with regard to the activity preference of users: 1) to motivate socialization around the content, 2) to motivate socialization regardless of content, and 3) to motivation content contribution (without socialization). They argue that these groups often have different desires and contribution patterns and, as a result, react differently to the same applied incentives (Step 1, 2 and 3).

3.2.2 Adaptive and personalized Incentives: The Case of Comtella

Reward mechanisms based on user reputation is another popular method for boosting participation [58]. In a project called *Comtella*, in which students can share articles related to weekly topics, Cheng and Vassileva [12] designed an adaptive reward mechanism to achieve two main objectives: encouraging timely participation and discouraging excessive (and often low-quality) contributions (Step 1). The rewarding was performed based on previous contributions of users and the time of contribution (Step 2). Their personalized incentive led to a sustained increase in the quality of contributions [49] (Step 5).

4 Discussion and Conclusion

4.1 Summary

This paper aimed to review and synthesize the literature on user participation and motivational incentive systems and theorize a target-oriented design model (cycle) for incentive systems in production communities. With the perspective that we have outlined in this paper, incentives are not simply general measures to increase participation, but ad-hoc and target-oriented practices to encourage specific activities for particular target-groups in line with a set of objectives. Selecting appropriate incentives and applying them to the right target group in a proper and personalized format takes various dimensions into account including users and community. We focused on online production communities, where content is deemed a unique and salient attribute and the main outcome. The main objective of production communities is to produce high-quality content (e.g. text, source, audio or video files, designs, etc.) by maximizing user participation in the community-related processes [58]. The extant interdisciplinary research was organized around an integrative framework that focuses on user desires and activity pattern as well as community characteristics, lifecycle and goals to address user participation and motivation (see Section 2). According to our model, upon defining the objectives of an incentive system (based on community's lifecycle and goals) and identifying the main user desires within the community, a list of incentives can be prepared and then assigned to specific group of users (targets) in a customized and personalized way. To establish a sound theoretical foundation for this dynamic, target-oriented and multi-dimensional design model, we reviewed and synthesized empirical

findings explored and drew upon pertinent theories from psychology and sociology to address human behavior regarding the production of content as public goods.

4.2 Contributions

Our review shows that a narrow focus on incentive systems can be misguided and misleading. Designing incentive systems should be carried out by a holistic consideration of user-related and community-related factors. In particular, the dynamic nature of both users and communities that is reflected in users' evolving desires and a community's lifecycle should not be underestimated. Furthermore, our review reveals that significant exploratory research and theoretical development has occurred in this area, but mostly in the context of a specific type of community (e.g. open source development) and therefore there is still a paucity of research providing clear and generalized prescriptions for effective incentive systems.

Each and every incentive is employed to address at least one of the primary personal desires: self-importance, self-development, fun, vindication, socialization, group identity and uniqueness. Studying the incentive from the perspective of user desires helps in their selection and prioritization in accordance with the overlap of the users' prominent desires and the desires an incentive is intended to fulfill or trigger. This approach points the way for researchers to give further consideration to general and multilevel issues as they study user participation and incentive systems.

From a theoretically perspective, our work provides a more detailed understanding of user participation and interdependencies between various incentives with a focus on user desires. The theorized design model extends the current body of research by accumulating and merging the academic findings from different types of communities into a unified design cycle with generic guidelines that can be modified and applied to not only all types of production communities but also to other online communities. From a practical point of view, our findings will help community designers move from ad-hoc speculation and press forward with concrete steps toward to a predictable and sustainable approach when it comes to designing an incentive system.

4.3 Practical Implications

One practical implication of the current research concerns the combination of incentives. Incentives are believed to not act in an additive fashion [1]. Interactions between different incentive approaches can sometimes culminate in the mutual neutralization of their motivational effects. Therefore, applying more than one approach should be performed carefully (or gradually to observe the effects).

Effective incentive systems are often a hybrid of economic incentives and social motivators. Economic incentives are less effective or possibly even counterproductive when they contradict intrinsic motivations such as altruism, fun, ethical norms or other known social preferences [7]. For this reason, even in competitive communities, economic incentives such as monetary payments should be applied with the greatest of care and consideration to avoid any negative side-effects. Moreover, determining target groups of the incentive system and an apt classification of users poses a great challenge in practice. First, defining the right number of target groups with fine distinction is a delicate matter and second, assigning users to the right category is not trivial. The question remains as to how effectively classification of users can be carried out without imposing unnecessary cognitive burden on them.

Whether or not to consider memory for incentive systems is another design decision that needs to be addressed. Incentives can "learn" from the past reactions of a user and employ specific incentives correspondingly. For example, if applying a specific incentive does not affect the contribution of a user,

it might not be wise to apply the same incentive repeatedly in the future. This, however, adds another dimension to the system and increases its design complexity. Finally, while true dynamic and multi-dimensional incentive mechanisms might be ideal in theory, they may prove too complicated to implement within a reasonable time and budget, especially for new and rising communities.

Proper customization of incentives based on user characteristics is also another open issue in practice. Empirical studies pertaining to this matter have often focused on one particular type of community with specific characteristics. Dynamic customization is a delicate matter, for user behavior can change depending on contextual factors such as culture [32] as well as individual factors (e.g. age). Some studies have shown that even the gender of users can be a decisive factor with some incentive practices such as social comparisons [24].

4.4 Limitations and Suggestions for Future Works

Many further steps can be taken in the address scientific areas to extend our theorizing. Above all, empirical evidence is required to scientifically evaluate the proposed model and the theorized hypotheses. This can be performed by testing the hypotheses in different types of production communities and observe and compare the outcomes.

Another area that requires further scrutiny is the alignment of primary desires with the objectives of an incentive. Some desires can be intuitively assumed (e.g. leaderboard addresses the desire for self-development, uniqueness and self-importance). However, identifying the right primary desires and their respective weights might be arduous for certain incentives, especially for less clear and subjectively defined desires such as fun.

Furthermore, most of the research is undertaken on successful and popular communities that have passed their "tipping point" of popularity [57]. This generality might instigate problems when it comes to providing and weighting certain incentives in a particular context. Failed communities or successful communities that were not able to sustain user participation and die out (e.g. Google Answers) deserve more academic scrutiny.

Finally, we focused solely on literature pertaining to production communities. The derived design model may be well applicable to other types of online communities, where creating and managing content is not the main purpose.

4.5 Conclusion

Despite the mentioned limitations, we believe the innovative desire-based design approach that was proposed in this paper will be helpful for the scientific community in addressing further design aspects in the context of online communities. Also, in the absence of any universal process model, the conceptualized design model will provide practical guide for community designers to follow a systematic approach to provide dynamic and target-oriented incentive systems to sustain or boost participation in communities that practically live off users' participation.

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6 Lifecycle-based Evolution of Features in Collaborative Open Production Communities: The Case of Wikipedia

Conference Paper

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Authors: Pujan Ziaie and Medin Imamovic

Contribution of first author: problem definition, research design, literature review and synthesis, information coding, conceptualization

Abstract: In the last decade, collaborative open production communities have provided an effective platform for geographically dispersed users to collaborate and generate content in a well-structured and consistent form. Wikipedia is a prominent example in this area. What is of great importance in production communities is the prioritization and evolution of features with regards to the community lifecycle. Users are the cornerstone of such communities and their needs and attitudes constantly change as communities grow. The increasing amount and versatility of content and users requires modifications in areas ranging from user roles and access levels to content quality standards and community policies and goals. In this paper, we draw on two pertinent theories in terms of the lifecycle of online communities and open collaborative communities in particular by focusing on the case of Wikipedia. We conceptualize three general stages (Rising, Organizing, and Stabilizing) within the lifecycle of collaborative open production communities. The salient factors, features and focus of attention in each stage are provided and the chronology of features is visualized. These findings, if properly generalized, can help designers of other types of open production communities effectively allocate their resources and introduce new features based on the needs of both community and users.

LIFECYCLE-BASED EVOLUTION OF FEATURES IN COLLABORATIVE OPEN PRODUCTION COMMUNITIES: THE CASE OF WIKIPEDIA

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Abstract

In the last decade, collaborative open production communities have provided an effective platform for geographically dispersed users to collaborate and generate content in a well-structured and consistent form. Wikipedia is a prominent example in this area. What is of great importance in production communities is the prioritization and evolution of features with regards to the community lifecycle. Users are the cornerstone of such communities and their needs and attitudes constantly change as communities grow. The increasing amount and versatility of content and users requires modifications in areas ranging from user roles and access levels to content quality standards and community policies and goals. In this paper, we draw on two pertinent theories in terms of the lifecycle of online communities and open collaborative communities in particular by focusing on the case of Wikipedia. We conceptualize three general stages (Rising, Organizing, and Stabilizing) within the lifecycle of collaborative open production communities. The salient factors, features and focus of attention in each stage are provided and the chronology of features is visualized. These findings, if properly generalized, can help designers of other types of open production communities effectively allocate their resources and introduce new features based on the needs of both community and users.

Keywords: Wikipedia, Online communities, peer-to-peer production, community lifecycle, governance, incentive mechanisms, conflict management, collaboration.

1 Introduction

Content crowdsourcing and online collaborative knowledge production have been increasingly attracting the attention of many academic and industry researchers (boyd and Ellison, 2007). The Internet provides a vast infrastructure for every online individual to create content and share it worldwide. Virtual or online communities can facilitate the accumulation of structured creation, extension, and distribution of knowledge. The case of Wikipedia shows that when proper organization and coordination processes are provided, the aggregated content can be transformed into a valuable source of knowledge.

The ubiquity and interdisciplinary character of online communities followed by rapid advancements in technology and constant changes of users' behavior makes it a dynamic and complicated area of study. A deciding limitation here has been largely the narrow focus on easily available quantitative data (Arazy, Nov, Patterson and Yeo, 2011). Kane and Fichman (2009) propose employing both controlled quantitative data and a qualitative observation and analysis of collaboration patterns to solve this issue. Identifying patterns in providing new features and policies in the case of Wikipedia is the main focus of this paper. Many communities fail to succeed because they do not provide proper features that would address users' needs at the right time in the course of their lifecycle. Correspondingly, the lifecycle (or lifespan) of communities is deemed as one of the most important aspects with regard to their design and development (Iriberri and Leroy, 2009). It has been shown that the focus of communities as well as the attitude and motivation of users changes during the community lifecycle (Preece and Shneiderman, 2009). The primary focus of previous studies has not hitherto explored the interactive dynamics of the community over time (Faraj, Jarvenpaa and Majchrzak, 2011). We study the evolution of features and mechanisms on Wikipedia as a collaborative open production community (OPC) (Ziaie and Krcmar, 2013) with regard to its lifecycle. Launched in 2001, Wikipedia is a well-known and successful community for open knowledge production which is being visited daily by every tenth Internet user since 2009 (Konieczny, 2010).

To observe the evolution of features and types of varying issues, we first gathered all the identified features and tried to cluster them into few general categories. We could address four categories main areas of interest that could be generalized to almost every collaborative production community: (1) user motivation and content generation (quantity), (2) user coordination and conflict management, (3) community governance (roles and policies), and (4) content quality assurance. Communities often adapt different approaches towards each of these areas in different stages of their lifecycle. For example, many monitoring activities or quality assurance mechanisms are not necessarily required in the early stages of the community; however, they become necessary when the number of users increases. In order to observe the focus of attention in each stage, we tagged each feature with its main corresponding category and mapped them into our theorized lifecycle model. The model draws primarily on two theoretical models proposed by Aaltonen and Lanzaa (2011) and Iriberri and Leroy (2009) and consists of three major stages: (1) Rising (infrastructure and content extension), (2) Organizing (user coordination and conflict management), and (3) Stabilizing (governance and content quality enhancement). The density and distribution of the features in each category in the course of Wikipedia's lifecycle reveals and confirms the focal points of each stage.

We expect that an overview of the evolution of features in Wikipedia will help community designers see the big picture and build up a platform with apt and relevant features with regard to the stage of

their community. Following the steps of successful community may maximize their effort and improve the allocation of resources and increase their probability of success. Also, we believe that our model adds a further aspect to the design complexities of socio-technical systems that can help explaining the changes in user behavior and community expectations as a community grows and matures.

This work is structured as follows: first a brief overview of related works in studying community lifecycle is proposed and our own lifecycle model will be presented. Then, based on the existing body of literature, our finding in terms of the evolution of features in each of the pertaining areas (categories) will be provided for each stage. Finally, the conclusion including the summary, future work and implications for practice will be provided.

2 Related works and Theoretical Framing

As of April 2013, after a little more than a decade of existence, Wikipedia contains more than four million two hundred thousand articles in English[1] and well over twenty million articles in all other languages. It provides an infrastructure to create, edit, and view content for about four hundred million readers per month. Since its inception in January 2001, Wikipedia has been constantly gaining popularity. Today there is an article for nearly every sufficiently important topic (Suh, Convertino, Chi and Pirolli, 2009) and *Wikipedia.org* ranks consistently in the top 10 most popular sites according to *Alexa.com*. Despite this enormous success, there has been problems caused by this rapid growth during its lifecycle and many structural and collaboration-related issues had to be addressed and resolved. In this section, we review relevant literature on community lifecycle and the evolution of features in Wikipedia. Based on the findings and pertinent models, we propose four main areas of interest (categories) for features and a three-stage lifecycle for Wikipedia that can be generalized to other collaborative production communities.

Iriberri and Leroy were among the first scholars who conceptualized four general stages for successful online communities[2] (Iriberri and Leroy, 2009). They argue that for each of these stages, namely *inception*, *creation*, *growth* and *maturity*, different tools, features, mechanism, technologies and management activities are required. Similarly, Aaltonen and Lanzara (2011) focused on Wikipedia and divided its evolution into three phases on the basis of trends observed with regard to the changes in the number of monthly contributors from 2001 to 2008. They found out that the main focus in the first phase, "tapping and exploiting distributed individual capabilities" (from 2001 to 2003), was the versatility and rapid expansion of content and during this time less attention was given to coordination-related activities. In the second phase, "take off and the building of collective capability" (from 2004 to 2007), the community had already taken off and the challenge was not covering more topics and generating more content, but to coordinate the activities that would culminate in productive content generation. The third and last phase, they argued, is "consolidating collective capability into role and rule structures", at which the management of overall quality and enforcement of the corresponding norms and rules happen to be the

[1] http://en.wikipedia.org/wiki/Wikipedia:Size_of_Wikipedia

[2] We exclude the "Death" stage here.

focus of attention. Their proposed transition from phase one to two is aligned with Voss's findings that observed the triggering of an exponential growth around the middle of 2002, when 10 active Wikipedians and 2,000 articles were exceeded (Voss, 2005). Although the proposed model by Aaltonen and Lanzara provides a general view of the characteristics of each stage, if does not address the pertinent features in terms of designing a community. To fill this gap, we defined three stages based on the needs and goals of the community: In stage 1, *Rising*, the focus of attention is mostly on building infrastructure and extending the pool of content. In stage 2, *Organizing*, the focus is on coordinating users and sorting and interrelating content. In stage 3, *Stabilizing*, the emphasis is on community governance and content quality enhancement. Table 1 shows these stages with their corresponding success factors and focuses in line with the two aforementioned models.

Stage	Stage (Aaltonen and Lanzara, 2011)	Stage (Iriberri and Leroy, 2009)	Success Factor	Community Focus
Rising	tapping and exploiting distributed individual capabilities	Inception	Purpose, codes of conduct, trademark, funding/revenue sources	Financing the project, defining viable and narrow objectives
		Creation	User-centered design, security, reliability and performance	Communicating the vision, building trust, acquiring new users
		Growth	Growth management, integration of new members, up-to-date content, reaching critical mass, transparency	responding to users' needs with agility, facilitating content generation
Organizing	take off and the building of collective capability	Maturity	Permeated management and control, recognition of contributions, subgroup management, recognition of loyalty, member satisfaction management, content quality, scalability	Facilitating coordination and effectively handling conflicts, providing visibility and interconnection between content
Stabilizing	consolidating collective capability			Enhancing quality of content, managing scalability

Table 1. Community lifecycle and the success factors and focus of attention in each stage.

Schindler and Vrandecic (2011) review the recent upgrades in Wikipedia and argue that introducing new features to Wikipedia is a complex sociotechnical process and should be viewed and examined from different perspectives. Gorgeon and Swanson (2009) also focus on the evolution of concepts within articles in Wikipedia and identify four major phases in the lifecycle of each article: seeding, germination, growth, and maturity. They do not, however, address the possible changes in the duration or characteristics of these changes according to the stage of the community. Regarding occurring changes in

user behavior, Kittur et al. (2007) study the involvement of admins in Wikipedia over time and conclude that the number of edits by admins has declined since 2002. This, they argue, is either because of the changes in responsibilities of admins or the introduction of bots that automatically take care of a significant portion of trivial editorial tasks. We believe that this is due to the fact that the definition and range of responsibility of admins has changed dramatically during the lifecycle of Wikipedia.

In the next section, we lay out the patterns of feature in each of the defined stages.

3 Focuses and Features in Terms of Community Lifecycle

Every successful community evolves in the course of its lifecycle. Various mechanisms often become necessary to deal with the increasing complexity resulting from their growth, and Wikipedia was not an exception. In this section, we review the theoretical and empirical aspects of the transformations which have been taking place in the last twelve years of Wikipedia's existence with regard to our theorized three-stage model. Each subsection represents a stage of Wikipedia's lifecycle and addresses the pertinent facts, interests and features.

3.1 Rising Stage: Infrastructure and Content Extension

Before a community reaches the tipping point of popularity and critical mass content, its main focus is usually on acquiring new users and motivating them to generate content. This situation is called the *start-up paradox*, when early in their life cycle communities have few members to generate content and insufficient content to attract new members (Kraut, Maher, Olson, Malone, Pirolli and Thomas, 2010). As for Wikipedia, several speculations have been expressed on how and why it could successfully take off. For example, Sanger (2006) names a couple of reasons including the Google Effect, the Slashdot Effect, openness, ease of editing, unquestioned focus on encyclopedia and neutrality. Structure by convention, soft security (ubiquitous access or *holoptism*), and the role of bots have also been mentioned as secrets of Wikipedia's success (Lih, 2004). The lure of an innovative platform where everyone can tweak the content of articles might also have contributed to Wikipedia's success.

These speculations all suggest the importance of user acquisition and content generation in the *Rising* stage of Wikipedia. An overview of the feature in this stage (Table 2) underlines two implications for community designers: First, the power of the idea and innovation (novelty of objective) which drives users toward a collective goal of participating in and being a part of a system, which is in Wikipedia enriching an online encyclopedia that is available to view and edit for everyone. Second, the power of popularity can serve as an incentive to contribute. Based on the reviewed literature, we hypothesize that the first incentive played a vital role in the first stage of Wikipedia and the second incentive plays an essential role in the following stages. Table 2 shows a list of salient features in the Rising stage. Providing features to support user reputation (Ziaie and Krcmar, 2012) are deemed important as well.

Feature	Description	Reference(s)
Namespaces	Wikipedia is divided into sections, called namespaces, each serving a special purpose.	(Viegas, Wattenberg, Kriss and Van Ham, 2007)

Barnstars	Barnstars were introduced to reward editors for their hard work and in doing so represent the reputation of users.	(Leskovec, Huttenlocher and Kleinberg, 2010)
Talk Pages	One of the oldest coordination mechanisms that are characterized as places where conflict was resolved.	(Viegas et al., 2007)
Wiki Projects	Wiki Projects are decentralized governance structures where several thousands of editors are involved.	(Forte, Kittur, Larco, Zhu, Bruckman and Kraut, 2012)
Policy Environment	The policy environment describes strategies of action, principles of encyclopedic content, and proper user behavior.	(Beschastnikh, Kriplean and McDonald, 2008)
New Roles Administrator	Various roles and privileges associated with them were defined in order to motivate users for participation and also delegate some tasks to the community. It began with Administrator.	(Goldspink, 2009)
Bots	One year after the foundation of Wikipedia, bots were introduced to perform repetitive administrative tasks and also import content from external sources and databases.	(Niederer and van Dijck, 2010)

Table 2. Prominent features during the Rising stage

3.2 Organizing Stage: User Coordination and Content Interrelation

Generally, after reaching a certain level of popularity and a critical mass of content, the inevitable increased size of collaboration can often have a destructive effect on the quality of content (Glance and Huberman, 1994) in collaborative communities. For this reason, a strong focus on facilitating user coordination is required. Gradually subgroups are formed based on common interests and goals (Kittur and Kraut, 2010) and proper tools and features are introduced to address the needs of such autonomous groups of users and to resolve the impending conflicts (Voss, 2005). The efficiency of the Wiki interface and the deployed technology (Wilkinson and Huberman, 2007), meticulous attention to process and policies, the community's strong emphasis on coordination and organization (Viegas et al., 2007) and the small number of active contributors compared to the total number of its users (Kimmons, 2011) all helped Wikipedia to successfully pass this crucial stage.

