

# Does Reputation Matter for Open Content Systems?<sup>1</sup>

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## **Abstract**

Traditionally, organizational knowledge bases are created in a highly centralized manner to ensure quality. In Open Content Systems (OCS), on the other hand, content is generated in a distributed and decentralized manner. OCS represents a new paradigm for content management, and is founded on the philosophy of the open-source movement. OCS emerged on the internet, with the most noticeable example being the online encyclopedia Wikipedia. The advantage of OCS is the speed in which content is accumulated, while the risk of open content systems is the lack of traditional quality control mechanisms. OCS replace traditional controls with decentralized mechanisms, e.g. reputation, in order to support cooperative behavior and encourage quality content contributions, and these controls are the key to OCS success in open settings. The purpose of this paper is to examine the impact of OCS controls on content quality, and to assess the differences in expected impacts between open and corporate settings. We adopt a modeling research methodology, to find that due to differences in users' characteristics, the type of OCS controls that are required for corporate settings differ from those suitable for open settings, and thus some control mechanisms, such as reputation, which proved vital in open setting, might not have similar impact in corporate settings.

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## 1. Introduction

Traditional knowledge bases, both in the private (e.g. organizational expert systems) and public (e.g. electronic libraries) domains, were created through a tightly-controlled process, where content creation, organization, archiving, and dissemination are concentrated in the hands of few experts. This controlled process ensures the quality of content, but at the cost of substantial labor and time. In recent years we have seen the emergence of new, decentralized systems, which aim to fundamentally change traditional processes, eliminate (or reduce significantly) centralized administrative control, and make users the system's owners. We adopt the term proposed by Arazy and Patterson (2005), and refer to these decentralized knowledge bases as 'Open Content Systems' (OCS)<sup>2</sup>. Recent years have seen the emergence of OCS, initially in open public settings and more recently in closed corporate organizational settings.

It is important to make a distinction between OCS and collaboration tools. Although the technology underlying OCS is not very different from some of the technologies used for collaborative applications, there is one fundamental difference between these two types of applications: collaboration tools (e.g. bulletin boards, Usenet, e-mail lists, online discussion forums, and applications such as Lotus Notes and MS One Note) are used primarily for enabling communication between users, where content is transient and is primarily viewed as an enabler to collaboration; in OCS on the other hand content is the main focus, and collaboration is only a tool for accumulating content. Thus, this paper focuses on a decentralized content management approach, and the discussion of tools such as discussion forums will be restricted to their content-generation (rather than communication) role.

Our study makes a distinction between open and corporate settings, and investigates the appropriateness of OCS for organizational settings. 'Open settings' are characterized by voluntary participation, and decentralization and informal ties, which characterize some internet communities; while 'corporate settings' are characterized by strong administrative control, hierarchical structure, and formal relations.

We restrict the scope of this paper to studying one measure of OCS success – content quality, thus other success measures such as efficiency or knowledge dissemination levels are

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<sup>2</sup> Stadler & Hirsh (2002) propose an alternative term to describe OCS - "Open Source Intelligence". We chose not to employ this term, as it used in the secret services world to refer to information which is gleaned from public sources.

outside our scope. In OCS, community members contribute content and control for its quality, and the accumulated content is disseminated to readers, as illustrated below.

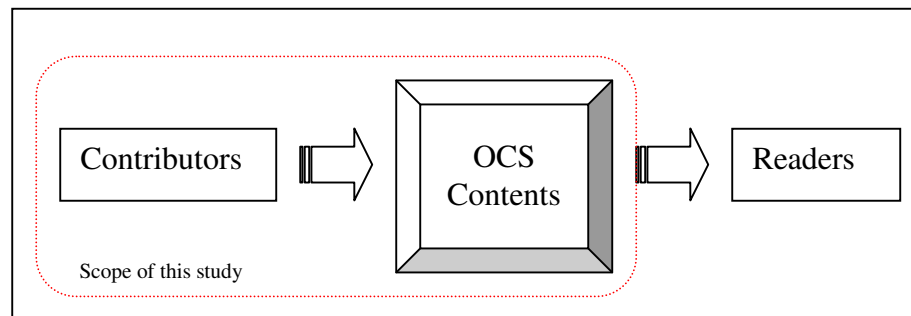


Figure 1: User Types in OCS – Contributors and Readers

Overall OCS contents quality depends on the quality of individual contributions, which in turn depend on the contributing authors. Since this paper is interested in investigating content quality, we will restrict the scope of our investigation to content accumulation processes (rather than dissemination processes), as illustrated in Figure 1 above.

## 1.1 The Origins of Open Content Systems

The origins of OCS could be traced to three sources: (a) the social mechanisms of open source projects, (b) the democratic philosophy of participatory journalism, and (c) the market economy, as described below.

The open-source movement aims to create high-quality software products in a distributed and decentralized manner, where numerous programmers, which are situated at various locations and who often never meet face to face, contribute to the joint effort (Ljungberg 2000). In open source projects, there is often some level of centralized control, with one or a few users responsible for the development of the skeleton system, and later for organizing the distributed work. The most notable open source projects are the Linux Unix-based PC operating system and the Apache web server. These projects, through their high success rate, demonstrate the potential of a decentralized approach to the creation of high-quality information goods (Ljungberg 2000, Stadler and Hirsh 2002). Open source differs from open content in that the output of open source projects are software products, rather than knowledge-bases. Nevertheless, the social mechanisms and the philosophy of the open source movement serve as a foundation for OCS.

