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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

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[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).

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[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).
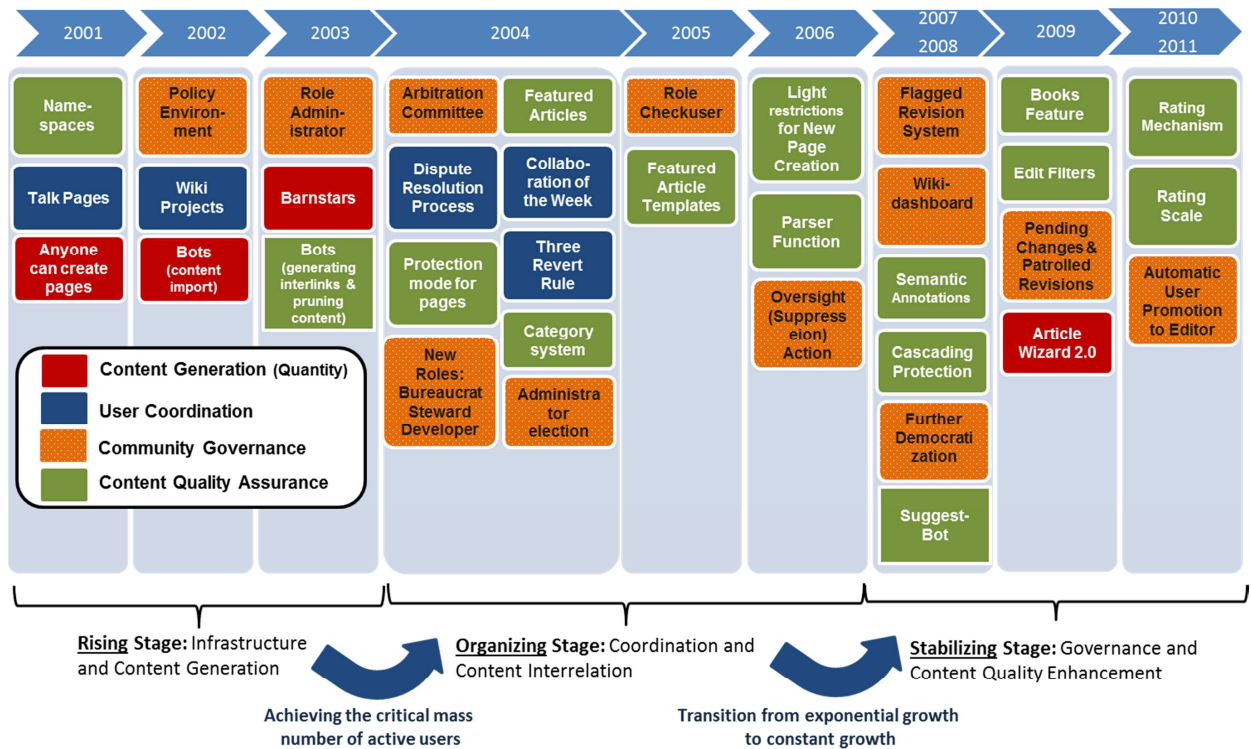

Figure 1. Feature evolution during the lifecycle of Wikipedia and the three distinguished stages

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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