Another problem after a community takes off is the rapid flow of new content into the system. This mass of content should be structured and interrelated so that an acceptable level of visibility is secured. The category system (Schindler and Vrandecic, 2011) and the concept of WikiProjects were introduced to address this problem. During this stage, the functionalities of bots were also extended to reduce the administration load for trivial cleanups and link-generations (Gorgeon and Swanson, 2009).

Table 3 provides a list of prominent features in the Organizing stage.

Feature	Description	Reference(s)
Protected mode	For controversial pages, protected mode was introduced to restrict modification of pages to certain roles.	(Mateos-Garcia and Steinmuller, 2006)
Arbitration	The Arbitration Committee was conceived of as the last step in	(Forte, Larco and

committee	a formal dispute resolution process.	Bruckman, 2009)
Dispute resolution process	The dispute resolution process is used to solve various conflicts between editors.	(Forte and Bruckman, 2008)
Collaboration of the week	Collaborations of the week is a specific mechanism which designate one or two articles to improve in a defined period.	(Zhu, Kraut and Kittur, 2011)
Three revert rule	With the three revert rule, member may not makes more than three reverts to a given page within a 24-hour period.	(Viegas et al., 2007)
New roles	More organizing roles (e.g. Bureaucrat or Steward)	(Forte et al., 2009)
Featured articles	Featured Articles are the examples of the Wikipedia's best quality and they appear on the main page.	(Stvilia, Twidale, Smith and Gasser, 2005)
Category system	With the category system each article could be put into an arbitrary number of freely chosen categories.	(Schindler and Vrandecic, 2011)
Featured article templates	Featured Article Templates was introduced to provide a framework and communicate the status of FA articles.	(Stvilia, 2007)
restrictions on page creation	Since 2006, the possibility of creating new pages was only available for registered users.	(Viegas et al., 2007)
Oversight action	a form of enhanced deletion that deletes from any form of access to protect privacy or remove defamatory material.	Wikipedia[3]
Parser function	A parser function is a wiki text that calls functions implemented in the underlying software.	(Schindler and Vrandecic, 2011)

Table 3. Prominent features during the Organizing stage

3.3 Stabilizing Stage: Governance and Content Quality Enhancement

The third stage in the lifecycle of Wikipedia was started when the contribution pattern shifted from exponential to a constant growth (Aaltonen and Lanzara, 2011). In this stage, the mass of content and the challenge of coordinating users have been largely dealt with and it was time to handle the mass of users and to enhance the quality of existing and future content. Regarding its governance, the policies of Wikipedia have grown enormously in terms of word counts and pervasiveness (Suh et al., 2009). Moreover, upon the expansion of the community, more roles and access levels were defined and enforced. This expansion has been mostly towards more decentralization and has been issued and performed based on consensus (Forte and Bruckman, 2008). Strictly speaking, Wikipedia has become constantly more democratized since its inception. Furthermore, a holistic observation of policy making and administration in Wikipedia shows that there exists a general and gradual shift from the development of rules and policies to their enforcement (Beschastnikh et al., 2008).

[3] http://en.wikipedia.org/wiki/Wikipedia:Oversight

Feature	Description	Reference(s)
Further Democratization	In 2007, Wales declared that the committee could overturn decisions that he had made within Wikipedia.	(Konieczny, 2010)
WikiDashboard	A social and dynamic analysis tool to improve social transparency by surfacing hidden social context of pages/articles.	(Suh et al., 2009)
Flagged revision system	A stable version of an article is shown until established Wikipedia editors confirm the latest edit as a clean version.	(Suh et al., 2009)
Cascading protection	A software feature which was implemented to guard against sophisticated and indirect vandalism in the main page.	http://en.wikipedia.org/wiki/Wikipedia:2007
Article wizard	This feature assists users through the process of submitting a new article to Wikipedia.	http://en.wikipedia.org/wiki/Wikipedia:Article_wizard
Books feature	A functionality to print books from a collection of articles.	http://en.wikipedia.org/wiki/Wikipedia:2009
Edit filters	A feature to allow trusted users to set specific controls over user activities and create rules for certain behaviors.	http://en.wikipedia.org/wiki/Wikipedia:Edit_filter
Rating mechanisms	For each article user feedback is collected for different criteria such as readability or objectivity to produce a quality report.	(Schindler and Vrandecic, 2011; Varlamis, 2010)
Automatic user promotions	Users will be promoted to Editor rank after they have at least X edits that are Y or more days apart.	http://www.mediawiki.org/w/index.php
SuggestBot	A suggestion mechanism that directs users towards work that matches their interests and competence.	(Cosley, Frankowski, Terveen and Riedl, 2007)

Table 4. Prominent features during the Stabilizing stage

Offering high quality content is deemed a critical success factor of online communities (Leimeister, Sidiras and Krcmar, 2006). Accentuating quality of content in the third stage does not mean that it should be ignored or undervalued in the previous stages. A certain level of quality should exist from the very beginning; nevertheless, in the third stage it gains a higher priority, since other concerns such as achieving a critical mass of users and content and organizing them in a coherent way has already been successfully dealt with. A list of prominent features within the Stabilizing stage is shown in Table 4.

3.4 Feature Timeline

Wikipedia's success is enabled equally by its human resources and by the technological innovations and governing dynamics that instruct and direct its users and foster a constructive development of content (Niederer and van Dijck, 2010). We discussed the gradual evolution of Wikipedia's policies and user-driven or content-oriented introduction of new features. Figure 1 visualizes the distribution of the identified features in different stages of Wikipedia. Each feature is color-coded based on its main category (purpose). As mentioned in the Introduction, these categories were extracted by classifying features based on their primary purpose. The density of features with the same category reveals the new issues

the community had to confront in each stage. Note that there is no fine line for distinguishing the inextricably entwined domains of governance, user coordination, and content quality/quantity. However, the density of features in each stage supports our theorized focus of attention for each stage (Figure 1).

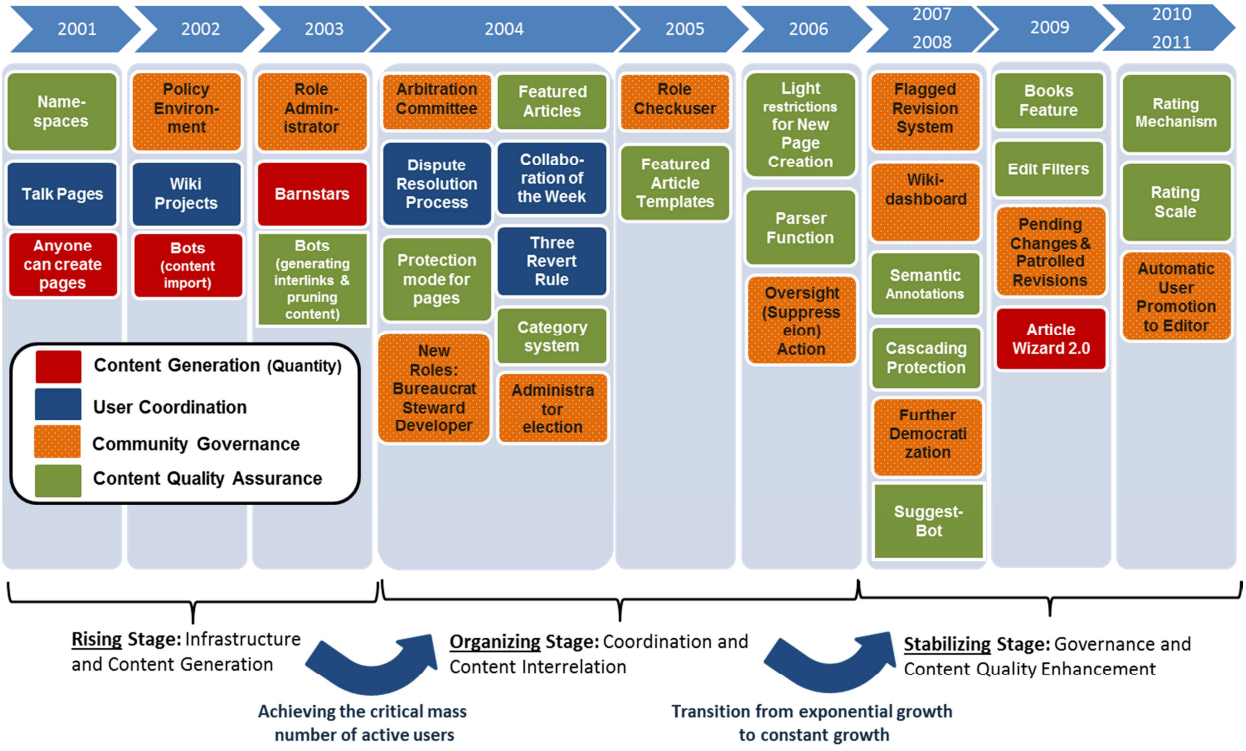

Figure 1. Feature evolution during the lifecycle of Wikipedia and the three distinguished stages

4 Conclusion

Sustaining and encouraging participation and assuring a certain quality of content are of great importance for the success of open production communities (OPCs). Our study of the growth of Wikipedia and the evolution of its features shows that after reaching a certain level of active participation, the focus shifts from attracting new users and accumulating content to organizing the existing content, facilitating coordination between users and to improving the quality of content. Inspired by the lifecycle model proposed by Aaltonen and Lanzara (Aaltonen and Lanzara, 2011), we theorized a lifecycle model with specific attributes and focuses of study for collaborative OPCs. This model encompasses three stages of Rising, Organizing, and Stabilizing. For each stage, we addressed the pertinent contextual factors and concerns with regard to users and community. Based on our conceptualization, after "rising" and reaching the tipping point of a critical mass of content and active users, a community enters the Organizing stage, where the emphasis is mostly on facilitating the coordination between users and structuring the content to enhance navigation and visibility. Later, after successfully dealing with the inevitable increased conflicts and the flowing load of new content, what we call a Stabilizing stage oc-

curs, in which a certain level of self-organized coordination and structuring of content prevails. At this stage, the community has to deal with scalability issues and the focus shifts from content quantity and versatility to assuring high quality content. Ultimately, based on the purpose of their deployment, we categorized the introduced features in Wikipedia into four categories: content generation (quantity), user coordination, community governance and content quality assurance and mapped them into the lifecycle mode. By doing so, we demonstrated that the density of features with a certain focus (purpose) is in line with our described attributes and attention focus for each of these stages (see Figure 1). It should be noted when studying the features in other communities, additional categories including socialization or entertainment may be needed.

We believe that this model is generalizable to other collaborative production communities, since similar trends and shift of orientation (e.g. from content quantity to quality) can be observed in many other production communities. A word of caution is however necessary here. The introduction of new features in socio-technical systems like Wikipedia might well lead to a huge perceived change in the mission and scope of the whole system (Whitworth, 2009). As in Wikipedia, challenges were posed upon introduction of the Flagged Revisions (Schindler and Vrandecic, 2011) and the change in the policy regarding deleting pages (Kostakis, 2010). If these changes, whether as a result of the interplay between human actors and technical constructs (Rogers, 2009) or different subjective opinions on their effectiveness or legitimacy, are not managed wisely, it might endanger the very existence of the community. This is an interesting area for future studies. Moreover, the criteria for introducing certain features with regard to the type of community require more academic scrutiny.

A variety of interesting questions remain on how much these results are generalizable to other communities. In creative production communities (where the main body of content is generated by one user), the coordination between users does not seem to have the same importance as in collaborative communities, for the content is created and modified solely by one user (the creator). Furthermore, some successful features in Wikipedia have failed in other communities (Lampe and Resnick, 2004) which makes deductions from one-to-one mappings of its features extremely challenging. Still, regardless of the extent of generalizability, we stipulate that a holistic observation of the development and evolution of features would provide a diagnosis tool for community designers to be aware of the inevitable changes. Moreover, our findings may be useful to other scholars that aim at enriching our collective understanding regarding dynamic design and development of collaborative open production communities as an increasingly important form of socio-technical systems.

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7 A Model for Context in the Design of Open Production Communities

Journal Paper

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Contribution of first author: problem definition, research design, literature review and synthesis, information coding, conceptualization

Abstract: open production communities (OPCs) provide technical features and social norms for a vast but dispersed and diverse crowd to collectively accumulate content. In OPCs, certain mechanisms, policies and technologies are provided for voluntary users to participate in community-related activities including content generation, evaluation, qualification and distribution and in some cases even community governance. Due to the known complexities and dynamism of online communities, designing a successful community is deemed more an art than a science. Numerous studies have investigated different aspects of certain types of OPCs. Most of these studies, however, fall short of delivering a general view or prescription due to their narrow focus on a certain type of OPCs. In contribution to theories on technology-mediated social participation (TMSP), this study synthesizes the streams of research in the particular area of OPCs and delivers a theoretical framework as a baseline for adapting findings from one specific type of communities on another. This framework consists of four primary dimensions, namely platform features, content, user and community. The corresponding attributes of these dimensions and the existing interdependencies are discussed in detail. Furthermore, a decision diagram for selecting features and a design guideline for "de-contextualizing" findings are introduced as possible applications of the framework. The framework also provides a new and reliable foundation on which future research can extend its findings and prescriptions in a systematic way.

A Model for Context in the Design of Open Production Communities

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Open production communities (OPCs) provide technical features and social norms for a vast but dispersed and diverse crowd to collectively accumulate content. In OPCs, certain mechanisms, policies, and technologies are provided for voluntary users to participate in community-related activities including content generation, evaluation, qualification, and distribution and in some cases even community governance. Due to the known complexities and dynamism of online communities, designing a successful community is deemed more an art than a science. Numerous studies have investigated different aspects of certain types of OPCs. Most of these studies, however, fall short of delivering a general view or prescription due to their narrow focus on a certain type of OPCs. In contribution to theories on technology-mediated social participation (TMSP), this study synthesizes the streams of research in the particular area of OPCs and delivers a theoretical framework as a baseline for adapting findings from one specific type of community on another. This framework consists of four primary dimensions, namely, platform features, content, user, and community. The corresponding attributes of these dimensions and the existing interdependencies are discussed in detail. Furthermore, a decision diagram for selecting features and a design guideline for "decontextualizing" findings are introduced as possible applications of the framework. The framework also provides a new and reliable foundation on which future research can extend its findings and prescriptions in a systematic way.

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1. INTRODUCTION

Thanks to the interactive features of Web2.0, technology-mediated social participation (TMSP) [Preece and Shneiderman 2009] has turned into a common practice to generate valuable content by facilitating the potential creativity, knowledge, and stamina of a vast crowd. Respectively, online or virtual communities are ubiquitous platforms to support TMSP in order to create, organize, and share knowledge; develop ideas; and solve problems [Hargadon and Bechky 2006]. Focusing on content development as the main purpose of a community, open production communities (OPCs) provide necessary mechanisms and features to support collaborative (peer-to-peer), creative, or even competitive creation of open content in particular topics of interest [Ziaie and Krcmar 2013b]. The type of generated content can vary from text (e.g., *Wikipedia* or

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Slashdot) and code (e.g., open source software [OSS] communities) to architectural sketching, video and audio editing, and geographical maps [De Alfaro et al. 2011].

With the concept of user-generated content (UGC) gaining interest, there has been increased attention among scholars and practitioners to OPCs. As a result, a vast body of literature has been devoted to investigating certain aspects of these communities. These aspects include user behavior [Vassileva 2012; von Krogh et al. 2012], community governance [Schwagereit et al. 2011], content crowdsourcing [Haythornthwaite 2009], content quality assessment [Yaari et al. 2011], community lifecycle [Iriberri and Leroy 2009], constructive collaboration [Forte and Lampe 2013; McKenzie et al. 2012], and design guidelines [Kraut and Resnick 2011a; Ziaie and Krcmar 2014]. Most of these studies have focused on one particular type of production community, for example, OSS communities, social media, Wikipedia, or open innovation communities.

Regarding the intriguing matter of designing OPCs, important steps have been taken in recent years to provide a more systematic view and prescriptive approaches [Gurzick and Lutters 2009]. Various empirical methodologies were applied to examine the existing socio-technical effects including multisite studies, longitudinal research, controlled experiments, computational modeling, programmatic research, or data mining to develop relevant theories [Fulk and Gould 2009]. Observing the current dispersed literature and lack of an all-encompassing view, scholars such as Kraut et al. [2010] and Forte et al. [2013] urged more consolidated theories and concepts to be developed to address different aspects of their intricate design possibilities. Designing OPCs, however, is more of an art than science [Vassileva 2012], since numerous contextual, social, individual, and technological factors evolve together and with a mutual impact on each other [Lev-On 2013; O'Day et al. 1996]. Furthermore, the intertwined requirements of different technical, personal, and social levels result in a situation where a narrow focus on one part or dimension can produce diminishing returns or cause problems to arise elsewhere [Whitworth 2009]. This is why in many cases, seemingly small changes in features have resulted in significantly different reactions [Butler et al. 2010]. Respectively, Faraj et al. [2011] point out the fluidity of online communities, since user-based resources including passion, time, or identity present a dynamic flow in and out of the community. Also, structural mechanisms like community size and rules, quality control, and user roles and needs vary perpetually during the lifecycle of a community [Ziaie and Imamovic 2013].

All these factors make the parameterization of pertinent theories and their generalization a nontrivial task [Ling et al. 2005]. Adding to the complication is that many developed theories have been based on findings from one specific type of OPC (e.g., OSS communities) and, therefore, their validity for other contexts is questionable due to the underlying, sometimes fundamental differences. An essential prerequisite for developing more holistic and general theories is a common framework to structure, organize, and cumulate isolated knowledge in order to quantify the characteristics of the target systems. "Decontextualization" of findings is one solution to this problem. Decontextualization here refers to a systematic approach to generalize the findings on one specific community (a certain context) so that it can be used in another, perhaps completely different set of communities (another context). This can be performed by elucidating and quantifying the contextual factors (attributes and their corresponding values) in OPCs to specify the context and then generalizing existing theories, hypotheses, or design assertions by reanalyzing them based on the different values of these attributes in another context.

In this article, Whitworth's framework for socio-technical systems (STSs) [Whitworth 2009] is extended for OPCs by adding a new dimension for "content." The conceptualized framework consists of four primary design dimensions, namely, platform features (technology), content, user, and community. By identifying existing attributes for each

dimension and the discovered interdependencies between them, a novel approach is introduced to decontextualize and generalize theories and empirical findings. Accumulating current dispersed knowledge in a structured framework also paves the way for the scientific community to consider new perspectives and gain a better generic insight of the key design factors in this area. Furthermore, community designers may benefit from the proposed design concept by gaining a finer view on the pertinent attributes of OPCs. They can select and prioritize various features from best practices of other communities only after drawing an analogy between the communities and comparing the values of pertinent attributes. This may increase the success of their community by raising awareness of the possible interdependencies and context-dependent measures and concerns in this multidisciplinary field.

The rest of this article is organized into four sections. The next section provides detailed descriptions of the theoretical framework for OPCs and its four design dimensions (platform features, content, user, and community). Then, the interdependencies between the attributes of each dimension are elaborated upon based on the theories and findings from the literature. In the following section, a systematic way for decontextualizing findings is introduced in the form of a decision diagram and a design model. Pertinent examples are also provided to elucidate the results. Finally, the article is concluded with a summary and a discussion of the theoretical and practical implications, common issues, and suggestions for future works.

