

Open Source Production of Encyclopedias: Editorial Policies at the Intersection of Organizational and Epistemological Trust

Paul B. de Laat

Bio: Paul B. de Laat is Assistant Professor of the Philosophy of Science, Technology, and Society at the Faculty of Philosophy, University of Groningen (Groningen, The Netherlands). He obtained his Master's in theoretical physics from the University of Utrecht and a PhD in organizational sociology from the University of Amsterdam. His main research interests focus on intellectual property rights, as well as governance and trust in open-content communities. His publications have appeared in journals such as *Ethics and Information Technology*, *The Information Society*, and *Research Policy*. E-mail: p.b.de.laat@rug.nl.

Acknowledgements: Acknowledgements are due to the participants of the ETHICOMP2010 conference in Tarragona, Spain (April 2010), and to two perceptive reviewers of this journal.

Abstract

The ideas behind open source software are currently applied to the production of encyclopedias. A sample of six English text-based, neutral-point-of-view, on-line encyclopedias of the kind are identified: h2g2, Wikipedia, Scholarpedia, Encyclopedia of Earth, Citizendium and Knol. How do these projects deal with the problem of trusting their participants to behave as competent and loyal encyclopedists? Editorial policies for soliciting and processing content are shown to range from high discretion to low discretion, i.e. from granting unlimited trust to limited trust. Their conceptions of the proper role for experts are also explored and it is argued that to a great extent they determine editorial policies. Subsequently, internal discussions about quality guarantee at Wikipedia are rendered. All indications are that review and 'super-review' of new edits will become policy, to be performed by Wikipedians with a better reputation. Finally, while for encyclopedias the issue of organizational trust largely coincides with epistemological trust, a link is made with theories about the acceptance of testimony. It is argued that both non-reductionist views (the 'acceptance principle' and the 'assurance view') and reductionist ones (an appeal to background conditions, and a—newly defined—'expertise view') have been implemented in editorial strategies over the past decade.

Keywords: encyclopedia; open source; testimony; trust; Wikipedia.

I argue that the identification of trustworthy agents is necessary to the constitution of any body of knowledge (Shapin 1994: xxvi)

Introduction

We are all familiar with the encyclopedias of our youth. Whether it was the Britannica, the Brockhaus, or the Larousse that were in our parents' bookcase, they guided our first steps towards acquiring knowledge. At the time, this business of learned encyclopedias was lucrative and stable. Invited specialists wrote balanced entries based on intimate knowledge of their field of expertise, which were bundled in a book, CD, or DVD, and sold at a considerable profit. With the advent of the Internet, encyclopedia content also came to be sold via Internet-based subscriptions. However, the Internet hardly allowed the continuation of business as usual—it overturned the field altogether. Most disruptive were new efforts towards creating non-commercial online encyclopedias written by volunteers. Directly inspired by the example of open source software (OSS), people are invited to contribute online whatever knowledge they may possess. In this fashion, a collectively evolving encyclopedia emerges, available to all. Wikipedia is of course the most conspicuous example, establishing the norm for the potential of online collaborative encyclopedias.

These online 'open source' (or 'open content') encyclopedias are no longer operating along informal lines. While their contributors are numbered in the thousands, control and coordination has now been instituted formally: governance has set in. Just as with OSS (cf. de Laat 2007), such encyclopedias now resort to formal rules and regulations. Some aspects of this governance have recently been the subject of research, concerning Wikipedia in particular. The editorial management system and its focus on quality control (Stvilia et al. 2008), the elaborate procedure for awarding entries the status of good or featured article (Viegas et al. 2007), policy making mechanisms, conflict resolution procedures and the role of local WikiProjects in quality control (Forte et al. 2009) have all been scrutinized.

This article extends the above research in two main ways. First, it goes beyond Wikipedia to focus on the whole domain of online encyclopedias that are created by volunteers. Apart from some publications in the popular press, these have been scarcely studied seriously in their own right. Secondly, it focuses on the central issue of governance: work flow processing. How are contributions to the encyclopedian undertaking solicited and subsequently processed? It is this *organizational* approach to work flow management that is central to this article. My aim is to take the analysis of Wikipedian editorial management processes started by Stvilia et al. (2008) to a higher level—specifically, by interpreting these processes in terms of trust, discretion, expertise and testimony and showing the links between them.