The second OCS source, Participatory Journalism (Bowman & Willis 2003), refers to grassroots journalisms that empowers readers to become active contributors. This movement has its roots in anti-globalization and anti-capitalistic movements, which seek to change the inherent imbalance of the capitalistic system, where a few influential media channels control the access to knowledge for large populations (Lih 2004). Participatory journalism supports both traditional paper-based newspapers as well as online news services (e.g. the South Korean OhmyNews web site). Recently, the development of Web Log (or blog) technology enables individuals to easily create interactive online journals, and “blogging” has become an important phenomenon in online culture in recent years. Although Participatory journalism resembles the open content movement in many ways, there are two fundamental differences. First, participatory journalism seeks to distribute news, which has a momentary value, while open content systems seek to develop long-lasting Knowledge Bases (KB). Second, participatory journalism retains a substantial level of central control, as news stories published by users are edited, screened, and organized before they are published, while open content systems seek to reduce central administration to the extent possible.

Lastly, the market economy suggests that decentralized decision-making processes may result in optimal decisions. In the context of knowledge-base creation, Surowiecki (2004) argues for ‘the wisdom of the crowds’, and suggest that “under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them. Groups do not need to be dominated by exceptionally intelligent people in order to be smart. Even if most of the people within a group are not especially well-informed or rational, it can still reach a collectively wise decision”. Thus, a diverse collection of individuals is likely to produce higher-quality knowledge than a single (or few) domain expert.

## **1.2: Technology and Community in Open Content Systems**

We define open content systems as knowledge base (KB) systems that are developed through a decentralized process. This entails that both content generation and quality assurance are largely decentralized. In an OCS, a user community contributes content and assures quality, usually by editing content, removing low quality postings, and rating others’ contributions. The strategies for assigning write, quality assurance, and read privileges differ between OCS

implementations. Although OCS are distinguished from traditional approaches to knowledge-base construction by their decentralization, some OCS do leave some roles in the hands of central administration.

Two types of architectures have been proposed for OCS: *append-based* (using discussion forums technology) and *overwrite-based* (using wiki technology) architectures. Append-based OCS enhance discussion-forums with feedback and control mechanisms, as demonstrated by Slashdot (<http://Slashdot.org>), arguably one of the most popular and influential OCS (Stadler and Hirsh 2002)<sup>3</sup>. Slashdot is as an online news service, mainly for the Unix-based technological community. The alternative architecture – overwrite-based OCS – is based on wiki technology<sup>4</sup> (Cunningham & Leuf 2001; Wagner 2004), which was introduced in 1995. Overwrite-based systems, and specifically wikis, differ from append-based systems in one fundamental aspect: while in append-based OCS comments are added to one another to form a discussion thread, in wikis new content overwrites old content. A reader is shown only the last version in an overwrite-based system. Wikipedia (<http://wikipedia.com>; Remy 2002) is an online encyclopedia, which is founded on the wiki technology, and is probably the most popular overwrite-based OCS. Wikipedia came to life in 2001, and soon grew to become a popular online encyclopedia<sup>5</sup>. The main technological feature of OCS – either append or overwrite-based - is that it enables decentralization of control and empowerment of users. Such distributed control requires that specialized mechanisms be put in place, as we will particularize in Section 2.3.

The success of both append and overwrite OCS relies on the user community, just as much as it relies on the technology. Since much of the responsibility in OCS projects lies in the hands of the users, the impact of the user community on project success is much greater in these projects than in traditional KB projects. OCS projects are usually characterized by a small and devoted community, which is linked by shared goals and strong community values. Work is mostly delegated and is coordinated by one or few “benevolent dictators” (Ljungberg 2000). Users take pride in their collective efforts, and often the reward for one’s contribution is social

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<sup>3</sup> The impact of Slashdot is illustrated through “the Slashdot effect” where links from Slashdot to other sites often lead to high traffic to these referenced sites [Stadler and Hirsh 2002].

<sup>4</sup> Wiki technology is only but one specific operationalization of overwrite-based OCS. However, the term overwrite-based OCS is not restricted to wiki technology, and it is possible that alternative technologies that support overwrite-based OCS will emerge in the future.

<sup>5</sup> A comprehensive analysis of Wikipedia’s features is found in (Lih 2004).

recognition. Similarly to “gift culture” (Kollock 1998; Raymond 1999), reputation which is gained through contribution is what brings social status and influence (Ljungberg 2000).

### 1.3 OCS: Status Report

While OCS emerge as an alternative approach to traditional content management systems in the public domain, the OCS approach is only now making its way into the corporate world. Examples of popular append-based OCS in the public domain include Slashdot and ePinions ([www.epinions.com](http://www.epinions.com)), a product recommendations forum which incorporates a rating and reputation mechanism. Examples of public overwrite-based OCS include Wikinfo (<http://www.getwiki.net>; which resembles Wikipedia in their broad coverage), Wikicities ([www.wikicities.com](http://www.wikicities.com); which allows users to create their own wikis), Memory Alpha (<http://memory-alpha.org>; dedicated to Star Trek), Uncyclopedia (<http://uncyclopedia.org>; dedicated to humor), Tolkien Wiki ([www.thetolkienwiki.org](http://www.thetolkienwiki.org); the writings of Tolkin), Kayak Wiki ([www.kayakforum.com](http://www.kayakforum.com); Kayaking), and Sensei’s Library (<http://senseis.xmp.net>; the game GO).

In organizational settings, despite earlier hesitation (Wagner 2004), wikis are attracting significant attention, and many organizations have begun to explore the use of this new technology (Hof 2004). These wiki implementations serve a variety of purposes, including project management, collaborative decision support, and development of knowledge bases. However, how many of these wiki implementations serve for content management (i.e. OCS), as opposed to alternative applications. We found no data on the deployment of append-based systems in organizational settings, and we suspect this number is lower than the number of wiki implementations. One factor that might explain the quicker adoption of wiki-based OCS is the availability of wiki tools designed for corporate settings, such as Twiki (<http://twiki.org/>), and the lack of similar append-based tools.