Also, in order to keep the number of citations tractable, prestigious international conferences and journals were focused on rather than workshop papers. Preference was given to more recent works, considering the rapid changes in technology and user behavior.

2. CONTEXT-AWARE DESIGN OF OPCS

2.1. Research Focus: Open Production Communities

Communities can generally be distinguished by following an approach based on users' needs, such as socialization, gaming, content or knowledge sharing, activism, development, and exchange [Hinds and Lee 2008]. The communities of interest in this study are OPCs, which have the primary goal of accumulating and sharing user-generated content. The term was inspired by the definition provided by Oreg and Nov [2008] and Wilkinson [2008], emphasizing the crowdsourcing of content and its openness as a public good [Andreoni 1990].

OPCs can be generally divided into two primary categories: *collaborative (peer to peer)* and *creative* [McKenzie et al. 2012]. In *collaborative* communities, content can be developed collaboratively and by more than one user. The type of content that can nowadays be created collaboratively is not limited to text and ranges all the way from knowledge generation (e.g., Wikipedia) to architectural sketching, product design, movie making, and geographical maps [De Alfaro et al. 2011]. In *creative* communities, however, each user is basically the "owner" of his or her generated content and other members may only contribute in the form of comment (discussion), ratings, recommendations, and other auxiliary forms. Table I shows popular types of OPCs with the corresponding content and examples.

Each of these categories and their corresponding subcategories have their own unique characteristics. The primary desires of users may differ as well. Still, it is safe to believe that all these communities follow some general patterns that can be availed upon to draw a generic framework for certain aspects of their design. Therefore, unlike many empirical studies that have focused on a certain type of community, the goal of this study is to provide a way to "decontextualize" [Hughes and Lang 2006] the findings that pertain to their design and characteristics based on a general framework.

Table I. General Categories and Types of OPCs

Category	Community Type	Content Type or Form	Example(s)
Collaborative	Open source software development	Software (compilable code)	*debian.org, apache.org*
	Collaborative content development	Hypertext	*wikipedia.org*
	Collaborative artifact development	Digital artifacts (e.g., product design)	*quirky.com, newgrounds.com*
Creative	Open media	News and timely information	*digg.com, slashdot.org*
	Open (creative) knowledge	Information (with certain topics)	*urbandictionary.com*
	Open file sharing	File (e.g., documents, audio, or video)	*flickr.com, youTube.com*
	Open discussion	Discussion	*answers.yahoo.com*

2.2. Theoretical Framework

OPCs, in general, fit in the notion of socio-technical systems, where, as the name suggests, individual activities and interactions are facilitated by technical features in a social context [Trist 1981]. Here two theories are drawn upon to propose a four-dimensional model as a baseline for OPCs. First is Kuutti's [1996] Activity Theory [Engeström 1999] in the context of human–computer interaction (HCI) research and design that encompasses three actors (subject, community, and object). The relations between these actors are mediated by three elements of tools, rules, and division of labor. The elements of this model can be adopted for the context of OPC by considering a new dimension for content, derived from the "object" element. In this way, users (subjects) utilize features (tools) within a community rule and norms (rules) to develop content (object).

The second theory is Whitworth's [2009] four-layer model for socio-technical systems that consists of physical (hardware), informational (software), personal (user), and communal (community) requirements. By merging hardware and software (infrastructure and platform) into a broader dimension of "technology," the abstraction levels of this model can be used to theorize an extended model that is suitable for addressing the design aspects of OPCs. In this model, platform features represent the central dimension of OPC design, where the activities and processes stem from the interaction of user, content, and community and are supported or enabled by the underlying features.

The focus of the technology dimension is, therefore, unlike Whitworth's model, on the tangible features of the platform instead of its underlying infrastructure. Hardware and software requirements can be derived from the general corresponding factors including the size of the community, the importance of data security, and the volumes of interactions. Therefore, the requirements of the underlying software and hardware infrastructure and their pertinent issues including scalability, interoperability, reliability, and security fall outside the abstraction layer of OPC design[1] that is addressed in this study. In a nutshell, based on this model, a community designer should select, prioritize, implement, and adjust features based on the pertinent attributes of content, user, and community (contextual factors).

Figure 1 depicts the proposed extended framework with platform features as the cornerstone of community design. The mutual relations and interactions between each

[1]Issues such as interoperability, reliability, or security should be addressed in all types of OPCs and therefore are less relevant for the purpose of "decontextualization."

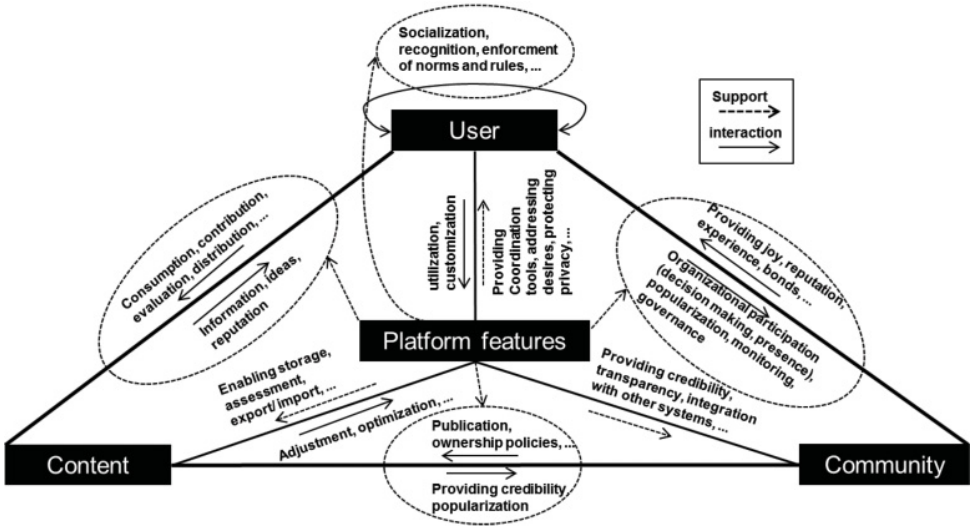

Fig. 1. Theoretical framework for designing OPCs.

of the identified dimensions and the corresponding activities and processes are shown with an arrow representing the direction of interaction.

Rules and policies in this framework act as a glue by providing certain disciplines and regulations for the community to prosper. They often have a mediatory role in regulating the interactions of users and other dimensions. This is facilitated by providing a suitable and viable frame for actions [Couger 1996], balancing the rights of both contributors and end-users [McNally et al. 2012], and strengthening the responsibility norms as a way of monitoring [Cheshire and Cook 2004].

In the next section, the essential design-related attributes of each dimension are addressed. The potential or possible interdependencies will be discussed as well.

3. DESIGN DIMENSIONS OF OPCS AND THE UNDERLYING INTERDEPENDENCIES

When designing OPCs, every decision should be made in line with the existing contextual factors. It is therefore of great importance to identify and be aware of these factors that fundamentally shape the essence of a community. Based on the conceptualized theoretical framework, these factors can be divided into four dimensions of platform features, content, user, and community (see Figure 1). A comprehensive list of the respective attributes not only helps explain the dynamics of OPCs but also can be used to address the discrepancies between different types of communities. In order to identify these attributes, the literature was surveyed from a design perspective. In the following, standalone and interdimensional attributes of every dimension are provided. Interdimensional attributes are those that stem from the interaction between two or more dimensions. These attributes can be later used as decision nodes to address differences between contexts and decontextualize findings, recommendations, or statements.

Figure 2 depicts a summary of the standalone and interdimensional attributes of each design dimension in the form of a matrix. These attributes are presented in the rows pertaining to their dimension, meaning that the interdependent dimensions are categorized in the columns of this matrix. In the following, the detailed definition and relevance of all the attributes of each dimension will be elaborated upon.

Design attributes of ↓ / with regard to →	Features	Content	User	Community
Features	• **Purpose** • Visibility • Autonomy • Mobile suitability	• Content dependency	• Perceived usability • Perceived usefulness • Perceived style • Employment (push/pull) • Target-orientedness • Customizability • Availability	• Lifecycle dependency • Size dependency
Content	• Processability	• Type • Function • Subjectivity of quality • Quality criteria • Timeliness • Layerability	• User dependency • Collectivity • Perceived quality	• Originality • Level of accessibility
User	• Technology efficacy	• Contribution behavior	• Internet efficacy • Basic desires • Gender • Age	• Level of trust • Tenure (lifecycle) • Organizational behavior • Attentiveness • Attachment type • Rank • Status
Community	• Level of integration	• Publication (release) policy • Content licensing policy • Critical mass of content	• Democraticness • Diversity • Multinationality • Expected expertise • Critical mass of active users • Perceived quality	• Vision • Goal(s) • Ownership and sponsorship • Stage of lifecycle • Condition • Size

Fig. 2. Design attributes stemming from mutual interdependencies.

3.1. Platform Features

3.1.1. Standalone Attributes of Platform Features. A considerable body of recent empirical research embodies information technology and technological interventions to empower users for activities such as communication, coordination [Hinds and McGrath 2006], and knowledge management [Sambamurthy and Subramani 2005]. As mentioned earlier, platform features are the relevant part of the technology layer that refers to all technical aspects of OPCs, from hardware and software infrastructure (e.g., servers and operating systems) to the underlying platform (software and algorithms). The platform[2] here provides the highest abstraction layer consisting of the necessary tools and structures for a community to achieve its goals.

Table II shows a list of identified (standalone) attributes for platform features in the context of OPCs.

[2]In this article, the term "platform" is used to refer to the "software platform." "Feature" also represents "software platform features," unless stated otherwise.

Table II. Attributes of Platform Features of OPCs

Attribute	Description
Purpose	Generally, the purpose of a feature can be user, content, or community oriented (see Figure 1). For user-oriented features, to avoid imposing cognitive burden, the feature's purpose should be in line with the needs and desires of users [Deng and Chi 2012]. Some common user-oriented purposes are facilitating navigation [Preece 2001]; addressing user desires to enhance participation and loyalty [Ziaie and Krcmar 2014]; facilitating personalization [Paliouras 2012], reputation [De Alfaro et al. 2011; Ma and Agarwal 2007], and socialization [Farzan et al. 2012]; enabling coordination of user activities [Herbsleb 2007]; and securing privacy [Awad and Krishnan 2006]. Content-oriented features are primarily used for importing, maintaining, generating, evaluating, reporting, filtering, searching, recommending, and distributing content [McKenzie et al. 2012] and ensuring an acceptable level of quality for content [Varlamis 2010]. Community-oriented features focus on the community's needs and collective actions of users. These include, but are not limited to, managing subcommunities and projects [Crowston et al. 2006; Kittur et al. 2009], managing users and enforcing norms [Sternberg 2012], signaling credibility [Benlian and Hess 2011], monitoring and visualizing activities and roles [Vassileva and Sun 2007; Welser et al. 2007], and increasing transparency [Bolici et al. 2009].
Visibility	Features can be visible or hidden within a community. Visible features are those that can be explicitly interacted with (e.g., search, content modification, discussion, etc.). Hidden features run in the background and are not in direct interaction with users or community. Bots to import content into Wikipedia [Niederer and van Dijck 2010] or automatic content-tagging functions [Siersdorfer et al. 2009] are a few examples of hidden features.
Autonomy	Features can be applied in combination with other features or autonomously. If a feature is not autonomous and relies on other systems or features to function, the attributes of those accompanying features should be taken into account as well. This includes their interdependencies with the respective attributes of other dimensions in the decontextualization process.
Mobile suitability	In recent years and after the introduction of smartphones and tablets, a considerable amount of people use these mobile devices to access and avail themselves of certain services and networks. OPCs often need complex mechanisms to develop content that are not easy to employ via a browser on a mobile device. Therefore, well-designed and self-contained apps are required to replace detailed and interconnected webpages [Simonite 2013].

3.1.2. Interdimensional Attributes of Platform Features.

Content-related attributes of features

Some features can function merely based on a sufficiently large pool of content. This *content dependency* is a crucial attribute, since the performance of a feature is highly dependent on existing relevant and useful content. For example, the performance of content recommendation features, automatic tagging, and autocorrections depends heavily on a substantial pool of content [Konstan and Riedl 2012; Siersdorfer et al. 2009].

User-related attributes of features

User-oriented features are principally employed by users to receive useful information or engage in community-related activities. Features also have an impact on users. Technology, in socio-technical systems, is not merely a tool to accomplish certain tasks and enable specific activities. It can practically shape the behavior of its users [Blanchard and Markus 2007]. In other words, our identity, behavior, and subjectivity are increasingly influenced by technological interventions [Dovey and Kennedy 2006]. Understandably, this only occurs if these features are actively utilized. Many technologies and features that have been developed with labor-intensive efforts remain largely underutilized [Keinz and Prügl 2010]. The reason is that they are not perceived by users as useful or easy-to-use tools. This is an important issue, since poor usability and

"requirement mess" [Lindquist 2005] often result in the failure of a community [Benbya et al. 2004].

Respectively, one of the most promising and widely used models with regard to technology in a social context is an extension of the technology acceptance model (TAM) [Venkatesh and Davis 2000]. A recent version of this model points out perceived technology usability, usefulness, and user technology efficacy as significant attributes to explain the adaptation of technology [Venkatesh and Goyal 2010]. *Perceived usability* refers to the extent to which a user believes a feature is easy to learn and work with within a specific context [Karat 1997]. *Usefulness* is defined as the degree to which a user believes a feature would enable him or her to perform certain actions more efficiently or effectively and therefore increase his or her performance [Davis et al. 1989]. These are critical attributes to consider when implementing new user-oriented features.

For visible features, it is also of great importance how they are introduced and presented. The *perceived style* and aesthetic quality of features and/or their formulation can have significant effects on their effectiveness and perceived ease of use. For example, Mamykina et al. [2011] found out that in Stack Overflow, a popular Q&A site for technical domains, the details of the features' design effectively induced desirable behaviors of users and discouraged undesirable ones. In line with this finding, Cyr [2014] suggests that features' graphical design and integrity can have a positive impact on trust, satisfaction, and loyalty of users.

Another reason for a possible failure or abandonment of features lies in the lack of possibility to apply them in a *target-oriented* and *customized* way. Many incentives,[3] for example, are ineffective or even counterproductive when applied to specific groups of users within the same community. For instance, Chen et al. [2010] show that in a movie-rating community, social comparisons are only effective for those users whose contributions are below the average, emphasizing the importance of target-oriented application of certain features. Different layers of features can also be customized, including their presentation (appearance and formulation) or frequency [Chung and Nah 2009; Paliouras 2012]. Finally, *availability* of features (whether available only online or also offline) can influence user behavior as well. For example, Lin [2007] showed that nonprofit virtual communities that offer offline features have a better chance of survival.

Features, similar to technology in a broader context, can be *employed* by being pushed on users or being pulled by them on demand [Parikh and Verma 2002]. For instance, features such as notifications and content recommendations are considered push features, while discussion, content generation, and messaging are deemed pull features. Introducing a push feature is a delicate matter and its success strongly depends on the characteristics of target users and the way these features are personalized and presented [Cyr 2014].

Community-related attributes of features

Many features can enable communities to secure a competitive advantage. Wikipedia's advance, for instance, is empowered by not only the vast number of contributors but also the technologies behind its structure to import and maintain content (e.g., by using bots) and facilitate coordination [Niederer and van Dijck 2010]. The features should be introduced in line with a community's state and characteristics. Some of these features, for example, may be *lifecycle dependent*. This means that their success depends

[3]The term "incentive" in this article refers to features and measures that motivate users to join a community and/or participate with their presence, actions, and contributions (see Ziaie and Krcmar [2014] for a detailed essay on user motivations and incentive systems).

significantly on when and under what conditions they are introduced to a community [Iriberri and Leroy 2009]. For instance, in the context of social news aggregators (open media), Lerman [2007] showed that leaderboards (lists of top active users) are only effective in the early stages of a community (see "stage of lifecycle" in Table V).

Some features may also be *size dependent* and prove useful only when a community is small or large enough. A feature for filtering information or monitoring user activities may, for example, only make sense when a community is large enough [Jones et al. 2004]. This also holds true for features to create and manage subcommunities, projects, and groups to divide tasks, increase familiarity, and facilitate coordination [Bateman et al. 2011].

3.2. Content

3.2.1. Standalone Attributes of Content. Content[4] is the end-product of OPCs and its development their main objective. As Jay Marathe once mentioned, content is "the king" in production communities and the new concept of user-generated content has inevitably changed our perception of many notions including collaboration, ownership, privacy, and quality [Fischer 2009]. In many OPCs, not only content generation but also content evaluation and qualification processes have been transferred from experts to the information-seeking public [Metzger 2007]. A comprehensive list of standalone content-related attributes can be viewed in Table III. These attributes are of great importance when selecting content-oriented features.

3.2.2. Interdimensional Attributes of Content. In order to study the interdependencies of content with other dimensions, a suitable model for representing content in the context of production communities is required. For this purpose, Ziaie and Krcmar's [2013a] model for production communities is drawn upon. According to this model, content (as a whole) is divided into four components: *content essence* or *main content* (main body of content), *metacontent* (additional descriptive or evaluative information such as tags, categories, ratings, etc.), *subcontent* (discussions pertaining to the content), and *metainformation* (statistical and context-dependent information such as location of generators, number of viewers, etc.).

The first three components are created and modified primarily by users, whereas the last part (metainformation) is generated automatically by the system (platform) (see Figure 3).

Feature-related attributes of content

The very nature of content can sometimes restrain the applicability of some of the features such as search or QA functions. This attribute can be called *content processability*. For instance, textual items have high processability. As a result, features that are based on algorithms to search or assess them are relatively easy to implement. For images and audio and video files, on the other hand, the same processes are relatively complicated to implement. Considering content with lower processability, supplementary information including metacontent and metainformation is often required to deliver acceptable results [Bischoff et al. 2008], which in turn accentuates the user dimension.

[4]A broader definition of content can encompass user-related (profile) data or educational information for the community; however, in the literature, the term "content" is often used as the information that is added or generated by users or experts for the sake of expanding and enriching the knowledge pool of the community. In this article, we follow the taxonomy proposed by Ziaie and Krcmar [2013] and use "user profile data" or "educational material" for other cases.

Table III. Attributes of Content in OPCs

Attribute	Description
Type (format)	Content can be presented in different types or formats including text, image, audio, video, code, design sketches, and 3D models [Fischer 2009]. The type of content has a direct influence on its modifiability and an indirect impact on its quality criteria and "searchability." The abstraction level for content type depends on the context and can be sketched in a more general fashion as in "textual vs. nontextual" or "compilable vs. noncompilable" content. For instance, scholars have noted that in communities with nontextual content, more attention is paid to supplementary information (metacontent), since it plays an important role in describing the content and providing a powerful tool to enable clustering [Han et al. 2012], indexing, and searching algorithms [Khabiri et al. 2009].
Function (form)	The function or form of content refers to the purpose of its application. Content can be intended as news, essays, entertainment, maps, designs, discussion topics, products, ideas (innovations), applications, and so forth. The function of content along with its type can sometimes determine its quality criteria and the primary desires of contributing users [McKenzie et al. 2012]. Also, it has been shown that the form or function of content may determine user attitudes toward information sharing [Constant et al. 1994].
Subjectivity of quality	The degree of subjectivity of content quality refers to the extent to which the quality can be assessed based on objective criteria. User-generated content has been argued to have a "subjective nature" per se [Hilligoss and Rieh 2008], suggesting that reaching a consensus on objective criteria to determine its quality is not an easy task. Still, in some contexts, certain criteria can be employed to estimate the quality (e.g., evaluating the quality of an essay by assessing the formality of the language) [Emigh and Herring 2005]. The higher the subjectivity of quality is, the more crucial the role of users or experts becomes in determining the quality through quantitative or qualitative measures [Diakopoulos and Naaman 2011].
Quality criteria	High-quality content is one of the major success factors of online communities [Leimeister et al. 2006]. Defining apt criteria (metrics) to assess and ensure quality is, therefore, of crucial importance. These criteria can be generally divided into two main categories: measurable or automatically deducible (via befitting algorithms) and nonmeasurable or human dependent (their value can only be estimated by users) [Yaari et al. 2011]. Also, quality criteria can be content based (pertaining to the components of content), usage based, or user based (estimated by the credibility or reputation of the contributors) [Agichtein et al. 2008]. Human-dependent criteria include novelty [Carmel et al. 2010], relevance, comprehensiveness [Riedl et al. 2010], accuracy, interactivity [Zheng et al. 2010], usefulness [Lin 2007], and objectivity [Stvilia et al. 2007].
Timeliness	Timeliness indicates whether the value or quality of content alters with time [Ballou et al. 1998]. For example, news or innovations are time dependent, whereas content aimed for entertainment or scientific articles and essays are, rather, timeless. Timeliness is an important factor or determinant for incentive systems and also predicting user behavior (for an example see Szabo and Huberman [2010] for a comparison between Digg and YouTube in modeling user behavior).
Layerability (interdependencies)	Content can consist of independent items or items with functional or utility dependency [Howison and Crowston 2011]. For communities with high layerability of content (e.g., OSS communities), content quality assurance (QA) processes are significantly different and more stringent than communities with low or no layerability (e.g., file sharing communities like YouTube). In communities that focus on content with low layerability, coordination between users is either not necessary or not complex [Malone and Crowston 1994; Van de Ven et al. 1976].
Interactivity	Content can be static or interactive. Interactivity has been shown to have a positive effect on the perceived satisfaction of users in some communities (see, e.g., Chung and Nah [2009] for open media communities).