Let me elaborate. Production processes in real life organizations are organized by means of rules and regulations. These impinge on the amount of *discretion* allowed to participants: the extent to which their wisdom, judgment and expertise are called on in the performance of their tasks (Fox 1974: ch. 2). The more an institution regulates behaviour according to rules and regulations, the smaller is the amount of discretion that remains. This discretion can in turn be interpreted as the amount of *trust* granted to participants by the institution. The conception of trust involved here is in line with the

findings of trust research conducted in recent decades: reliance on the good intentions and adequate competences of others in a context of dependence, vulnerability and risk (cf. Luhmann 1968; Baier 1986, 1992; Gambetta 1988; and Hardin 2002 to mention just a few authors; for a review see de Laat 2008). This reasoning argues that discretion is the lynchpin between rule formation and trust. The more/fewer rules that are propagated, the less/more discretion there is for organizational task execution, which in turn reduces/increases the level of de facto trust granted to employees. Observe, correspondingly, that a *perceived* lack of trustworthiness among employees may induce a managerial preference for proliferating rules and regulations (while leaving little trust); and vice versa: a *perception* among management that employees can be fully trusted may warrant an absolute minimum of rules and regulations (while allowing heavy reliance on trust).

A similar analysis applies to virtual communities, encyclopedias in particular, (cf. de Laat 2010). Contributors may volunteer, but nevertheless—once their numbers start to grow—a community has to specify the extent to which they may have access to website files, and may engage in activities on them. Moreover, they must respect a formal procedure. In all, a certain *regime* has to be promulgated for the production processes involved. In view of this close relationship between organizations and volunteer virtual communities, I shall henceforth refer to ‘editorial regimes’ and similarly apply the analytic tools of discretion and trust.

That trust is a central issue can easily be shown as follows. The reliance on volunteer encyclopedists is characterized by risk and vulnerability. Contributors may pollute entries with incorrect details or inaccurate facts, whether on purpose (‘vandalism’) or not. Especially within Wikipedia over the years a whole vocabulary about such non-helpful contributors has developed. ‘Cranks’ insert nonsense, ‘trolls’ and ‘flamers’ stir up trouble, ‘amateurs’ contaminate entries with their bogus knowledge, ‘partisans’ smuggle their personal point of view into articles, and ‘advertisers’ focus on subtly promoting their own wares (Wikipedia: RCO). One is only too well aware that such contributors may pollute entries and create a lot of damage; repairing such damage is obviously a major nuisance. It is this kind of vulnerability that is at issue.¹

Trust being the issue, what *specific* kind of trust is involved in crafting editorial policies for encyclopedias? This revolves, as it were, around entrusting the central body of textual entries to the public at large. For that matter it is crucial whether volunteers can be adjudged capable of delivering contributions in proportion to their competence, with the aim of building a comprehensive body of encyclopedic knowledge, and with no intent to wreak havoc by inserting nonsense and the like. In summary: can one suppose that contributors bring adequate competence and full goodwill to the encyclopedic community?²

¹ Whenever web-based communities solicit input from contributors and just amass it all together (like photographs, videos, music samples or logo designs), dubious input does little harm while it remains isolated. When, however, contributors *interact* continuously to create content together with the intention of raising quality ever higher, the problem becomes acute (de Laat 2010). Any questionable input at any stage in the process potentially propagates to subsequent versions. Apart from collectively composed software, journals and books, such is especially the case for encyclopedias.

² Note that we are talking here about the question whether and to what extent communities consider their members trustworthy and build their socio-technical architecture accordingly—not the other way round. The reverse issue—how communities may inspire trust with their members—is the usual focus of

Subsequently we make a leap towards the field of epistemology, which studies the constitution and maintenance of systems of knowledge. In these knowledge processes ‘epistemological’ trust, i.e. the grant of epistemic authority, plays an essential role (cf. Hardwig 1991; Shapin 1994). At the heart of assessing epistemological trust one finds both cognitive competence and honesty. Depending on which knowledge community is involved, such honesty can refer to a range of values, like conscientious work, intellectual honesty, disinterestedness, or allegiance to environmental ideals (cf. Van House 2002; useful review in Simon 2010).