### 1.4 Research Objective

The key to OCS’s success is the embedded (decentralized) control mechanisms, such as reputation mechanisms. The objective of this study was to investigate which control mechanisms are suitable for corporate or open settings. We perform our investigation in three steps. First, we

identify the factors affecting content quality in OCS – namely contributor’s benevolence, integrity, and competence - and study how these factors differ between open and corporate settings. Second, we analyze the types of control mechanisms in OCS, and argue that controls operate by impacting users’ benevolence and integrity. Lastly, we demonstrate how, due to differences in integrity and benevolence levels between open and corporate settings, the impact of OCS controls differs across settings.

Our research adopts the design science (Hevner et al. 2004) approach to the development of open content systems. We use theoretical foundations to analyze the suitability of various OCS features (i.e. control mechanisms) at different settings. We provide a formal analysis of the problem, to yield some important insights.

The contribution of this work is in proposing a model that explains the factors determining content quality in OCS. Our proposed model yields some interesting insights regarding OCS design and deployment. For example, the model predicts that (1) in corporate settings reputation mechanisms are unlikely to make the same impact as they do in open settings, and (2) overwrite-based OCS (i.e. wikis) are more suitable than append-based OCS for corporate settings, due to differences in the control mechanisms employed by these two architectures. Further, we provide some prescription regarding the design features required for successful OCS realizations in open and corporate settings.

The remainder of the paper is organized as follows: Section 2 describes the prior works on open content systems, contributors’ trustworthiness, and control mechanisms; Section 3 introduces the proposed model’s definitions and assumptions; Section 4 describes the model’s predictions; Section 5 discusses our analytical results; and Section 5 concludes the paper.

## **2. Prior Research**

In the following section we review prior research on open content systems (OCS), specifically focusing on the impact of users’ characteristics and control mechanisms on OCS content quality. We include in our analysis works from related fields, such as: economics of cooperation, online social networks, open source software movement, and management (specifically, knowledge transfer and trust).

## 2.1 Open Content Systems

Like many other areas of computing, in the study of open content systems practice preceded theory, and since OCS is an emergent phenomenon research on the topic is in preliminary phases. Ljungberg (2000), builds on the earlier works of Kollock (1998) and Raymond (1999), and studies the social mechanisms in open source projects. Although these works focus on open source projects, they are very relevant to OCS in highlighting the importance of tight community bonds for ensuring cooperative behaviors. Neus (2001) and Stadler and Hirsh (2002) identify some important design factors for OCS: feedback and ranking (i.e. peer-review) mechanisms, decentralization of authority to reputable users (which implies the usage of reputation mechanism), free sharing of products, and flexible levels of involvement and responsibility. Lampe and Resnick (2004) investigate one key OCS feature – the moderation (i.e. rating) mechanism, through an empirical study of Slashdot. They find that a decentralized moderation mechanisms “can quickly and consistently separate high and low quality comments” (P. 1). Emigh and Herring (2005) study OCS from yet another perspective – the communication genres of users – and shed light on the ways in which OCS users shape features of content. Finally, Arazy & Patterson (2005) provide a recent review of OCS, where they analyze the interactions between three pillars of OCS: technology, community, and content.

## 2.2 Cooperation, Trust, and OCS Content Quality

Cooperative behavior is a critical success factor for decentralized systems (Previte et al. 2001), and for OCS. Specifically, cooperative behavior is a contributing factor to the quality of postings, as motivated users are likely to contribute higher quality postings (Neus 2001). In economics literature, it has been demonstrated that cooperation increases the social welfare in a community (Kollock 1998; Dellarocas 2003). Management literature suggests that cooperative behavior increases the likelihood that a person would contribute knowledge and advice to peers (e.g., advice networks; Dellarocas et al. 2004)

Cooperation and trustworthiness are interchangeable concepts (Miller 2004). Management research further suggests that the quality of advice or knowledge given is determined by the advice source’s trustworthiness (Levin & Cross 2004). Trustworthiness is a multi-faceted construct that has attracted significant attention in recent years (McKnight et al.

2002). One of the most popular trust models was proposed by Mayer et al. (1995), and conceptualizes trustworthiness as having three dimensions: integrity, benevolence, and competence. Integrity implies truthfulness, honesty, reliability, and ethical conduct; benevolence implies kindness, generosity, good-will, and affection; and competence denotes expertise, knowledge, and skills, and is usually content-specific. McKnight et al. (2002), in an extensive study of trust, concludes that integrity, benevolence, and competence are indeed distinct concepts. Integrity and benevolence, although distinct concepts, are interrelated; they are often seen as two complementing aspects of cooperative behavior. Competence, on the other hand, is independent of integrity and benevolence, as a person's may be an expert and still deny cooperation. Gill et al. (2005) argue that trustworthiness should not be treated as a single concept, but rather future research should focus on competence, benevolence, and integrity as distinct constructs

We propose that the motivations driving one's contribution in an OCS are similar to those of advice-giving and knowledge-sharing. Indeed, these tasks share many commonalities – in both OCS contributions and advice-giving a community member consents to spare his time, energy, and knowledge in return for social capital, as well as additional self-interests. Further, we will adopt Mayer et al.'s (1995) three-dimensional trustworthiness framework, as illustrated in the diagram below.