User-related attributes of content

User dependency of content refers to the degree of users' involvement in generating content. Content may be generated by users (e.g., OSS communities), users and experts (e.g., UrbanDictionary.com), or users and bots (e.g., Wikipedia).

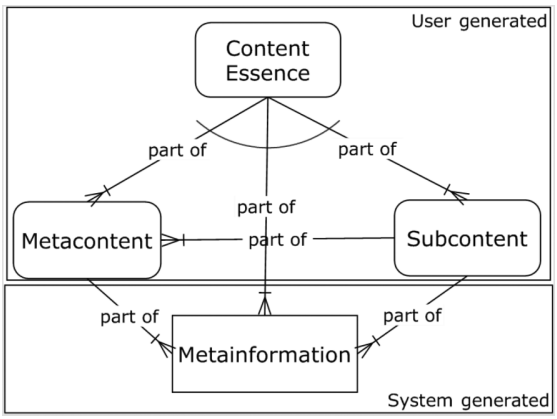

Fig. 3. Content construct and relevant actors [Ziaie and Krcmar 2013a].

Collectivity of content [Olsson 2009] is another essential attribute of content. It corresponds to the depth of user collaboration to develop content. In other words, it refers to the components of content that can be collaboratively modified or extended (see Figure 3). The highest collectivity takes place in collaborative communities such as Wikipedia or OSS communities [De Alfaro et al. 2011], where any eligible user can alter and update content essence.

Lastly, the *perceived quality* of content may also influence the perceived credibility of a community and consequently the contribution behavior of users and their level of trust [Zheng et al. 2013].

Community-related attributes of content

With regard to the community dimension, the *originality* of content is an important attribute. Originality here means to what extent is this content created and developed within the community. Some communities are largely functioning as content propagators (e.g., social media or open file sharing), and as a result the accumulated content is derivative. Users of these communities submit items that have been developed in other communities or by other individuals. Other communities may serve as remixing tools to develop and enhance already generated (unoriginal) items into something new and original[5] [Benkler 2006]. Remixing practices often play a significant role in new forms of innovation [Hill and Monroy-Hernández 2013]. Originality is usually interrelated with content licensing and may have an impact on the contribution behavior of users.

Finally, *level of accessibility* was also identified as an influential attribute for content. In most of the OPCs, as the term "open" suggests, content is open to everyone (user and nonuser). However, some communities may develop a hierarchy for accessing content. This has been shown to have considerable effects on users' perceptions of the community and their behavioral intention [Teo et al. 2003].

3.3. User

3.3.1. Standalone Attributes of User. Users are one of the pillars and shapers of online communities. The term "users" here refers to all groups of individuals who use the features in a community. This includes guests (unregistered users), normal users, and privileged users (e.g., admins and operators). The distinction between privileged and

[5]A good example here is the "*Scratch Online Community,*" endorsed by MIT, in which users can create new interactive animations or videos by using already made pieces of animations or videos (see scratch.mit.edu).

Table IV. Attributes of User in OPCs

Attribute	Description
Internet efficacy	Efficacy refers to an individual's perceived ability or sense of personal competence to perform certain actions [Bandura 2001]. Internet self-efficacy of users is believed to have a significant effect on the amount and type of their participation [Wang et al. 2011].
Basic desires	User desires are deemed essential in research pertaining to user participation and conflict management [Kraut and Resnick 2011b]. User desires can be used to predict their primary motivations within a community [Lampe et al. 2010], since individuals often behave in such manners that are appealing to both other members and their own desires [Wang and Fesenmaier 2003]. In line with Reiss's [2004] theory of 16 basic desires, Ziaie and Krcmar [2014] identify seven relevant desires in the context of OPCs: self-development, self-importance, fun, vindication, socialization, group identity, and uniqueness. Identifying the basic desires of users sheds ample light on their motivation to participate and can predict or explain their behavior in a community and their reaction to certain features. More interestingly, the primary basic desires of users in a certain type of OPC might differ from another one. For example, in open source software development communities, self-development, socialization, and group identity are primary user desires [Oreg and Nov 2008; von Krogh et al. 2012], while in open discussion communities, self-importance, socialization, and fun can be highlighted [Lou et al. 2013].
Gender	The gender of users determines their perception of features [Benlian and Hess 2011], trust [Porter et al. 2012], preferred form of communication or layout, desires [Ma and Yuen 2011], and sometimes even rating behavior [Stumpf and London 1981].
Age	Studies conducted on digital divide show that demographic differences in general and age in particular play a major role in the suitability and effectiveness of certain design components of online communities [Gurzick and Lutters 2009]. Users' age may also be used as an indicator to predict their interests, values [Lam et al. 2011], and reactions to certain incentives [Gefen and Ridings 2005]. For example, Chung et al. [2010] found negative relations between age and Internet self-efficacy of users and the perceived quality of content.

normal users fades particularly in collaborative OPCs, where usually users can be promoted to higher levels in the organizational hierarchy based on their accomplishments [Ziaie and Krcmar 2012].

Users bring various and diverse skills, experiences, interests, desires, and biases into the community [Fulk and Gould 2009]. This diversity brings different desires and needs that should be addressed accordingly. Several standalone attributes of users were identified that have significant influence on their behavior to each other and the community. These include *Internet efficacy*, *basic desires*, *gender,* and *age*. In Table IV, a summary of these attributes and some of their more common values are listed.

It should be noted that these attributes are not completely independent and the values of one might have an impact on another. For example, the primary desires of users within a community can be predicted by their entrenched desires and beliefs [Kraut and Resnick 2011b]. Furthermore, relational properties between users imply cross-level or multiple-level relations [Contractor et al. 2006], as depicted in the theoretical framework (Figure 1) by the "socialization" arrow. The age of a user might also indicate his or her Internet efficacy or vice versa.

3.3.2. Interdimensional Attributes of User.

Feature-related attributes of user

Similar to Internet efficacy, *technology efficacy* of users indicates their perceived familiarity with features of a community and the comfort of using them [Jarvenpaa and Staples 2000]. This perception sometimes determines their affection toward the community and influences the quality, quantity, and type of their contributions [Lai and Hsieh 2013; Leung 2009].

Content-related attributes of user

With regard to content, the *contribution*[6] *behavior* of users represents the type and orientation of their behavior toward content development and usage. Depending on the context, different terms have been used in the literature to distinguish between different behavioral patterns. A well-known framework, introduced by Preece and Shneiderman [2009], categorizes users' behavior into readers, contributors, collaborators, and leaders. According to this framework, new users mostly start by passively reading and exploring the content in order to acclimate themselves with the community and its culture, and eventually start contributing [Preece and Shneiderman 2009]. Depending on the type of community, other terms and definitions may be used including passive users, peripheral members, core members, and leaders [Hinds and Lee 2008] or consumers, contributors, collaborators, and meta-designers [Fischer 2009]. There are also additional roles such as bug reporters, active developers [Ye et al. 2005], shapers [Yates et al. 2010], cleaners, and testers [Jensen and Scacchi 2007] that exist solely in certain contexts (e.g., bug reporters in OSS communities or cleaners in Wikipedia).

Community-related attributes of user

Most of the attributes of users can be identified by studying their interaction with the community. These include *level of trust*, *tenure (lifecycle), attentiveness, rank, roles,* and *status*. Trust can generally be divided into two dimensions:[7] system trust (trust in the community as a system) and interpersonal trust (trust in other members) [Benlian and Hess 2011]. *Level of trust*, whether in the system or in other members, has been identified as one of the most important attributes that has a significant impact on participation and loyalty in online communities [Leimeister et al. 2006; Ridings et al. 2002]. For example, level of trust determines the expectation for reciprocity, which is positively related to positive attitudes toward contributions [Bock et al. 2005]. In line with users' contribution behavior, they may also take *organizational roles* including leaders or moderators [Holmes and Cox 2011; Zhu et al. 2012b]. Furthermore, *tenure* of users (their stage of lifecycle) may sometimes reflect the course of their active participation and their adapted role in a community (contribution as well as organizational) [Danescu-Niculescu-Mizil et al. 2013; Hsieh et al. 2013; Velasquez et al. 2014]. For example, *attentiveness* or the willingness to help others out can often be associated with users' tenure, desires, and level of trust. On this matter, Hsieh et al. [2013] show that in Wikipedia, attentiveness has a quadratic effect on the socialization behaviors of users, meaning that new and long-time members are both more likely to help socializing newcomers than those in between.

Users are also attached to a community in two general ways: identity based and bond based [Ren et al. 2012]. This *type of attachment* has been shown to have a considerable effect on users' behavior toward others and the community [Amichai-Hamburger 2005; Michinov et al. 2004]. For instance, attention to others' behavior and enforcing norms is stronger in identity-based attachment in comparison with bond-based attachment [Dabbish et al. 2012].

Finally, the *rank* of a user refers to the official position of him or her within a community [Shin et al. 2010]. Rank often corresponds to a user's access level (privileges). The most basic ranks in online communities are guest, normal user, and admin. Similar to a rank, s*tatus* is also assigned to users based on their preferences or past achievements [Introne and Alterman 2006]. However, unlike ranks, it is a symbolic badge and does not give users any privileges over others [Ziaie and Krcmar 2012].

[6]In recent years, "contribution" has been used to refer to a particular kind of participation (activity) that culminates in the generation of content (see Reiser [2008]).

[7]We excluded "dispositional trust," since it is independent of any party or context.

3.4. Community

3.4.1. Standalone Attributes of Community. Community, as a design dimension, is the context in which users utilize the existing features to perform certain activities to reach specific goals. In OPCs, the main goal is to develop content either individually or collectively. A community encompasses an established yet dynamic structure including workflows, hierarchy, rules and norm, quality control, requisites, and other contextual factors [Kittur et al. 2013]. A number of design attributes were identified in the literature. These include community *vision* (philosophy of existence), *goals*, *ownership* and *sponsorship* (business model), *lifecycle*, *popularity*, *condition,* and *size* or volume. An aptly enforced harmony between these attributes and those of other dimensions has a direct or indirect influence on a community's success [Kim and Han 2009]. Table V provides a list of the most essential standalone attributes of communities.

3.4.2. Interdimensional Attributes of Community.

Feature-related attributes of community
Similar to other dimensions, several attributes of communities are shaped with regard to and with interplay with other dimensions. *Level of integration* is a relatively recent trend that indicates the extent of integration and interaction of the features of a community with other communities. Integration can be realized by utilizing other communities' features or offering certain features to other communities by means of APIs, online gadgets, or other kinds of technological interfaces. Integration appears to be an effective strategy to obviate the need or minimize the effort for implementing features for socializion, authentication, or announcements [Spagnoletti and Resca 2012]. It can also compensate for communities' possible lack of resources for supporting collective action [Lev-On 2013]. Respectively, integrating features from well-known social networks can have a positive effect on motivating users to be more active by satisfying their desire to show off (*self-importance*) [Huberman et al. 2009].

Content-related attributes of community
Critical mass of (relevant and up-to-date) *content* is another essential attribute that is associated with the content dimension, particularly in the early stages of a community [Rainie and Tancer 2007]. In OPCs, one of the critical success factors is how to establish this critical mass in the Rising stage of their lifecycle (see "stage of lifecycle" in Table V) [Ziaie and Imamovic 2013]. *Publication* or release policy is another content-related attribute of communities. Publication, in this context, refers to making content available to the public or to other websites. Publication normally follows one of two general policies: open gate and closed gate [Bruns 2005]. In open-gate communities, content will be published instantly after being submitted with no prior review procedures. In closed-gate communities, however, the generated content must first be approved before it can be published. Most OPCs adapt certain measures to qualify content if an open-gate policy is implemented [Valcke and Lenaerts 2010].

Lastly, the kind of *content licensing policy* (ownership) is believed to have a great influence on promoting a community and motivating its users. Especially in collaborative OPCs where content has a high collectivity (see Section 3.2.2), the openness and freeness of using, disturbing, and modifying content may have a positive effect on voluntary participation [von Krogh et al. 2012]. It can have an impact on the motivation of users by defining appropriate rights and preventing plagiarism [Colazo and Fang 2009; Kittur and Kraut 2010].

User-related attributes of community
Most of the interdimensional attributes of OPCs hold meaning with regard to users. These attributes are often related to the way these communities are governed. Users find it at times necessary to create new forms of governance to protect interests as the

Table V. Attributes of Community in OPCs

Attribute	Description
Vision (philosophy of existence)	There is a vision or philosophy of the existence for every online community, including OPCs. The vision of a community should be adequately communicated with users and the outside world to increase the likelihood of its success [Kim 2000]. An attractive, novel, and universal vision has a positive effect on the commitment and motivations of users [Bryant et al. 2005; Dholakia et al. 2004]. A sound vision should be interpretable, plausible, paramount, and persistent [Ramiller and Swanson 2003].
Goal(s)	Goal(s) of a community can be deduced from its vision and be adopted in terms of the existing contextual factors. Common goals for OPCs include attracting more users, enhancing content quality, increasing content quantity, increasing metacontent quantity, increasing user commitment, increasing organizational activities (e.g., managing users and subcommunities), enhancing content visibility, or achieving timely contribution. The purpose of a feature should be in line with a community's current goals and focus.
Community ownership or sponsorship	How a community is sponsored and/or who or what organization stands behind it is a determining factor for enhancing a community's credibility and gaining users' trust [Poorisat et al. 2009]. In communities that are sponsored or operated by commercial companies, "firm recognition" is believed to be a strong motivating factor [Jeppesen and Laursen 2009]. Furthermore, in OSS communities, sponsored projects have been shown to be more likely to be successful [Stewart and Ammeter 2002]. In other types of communities, the involvement of commercial companies as sponsors might lessen their credibility [Metzger et al. 2010] and devalue their vision.
Stage of lifecycle	All communities exhibit distinguished stages/phases during their lifecycle. Success factors and user needs often change during this lifecycle. Iriberri and Leroy [2009] conceptualize four stages of inception, creation, growth, and maturity for successful communities. As for collaborative OPCs, three distinct stages of Rising, Organizing, and Stabilizing have been identified [Ziaie and Imamovic 2013], each with a different focus that demands the addition or removal of some features. How popular (well known) a community is also has a significant effect on its objectives and the motivation of users. Empirical data suggest that when users believe that their contributions may reach a wider audience or be presented at a well-known website, they tend to be more motivated to contribute [Raban et al. 2010]. Popularity can be derived from the stage of lifecycle. A community is popular after the stage of Rising (or Creation).
Condition	Empirical studies in the literature primarily focus on two kinds of communities: real communities, where the focus of study is an actual and usually active community, and artificial communities. Artificial communities are short-term communities that are created with a limited number of users for laboratory experiments. Short-term experimental communities mostly focus on one particular feature or user behavior (see, e.g., Riedl et al. [2010]). It is of the utmost importance that the results of artificial communities be investigated carefully before being applied to real communities. Regardless of the often poor construct and invalid pool of users, the lifecycle and dynamism of a real community are not reflected in such experiments. Long-term artificial communities are more legitimate, since they run for a longer period of time to test sustained behavior of users or effects of features (see, e.g., Cheng and Vassileva [2006]).
Size	Size of a group (whether a community of a subcommunity) is an important attribute when introducing new features. An increase in the size of a community inevitably reduces the users' familiarity with each other [Espinosa et al. 2007]. Furthermore, coordination is more complex and difficult in larger teams [Hinds and McGrath 2006]. Therefore, if moderating the effect of the size of a community (or target group) is the purpose of introducing certain features in a specific community, this should be taken into account when these features are applied in other contexts with different sizes.

community grows and they confront new challenges [Chen 2009]. In addition to governance, the community itself evolves during its lifecycle as well. Many attributes change, including *democraticness*, *diversity, multinationality, expertise orientation, required skills* (from users), and *critical mass of active users*. *Democraticness* of a community indicates how the leadership is shared and how much users have influence in the

decision-making process [Luther et al. 2013]. Particularly in collaborative communities, users are more motivated to contribute if they have sufficient influence over decisions and policies in the community [Malone et al. 2010] (see also O'Mahony and Ferraro [2007] for an example in the context of OSS communities). How leadership is shared and distributed may have a significant impact on users' contributions [Zhu et al. 2012a] and be a critical factor for a community's success [Forte and Lampe 2013]. Despite increasing satisfaction, it should be noted that in some cases shared leadership may also actually reduce team performance [Robert 2013].

Diversity of users, if managed properly, also has a considerable impact on knowledge transfer, including content quality [Arazy et al. 2011] and the scope of contributions [Cummings 2004]. This is why Jimmy Wales, the founder of Wikipedia, named "editor diversity" as his biggest issue in developing content [Simonite 2013]. In the literature, diversity has often been divided into two general categories: surface level and deep level [Mannix and Neale 2005]. Surface-level diversity represents possible varieties in demographic characteristics, while deep-level diversity refers to the differences in educational or functional background and knowledge. Deep-level diversity can be divided further into social, value-based, or informational categories [Jehn et al. 1999]. Both kinds of diversity can influence knowledge sharing and social integration within communities [Guillaume et al. 2012], although the effect and interdependencies may differ in different contexts (see, e.g., Daniel et al.'s [2013] study of diversity in OSS communities).

In addition to diversity, many aspects of online collaborations are influenced by preexisting cultural similarities or differences between users [Pfeil et al. 2006]. This makes *multinationality* another relevant attribute. For communities that are being used solely within a particular country, national culture plays an apparent role in shaping the dynamics of communities [Koh et al. 2007].

Expected expertise is another essential attribute in OPCs. It indicates the expected level of expertise and skillfulness from users within a community. Different OPCs demand varying expertise and investments from the users as the main content contributors [Lev-On 2013]. In OSS communities, for example, the expected expertise is high. Open media or open file sharing communities require less or no expertise of users. Expected expertise may indicate or accentuate the primary desires of users. For instance, self-development is shown to be a primary desire of users in OSS communities [Hars and Ou 2002], where the expected expertise is high.

Similar and pertinent to the critical mass of content, *critical mass of active users* also has a significant role in the growth and success of communities [Butler 2001]. Similar to many other projects and start-ups, communities have a tipping point [Gladwell 2006] from which they take off and move from the Rising or Creation phase to the Growth or Organizing phase of their lifecycle [Iriberri and Leroy 2009; Ziaie and Imamovic 2013]. This transition is believed to be significantly influenced by a critical mass of active users [Bruns 2006; Butler 2001]. Moreover, if a community loses these core users, there is a good chance that it gradually heads toward failure [Haythornthwaite 2009].