On closer inspection, the ‘encyclopedic’ trust involved in our case to a large extent coincides with epistemological trust. The question whether contributors can be trusted to perform adequately as members of the encyclopedic community largely hinges³ on the question: can we believe what they are saying? In terms of testimony: can their testimony be accepted as true belief, do they provide credible assertions? The issue of the scale and scope of their epistemic and moral qualities lies squarely on the table. Specifically, an important part of their ‘epistemic character’ in this case will be ‘adequate epistemic self-assessment’ as suggested by Hardwig (1991: 700): being honest about where one’s knowledge begins and ends. This connection enables us to try to classify editorial policies for encyclopedias not only as instances of organizational trust granted, but also, subsequently, to try and interpret them, on a deeper level, as an expression of views on epistemological justification of testimony.

This framework yields an organizational analysis of open source encyclopedias in terms of trust, discretion, expertise and testimony. The central argument developed below can be summarized as follows. Besides Wikipedia, five other encyclopedias of a general nature, based on open source production methods, can be distinguished. A range of editorial policies is in use, which vary in their grant of discretion to contributors. Some communities start from the assumption that anybody can be trusted to collaborate within the limits of their own competence; accordingly, direct textual editing is open to all on an egalitarian basis (Wikipedia in particular). Others, from the outset, lay more emphasis upon expertise of a specific kind; accordingly, access to (wiki) spaces is more restricted and edits are routinely moderated. Conceptions about the proper role of expertise weigh heavily when such policies are being crafted. Whenever editing and/or subject expertise is deemed to play a special epistemic role, experts with these specific skills obtain privileged access to entries and/or are assigned privileged roles of moderation. Subsequently, problems are analyzed concerning the credibility of textual items, as experienced within Wikipedia in particular. In response, information scientists have investigated various computational metrics for measuring textual quality. As a result, measures that provide ‘transparency’ to users and schemes for tightening of editorial policy through review of edits have been proposed. In the final section, editorial policies are interpreted as instances of views about the justification of

discussions on structuring web presences (Shneiderman 2000; critical review in Riegelsberger et al. 2005). Nevertheless, the issues are closely related because of the close connection between users and producers of knowledge: precisely by granting trust in their design to the audience-as-producers tailored to the extent that this is justified, encyclopedias may inspire confidence with the audience-as-users.

³ But not completely, while e.g. technical and social aspects of cooperation with other volunteers in collaborative spaces are also important, which fall outside the epistemic purview. Being a trustworthy expert on something, whether an academic subject or more mundane affairs, can best be seen as a *necessary* condition for becoming a good encyclopedist.

testimonial acceptance. It is argued that, apart from the reductionist view of somehow seeking epistemic guarantees in the credentials of (established) expertise, other views are (or have been) implemented as well: the ‘acceptance principle’, which argues for acceptance of testimony under normal conditions; the ‘assurance view’, which starts with the presumption that speakers assume responsibility for their utterances; and an appeal to the (wiki) format of production processes as sufficient epistemic ‘background conditions’.

Open Source Encyclopedias: The Sample

First we need to survey the present-day online general-purpose encyclopedias that rely on ‘open source’ methods for their production. For the purpose of this discussion ‘open source’ production refers to entry creation that relies on (1) an open invitation (2) to contribute comments and/or original content (3) which after being ‘processed’ ultimately becomes publicly accessible and distributable.⁴ Contributors may—but also may not—collaborate by means of wiki software to create encyclopedic entries together. Several aspects of the collaboration are deliberately left unspecified in this working definition and they need to be investigated more closely: to whom exactly is the open invitation forwarded, and on what terms are the product made publicly available? Note that for OSS, the inspirational model for all open-source-like developments of the present, these two parameters have quite specific values: an open invitation to all without entry restrictions, and accessibility of the public version of the source code files on terms of ‘open source licenses’ (mainly the GPL and BSD-like licenses).