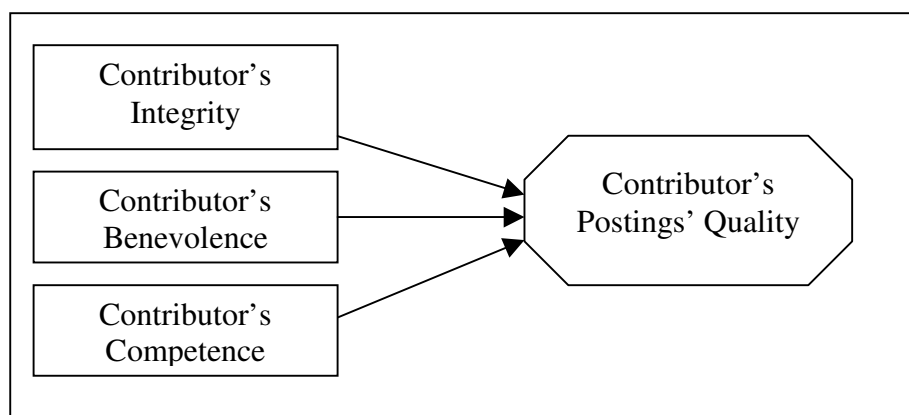


Figure 2: Contributor's Trustworthiness Dimensions and Posting's Quality

### 2.3 Organizational and Technological Control Mechanisms

Contributor's trustworthiness determine the quality of their contributions (as argued above), thus the key to ensuring high quality content is in encouraging trustworthiness and

cooperation in the OCS community (Previte et al. 2001). Trustworthiness of community users could be encouraged through organizational mechanisms, as well as by technological mechanisms. Both positive (e.g. creating a sense of ownership, acknowledging positive behavior, etc) and negative (e.g. enforcement, auditing, punishment, etc) organizational controls could potentially increase cooperation and trustworthy behavior (Resnick and Zeckhauser 2002). Technological mechanisms could also be utilized to encourage cooperation, and prior research suggests that the key to the success of OCS is in the use of decentralized quality control mechanisms (Stadler & Hirsh 2002; Wagner 2004). OCS advocate the decentralization of system administration tasks; however, decentralization does not entail lack of control, and in fact control mechanisms could also be decentralized. Following we will review the type of control mechanisms that have been used in OCS.

In append-based systems, three mechanisms prevail: rating, reputation, and auditing. A **rating mechanism** allows users to rate OCS contents published by others, and act as a distributed quality control mechanism. This mechanism serves three purposes (a) the summary of a posting's ratings serve to indicate posting's quality, allowing users to filter-out low-quality content, (b) implicitly establishing a contributors' reputation, and (c) providing the input for reputation mechanisms. The second type of control mechanisms - **reputation mechanisms** - play a primary role in ensuring honest and cooperative behavior in decentralized environments (e.g. eBay's electronic market; Dellarocas 2003), and particularly – in ensuring the quality of content in OCS (Stadler & Hirsh 2002). Reputation mechanisms try to automatically assign a score to an OCS user to indicate the contribution of that user to the community. Scores are commonly calculated based on how the contributor's postings are rated by other community members. By publicly advertising the reputation of contributors, reputation mechanisms provide a conformity incentive that motivates users to cooperate (Dellarocas 2003). Lastly, **auditing** is a process where user's contributions (postings or ratings) are inspected for quality. Low-quality content will be removed from the system, and its authors may be punished (usually be revoking their user rights for a given time period). Auditing could be performed by central administration (as in traditional information systems), by the decentralized community (as in Wikis), or by both (e.g. Slashdot). The three control mechanism described above – rating, reputation, and auditing – have been used in append-based OCS. In Slashdot, probably the most prominent append-based OCS, rating of content (i.e. 'moderation') privileges are given for all users (based on seniority

and activity levels), but are restricted in quantity (a user receives only few ‘rating tokens’ per each period). Contributors’ reputation in Slashdot is calculated based on how contributors’ postings are rated. Auditing (i.e. ‘meta-moderation’) rights are reserved for administrators and very few privileged (i.e. senior and highly-active) users.

The alternative class of OCS – overwrite-based – also employs a series of control mechanisms, but these mechanisms differ from the ones used in append-based systems. While wikis do not provide rating or reputation mechanisms, they provide an alternative mechanism for encouraging cooperative behavior. Wikis provide a decentralized auditing mechanism, where all users have the right to inspect content pages, remove low-quality content, and revert the content to a previous version<sup>6</sup>. In addition, Wiki users can act as content ‘owners’ and receive alerts of any changes to specific content, and users’ involvement in various administrative issues is encouraged through open discussion pages (available for every content subject). Some wikis, such as wikipedia, also include conflict resolution mechanisms for cases where conflicting worldviews lead to ‘graffiti wars’.

In summary, organizational mechanisms have traditionally been used to encourage cooperative behavior (Merchant 1998). OCS emerged in the public domain, where traditional organizational control mechanisms are unavailable. Instead, OCS embedded controls, such as reputation mechanisms – into its architecture. These technology-based controls – in both append and overwrite-based systems – are the primary reason for the success of OCS (Stadler & Hirsh 2002).

## **2.4 Contributors’ Trustworthiness: Open vs. Corporate Settings**

Following the evidence for successful implementations of the decentralized approach for knowledge-base construction in the public domain, organizations are now considering the use of OCS. While OCS present many advantages - namely low costs, speed, and content quality – there is still significant hesitation within organizations regarding the appropriateness of OCS for corporate settings. The main impediment to the adoption of OCS is the lack of centralized quality control and the concern that, without such central administration, content’s quality will be

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<sup>6</sup> Wikis keep a log of all changes made, and make it extremely easy to revert to a previous version. Thus, it is much easier to correct damage than to cause damage. An argument is that this asymmetry between the effort required to cause and fix damage is the key to wikis’ success (Neus 2001).

jeopardized. This objection is rooted in traditional information management practices, which relied on thorough evaluation and approval processes, carried out by central administration. Corporations fear that abandoning these traditional processes without a suitable substitute will result in low quality content.

We make the distinction between ‘open’ settings, such those that characterize online communities, and ‘corporate’ settings. Open settings (referred to as ‘community’ organizations by Adler (2001)) entail flat organizational structure, voluntary participation, and decentralized administration. Corporate settings (referred to as ‘hierarchy’ organizations by Adler (2001)), on the other hand, could be generalized as having hierarchical organizational structure, compulsory participation in organizational activities, and centralized administration. Clearly substantial differences between corporations exist: some organizations are hierarchical and bureaucratic, while others, such as network organizations (van Alstyne 1997), are distributed and decentralized. Nonetheless, the distinction we make between ‘open’ and typical ‘corporate’ settings is useful for analyzing the potential of OCS in corporate settings.