4. ATTRIBUTE-BASED FEATURE SELECTION

4.1. Design Dynamics and Multiple Interdependencies

As discussed earlier, there is a constant interplay between two or more dimensions of a community. The introduced features should support, enhance, or enable these interactions and be perceived useful and usable to be successful and add real value to the community. Features, for instance, can be introduced to facilitate leadership [Luther et al. 2013] and to monitor and visualize user contributions [Vassileva and Sun 2007]. The perceived quality of the features may also influence users' perception

Table VI. Common Differences in Attributes of Collaborative and Creative Communities

Dimension	Attribute	Collaborative	Creative
Content	Layerability	High	Low
	Collectivity	High	Low
	Originality	High	-
	Level of accessibility	Hierarchical	Flat
User	Technology efficacy	High	-
	Internet efficacy	High	-
	Basic desires	{self-development, socialization, group identity}	{self-importance, fun, socialization, vindication}
Community	Content licensing policy	Open	Limited
	Democraticness	High	Low
	Expected expertise	High	Low

of the credibility of a community and the quality of its content [Flanagin and Metzger 2007]. Users often rely on the neat implementation of features and on content-related signals to assess a community's credibility [Benlian and Hess 2011] and content quality [Fogg et al. 2003].

Content quality assurance is another essential mechanism in which the roles of content, users, and features are inseparable. Users provide subjective assessments for nonmeasurable metrics and features can support automatic assessments, corrections, and necessary normalizations. Correspondingly, a community's stage of lifecycle may also have an impact on users' contribution behavior [Quigley et al. 2007] and, in some cases, on the perceived quality of content [Wöhner and Peters 2009].

As a result, in order to have a dynamic and productive community, the pool of content, the set of features, and the behavior of users should be in line with the goals of a community [Ostrom 2009]. In other words, features should be selected based on the values of their standalone attributes and the respective values of the interdependent attributes of other dimensions. The key question here is, as elaborated in the Introduction, how one can aptly and systematically select features that have been utilized in other communities, particularly in a different type of community.

4.2. Collaborative Versus Creative: Salient Differences of Attribute Values

One of the applications of the theorized framework is to describe the different worlds of collaborative versus creative OPCs. Before adapting a successful feature from one of these categories in the other, the differences between the values of those attributes that have interdependencies and the attributes of the adapted feature should be studied carefully. Table VI shows the identified usual differences in common types of both categories.

This table only points out the general and common differences between the two categories. Certainly, differences in exact types of the selected communities should be identified during the feature selection process to increase the success of features. By zeroing in on the differences within each type, several other attributes can be found that might have different values. For instance, when comparing OSS development and

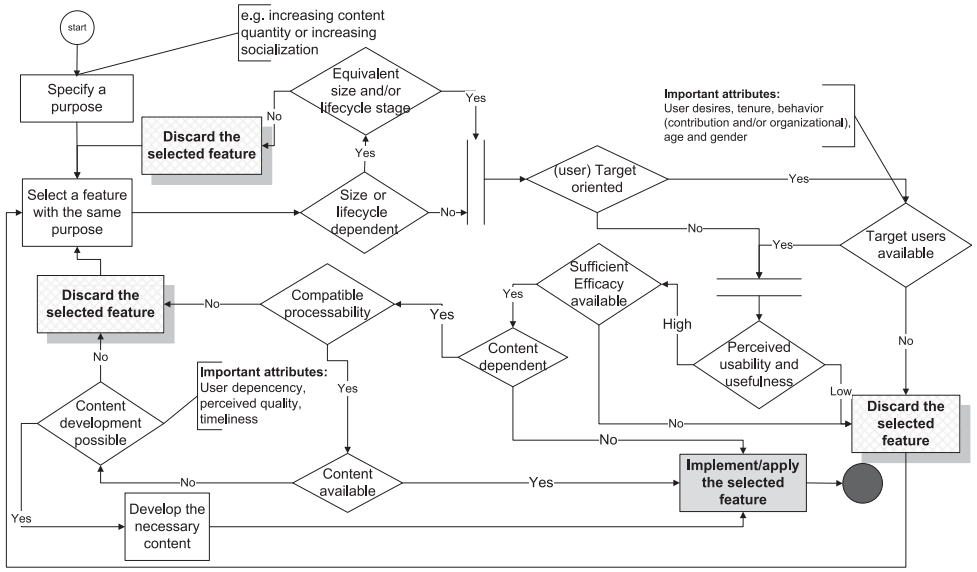

Fig. 4. A simplified decision-making process for selecting a feature based on a specific purpose.

collaborative content development communities, other attributes including content dependency of features; type, quality criteria, and level of accessibility of content; attachment type of users; and stage of lifecycle of the community should also be taken into account. In the next section, a general and simplified decision-making diagram for feature selection is explained to further clarify the decision process based on the introducing framework.

4.3. Decision Diagram for Feature Selection

In Figure 4, the general decision-making steps toward selecting a feature are shown. The feature is selected from another context based on a specific expected purpose. Examining the values of different attributes is based on the interdependencies of the selected features with content, user, and/or community dimensions (see Section 3.1.1). The purpose of the feature is deemed the same in both contexts.

As depicted in Figure 4, the decision-making process starts by selecting a feature from another context (another type of community) with the same purpose as the target community's. This purpose, as referred to in Table II, can be anything including, for example, addressing user desires to enhance participation, facilitating personalization, enabling coordination of user activities, enhancing content quality, enforcing norms signaling credibility, and so on. The next step is to check the dependencies of the selected feature and see whether it is size, lifecycle, target user, or content dependent. For each existing or assumed dependency, the values of pertinent attributes and their analogy to the corresponding attributes in the target community should be verified. For example, if a feature is lifecycle dependent and it has been used in the Stability stage of the source community, it may not be applicable to a community in its Rising stage. Therefore, it should be discarded. The process will be continued with a new feature (obviously with the same purpose) until all dependencies are met.

Figure 5 demonstrates a more general layout of these processes. Decontextualization is basically extracting the significant attributes and making sure of their analogy.

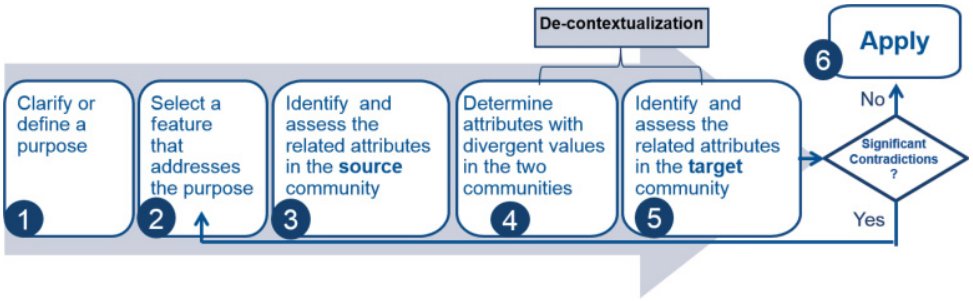

Fig. 5. A general design guideline for selecting and introducing new features.

4.4. Determining Values and Interdependencies

The value of many of the identified attributes can be generally categorized into broad sets, such as "low," "medium," and "high." Few attributes may require specific values. For example, the purpose of a feature may comprise diverse values extending from increasing quantity or enhancing quality of content (content oriented), to facilitating participation by addressing user desires (user oriented), to helping with a community's decision-making processes or rank management (community oriented). These values are only important as long as the pertaining attributes have compelling interdependencies with each other. Moreover, knowing the threshold at which the user behavior or community condition deviates from one assumption to another is of great importance to characterize the overall context to deploy new features [Bolton and Ockenfels 2000].

The values of attributes can be determined based on available statistics and the experience of community operators and designers. A detailed explanation of how these values can be estimated or derived is not within the scope of this article. Yet, the proposed attributes in this study can be employed as a theoretical ground to start the analysis. Furthermore, new hypotheses on possible correlations and dependencies can be made to shed light on the design intricacies in each type or category of OPC. In the next section, a concrete application of the framework in the field of incentive systems will be elaborated upon.

5. APPLYING THE FRAMEWORK IN INCENTIVE SYSTEMS

As remarked in the Introduction, one major problem in designing online communities and introducing befitting features is the lack of apparent contextualization and decontextualization methods to facilitate the application of one successful feature in one type of community to another. Incentive systems are vital systems in many OPCs to sustain participation [Koh et al. 2007]. A systematic assessment of new incentive features can be enormously helpful by decreasing the likelihood of feature underutilization or users' disappointments. The key question here is: would a successful incentive in one specific type of community prove effective in another? For instance, if a feature such as leaderboard has increased users' contribution in the early stages of an open media community, would that yield the same results in the context of OSS or open file sharing communities in later stages? Here, a general design guideline is provided based on Figure 5 to be followed in order to increase the success of a selected feature.

Step 1: Clarifying the purpose

The objectives of incentive systems are often defined and redefined according to the confronted challenges and the primary needs of the community and users. Based on these objectives, suitable incentives with a specific purpose should be selected and prioritized. Correspondingly, target groups should be determined.

The first step before introducing any feature, therefore, is to specify the purpose of making a new addition. This purpose should be clear and in line with the community's goals and users' desires. Otherwise, showering users with unnecessary features may culminate in users being cognitively overloaded and features being underutilized[8] [Deng and Chi 2012].

Step 2: Selecting a Feature
After clarifying the purpose, a set of features can be prepared based on the best practices of other communities. This list can be filtered according to the relevance, viability, and affordability of the identified features.

Step 3: Identifying interdependencies in the source community
Interdependencies or correlations of the attributes of the selected feature with other attributes in the source community are of great importance. This list of identified interdependent attributes will be used in the next step to address possible disparities.

Step 4: Finding attributes with divergent values
In this step, the values of the pertinent attributes in the target community are determined or estimated. Then, those attributes with divergent values (compared to the source community) should be identified. For instance, if the related attributes of a feature (in the source community) are user dependency (value: high) and technology efficacy (value: high), and the value of technology efficacy in the target community is "low," then technology efficacy is added to the list as a disparate attribute.

Step 5: Identifying interdependencies in the target community
The last step in deciding whether a feature can be applied with no considerable negative consequences is to identify the correlations of the disparate attributes in the target community. Following the previous example, if the majority of the users of the target community have low technology efficacy, this has a direct impact on the usability attribute and nullifies the purpose of the feature. Therefore, applying such a feature is not recommended. On the other hand, if there are no disparities or the disparate attributes do not show a significant impact on the use and particularly the purpose of a feature, it can be applied accordingly. Also, it should be remarked that features that have high target orientation may still be suitable merely for a certain group of users. Considering the aforementioned example, the selected feature should preferably be offered to only to users with high technology efficacy.

Indeed, all these are viable if the interdependencies and values of the relevant attributes have been identified and are available. As mentioned in the previous section, this can be made possible by completing the list of interdependencies of attribute for all types of OPCs in future works. Until then, the experience and "gut feeling" of designers in assessing the values and assuming the interdependencies may determine the success of a community. Nevertheless, the provided attributes provide a clear image and a structured framework to address design issues.

6. CONCLUSION, IMPLICATIONS, AND LIMITATIONS

In this article, a theoretical framework for OPCs and a model for adapting successful features from other communities were conceptualized. The main objective of an OPC is to produce relevant and reliable content by maximizing voluntary user participation. Designing OPCs requires well-thought-out, target-oriented, and context-dependent

[8]This lavish and ad hoc introduction of features used to happen very often, particularly in communities that were based on an open source platform. The corresponding designers of these communities try to include as many free and available features as possible with the intention of making their community more appealing to a wider range of users.

features. Numerous studies were surveyed on factors that support or restrict the growth of OPCs. These factors were characterized as different attributes classified into different dimensions. The interdependencies and significance of each attribute were addressed in different types of OPCs and a general model of the contexts was developed in which these attributes could be situated. The theoretical framework consists of four primary design dimensions: platform features, content, user, and community. The literature was studied in terms of their interactions and interdependencies rather than merely their main or additive effects. Finally, a decision model for selecting features and a design guideline for incentive systems were introduced to show how the identified attributes and their interdependencies can be applied in practice.

The results contribute to our understanding of design complications and how various practices play together in the context of OPCs. The invaluable yet dispersed knowledge on this matter was accumulated and synthesized to theorize the introduced framework. This framework basically provides a new baseline on which future research can build more holistic and prescriptive theoretical models.

Moreover, by elucidating the contextual factors (values of the attributes) that lead to a certain conclusion, the identified attributes can be employed to make hypotheses or design assertions more accurate (contextualization). Furthermore, the identification of certain attributes of technology and context is deemed necessary to make comparisons with other technologies and contexts possible [Nass and Mason 1990]. The findings provide a collection of important attributes for community designers to pay attention to when introducing new features and setting new policies.

There are several theoretical and practical implications to address. One theoretical implication is that the studies relating to a specific type of community may not be generalizable and applicable to other communities with different attributes on one or more of the proposed design dimensions. For example, the effect of gender on user motivation or contribution pattern is different in various contexts and not always supported [Yukselturk and Bulut 2009]. The same is true for the age of users [Bateman et al. 2011]. This fact should not be neglected when designing online communities or providing design principles or claims for them. Also, depending on the purpose of study, different levels of detail may be necessary. For example, whether the lifecycle of a community should be divided into two (before and after tipping point), three (Rising, Organizing, and Stabilizing), or four (inception, creation, growth, and maturity) stages significantly depends on the goal of a designer or the context of research.

Another theoretical implication is a call for categorizing communities in parallel with the proposed attributes. New categorizations may follow based on similar values for some of these attributes rather than in terms of one aspect (e.g., motivation) or dimension (e.g., content).

As for practice, one implication is to find and conceptualize apt methods to estimate the values of the proposed attributes. The introduced model for context suggests looking for features with compatible values on significant attributes. While for some attributes these values might be obvious or easy to extract, some others, particularly those related to users, might not be easily assessable. How this compatibility would be assessed in practice for tricky attributes such as user desires [Gauch et al. 2007] is an area to be further investigated in the future. Moreover, redefinitions and rethinking of the meaning and value of some of the attributes in the context of OPCs may be necessary [George and Scerri 2007].

There are still many open and interesting issues that call for attention. The direction of causality between many attributes is still not clear [Nov et al. 2010]. For instance, Brandtzæg and Heim [2008] argued that the correlation between user tenure and contribution patterns is not apparent in many cases. Also, as remarked earlier, further investigations are needed to identify the correlations between attributes for

each identified type of OPC. This may be due to the fact that no fine lines were hitherto set to distinguish different types of communities. There is valuable research on several attributes in a few contexts. For example, Luther and Bruckman [2008] showed the correlation between publication policy and leadership in the specific community type of collaborative artifact development. These correlations are of great importance for a systematic examination of existing interdependencies between attributes of social structures and understanding their long-term effects and constant evolution. However, the list is still incomplete and the interdependencies and causal correlations are unclear for many attributes and many types (contexts). Furthermore, this study merely focuses on OPCs. The list of attributes along with the pertinent interdependencies and values can be extended to be used in other online communities (e.g., online gaming communities).

Another issue is the financial independence of a community. What are the possible scenarios to effectively involve users, with regard to the community lifecycle, to find new revenue streams? OPCs rely mostly on donation and advertisement, and in the early stages of a community neither of these two methods has been proven effective. I am confident that these issues will be easily addressed by the research community in future studies to shed light on this relatively new and complex field of study.

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8 Design and succeed: Lifecycle-oriented Design Principles for Open Production Communities

Journal Paper

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Contribution of first author: problem definition, research design, literature review and synthesis, online survey design, survey conduction, information analysis and coding, theorization

Abstract: Successful design, development and operation of online communities is a delicate and complex matter due to their heterogeneous groups of users, vibrant nature and constant flux. In open production communities (OPCs), a subdomain of online communities where voluntary users contribute content on a specific area of interest within a predefined structure, this task is even more challenging. The interdependencies between different abstraction layers of technology, content, user and community vary through the lifecycle of a community and the external contextual factors change perpetually. In this work, generic design principles are theorized to provide a context-free approach toward designing OPCs. This set of design principles is drawn from the literature and evaluated and revised based on the Delphi method to iteratively conduct interviews with community experts and academic scholars. These principles present generic, yet acceptably actionable guidelines for community designers and operators to follow independent from context-dependent variables. They also offer community designers a structured framework to hold onto when designing such complex systems by revealing a great deal about their dynamics and issues.

Design and succeed: lifecycle-oriented design principles for open production communities

Successful design, development and operation of online communities is a delicate and complex matter due to their heterogeneous groups of users, vibrant nature and constant flux. In open production communities (OPCs), a subdomain of online communities where voluntary users contribute content on a specific area of interest within a predefined structure, this task is even more challenging. The interdependencies between different abstraction layers of technology, content, user and community vary through the lifecycle of a community and the external contextual factors change perpetually. In this work, generic design principles are theorized to provide a context-free approach toward designing OPCs. This set of design principles is drawn from the literature and evaluated and revised based on the Delphi method to iteratively conduct interviews with community experts and academic scholars. These principles present generic, yet acceptably actionable guidelines for community designers and operators to follow independent from context-dependent variables. They also offer community designers a structured framework to hold onto when designing such complex systems by revealing a great deal about their dynamics and issues.

Keywords: Online communities; socio-technical systems, collaboration; open production, user-generated content; social participation, community design, Delphi method

Introduction

The idea of crowdsourcing content generation and relying on the diverse knowledge and immense manpower of a vast crowd has attracted many online community designers in the last decade. As a popular subset of technology-mediated social participation (TMSP) systems (Preece and Shneiderman, 2009), these open production communities (OPCs), benefit from the Internet as a ubiquitous infrastructure and the technologies that Web 2.0 provides and channel the passion and expertise of voluntary individuals into relevant content in specific areas of interest and handle them as public goods. These communities often provide apt collaboration tools (Forte and Lampe, 2013) incentive mechanisms (Ziaie and Krcmar, 2014) within certain norms and regulations (Sternberg, 2012) for

participants to generate, evaluate, extend, discuss and share content. Unfortunately, spectacular success of collaborative communities including Wikipedia and many open source communities and the rise of numerous successful creative communities such as Slashdot.org or Flickr.com might have overshadowed the complexity and difficulty of designing such dynamic systems (Vassileva, 2012).

Unlike in the early stages of the Internet boom, nowadays and in a world filled with saturated users, time-consuming social networks and various colorful online social and game communities, designing a successful community to persuade and motivate members to contribute time and energy is an ambitious goal. Attracting a free work-force at disposal to create, evaluate content and, sometimes, perform administrative and governance-related tasks in a sustainable manner is not easy nor trivial. For instance, in the field of collaborative knowledge accumulation, Wikipedia's success can be considered more an exception than the rule (Kraut et al., 2010). Of the more than 6,000 wikis using the *MediaWiki* platform, hardly fewer than half have attracted more than eight contributors (Kittur and Kraut, 2010). The situation is not any better in other types of OPCs. Most open source software (OSS) projects end in failure and fall short of retaining developers despite attracting sufficient initial interest (Crowston et al., 2006). Many creative communities also fail to achieve their goal due to reasons including, but not limited to lack of proper incentives, boredom, external disruptive technologies or simply disregard for boundary conditions (Chesbrough, 2012).

In addition to contextual factors, online communities, in general, have a dynamic and complex nature. They go through constant changes based on contextual, interpersonal and technological factors (Whitworth, 2009). Also, as in many group activities, online communities often show opposing individual and collective dimensions (Petrič and Petrovčič, 2014). Therefore, in order to be successful in the long run, community designers have to achieve a delicate balance between technical features, content-related issues, individual desires and community objectives and conditions. In OPCs, in particular, four abstraction layers of feature, content, user and community exist with various attributes that change in value and interdependencies over time (Ziaie, 2014). For example, user-related attributes such as desire, efficacy or tenure present a dynamic flow in and out of the community. Community-related attributes including community size, leadership, culture and norms also vary constantly (Faraj and Johnson, 2011). For this very reason, several calls have been made to investigate mechanisms and

guidelines in such a dynamic landscape in order to be able to successfully sustain collaboration and contributions in line with the objectives of such heterogeneous systems (Forte and Lampe, 2013; Wyatt et al., 2013). This means new theories, concepts and/or frameworks are required for both researchers and practitioners to help them better understand the dynamics and intricacies of these systems and to assist them in designing and operating them more aptly (Dannecker et al., 2007).