The potential for OCS success in corporate settings depends on the cooperation and skills of the contributing community. Earlier we have argued that OCS success, and specifically OCS content quality, depends on the trustworthiness of contributors. Thus, in order to understand the impact of settings on content quality, we need to understand the characteristics of contributors in each setting.

Users’ characteristics differ between open and corporate settings. Tenbrunsel and Messik (1999) found that in a business setting people often employ a calculated frame of thought, trying to maximize one’s profits, while in out-of-work and social settings people often employ an ‘ethical’ frame. The quality of contributor’s postings depends on the contributor’s trustworthiness, specifically the contributor’s integrity, benevolence, and competence. Corporations employ various control and incentive schemes to ensure that users conform to norms of ethical conduct (Ezzamel et al. 1990), and thus integrity levels are expected to be higher for corporate than for open settings. Also, in corporate settings, employees are held accountable for their actions, and accountability motivates honest behavior. Online environments, on the other hand, lack these control mechanisms, and in addition often conceal user’s identity, resulting in low integrity levels. Benevolence levels are expected to be higher for open settings, because of the voluntary participation, the sense of ownership and empowerment.

Corporate settings, conversely, reduce employees’ autonomy (what is referred to as ‘the control paradox; Miller 2004), and thus often result in malevolent feelings amongst employees (Zweig 2005).

Competence levels, the third Trustworthiness dimension, can vary greatly within settings. Further, the literature does not provide any reasons to assume higher competence levels for one setting (i.e. corporate or open) over another. The table below illustrates how contributors’ trustworthiness levels compare between corporate and open settings.

Contributors’ Trustworthiness Component	Corporate Settings	Versus	Open Settings
Integrity		>	
Benevolence		<	
Competence		≈	

Table 1: Integrity, Benevolence, and Competence – Comparing Levels between Corporate and Open Settings

Hence, the major differences, for OCS purposes, between open and corporate settings are in integrity and benevolence levels. Following we will discuss the impact of control mechanisms on integrity and benevolence levels.

**2.5 The Impact of Control Mechanisms on Integrity and Benevolence**

Control mechanisms may be used to encourage cooperative behavior, and specifically to manipulate two aspects of cooperation: integrity and benevolence. We now analyze the impact of those mechanisms on integrity and benevolence levels. Integrity, honesty, and conformity could be promoted through enforcement mechanisms, such as auditing. Specifically within the context of open content systems, organizations could manipulate users’ integrity by enforcing participation and auditing the quality of users’ contributions. Further, organizations could provide incentives, monetary or others, for honest behavior in OCS. Benevolence, the alternative dimension of cooperative behavior, is more difficult to manipulate. Organizations could promote

benevolence by adding to users' sense of worth and recognizing user contributions. In the context of OCS usage, organizations could promote benevolence by recognizing the contributions of active users (Ludford et al. 2004), or alternatively by designing OCS that provide value to users. In addition, general benevolence levels towards the organization are likely to carry to the OCS context, and thus promoting benevolence within the larger organizational context will likely impact benevolence levels in the OCS context.

Mechanisms which promote accountability and make visible users' contributions (such as rating and reputation mechanisms), which are available in append-based OCS, are likely to impact integrity levels as they provide an incentive for conformity to norms<sup>7</sup>. Computerized auditing mechanisms (Hargittai 2000; Barzilai-Nahon & Neuman 2004), such as the ones used in both append and overwrite-based OCS, are likely to promote integrity by making users accountable for their postings, very much in the same way organizational auditing mechanisms do. In addition, the ease in which bad-content pages could be reverted in wikis reduce incentives for behaving dishonestly (Neus 2001), and thus act to increase integrity levels. Manipulating benevolence with technological mechanisms, however, is more difficult. Most append-based systems do not provide benevolence-enhancing mechanisms, aside from the decentralized design and the openness to all users. Wikis, on the other hand, provide several mechanisms promoting benevolence. A sense of ownership is created by allowing users to monitor specific threads they are interested in. A sense of empowerment is created by decentralizing quality control mechanisms, and enabling all users to remove low-quality content (differently from some append-based systems, e.g. Slashdot, where administrators and few privileged users hold auditing rights). Finally, wikis allow users to play an active role in system-related decisions, through the use of discussion pages, further promoting the sense of ownership.

### ***3. The Proposed OCS Trust Model: Definitions and Assumptions***

Our proposed model is a static model; i.e. we analyze OCS at point in time, rather than looking at the development of OCS. In the figure below we present a model of the factors

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<sup>7</sup> Reputation mechanisms, on the other hand, are unlikely to impact benevolence, as users feel encouraged (in the case where their reputation meets their expectations) or discouraged (in the case where the posted reputation does not seem to reflect their efforts and skills) by making their reputation scores public.

determining content quality in OCS. We will employ this model to study the difference between open and corporate settings. Following is a description and formulation of the proposed model.

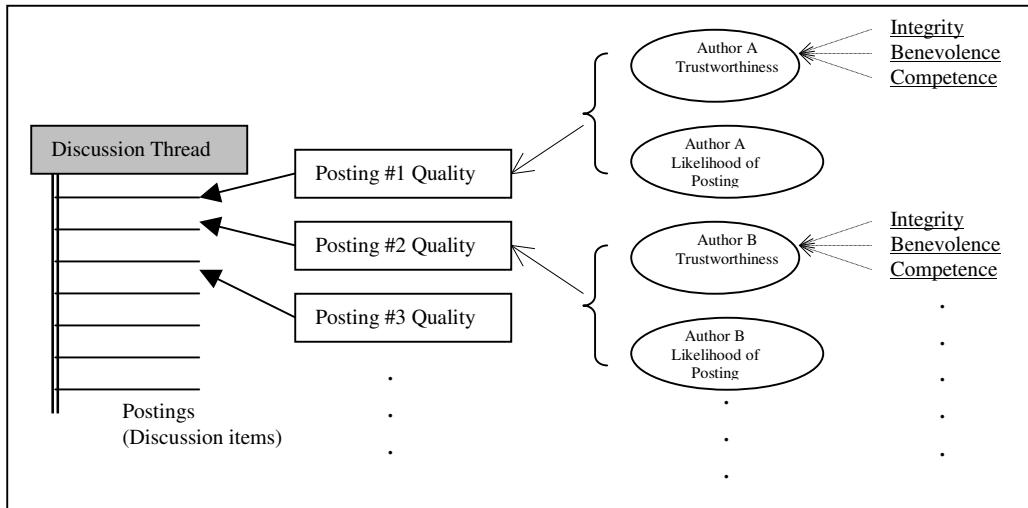


Figure 3: Illustration of the Proposed OCS Trust Model

It is important to note that ‘posting quality’ in our model refers to some objective quality. Similarly, ‘author’s trustworthiness’ refers to the public perception of the author (i.e. how the author is viewed by the entire OCS community).

### 3.1 The Quality of Postings

The total quality of an OCS is a function of postings’ quality. For simplification’s sake, let us assume an OCS with only one discussion thread, where users post comments related to that one thread and rate other’s postings. We model the quality of a posting,  $Q_\alpha$ , as an objective measure, where  $\alpha$  indicates the author.

The quality of knowledge that is shared depends to a large extent on the quality of the knowledge source (Levin et al. 2004), thus  $Q_\alpha = f(\alpha)$ . Specifically, the quality of a given contributions depends on source’s trustworthiness (Levin & Cross 2004). We adopt Mayer et al. trustworthiness framework of three dimensions: Integrity, Benevolence, and Competence. We identify each user by his integrity, benevolence, and competence levels, as follows:

$I_\alpha$  = integrity of person  $\alpha$  ;  $B_\alpha$  = benevolence of person  $\alpha$  ; and  $C_\alpha$  = competence of person  $\alpha$  .

The relation between these trustworthiness dimensions is not known. We conjecture that

integrity and benevolence are interrelated (as these are two complementing aspects of cooperative behavior), while Competence is independent of integrity and benevolence (as a person's may be an expert and still deny cooperation).

Assumption 1: Integrity and Benevolence are correlated, while Competence is independent of Integrity and Benevolence.

The quality of a posting by user  $\alpha$  is  $Q_\alpha = f(I_\alpha, B_\alpha, C_\alpha)$ . However, the exact form of the quality function is unknown. However, we can make some logical assumptions. First, we assume that the marginal impact of integrity changes on quality decrease, such that an integrity increase of a constant size will have a larger impact on quality when integrity levels are initially low. Second, we assume that the impact of benevolence of quality is similar. Third, we assume that the interaction between benevolence and integrity (which could be interpreted as 'cooperation level') has a positive impact on quality. We formulate these assumptions as follows:

Assumption 2a:  $Q_\alpha$  is an increasing and concave function of  $I_\alpha$ , i.e.,  $\frac{\partial Q_\alpha}{\partial I_\alpha} > 0$ , and  $\frac{\partial^2 Q_\alpha}{\partial I_\alpha^2} < 0$ .

Assumption 2b:  $Q_\alpha$  is an increasing and concave function of  $B_\alpha$ , i.e.,  $\frac{\partial Q_\alpha}{\partial B_\alpha} > 0$ , and  $\frac{\partial^2 Q_\alpha}{\partial B_\alpha^2} < 0$ .

Assumption 2c:  $I_\alpha$  and  $B_\alpha$  have a positive interaction effect on  $Q_\alpha$ , i.e.,  $\frac{\partial^2 Q_\alpha}{\partial I_\alpha \partial B_\alpha} > 0$ .

### 3.2 Total Quality of an OCS Thread

Total quality of the thread will be calculated differently for append-based (e.g. Slashdot.org) and overwrite-based (e.g. wikipedia) systems. In append-based systems, the expected total quality  $TQ$  could be calculated as the average of all the postings. Thus,

$$TQ = \sum_{\alpha=1}^{|A|} Q_\alpha * P_\alpha$$

, where  $Q_\alpha$  represents the quality of an item posted by user  $\alpha$ ,  $P_\alpha$  represents the

probability that user  $\alpha$  will post an item, and  $A$  is the set of all users,  $\alpha \in A$ , and  $|A|$  is the number of users.

For overwrite-based systems, on the other hand, the expected total quality,  $TQ$ , is equivalent to the quality of the last posting (as the last postings overwrites previous posting on

that thread);  $TQ = \sum_{\alpha=1}^{|\mathcal{A}|} Q_{\alpha} * P_{\alpha}$ . Hence, the two systems, append- and overwrite-based, have the same expected total quality, despite the differences in system features<sup>8</sup>.

The model assumes that user's activity level and the quality of his contributions are not directly related. This assumption is supported by Dellarocas et al.'s (2004) findings for eBay.

Assumption 3: the probability that user  $\alpha$  will post,  $P_{\alpha}$ , is independent of the expected quality of that posting  $Q_{\alpha}$

Further, since the model is static, the probability that a user  $\alpha$  will post,  $P_{\alpha}$ , depends only on user  $\alpha$  and his activity levels.

### 3.3 Differences between Open and Corporate settings

The user population is different between open and corporate settings, namely in integrity and benevolence levels. We will characterize open settings by  $I_{\alpha}^{Open}$ ,  $B_{\alpha}^{Open}$ ,  $Q_{\alpha}^{Open}$ , and  $TQ^{Open}$ , and corporate settings by  $I_{\alpha}^{Corp}$ ,  $B_{\alpha}^{Corp}$ ,  $Q_{\alpha}^{Corp}$ , and  $TQ^{Corp}$ .