In recent years, valuable research has been conducted to provide a more prescriptive approach to systematic design of online communities (Gurzick and Lutters, 2009). Various strategies (Kim, 2000), trade-offs (Ren et al., 2007), suggestions (Wenger et al., 2002), lifecycle models (Iriberri and Leroy, 2009; Ziaie and Imamovic, 2013), decision frameworks (Wenger et al., 2010), abstraction layers (Ziaie, 2014), operational aspects (Denison and Williamson, 2012) and design claims (Kraut and Resnick, 2011) have been theorized in order to structure and ease the pertinent design process. The majority of the studies, however, have been recipes specific to specific topics (e.g. incentive systems (Vassileva, 2012), creativity (Kipp et al., 2013) or privacy issues (Tang et al., 2008)), particular target-groups (e.g. guidelines for older adults (Patsoule and Koutsabasis, 2013)) or aspects of a particular type of community (e.g. Q&A communities (Lou et al., 2013) or Wikipedia (Halfaker et al., 2013)).

Another key limitation of prior research in this area is the relatively narrow focus on available, yet not easily generalizable, quantitative data without a deeper analysis of qualitative factors and generic behavioral and contextual patterns (Kane and Fichman, 2009). Many attempts to design from theory have often resulted in naïve and ineffective instantiations (Chi et al., 2010). Moreover, accumulating knowledge and learning from the past has failed at times because these complex systems often defy a systematic and meaningful conceptualization, let alone generalization (Grudin, 1988). This invites further advancements in scientific theorizations, models and methodologies to extend our understanding of design complexities of OPCs to help us move "from ad-hoc approaches to predictable and sustainable socio-technical systems" (Kraut et al., 2010).

To address this gap, the goal of this paper is to theorize high-level design principles that can provide generic yet clear and actionable instructions that can be applied to all types of OPCs with regard to their lifecycle, in a way that their vibrant nature and constant flux (Danescu-Niculescu-Mizil et al., 2013) is acknowledged and taken into account. The initiation of this study was inspired by Ostrom's

design principles (Ostrom, 2000) for long-surviving and self-organized public resource institutions. The principles for offline communities, however, are impractical for explaining collaboration in online communities or prescribing guidelines, given, particularly, the very different nature in collaboration, monitoring and the produced and shared public good (Lev-On, 2013). Non-exhaustive nature of online content, possibilities for real-time monitoring of a large number of participants and lack of close ties all intensify this distinction.

The approach that was followed in this work is a type of generalization that results in theoretical statements that are based on empirical studies and experts' wisdom and consensus. The main challenge here was to identify and formulate generalized principles despite the tension between generic prescriptions and the fundamentally goal-driven and context-dependent nature of OPCs. The final set of principles is not intended to be comprehensive nor can it possibly be exhaustive. Still, it shall serve as a first step towards design-oriented interpretation of accumulated knowledge in this complex field in a way that high level conceptual guidance can be provided for OPC designers and operators. Both technical and social decisions adopted by community operators (Shen and Khalifa, 2013) and community members can have significant repercussions and the theorized design principles may prove of great help in increasing the likelihood of success.

Related Work

There has been several approaches towards providing insight into the intricate matter of community[1] design. Each of these approaches address different issues by providing applicable models, suggestions and claims or discussing possible trade-offs. Kollock (Kollock and Smith, 1996), Kim (Kim, 2000) and Preece (Preece, 2000a), for instance, explore methods and complications of developing online communities in the rising years of online –then virtual- communities. They discussed strategies for their design, as Ren el al. (2007) once aptly stressed, without adequately delving into findings from social science research. In the same study, Ren et al. (2007) provide a set of theoretical predictions to

[1] The term "community" represents online "community" throughout this paper, unless expressly stated otherwise.

understand trade-offs and design choices. These trade-offs include, for example, whether to limit the size of an online community or allow unlimited growth, whether to cluster users into communities of interest or provide unstructured access to all content, and whether or not to ask members to register with a verifiable identity.

On a more abstract level, Wenger et al. (Wenger et al., 2002) derive several instructions for communities of practice based on their hands-on experience. Crumlish and Malone (2009) also present a set of design patterns identified in online communities and conclude that economical approaches wouldn't work in designing such systems. Some scholars also look at online community design from a user perspective and focus primarily on enhancing user experience. For example, Joshua Porter (2008) presents design strategies for online communities and states that the right strategy in this context is to "use this social interaction to get people signing up, coming back regularly, and bringing others into the fold".

Kittur et al. (2013) also outline a framework to help enabling the complex and collaborative nature of crowd work more sustainable. They lay out the existing challenges in twelve major areas including workflow, task assignment, hierarchy, quality control, platforms, reputation, and so on. By far, however, the closest work to the cause of this study is Kraut and Resnick's comprehensive exploration of the literature (Kraut and Resnick, 2011) to translate theory to design alternatives in order to increase the likelihood of success in a community. They list and discuss many design claims that can be applied to certain types of online communities under various circumstances.

What distinguishes the theorized set of high-level design principles in this work from similar studies is its applicability and validity for all categories of OPCs. In other words, in does not focus on a certain community type or category. Furthermore, the selected approach was to move away from general guidance (i.e. better to go this way) and empirical guidance (i.e. the majority of successful people go this way) to conceptual guidance (go this way and do NOT go that way). Here, conceptual guidance implies that the intended theorization draws on empirical studies and theoretical concepts to show how communities may increase their chance of success by following certain principles in certain stages of the community lifecycle.

Theoretical Background

Research focus: Open Production Communities

Open production communities (OPCs) are "user-generated content"-oriented communities with the primary goal of generating or collecting purposeful and public content without a specific time frame within a pre-defined technological, philosophical and social framework. They can be distinguished from social networks[2], service-based[3] and open innovation[4] communities by two major principles: 1) the primary goal of accumulating content and 2) the pivotal role of voluntary users in achieving this goal

Based on the type, function or collectivity (Olsson, 2009) of content, these communities may have different collaborative or creative approaches towards generating content (McKenzie et al., 2012; Ziaie and Krcmar, 2013). In collaborative OPCs users develop the main body of content by following certain rules and norms for collaboration and coordination. These communities include open source software (von Krogh et al., 2012), open artifact creation (Maher, 2010) and peer-to-peer knowledge creation sites like *Wikipedia* (Zhu et al., 2012). Creative OPCs, on the other hand, do not allow much collaboration on the main body of content and the social interaction and communication stays mostly on the metacontent layer (e.g. ratings, comments, shares, etc.). Creative communities include open media (Bruns, 2005), open file sharing (e.g. *YouTube* or *Flickr*), open discussion (e.g. *Yahoo Answers*) (Butler and Wang, 2012) and open innovation (Chesbrough, 2012; Hutter et al., 2011). Table 1 summarizes well-known categories and types of OPCs.

[2] Social networks are online communities with the primary goal of socialization between users. The information sharing in social networks is more on the private side than public.

[3] Service-based communities provide specific services including gaming, shopping, booking, etc.

[4] Open innovation communities are competitive production communities where participants provide ideas or artifacts. These are then sorted based on experts' or other users' evaluation in one or more phases. The competition is often short-term and on a particular and narrow topic.

Table 1 Open Production Communities: types and categories (from (Ziaie, 2014))

	Community Type	Content Type	Example
Collaborative	Open source software development	Software (compilable code)	*Debian.org*
	Collaborative content development	Hypertext	*Wikipedia*
	Collaborative artifact development	Digital artifacts	*Quirky*
Creative	Open media	Daily information	*Slashdot*
	Open (creative) knowledge	Information	*Urbandictionary*
	Open file sharing	File	*Flickr*
	Open discussion	Discussion	*Yahoo Answers*

Generalization

The purpose of this study is to follow a theorization process to introduce generic yet actionable design principles to increase the success likelihood of OPCs. "Generic" means that every principle should be applicable to all categories and types of OPCs. Here, the concept of generalizability is of great importance. Researchers with a qualitative approach towards information systems have often struggled to achieve generalizability without defining pertinent conceptions that may be appropriate to their own research (Lee and Baskerville, 2003). The concept of generalization in this study is similar to that of (Yin, 1998) which represents a form of generalizing from experimental findings to theory. Lee and Baskerville (2003) call this approach the ET[5] generalizability, where empirical statements are used as inputs to conceptualize theoretical statements (as outputs).

Lifecycle models

Consistent with the literature on organizational lifecycle (Phelps et al., 2007), some researchers have tried to identify existing regularities and patterns in the development process of a community and, then,

[5] ET: from empirical statements to theoretical statements

conceptualize them into distinct stages with specific structural, behavioral and contextual characteristics. The results of the performed studies suggest that online communities exhibit distinct stages, with each stage demonstrating particular success factors and prerequisites based on the dynamic characteristics of the attributes of each of the four aforementioned dimensions: features, content, users and community. Iriberri and Leroy (2009) were among the first scholars who proposed four general stages for successful online communities[6]: *inception*, *creation*, *growth* and *maturity*. They argued that each of these stages require different tools, features, mechanism, technologies and management tactics. As for collaborative OPCs, Ziaie and Imamovic (2013) theorized three distinct stages of Rising, Organizing and Stabilizing based on observed trends, operational activities and desires of users and leadership orientation in Wikipedia.

In the more general context of OPCs, a simpler and design-oriented lifecycle model may be drawn upon from the two models above: the stage before a community is established (before reaching its growth and popularity "tipping point" (Gladwell, 2006)) and the stage after that. The first stage is referred to as "pre-establishment" stage and the second as "post-establishment". The pre-establishment stage corresponds to the Inception and Creation stages in Iriberri and Leroy's model (2009) and the Rising stage in Ziaie and Imamovic's model (2013). Design principles were theorized with regard to these two generic stages and were, therefore, sorted into three categories: pre-establishment principles, post-establishment principles and all-time principles (valid in both stages). In the next section the methodology to collect data and theorize the final principles is laid out. Thereafter, the detailed characteristics of each lifecycle stage and the pertinent design principles will be discussed.

Methodology

Theorizing generic design principles for the versatile, controversial and dynamic topic of online communities demands profound study of the past empirical and theoretical studies. All different types and categories of OPCs should be investigate in order to achieve an acceptable level of generalizability

[6] We have excluded the "Death" stage here.

for the findings. It also needs tapping wisdom and tacit knowledge of hands-on experts and versed scholars. In order to duly perform the study and theorize the final set of principles, three distinct phases were carried out: 1) data collection, consisting of comprehensive literature review, 2) data conceptualization and pattern recognition by conducting qualitative expert interviews and 3) evaluation, (re)formulation and finalization of the design principles (theorization) by following a Delphi study (Okoli and Pawlowski, 2004). Figure 1 demonstrates these phases and their corresponding steps.

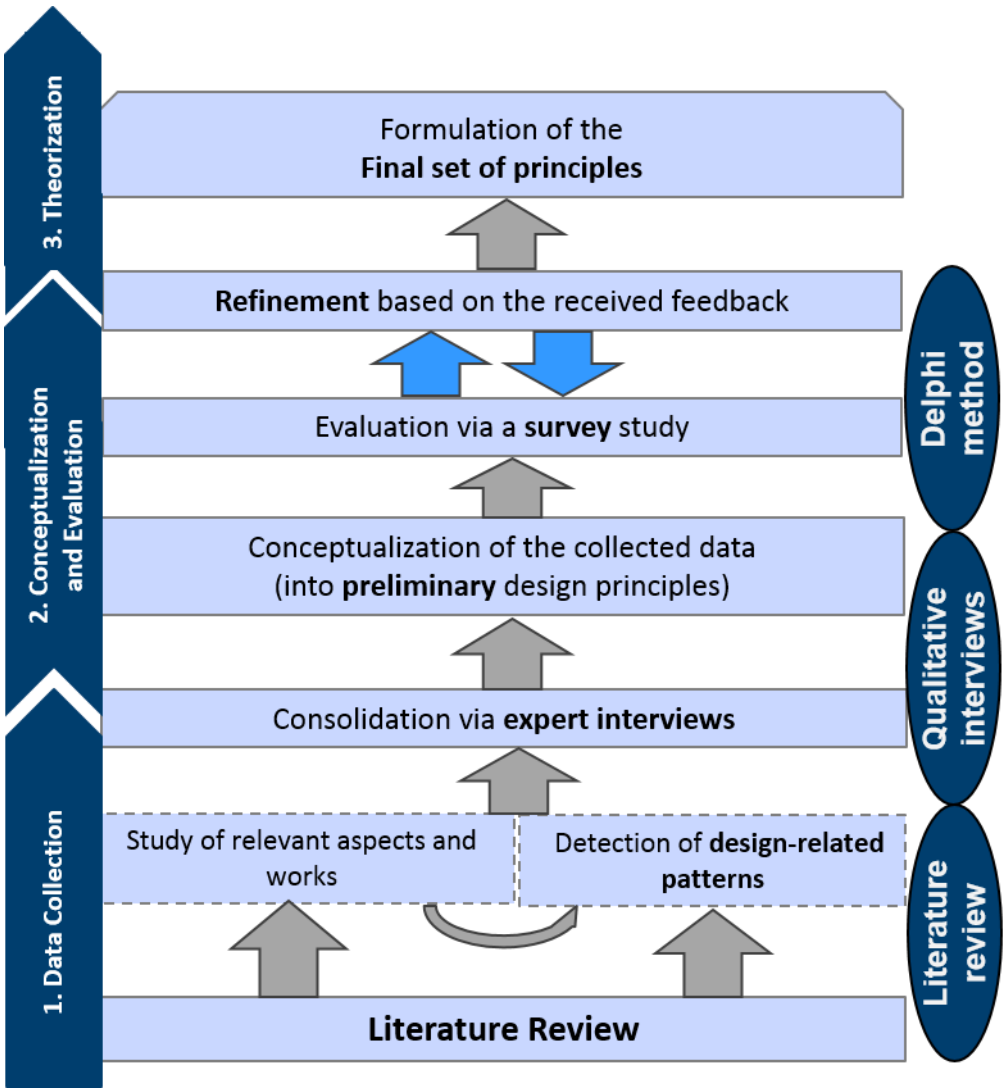

Figure 1 Research methods to theorize the final set of design principles

Data Collection Phase

To begin the study, a comprehensive critical review of the literature was conducted in order to gain sufficient insight and identify the existing design patterns in different types and categories of OPC.

Consistent patterns (Forte and Lampe, 2013) were sought to synthesize a wide range of literature and make the leap from design intricacies, theories and empirical findings to an all-encompassing image of the design issues and success factors. To structure and later "de-contextualize" the findings, the four-layer context model for OPCs (Ziaie, 2014) was employed. For instance, the identified patterns for User dimension include the inequality of user participation (see for example (Santos et al., 2012) for Pareto Principle in OSS communities), special requirements for socializing new users (Wenger et al., 2010) and motivation (Velasquez et al., 2014) and contribution pattern (Preece and Shneiderman, 2009) of users based on their tenure.

Data Conceptualization Phase

The collected and processed information from the literature review was then used to layout the content and direction of qualitative interviews with experts. The interviews were designed based on the dramaturgical model of Myers and Newman (2007) for qualitative interviews in IS research and were conducted in person or on the phone. The aim of these interviews was to identify common design complexities and undocumented operational challenges and gather general DOs and DON'Ts in different types of OPC by extracting the tacit knowledge of hands-on community experts. The experts simply had to have adequate experience as operators, designers or founders of a successful or failed OPC.

The gleaned information was then studied through a thematic analysis (Miles and Huberman, 1994). The process was aimed at identifying coherent patterns in common problems, issues and solutions that were provided by the community experts and also at tracing their underlying causes. The information was formulated into preliminary design principles. The deciding criterion for a principle was that it should have been valid for and applicable to all categories of OPCs regardless of the underlying design attributes and characteristics.

Theorization Phase

In order to evaluate and refine the identified preliminary principles, an approach based on Delphi method was devised so that the most reliable opinion consensus of a group of community scholars could

be obtained. The Delphi method was deemed appropriate for evaluating and revising the principles for three major reasons: first, a quantitative evaluation of such principles for all types of OPC was not viable nor reliable within an acceptable time frame. Second, for a dynamic, complex and multi-dimensional topic a group decision analysis methods often prove more reliable that quantitative approaches (Denzin, 2009). Third, Delphi was desirable in that not only it has high validity in social sciences (Landeta, 2006), but also it does not require the physical presence and interaction of experts (Okoli and Pawlowski, 2004), which was impractical for the globally scattered target experts.

A rigorous procedure to ensure the identification of relevant experts is a requirement of the validity and reliability of the results obtained through a Delphi method (Delbecq et al., 1975). In order to identify the experts with sufficient academic background and esteem, scholars were searched who –at the time- had at least ten publications in areas relating to the design and operation of online communities, with at least one publication having more than 50 citations. 60 scholars were identified.

As for evaluation tool, an online survey was designed in a way that participants can rate the preliminary principles based on the perceived usefulness, accuracy, insightfulness (i.e., non-obviousness) and generalizability. They could also comment on each principle and elaborate on their opinion and/or suggest new ideas. 30 of the identified experts were then invited by individual emails to participate in the devised survey. 14 accepted the invitation and took part. This procedure was conducted in four rounds, and in each new round about 10 more experts were invited in addition to the previous ones. Each round had an attrition rate of 5 to 8 participants, with at least 3 new experts being involved. As a result, the average number of contributors stayed somewhere between 8 and 14 in each round. By the end of every round, the principles were revised and –when needed- removed or added based on the experts' feedback. In total, 24 scholars took part in the survey. In the fourth and last round, 8 experts participated and a general consensus was reached on the remaining principles. The formulations was revised for that last time based on their comments and the results were finally concluded.

Design Principles for OPCs

12 design principles were ultimately developed through the presented methodology. Acknowledging the different characteristics, priorities and directions of OPCs in different stages of their lifecycle, these principles were sorted into three broad categories. The categorization was based on two generic lifecycle stages, namely pre- and post-establishment as characterized in the section on Theoretical Background. The principles are either valid throughout the lifecycle of a community (all-time principles), or most effective and recommended for only one of the pre-establishment or post-establishment stages.

All-Time Principles

Overview

Many important issues regarding the design and governance of OPCs should be handled throughout the lifecycle of communities. These include user acceptance of community features, security and reliability of the platform, form of governance and delegation, training and socialization, privacy of users, accountability of actions and sustained participation. Table 2 provides a summary of these stage-independent issues and the corresponding defined goals and measures to deal with them.

Table 2 Timeless (stage-independent) issues of OPCs and their corresponding goals/measures

Issue	**Corresponding goals and measures**
Sustained participation	Responding to users' needs and voice Introducing user-oriented incentives and features Providing an atmosphere of "do-ocracy"
Learning and communication of norms	Facilitating community memory Providing training and learning mechanisms Supporting deliberation
Acceptance of features	Increasing usability and ease-of-use Reducing cognitive burden on users Progressive and need-based introduction of features Integrating features from other communities or social networks
Cognitive burden on users	Reducing cognitive costs of participation Facilitating content development

	Increasing usability and ease-of-use
Security and reliability	Offering solid infrastructure Providing secure communication channels
Privacy	Building trust Decreasing legal complexities
Accountability	Providing training and learning mechanisms Defining and effectively communicating norms

Principles

P1 - The principle of aligned and evolutionary feature development: features should have a clear and comprehensible purpose and be developed progressively in line with the goals and needs of both community and users.

Background: The involved issues and risks in over-engineering information systems and particularly in online communities by providing too many features and too much information have long been an important topic. The pertinent discussions and academic endeavors have resulted in propositions and new research areas such as IT-alignment (Chan and Reich, 2007) and disciplinary repository development (Reznik-Zellen and Adamick, 2012). In the context of online communities, designers sometimes try to include as many features as possible in their platform in order to address the needs of a wider range of users. This is especially true when the underlying platform is developed by adapting and customizing open source technologies and portals (Gwebu and Wang, 2011). Such measures behavior can be explained by technological determinism (Leonardi and Barley, 2008) and often culminates in users being cognitively overloaded and features being underutilized (Deng and Chi, 2012).

Features must evolve according to members' needs (Wang and Yu, 2014), especially before a community is well-established in order to refrain from distracting and overloading still-not-committed users. Since these goals and needs change overtime, the development of features should be carried out progressively with regard to these changes in an evolutionary way. Correspondingly, goals and needs of a community and those of its members might sometimes be inconsistent, unstable, and unknown, especially in the early stages of a community.