Although integrity, benevolence, and competence levels may differ across organizations, based on our analysis in Section 2.3, we conjecture that in typical cases integrity levels would be higher in corporate settings,  $I_{\alpha}^{Corp} > I_{\alpha}^{Open}$ , while benevolence levels would be higher for open settings,  $B_{\alpha}^{Corp} < B_{\alpha}^{Open}$ .

Assumption 4:  $I_{\alpha}^{Corp} > I_{\alpha}^{Open}$

Assumption 5:  $B_{\alpha}^{Corp} < B_{\alpha}^{Open}$

Since we found no evidence to suggest that competence levels are higher at either corporate or open settings, we assume that competence levels are similar for open and corporate settings.

Assumption 6:  $C_{\alpha}^{Corp} = C_{\alpha}^{Open} = C_{\alpha}$

<sup>8</sup> It is expected that the variance of  $TQ$  will be higher in overwrite-based systems, since  $TQ$  is based on the quality of one item, in contrary to append-based systems where  $TQ$  is the average of many postings; quality. This does not have any implications for our proposed model.

Similarly, there is no evidence to support a systematic difference in users' activity levels (and thus probability of posting), and we assume similar levels for corporate and open settings.

Assumption 7:  $P_{\alpha}^{Corp} = P_{\alpha}^{Open} = P_{\alpha}$

## 4. The Model's Predictions

Previously we reviewed various control mechanisms that are embedded in OCS – append and overwrite-based. We categorized these mechanisms into two categories: tools for enhancing integrity (e.g. reputation mechanism) and tools for enhancing benevolence (e.g. 'ownership' of content). Following we'll analyze the expected impact of these mechanisms, using the model developed above.

### 4.1 The Affect of Integrity-Enhancing Controls on Total Quality: Open vs. Corporate Settings

The effect of integrity-enhancing controls on integrity is given by  $\Delta I = I_{final} - I_{initial}$ . We propose that these tools have the same impact on integrity in both open and corporate settings, i.e.,  $\Delta I$  is the same for both settings. Further, these tools are expected to have no effects on benevolence and competence, i.e.  $\Delta B = \Delta C = 0$ .

The relationship between  $\Delta TQ^{Open}$  and  $\Delta TQ^{Corp}$  is given by the following proposition:

**Proposition 1:** *Under the assumption that  $I_{\alpha}^{Open} < I_{\alpha}^{Corp}$  and  $B_{\alpha}^{Open} > B_{\alpha}^{Corp}$ , then the change in total quality due to improvements in integrity is greater in the open setting than in the corporate setting.*

Proof:

The change of the total quality in an open setting  $\Delta TQ^{Open}$  is given by

$$\begin{aligned} \Delta TQ^{Open} &= TQ_{final}^{Open} - TQ_{initial}^{Open} = \sum_{\alpha=1}^{|\mathcal{A}|} P_{\alpha} \times [Q_{\alpha}(I_{\alpha}^{Open} + \Delta I, B_{\alpha}^{Open}, C_{\alpha}^{Open}) - Q_{\alpha}(I_{\alpha}^{Open}, B_{\alpha}^{Open}, C_{\alpha}^{Open})] \\ &= \sum_{\alpha=1}^{|\mathcal{A}|} P_{\alpha} \times \int_{I_{\alpha}^{Open}}^{I_{\alpha}^{Open} + \Delta I} \frac{\partial Q_{\alpha}^{Open}}{\partial I_{\alpha}} dI_{\alpha} \end{aligned}$$

Similarly in a corporate setting, we have:

$$\Delta TQ^{Corp} = \sum_{\alpha=1}^{|\mathcal{A}|} P_{\alpha} \times \int_{I_{\alpha}^{Corp}}^{I_{\alpha}^{Corp} + \Delta I} \frac{\partial Q_{\alpha}^{Corp}}{\partial I_{\alpha}} dI_{\alpha}.$$

By using Assumption 2a, and 2c, we can show that the difference in the change in total quality in the two settings is given by:

$$\begin{aligned} \Delta TQ^{Open} - \Delta TQ^{Corp} &= \sum_{\alpha=1}^{|\mathcal{A}|} P_{\alpha} \times \left( \int_{I_{\alpha}^{Open}}^{I_{\alpha}^{Open} + \Delta I} \frac{\partial Q_{\alpha}^{Open}}{\partial I_{\alpha}} dI_{\alpha} - \int_{I_{\alpha}^{Corp}}^{I_{\alpha}^{Corp} + \Delta I} \frac{\partial Q_{\alpha}^{Corp}}{\partial I_{\alpha}} dI_{\alpha} \right) \\ &> \sum_{\alpha=1}^{|\mathcal{A}|} P_{\alpha} \times \int_{I_{\alpha}^{Corp}}^{I_{\alpha}^{Corp} + \Delta I} \left( \frac{\partial Q_{\alpha}^{Open}}{\partial I_{\alpha}} - \frac{\partial Q_{\alpha}^{Corp}}{\partial I_{\alpha}} \right) dI_{\alpha} = \sum_{\alpha=1}^{|\mathcal{A}|} P_{\alpha} \times \int_{I_{\alpha}^{Corp}}^{I_{\alpha}^{Corp} + \Delta I} \left( \int_{B_{\alpha}^{Corp}}^{B_{\alpha}^{Open}} \frac{\partial^2 Q_{\alpha}}{\partial I_{\alpha} \partial B_{\alpha}} dB_{\alpha} \right) dI_{\alpha} > 0. \end{aligned}$$

QED.

## 4.2 The Affect of Benevolence–Enhancing Controls on Total Quality: Open vs. Corporate Settings

A similar analysis of total quality, under similar assumptions, where only benevolence levels are manipulated, leads to the following proposition:

**Proposition 2:** *Under the assumption that  $I_{\alpha}^{Open} < I_{\alpha}^{Corp}$  and  $B_{\alpha}^{Open} > B_{\alpha}^{Corp}$ , change in total quality due to improvements in benevolence is greater in a corporate setting than in an open setting.*

Proof: the proof is very similar to the one used in Proposition 1 and therefore omitted.

Another advantage of benevolence-enhancing mechanisms for corporate settings is worth noting. Integrity-enhancing mechanisms could persuade non-active users to become active contributors. Thus, in addition to changing the motivations of already-active contributors, benevolence-enhancing controls could act to increase the number of contributors.

## 5. Discussion

In this paper we introduced an emerging approach for the construction of knowledge bases through decentralized processes - open content systems (OCS). OCS have emerged in open settings in recent years, and already there is growing evidence showing that this approach has the potential to yield high quality knowledge bases (e.g. wikipedia). The key to OCS's success is the embedded (decentralized) control mechanisms, such as reputation mechanisms. The objective of

this study was to investigate which control mechanisms are of concern for corporate versus open settings. We analyzed the factors affecting content quality in OCS – namely contributor’s trustworthiness. We studied the differences between open and corporate settings, and found that open settings are characterized by higher benevolence levels, while corporate settings are characterized by higher integrity levels. The model presented in this paper relates contributor’s trustworthiness to content quality, and examines the impact of OCS control mechanisms on content quality. Our analysis reveals differences in the impact of control mechanisms across settings. Below we discuss the major results from our analysis, and their implications.

Two important conclusions from this analysis are (1) control mechanisms – whether organizational or technological – that affect integrity levels (e.g. rating and reputation mechanisms) will have greater impact in open settings, and (2) control mechanisms that affect benevolence (e.g. creating a sense of ownership) are likely to make a greater impact in corporate settings. This somewhat counterintuitive conclusion stems from the fact that initial integrity levels are higher for corporate environments (due to the usage of institutional controls and the lack of anonymity), while initial benevolence levels are higher for open settings (due to the voluntary nature of open environments and the ‘control paradox’ in corporate settings).

Our analysis has several important implications. First, since mechanisms that affect integrity are less effective (as far as OCS content quality) in corporate settings than in open settings, it is not clear that rating and reputation mechanisms can ‘work’ in corporate settings. This result is at odds with most works on reputation mechanism (e.g. Dellarocas 2003), which suggest that reputation mechanisms are ready to play a significant role in corporations<sup>9</sup>. Second, since OCS mechanisms that affect Benevolence are likely to make a significant impact in corporate settings, it seems that wikis are better suited for corporate settings than append-based systems (such as the one used by Slashdot). This result, too, is somewhat surprising, as the prevailing view in organizations suggests that wikis are ‘too open’, lack rating and reputation mechanisms, and thus are at odds with traditional organizational control practices (Wagner 2004). Recent data suggests that wikis are quickly being adopted in corporations, while the adoption rates of append-based systems are significantly lower which supports our model’s predictions. Lastly, our model explains why wikis do not require rating and reputation

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<sup>9</sup> We would expect reputation mechanisms to enhance adversarial settings where users’ integrity may be lower, such as on-line market situations. In the case of such adversarial tasks, integrity-enhancing mechanisms, e.g. reputation, could prove useful in both open and corporate settings (consistent with Dellarocas 2003).

mechanisms. There are a growing number of supporters within large wiki communities (e.g. wikipedia) that call for the inclusion of additional control mechanisms, such as reputation. We find that a reputation mechanism has a similar effect to that of auditing – both influence contributors’ integrity levels. While wikis lack reputation mechanisms, they promote an extensive auditing process by allowing any user to remove low quality content. Append-based OCS systems lack this extensive auditing process<sup>10</sup>, and thus require alternative means of controlling integrity – such as rating and reputation mechanisms.

It is important to note that while we make the distinction between corporate and open settings, corporations vary greatly on the extent to which they are open, distributed and decentralized. In fact, large, decentralized, and flat-structure corporations may behave similarly to open settings. Hence, managers considering the adoption of OCS should first examine their organization’s openness, to decide whether to adopt control mechanisms suitable for open or corporate (i.e. centralized or decentralized) settings.

Notwithstanding the limitations highlighted above, OCS could still be successfully deployed in traditional hierarchic corporate settings. However, successful implementations of OCS in such settings require that an organizational culture that encourages benevolence be present. There is a long line of research that focuses on organizational mechanisms for enticing benevolence, trust, and cooperation, as a tool for enhancing productivity (Miller 2004)<sup>11</sup>. Our conclusions are in line with this stream of research, and highlight the importance of cooperative behavior for successful implementations of decentralized knowledge-base development projects.

## **6. Conclusion**

The main contribution of this work is in proposing a model that explains the factors affecting content quality in OCS. In addition, our proposed model sheds light on some interesting aspects related to OCS, such as why wikis do not need reputation mechanisms.

This paper provides a first step towards an understanding of open content systems. The proposed model makes several assumptions, which we intend to further substantiate in future research. Specifically, we see three future directions for this line of work. First, the robustness of

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<sup>10</sup> Although some append-based OCS, such as Slashdot, use auditing, which is often carried out by administrators or few privileged users.

<sup>11</sup> For example, Barnard (1938) has written that the function of executives is to develop cooperation among organizational members.

the proposed model and the results' sensitivity to the assumptions could be studied using a simulation. Second, the model could be enhanced by adding details or relaxing some of the assumptions. Lastly, we plan an empirical evaluation of OCS to gain greater insight into the technological and organizational mechanisms that play part in an OCS. Although the analytical model presented in this paper stands on its own, external validation can be achieved by either controlled experiments or through field studies of existing corporate OCS implementations.

We hope that this paper will draw attention in the research community to the emerging OCS phenomena. We believe that OCS have the potential to revolutionize organizational knowledge management practices, and we expect that the analysis from this study could be used to direct successful OCS deployments in corporate settings.

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