An important overlooked aspect on this matter concerns how different tools can be effectively combined to stress the core functions and eliminate unnecessary features (Matthews et al., 2014). On these grounds adding or adopting any additional feature that is not at the time in line with a community's objectives or its users' needs should be spared, since not only is this decision an unwise allocation of resources (particularly in the early stages of a community's lifecycle), but it also imposes an unnecessary cognitive burden on users.

Notes: Much of the use of technology in OPCs is often emergent, meaning people use tools for locally situated purposes. Therefore, single purpose, too-clearly framed, inflexible features are likely to disrupt this flow. There are suggested categories of features that are highly associated with important issues including online contribution (e.g. features to enhance perceived identity verification (Ma and Agarwal, 2007) or objectivity evaluations (Goes et al., 2014)) or socialization (Matthews et al., 2014). Still, the weight and criticality of these issues may vary depending on the context. Also, some ambiguity can sometimes be a good thing, especially in communities with a more social orientation (e.g. the philosophy of "Poking" in Facebook). A feature should certainly have a purpose, as stated, however, the purposes of a community shall not be defined strictly and with a narrow and inflexible focus. As an example, users of a file sharing community definitely do not expect and use a calendar offered by that community. They might, however, make use of features to support interpersonal communications.

P2 - The principle of training and socialization: Opportunities and relevant information should exist for new members to familiarize themselves with the codes of conduct, protocols, routines and tasks.

Background: Sometimes it can be hard for new users to discern what norms and social structures of a community are, what tasks can be performed, and to know about how their contributions are valued (Choi et al., 2010). Community designers should provide means and opportunities to educate new users and facilitate their interaction with existing members (Farzan et al., 2012; Morgan et al., 2013). This learning/training process can be achieved through various venues including educational material (tutorials), initiation rituals, protocols, routines (Howard, 2009), discussion (Q&A) forums (Farzan et al., 2012) and feedback mechanisms (Lampe and Johnston, 2005). In some communities new users can acquaint themselves with relevant regulations, norms and skills by serving a kind of

apprenticeship (see for example (Bryant et al., 2005) for the case of Wikipedia). These practices educate users about available features and functionalities, practical techniques and how to behave properly within the bounds of the community.

More importantly, effective training and socialization processes can enhance users' motivations to contribute (Nov et al., 2010) and, by doing so, expedite the so called "de-lurking" process (Rafaeli et al., 2004; Preece and Shneiderman, 2009). Respectively, unwelcoming reception of new users can easily lead to a decline in participation and recruitment of potentially active and valuable members (Halfaker et al., 2013).

Notes: Training processes are more an opportunity that should be provided rather than a requirement to be fulfilled. In many cases, users are welcome to join the community and start contributing without knowing what exactly the rules are. Opportunities can be provided, for example, by simple means including public or private comments on activities and contributions. In collaboration communities, it can be achieved by convincing/training members on how to constructively rectify the initial contributions or give productive feedback. Furthermore, many OPCs have a very large group of peripheral participants who only minimally engage with the community. This means, again, that training and socialization should be regarded solely as opportunities and not strict requirements.

P3 - The principle of deliberation support and community memory: features should exist to enable users to openly discuss items and issues, capture these discussions and provide visibility for the essential relevant information.

Background: In line with the principle for training and socialization, facilitating deliberation and community memory is an indispensable matter in OPCs in both reinforcing training via informal communication of norms and culture (Preece, 2000b), and supporting deliberation as a measure to resolve disputes (Ostrom, 1990) and enhance engagement (Ray et al., 2014) and commitment. Accordingly, Deliberative Democratic Theory states the vitality of deliberation in democratic constructs (Chambers, 2003). Due to their dependence on voluntary contributions, most OPCs tend to have a democratic nature (Luther et al., 2013). Particularly in collaborative OPCs, users are more inclined to

contribute if they have sufficient influence or voice over decisions and policies in the community (see (O'Mahony and Ferraro, 2007) for the case of OSS communities).

Furthermore, Visibility of the relevant and important parts of these discussions and realizing an effective and sustainable memory for a community is an important issue pertaining to deliberation. Accessibility of information, in general, is also shown to have positive impacts on the sustainability of online communities (Teo et al., 2003). Since online communities are in a constant flux, in absence of proper visibility-providing features the institutional memory will be lost (Agrawal and Joshi, 2011) which in turn may impede the learning process and upset the culture. This memory can be preserved by various means including a knowledge framework, relevant discussion forums, effective data-mining mechanisms (Lee et al., 2014) and online or offline meetings of members so that they can share they experiences and stories with another. Such measures can strengthen the social bonds, explain the routines and culture and, as a result, combat the so-called "routinization of charisma dilemma" (Chen, 2012).

P4 - The principle of authorship transparency: rights including the ownership and/or authorship of content, if any, should be transparently communicated.

Background: In OPCs, the openness of content implies its accessibility and (re)usability. Authorship and legal accountability of community owners/operators regarding content are new, yet crucial issues that need to be properly addressed (McNally et al., 2012). This is especially true when the content is used commercially. In collaborative OPCs, the transparency of authorship helps avoid the instabilities and uncertainties that result from collective content development (Humphreys, 2009). Discounting the "disparity between who does the work and who gets the benefit" (Grudin, 1988) can also reduce misunderstandings and conflicts (Xu and Jones, 2010).

Notes: There could be collaborative OPCs where no ownership or authorship might prove more productive, since some members may be unwilling to alter or rectify content which 'belongs' to others. Therefore, the distinction between authorship and ownership of content should be as apparent as possible. Moreover, members shall be held minimally accountable for any liabilities to prevent a break on participation. Any announcement of accountability may frighten the members and force them think

twice before any contributions. In many cases, if they need to do this, they are more likely to sit back and do nothing.

P5 - The principle of privacy transparency: the level of disclosure for any user-related data, whether personal data or transaction records, should be transparent to users.

Background: Sometimes, in order to justify the development of items or enrich them with new perspectives and metadata, it is important to make users' interactions with items or other users partly or wholly public. The full transparency of such disclosures significantly enhances users' perceived privacy protection, which is positively associated with their perceived usefulness of the community (Chung et al., 2010).

Privacy has been an important issue for many Internet users when they engage in online activities (Paine et al., 2007). Although the concept and concerns of privacy may vary in different generations due to the effects of ubiquitous social networks (Raynes-Goldie, 2010), people still need and are entitled to be aware of how much information about them will be captured and is searchable or viewable by other users or the public.

Also, previous misconducts over data privacy has made many unwilling to share their personal data (Awad and Krishnan, 2006). Features that signal the intent to respect and protect their privacy by empowering users to have full control over the privacy level of their personal data are believed to have a significant positive effect on users' trust in the community (Tang et al., 2008) and increase their contributions (see the so called "*chilling effect*" in (Solove, 2007) on this matter).

Notes: Due to the currently underdeveloped measures to communicate privacy policies to users, it is often a tradeoff between privacy transparency and use. Though rarely exercised in collaborative OPCs, some creative for-profit OPCs rely on selling user data and preferences as an important revenue stream. The delicacy of the situation (the tradeoff) should be handled aptly with regard to the context, meaning what kind of members are contributing what sort of content and how sensitive they generally are to privacy-related issues.

P6 - The principle of do-ocracy: users should be empowered to perform and be credited for any community-related activities they wish for, as long as the failure of these activities does not jeopardize

a community's credibility or very existence.

Background: Successful OPCs can increase in complexity while maintaining democratic principles (Morell, 2010). Sustainable growth within OPCs as democratic constructs is not likely to be attained without efficient use of knowledge and manpower of sufficient number of active members, enabled by imperfect mix of leadership, informal coordination mechanisms (Kostakis et al., 2014). Do-ocracy here means that those members who show commitment and contribute get the credit for their action and gradually gain more influence over community-related matters and decisions (Chen, 2009). Promotion in online communities can be symbolic or organizational, serving one or both of the roles of selection and incentive (Collier et al., 2010). The question here is, who is entitled to systematically gain more reputation (Ziaie and Krcmar, 2012)? Do-ocracy differs from democracy, in which those have a say who contribute in one way or another (not everyone). It can also be distinguished from meritocracy, since in a do-ocracy those who perform the tasks get them, and not necessarily those who are more qualified. Benkler and Nissenbaum (2006), for example, found no empirical studies that could "rigorously confirm the causal connection between virtue and participation" in OPCs.

Notes: Community designers need to be careful about allowing an Old Boys Club or a gerontocracy to shape, where old timers gain so much power that may result in implicit or explicit exclusion or intimidation of potentially valuable newcomers (Zilouchian Moghaddam et al., 2011). Moreover, even with actual inactive members (in sense of contribution), members should be made aware of the value of lurkers and casual visitors and their sometimes vital role in sustainable growth of a community (Yeow et al., 2006).

Pre-Establishment Stage

Overview

At the pre-establishment stage, the focus of a community is primarily on promoting the community and attracting new users, securing a critical mass of active users and content, communicating the vision and financing the project. Table 3 summarizes essential issues, goals and measures of this stage.

Table 3 Characteristics of the pre-establishment stage

Issue	**Corresponding goals and measures**
Vision recognition	Communicating/promoting the vision increasing quality contributions increasing motivation
Content quantity	Facilitating content development Reaching a critical mass of content Reaching a critical mass of active users Reducing collaboration costs
Financing	Finding sponsors and/or investors Collecting donations Cost-efficient development Cost-efficient governance
Attracting and acquiring new users	Integrating the platform with other networks/communities Advertising/promoting Building trust Offering group identity
Community credibility	Building trust Providing attractive content base Offering solid infrastructure
User motivation	Offering a novel vision Building trust Reducing collaboration costs Providing user-oriented features

Financing is often dependent on how fast a community is growing, which depends on the number of active and motivated users which, when guided correctly, result in an increasing the quantity of content and the credibility of a community. These critical success factors are themselves determined by how successful a community is in communicating its vision in the early stages and in attracting and maintaining new users.

Principles

P7 – The principle of low barrier entry and exit: the process to join the community (registration process) and the procedure to unsubscribe should be enabled with the minimum efforts possible.

Background: While in identity-based communities more distinction with outsiders and having to earn

the privilege to become a member may increase the motivation and pride of members (Seraj, 2012), in OPCs, the opposite is often true (Forte and Lampe, 2013). Unnecessary barriers or steps in the registration process may let potential members forgo registration despite their initial interest. Community designers are sometimes tempted to collect as much information as possible from their future users, culminating in longer forms and an increase in the number of clicks and amount of time necessary to complete the process. Since the Initial motivations of newcomers might often be very different from one individual to another (Fang and Neufeld, 2009; Budhathoki and Haythornthwaite, 2013), it is wise to minimize the registration effort, at least during the pre-establishment stage of a community's lifecycle, and collect useful information on users, their behaviour and desires later, and in a more implicit and subtle way (Ziaie and Krcmar, 2012). The registration can be made easy by integrating a community with other social networks (Resnick et al., 2012) or simply keeping the registration form as simple and short as possible.

Regarding the features and procedure to unsubscribe from a community, low barrier to leave a community may seem unwise at first, however, it may actually help engender commitment by creating a sense of vibrancy (Dabbish et al., 2012).

Notes: In some types of OPC, communities may suffer attrition when one member leaves due to herding effects (Oh and Jeon, 2007). Instead of trying to make leaving difficult and as insufferable as possible for members to ease the effect, community operators should pay attention to the underlying cause of the problem and try to increase the perceived benefits of a community instead of raising the costs of leaving. It should also be noted that attrition is not always negative and can be seen as an opportunity to welcome fresh faces, invite new ideas and increase the dynamism of a community.

P8– The principle of vision comprehensibility: the vision of a community should be formulated in a comprehensive way and communicated and publicized effectively.

Background: A clear, creative and novel vision is an essential success factor in online communities (Kim, 2000). Its effective communication is, therefore, one of the essential tasks of the leadership (Luther et al., 2013). Similar to organizations and other group activities (Ramiller and Swanson, 2003), clarifying an interpretable, plausible, paramount and persistent vision for a community

is crucial for aligning activities, strengthening the bonds and boosting their motivation. Defining clear group boundaries, as Ostrom (Ostrom, 1990) puts it, also enables users to internalize these group norms into their own beliefs (Lazar and Preece, 2002; Zhou, 2011).

Correspondingly, members' eagerness to share knowledge has been shown to be positively associated with a shared vision (Chiu et al., 2006).

Notes: a vision is different from a goal or an objective. Many successful communities can have vague goals, such as general discussion around a shared interest. Vision, on the other hand, is the philosophy of existence for a community and shall, therefore, not be left vague or unspecified. It should also be remarked that a vision should be articulated, however, assuming that it is possible to articulate THE vision may result in calcification and should be avoided to permit flexibility and support fluidity (Faraj et al., 2011) for a rising and yet-to-be-established community. Often, even without a definite and solid vision, "personal satisfaction or other individual benefits can go a long way towards motivating people to contribute" (J.T. Morgan).

Principles for the Post-Establishment Stage

Overview

The post-establishment stage corresponds to the Growth and Maturity stages in Iriberri and Leroy's model (2009) and Organizing and Stabilizing stages in Ziaie and Imamovic's lifecycle model (2013) for online communities. Since, at this stage, a community has secured a critical mass of active users and relevant content, and is relatively well-known (established), the focus is primarily on managing growth, in both terms of user and content administration, and increasing the quality of available and future content.

Table 4 summarizes the essential issues and their corresponding goals and measures during the post-establishment stage.

Table 4 Characteristics of the post-establishment stage

Issue	**Corresponding goals and measures**

Content quality	Adapting proper quality-oriented regulations Facilitating appropriate rating/evaluation techniques Providing communication channels and feedback mechanisms
information overload	Providing apt filtering, search and recommendation systems Providing content visibility
Task coordination and conflicts handling	Providing proper coordination features Enforcing codes of conduct Monitoring activities Encouraging personal bonds
Rapid Growth	Managing ranks and enabling the emergence of sub-groups Delegating administration-related activities (democratizing governance) Monitoring activities Clarifying accountabilities Enforcing self-monitoring
Integration of new members	Introducing proper training and socialization features Enforcing community memory
Diversity	Managing ranks and sub-groups Facilitate collaboration Enhancing/normalizing evaluations Preventing majority or active minority dictatorship
Legal complications	Adapting proper regulations Supervising and monitoring activities Clarifying accountabilities and obligations
Member attrition	Recognizing loyalty and contributions Introducing user-oriented incentives Building trust Smoothing integration of new members

As seen in Table 4, clarifying and enforcing quality criteria for content, monitoring user activities and results, creating an atmosphere of "do-ocracy" (Chen, 2009), managing diversity (Daniel et al., 2013), encouraging personal bonds and providing means for sub-groups and sub-communities to emerge are among typical exercised measures to deal with common issues in the post-establishment stage.

Principles

P9 - The principle of clear rating criteria: the criteria for assessing the quality of content, if available, should be stated and communicated clearly.

Background: Content quality is considered as one of the major success factors of online communities (Leimeister et al., 2006). Considering the subjective nature of quality in OPCs (Hilligoss and Rieh, 2008), in order to achieve high quality content, criteria for specifying high-quality should be declared and communicated properly. This normative determination, as in many other decisions, can be achieved via a top-down (elitism) or bottom-up approach (egalitarianism), though in OPCs generally a bottom-up mechanism is more prevalent.

Still, regardless of how these criteria are determined or developed, their clarification helps the community from three major aspects: 1) quality awareness at the time of content generation, 2) better judgment when it comes to quality assessment and 3) appreciation for good contributions. There are plenty of examples regarding quality clarity measures including featured articles in Wikipedia (Stvilia et al., 2005), publication of standardized measurement model in OSS communities (Baggen et al., 2012), better visibility of insightful comments in Slashdot (Chen et al., 2011) and tutorial pages and videos in other types of OPCs.

Notes: In OPCs, due to their democratic nature (Luther et al., 2013), a top-down approach on the topic of content quality and other norms should be avoided. In most cases, letting the community determine which content is more effective and more widely practiced. It should also be noted that in some cases there might not be a consensus on common quality standards. If so, the means and measures to reach consensus should be clarified, as opposed to determining specific quality criteria. Furthermore, the clarification and communication of quality criteria should not necessarily be stated in policy. Sometimes they can simply be communicated through the interface, e.g. through rating/recommending systems, points, stars, karma, etc. (J.T. Morgan). Lastly, clarification of quality criteria should not be misunderstood with revelation of mechanisms behind reputation systems, where full transparency is not always well advised so that it wouldn't make it very easy to game (cheat) the system (Cheng and Vassileva, 2006; Chen et al., 2011).

P10 - The principle of active monitoring: features should exist to capture and share insightful information including relevant user activities, content situation, achievements and occurring incidents within the community.

Background: Monitoring in the context of online communities slightly diverges from Ostrom's fourth principle for CPRs (Ostrom, 1990) that advises keeping an eye on the activities by certain guards or watchmen. Activities of members and the state of content (representing "resource") are only one aspect of monitoring. Online monitoring encompasses features that can help all community members including leaders, operators, moderators and users foster healthy communities and plan future actions by early identification of possible trends, risks and inadequacies. Such issues should be detected promptly and reacted upon accordingly to constrain further damages. Monitoring has also a significant positive effect on building trust, which in turn influences members' loyalty and their willingness to contribute (Wu and Tsang, 2007).

Regarding effective governance of communities, community decision makers often require two essential pieces of information: first, how healthy and successful the community is and second, what measures can be taken to enhance its success or resolve existing issues (Matthews et al., 2013). Monitoring helps with providing insightful information on both aspects. The output can also provide normal users with a better look into the community to which there are contributing to and spending their valuable resources.

Notes: Insightful information is not easy to define within a complex context like online communities. An important task of the governing body is, therefore, to define appropriate and relevant factors and indices based on what their community is trying to achieve and what issues are at stake. Also, unwisely displayed information resulting from aggregated user behavior may trigger particular behaviors leading to feedback loops. For instance, creating a "top-users list" might discourage users with less reputation to contribute if the algorithm is not well-designed and excludes less active or junior members (Lerman, 2007).

P11 - The principles of organization by disaggregation: it should **be** possible for users to form or join formal or informal sub-communities or groups to share information, performing certain tasks or represent a group of specific interest or expertise.

Background: Sustainability of a community requires flexibility for groups (sub-communities) to emerge, so that member are able to collaborate with others who share the same goals, interests or

preferences (Porra and Parks, 2006; Jones and Rafaeli, 2000). This is due to a variety of reasons, including diversity of views and technologies, division of labor, reduction of information overload and the possibility of rapid response to members' queries (Hew, 2009). Task-oriented groups (e.g. *WikiProjects* in *Wikipedia*), can structure activities and contributions, provide flexible coordination mechanisms (Morgan et al., 2014), and by doing so increase the overall quality of a website (Kittur et al., 2009).

Groups can also help reduce the information overload pertinent to communication and collaboration efforts (Mueller-Birn et al., 2010; Jones et al., 2004). Correspondingly, in post-establishment stage, the negative logistical and psychological effects of growth might sometimes outweigh the potential gains from expanded resources (Butler, 2001). Forming groups can also have a positive impact on motivation for participation (Bateman et al., 2011) in two ways. First, individuals have been shown to be more inclined to help those who are part of a group that they feel more sympathy with (Grant, 2007). Second, interesting findings show that feelings of attachment to subgroups increase loyalty to the larger community as well (Tausczik et al., 2014).

Notes: The time at which features to support sub-communities are introduced is of great importance. In other words, it would be better if we knew how and when groups are desirable. In the early phases of a community, one may not want to emphasize sub-groups before a strong sense of community is established among the members (see (Kim, 2000) for a perceptive discussion on this matter).

Also, depending on the context, tensions and possible negative consequences of disaggregation including fragmentation, loss of critical mass, concentration and disintegration of activities and increased search costs should be carefully pondered with, before introducing measures for groups to emerge.

P12 - The principle of transparent and incremental sanctions: if disciplinary measures are going to be carried out for enforcing the norms, they should be clear, incremental and approved/justifiable by the community.

Background: Digital misconduct including cyber-bullying, spamming, flaming or scamming is an inseparable part of the virtual world. Certain rules and norms should, therefore, be made and enforced in order to curtail misbehavior and disappointments and prevent chaos from happening in the community. A key aspect of resilience, defining norms can also assure a certain quality of content (Sternberg, 2012). Mechanisms for resolving conflicts, however, vary and are by large experimental in nature (Lev-On, 2013). What jeopardizes collective action in online environments is not often the absence of relevant norms and rules, but the lack of measures to effectively enforce them. This implies that all norms and rules (netiquettes) require some sort of rewarding (incentives) or fining mechanisms (sanctions) so that they are respected and their effectivity can be secured (Gillen, 2007).

In case a community opts for certain sanctions instead of or in addition to incentives, these sanctions should be transparently communicated with users. Empirical studies also show that they should be incremental and justifiable by the majority of users to be effective (Cox et al., 2010). This is an important principle in (offline) CPR communities as well (Ostrom, 2000). Incremental or graduated sanctions, applied in an environment in which users are aware of the potential consequences are believed to be far more effective than a swift and major punishment imposed at the first occurrence of misbehavior (Kollock and Smith, 1996).

Notes: Providing means to make sure of the justifiability of sanctions is not always trivial. Established communities may (and should) have diverse groups of users with –sometimes- opposing views on various topics including quality of content, rights of users or a community's goals and norms. Normally, if there are enough people that are favored by a mechanism to get the work done, that does the trick. However, the question is what is "enough"? In do-ocratic societies including OPCs (see Principle 6), those users who participate actively and contribute positively are often entitled to set and enforce the norms, even if they are considered a minority statistically. Also, not every case can go to a vote and in some cases administrators/leaders/owners have to make decisions. In such cases, the decisions has to be explained and rationalized to the community.

Furthermore, rewarding sometimes works more effective than punishing. Depending on the context, rewarding good behavior and valuable contributions might work better than punishing misbehavior and harmful contributions. Also, as the category of this principle suggests, in new and

rising communities a clear communication of sanctions may disturb new members and avert the community from taking off.

Contributions

While inspiring research of the high-level and prescriptive design of OPCs, the theorized principles offer community designers a structured framework to hold onto when designing such complex systems by revealing a great deal about their dynamics and issues. By remarking the structural properties of their system, community designers can exploit the presented principles to devise efficient design strategies with regard to the lifecycle stage of their community and refrain from costly mistakes by learning from past experiences. The findings can be considered as a foundational contribution to the comparative study and analysis of open production systems found across diverse online communities and socio-technical systems.

The outcome also contributes to theory by integrating and extending previous studies on design complexities of OPCs as a foundation for further research. Our emphasis on generalizability suggests a new direction of research to scholars interested in behavioral and structural patterns in online communities. Furthermore, this study makes an important contribution by highlighting the need to perform post-mortems of unsuccessful OPCs rather than fetishizing the success of a handful of successful ones.

Lastly, the theorized principles make an important contribution by highlighting the need to perform post-mortems of unsuccessful OPCs rather than fetishizing the success of the surviving successful communities.

Discussion

Implications for Research

The theorized principles suggest a context-free look at design patterns and issues of OPCs. The only design dimension that is incorporated is the lifecycle stage, due to dynamism and constant flux of online communities in general. In line with other studies that suggest methodologies to “decontextualize”

findings (Ziaie, 2014) from different contexts in online communities, the findings implies the possibility of considering OPCs as a general entity with generic design patterns, issues and resolutions.

Implications for Practice

Generalizability: Generalizability of any set of instructions or guidelines for online communities largely depends on shared paradigms in governance mechanisms, user behavior and content development procedures. Although using the Delphi Method is a sound qualitative evaluation approach, another scientifically acceptable way to ensure sufficient generalizability of the theorized principles is showing that they "survive" empirical tests in different settings (Lee and Baskerville, 2003). This can be achieved by future experiments that examine the extent to which the absence of each principle would induce problems (e.g. reduction in participation) or unexpected issues (e.g. more conflicts or raised dissatisfactions). Such studies may also help reveal more on the dynamics of underlying lifecycle-related intricacies and interdependencies of these principles in different contexts (different types of OPC). Still, even without such complementary studies the theorized principles can be deemed well-founded hypotheses based on the past empirical findings and consensus of experts. To strengthen the theoretical foundation, sufficient propositions, concepts, hands-on experience and empirical findings were provided to connect the hypothesized principles with the broader picture of empirical reality.

Vitality and Tensions: The tension between the theorized generic design principles and the fundamentally goal-driven and contextual nature of OPCs is another implication for practice. The vitality of each principle in different lifecycle stages is another also of great importance to be further studied and fine-tuned. Future investigations can reveal, for instance, whether strictly following a principle in a stage other than the one suggested in this study can be harmful in certain constructs. Also the degree of their significance and vitality of each principle in different categories (collaborative vs. creative) can be analysed. Moreover, the may be times when one has to violate a principle for some other goals such as profit maximization or strategic alignments. Deeper and broader studies may shed light on pertinent issues and refine the principles accordingly.

Limitations and future research

Exhaustiveness: The exhaustiveness of the findings is based on the consensus of the limited number of experts that were involved in the evaluation and refinement process. Therefore, one may be able to think of additional issues that have to do with relevant matters including collective decision making, cultural context, community expansion policies, formation of interest groups within communities, community's emulation\rejection of professional norms (e.g. Citizendium), commercial or non-commercial use of the community outcome, etc. A clear boundary is not very likely to be drawn for the complex and dynamic matter of OPCs. Under more academic scrutiny and future studies, the list can be completed, if there exist principles that were missed or issue that were not sufficiently addressed in this paper. As mentioned in the Implications for Research, the findings of this study can be used as a foundation with a context-free approach towards OPCs.

Lifecycle: Lifecycle models of social systems are conceptually useful, but often empirically dubious. The problem is, organizations, groups, and, in this case, online communities rarely follow a clean sequence of "stages". Application of a "tipping point" (Gladwell, 2006) framework is dichotomous and not very easily to support, since it assumes in its very philosophy that there is a singular event. That is why there is always a grey area in which community designers may not be sure whether their community can now be considered "established" or not. Based on the literature, factors including the number of active members, the amount and growth rate of relevant content, and pertinent indices like the ratio of subscribers to leavers or number of unique visits of pages may be considered to make an assessment regarding the stage of lifecycle. Future studies can reveal more on this matter and propose sounder measures for this matter.

Universality: the focus of this study was on OPCs as opposed to social networks, open innovation platforms, service-based communities and other types of online communities. Some principles may hold true for online communities in general (e.g. privacy transparency). Future research can follow this approach and try to find generic principles for online communities. Whether such generalization is possible, or whether such general principles are valuable in case of applicability is an interesting question to seek an answer for.

Conclusion

In this paper, empirically grounded and qualitatively evaluated theory (Weick, 1989) was developed to offer generic, yet applicable principles for designing and operating OPCs. This was achieved through collecting relevant findings, conceptualization of patterns and prescriptions, evaluation, refinement and formalization of the results. Acknowledging the different needs and goals of OPCs in different stages of their lifecycle, a simplified lifecycle model was proposed consisting of two general stages of pre-establishment and post-establishment. Thereupon, a set of context-free (generic) design principles was devised grounded on literature review and was further evaluated/refined/rectified by groups of online community experts as evaluators by following a Delphi Method. The principles where categorized into three sets of all-time principles, principles for pre-establishment stage and those for post-establishment stage. For each principle, the theoretical background, tensions, relevant issues and pertinent empirical studies were analyzed and explained. Specific discussion of the nuance ideas and issues associated with each principle were provided to shed light on design complications and intricacies pertaining to each principle. The hybrid approach of structured literature review and Delphi Method makes the results of this study rest in part on implications by theories and empirical findings in OPCs and in part on intuition, wisdom and experience of accomplished scholars and knowledgeable practitioners. Research implication is that a context-free look at design complications of OPCs is possible. Implications for practice are that operators should be more aware of the lifecycle stage of their community and, in case of scarce resources, prioritize the principles based on the needs, goals and tensions of their community at each stage.

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Part C: Discussions, Research Opportunities and Conclusion

1 Discussion on Generalizability

In many design cases, theories should be developed to provide prescriptive guidelines on how to tackle the intricacies and complications of the target system. Developing any theory, whether a design model based on "de-contextualization" (Ziaie 2014) or introducing generic design principles (Ziaie/Krcmar 2016) is an effort to broaden our understanding and a step toward improving decisions pertaining to the design and operation of the target community. In Weick's words, this can be seen as "interim struggles inching toward stronger theories" (Weick 1995). Generalizability of the results, particularly in the last four papers, largely depends on shared paradigms and the consensus of experts. These paradigms may be on various subjects including governance mechanisms, user behavior, incentive systems or content development procedures in different types of OPCs. This is why regardless of the methodology of the conducted research, the only scientifically valid way to verify the generalizability of a theory is to test it in different contexts with different actors and settings (Lee/Baskerville 2003). For example, for the last paper (Paper 8), this validity can be achieved by examining the extent to which the absence of each principle would induce problems or unexpected issues in various contexts. Generalizations that are provided in papers 4 to 8 of this study are not empirically proven statements, but well-founded hypotheses based on multiple sources, synthesized literature and justifiable facts. This thesis is, therefore, the first step by providing the foundation for future research. As Lee and Baskerville (2003) duly stipulated, "theory may never be scientifically generalized to a setting where it has not yet been empirically tested and confirmed.". The results (models, frameworks, principles, etc.) can surely be empirically verified under multiple case studies or other scientific methods. As long as the correspondence to reality wouldn't vanish in the generalization process (Hidding 1998), the rest is simple science. To address this concern, sufficient propositions, concepts, hands-on experience, qualitative evaluation and empirical findings were provided to back the hypothesized theories, models and guidelines. More importantly, the results are approved by esteemed scholars who acted as the reviewers of internationally known and respected journals and conferences.

To sum up, the publications in this thesis are a thorough treatment of a difficult and delicate empirical topic. Few topics and issues exist that call for more attention and shall be adequately addressed in future

endeavors including the scope and rigidity of the provided generalizability, the comprehensiveness of the theorized models, the interdependencies of the introduced design dimensions and principles and, finally, the weight of different attributes in different contexts. Following a systematic support to this thesis may encourage more vivid theories to be constructed that shall assist community designers in the arduous task of building up and maintaining a successful OPC.

2 Suggestions for Future Work

There are vast research opportunities in many areas that were covered in this study to follow. Suggestions for future works have been addressed in each paper with respect to the relating topic. Here, a summary of most important suggestions is provided to give the readers an insight on what is still open and what are the general research venues to pursue based on the findings of this work.

2.1 Design attributes

2.1.1 Dynamism of design attributes

The impact of a community's lifecycle on its different attributes is not widely investigated yet. For example, with regard to the feature dimension (see Section 3.7.1 for more details on the design dimensions), the success of a community strongly depends on what features are introduced at what time (Iriberri/Leroy 2009). Still, the interdependencies between lifecycle stages and design features is not well-known or sufficiently addressed. Regarding the content dimension, the correlation between user behavior and the completeness or quality of the pool of content is not yet addressed in the literature. Moreover, whether a closed-gate policy would work better or an open-gate one, depending on the stage of the lifecycle is not clear yet and needs further investigation.

Time is not the only factor that may influence the value of attributes in OPCs. User behavior and desires can, for instance, change depending on attributes including the age, language, gender or national culture of the majority of users (Koh et al. 2007; Harper et al. 2007).

2.1.2 Direction of causality

The direction of causality between many attributes is another issue to be studied in future works (Nov et al. 2010). The correlation between user tenure and contribution patterns is one example on this matter that is not yet apparent in many cases (Brandtzæg/Heim 2008). Also, further investigations are required to identify possible correlations between attributes for each identified type of OPC. With the proposed distinction between different types of OPC, it is not possible to study these differences and try to de-contextualize (Ziaie 2014) them so that they can be applied to other types. As an example on this subject, Luther and Bruckman (2008) showed the correlation between publication policy and leadership in communities focusing on collaborative artifact development. Such correlations and/or causalities may prove helpful for a systematic examination of existing interdependencies between attributes and their long-term effects on a community and how it should be operated. For instance, exploring the interdependencies between implicit motivational factors (Paper 3, Section 3.3.1) with explicit incentives (Paper 5, Section 3.5) is one interesting topic to point out.

2.1.3 Significance (weight) in different contexts

The significance or weight of attributes for different systems (e.g. incentive systems) or on users is another issue that has not been sufficiently addressed. We already know the effect of some attributes on others in certain types of OPC (e.g. effect of monetary incentives on user behavior). However, given the comprehensive list of attributes provided in Paper 7 (see Section 3.7.1), the importance of all these attributes for different systems in different types of communities needs to be investigated. Few examples that can be mentioned here are: the importance of *independence from commercial ads* (relying on donations) in different types of communities, the significance of *content quantity* on the perceived quality of system/community, or *desires of users* on content contribution and commitment to a community.

2.2 The notion of user-generated content

User-generated content requires some redefinitions of who owns the developed content (Humphreys 2009) or who has responsibility or authorship over it (George/Scerri 2007). New notions of authorship should be pondered, especially in collaborative OPCs (Hunter 2011). Moreover, it is of great importance

to know what kinds of metainformation for content should be defined to enable us have a better assessment, recommendation or filtering process. This list can be different for certain types of OPC. Upon an apt definition of such useful information, it can then be collected/calculated and added to the content, so that not only the pool of content is richer, but also systems that function based on content would perform better. For example, the versatility of evaluators of content can be captured and be considered as a quality factor for certain community types.

2.3 Effect of self-organization on user behavior

Another issue that needs further scrutiny is the effect of various system (e.g. reputation or incentive systems) on different tiers (ranks) of a community (see Paper 4, Section 3.4). The interdependencies or significance of the rank of users on other attributes and systems has not been adequately studied yet. In communities with a multi-tier (multi-rank) structure (MPCs), understanding and acknowledging this effect may be vital for the success of many systems, particularly the incentive system. This implies more dynamism and customization for subsystems with regard to the rank of users (tiers).

2.4 Financial dependencies of OPCs

The last issue I want to remark is the financial independence of communities. Possible scenarios to effectively involve users to find new revenue streams can be studied. Also, it might be worth investigating how important is the lifecycle stage of a community with regard to its financial independence. Some OPCs may rely mostly on donation and advertisement. In the early stages of a community neither of these two methods has been proven effective. Considering the importance of the sponsors in some types of OPC, this issue seems to need more academic attention.

2.5 Validity verification in other contexts

Last but not least, the validity of the introduced frameworks, models and theories can be verified for contexts other than OPCs. Incentives, design dimensions and design principles are here of greater importance. Since we focused solely on OPC, for example, it is worth knowing how comprehensive the list of incentives and their interdependencies are (see Paper 5) in other online communities. Or future

work can show how much of the introduced sets of attributes and dimensions in Paper 7 (see Section 3.7.1) and the identified interdependencies can be extended beyond the notion of OPCs. Lastly, many of the 12 design principles in Paper 8 (see Section 3.8.1) might hold valid for other online communities as well. Therefore not only their generalizability with the scope of OPCs, but also their applicability to other forms of online communities can be tested in future research.

3 Conclusion

The overall purpose of this thesis was to develop theories to offer prescriptive guidelines for designing OPCs. The available literature on the design aspects of OPCs suffers at times from arbitrary or context-specific statements with unclear generalizability, resulting in contradictory or ad-hoc prescriptions. This is mainly due to the fact that OPCs have a complex and dynamic nature. Technical features (technology), individual behavior (user), system product (content) and the social context (community) are subject to continuous changes and fluctuations that stem from contextual factors, individuals' interactions with each other and the system (Trist 1981) and constant changes in priorities and goals in the course of their lifecycle (Ziaie/Imamovic 2013; Iriberri/Leroy 2009).

My goal was to introduce theories, models and guidelines that are sufficiently generic to be applicable to all categories and types of OPCs. To achieve this, a deep review of the pertinent literature was conducted for different aspects and systems of OPCs. For the design principles, more than 30 distinguished scholars participated in the evaluation and refinement process. The results, therefore, rests in part on implications by theories and empirical findings in different types and categories of OPCs and in part on intuition, wisdom and experience of scholars and practitioners.

The findings, in general, offer OPC designers structured frameworks and guidelines to hold onto when designing such complex systems. By remarking the structural properties of their system, community designers can use the presented models, hypothesis and theories to introduce apt features, address users' needs properly and devise efficient design strategies. This may help them refrain from costly mistakes by learning from synthesized accumulated knowledge of past experiences.

Finally, I hope the existing research can help shed new light on the elaborate matter of online community design by interpreting and synthesizing the pertinent theoretical and empirical achievements and translating them into unequivocal statements, frameworks, models, design processes and theories.

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Ziaie, P.; Krcmar, H. (2014): Designing Target-Oriented Incentive Systems for Online Production Communities. Paper presented at the Die Multikonferenz Wirtschaftsinformatik (MKWI), Paderborn, Germany.

Ziaie, P.; Krcmar, H. (2016): Design and succeed: lifecycle-oriented design principles for open production communities. submitted and under review at the Information Systems Research (ISR) Joural.

The End

Appendix A: Research Questions

Paper 1	
RQ1	What are distinct types of production communities that can be identified based on the literature?
RQ2	How can different types of production communities be categorized into few general groups with relatively similar characteristics?
Paper 2	
RQ1	How can the content, as a construct, be represented in the context of open production communities?
RQ2	What types of OPCs can be distinguished based on the approaches to generate and publish content?
RQ3	What taxonomy can address and standardize content-related entities and activities?
Paper 3	
RQ1	What are the salient implicit or hidden contextual factors that influence user participation?
RQ2	How can the interdependencies or mutual reinforcements between these implicit factors be hypothesized as a model?
Paper 4	
RQ1	What are the significant and context-free attributes and input variables of reputations systems in production communities?
RQ2	What are the main elements of a generic reputation system?
RQ3	How can a reputation system be employed to facilitate promotion in multi-tier production communities (MPCs)?
Paper 5	
RQ1	What are the distinct desires and motivations for users in different type of OPCs?
RQ2	What are the implicit and explicit incentives in OPCs?
RQ3	How can a generalized design model encompass generic guidelines and steps and address essential factors and interdependencies for all types of OPCs?
Paper 6	
RQ1	What are the main categories of features in an OPC with regard to content, user and community dimensions?
RQ2	What is the density of the defined groups of features in the course of *Wikipedia*'s lifecycle?
RQ3	How can a lifecycle model be conceptualized for Wikipedia as a collaborative OPC based on the density of the defined feature groups?
Paper 7	
RQ1	What are design dimensions and their pertinent attributes for OPCs?
RQ2	What are the main differences between the identified dimensions of the main categories of production communities?
RQ3	How can the applicability of findings from one type of OPC be verified for another type?
Paper 8	
RQ1	What are possible context-free (generic) principles for designing OPCs?
RQ2	How can the identified design principles be evaluated and validated?
RQ3	What is the role of community lifecycle in defining such context-free principles?

Appendix B: List of invited scholars for evaluating the design principles (paper 8)

Alexander Benlian	Ivo Blohm	Molly Wasko
Alok R. Chaturvedi	Jan Marco Leimeister	Ofer Arazy
Andrea Forte	Jonathan T. Morgan	Paul Duguid
Aniket Kittur	Julita Vassileva	Paul Resnick
Benjamin Collier	Kurt Luther	Ran Cheng
Bradley Staats	Karim R. Lakhani	Robert Kraut
Brian S. Butler	Katherine Chen	Sara Kiesler
Brian Whitworth	Kathy Ning Shen	Siobhan O'Mahony
Christoph Riedl	Kelly Lyons	Sirkka Jarvenpaa
Claudia Müller-Birn	Kevin Crowston	Stece Withtaker
Clifford Lampe	Khe Foon Hew	Tara Matthews
George Paliouras	Laura Dabbish	Thomas Malone
Gerald Kane	Mayo Fuster Morell	Ulrich Bretschneider
Hernan Badenes	Michael Gilbert	Yla R Tausczik
Honglei Li	Michael Huber	Yuqing Ren
Hsiu-Fen Lin	Moira Burke	