My investigations have yielded a considerable list of web-based encyclopedic initiatives that rely predominantly on such an ‘open source’ approach.⁵ Wikipedia, although the largest, is by no means the only one. From the whole list, six projects were ultimately selected for further investigation: Citizendium, Encyclopedia of Earth, h2g2, Knol, Scholarpedia and Wikipedia (in alphabetic order). The rest were discarded. What are my criteria for this selection? The focus chosen is on web-based projects that satisfy the following criteria:

(1) They deal predominantly with text, not images. This choice is motivated by the fact that within an open source context textual collaboration appears more challenging than image collaboration. By this criterion, e.g., the Encyclopedia of Life (which mainly solicits photos and videos of living organisms) was eliminated;

(2) They employ the English language. This criterion is mainly a practical matter: other researchers, more versed in a particular language other than English, are more capable of carrying out such investigations. Once this criterion had been applied, enough same-language-encyclopedias (namely English) remained to allow proper analysis. It was on this count, for example, that Chinese (Baidu Baike), Spanish (Enciclopedia Libre) and Turkish (Private Sözlük) encyclopedias were discarded. For the same reason, non-English language versions of Wikipedia were left out of consideration (but see point 5 below);

⁴ Other authors refer to this as ‘open content’ production.

⁵ The list can be obtained from the author on request.

(3) They are encyclopedic to a considerable extent; that is, online projects that are a mash-up of styles are excluded. On this count, Everything2 (soliciting, besides encyclopedic entries, also pieces of personal opinion, poetry, and fiction) and WikiPilipinas (being a directory, almanac and community portal besides) were eliminated;

(4) They intend to produce balanced, objective entries with a neutral point of view. On this criterion, several ‘partisan’ ideological projects were excluded: Conservapedia (a Wikipedia-clone based on right-wing Christian beliefs, supporting creationism, which mainly appears to be on a crusade against Wikipedia), Metapedia (supporting pro-European, nationalist struggles for recognition) and SourceWatch (an effort to expose propaganda from vested interests that influence public opinion). The above mentioned Everything2, incidentally, does not qualify in this respect since it encourages original entries without a neutrality requirement;

(5) If projects are set up as Wikipedia clones, they are not considered for analysis. This criterion is simply inspired by the fact that no new results are to be expected as regards rules and regulations—almost by definition. The original Wikipedia offers sufficient material for analysis. On this count, other language versions of Wikipedia were disposed of (in addition to criterion 2), as well as neutral-point-of-view projects like Kathpedia (for Catholics who can read German) and Orthodoxwiki (for orthodox Christians). Notice, though, that in the long run clones may develop distinct policies of their own—cf. the analysis of the German Wikipedia below;

(6) Finally, they should preferably still be alive at present, with incoming contributions still being incorporated in the main body of text. On this count, the projects Open Site, Project Galactic Guide and Veropedia were considered dead and were therefore eliminated.

Six Open Source Encyclopedias: Editorial Policies Compared

After this explanation of which online ‘open source’ encyclopedias are to be included in the comparative analysis, I now turn to providing some core data about each of the six projects, rendered in chronological order of their foundation (table 1). The British h2g2 and the American Wikipedia are the founders of the genre, so to speak. Partly inspired—or angered—by Wikipedia in particular, the other four (Scholarpedia, Encyclopedia of Earth, Citizendium and Knol) followed suit. All have a general focus, Scholarpedia and the Encyclopedia of Earth excepted, since they focus on natural science subjects. As regards point of view, most strive for balanced and objective coverage, with Knol allowing multiple viewpoints alongside each other on the same topic (which, in their entirety, may be taken to amount to a balanced approach). Most of the encyclopedias demand or at least allow creative commons licensing terms, with h2g2 as the clear exception to this rule: authors simply retain their copyrights. Signing one’s articles is the rule, apart from Wikipedia and Citizendium. How many entries have been produced to date is difficult to ascertain, since all projects present their own indicators. Nevertheless, Wikipedia clearly emerges as the largest of all, followed by Knol and h2g2. In comparison, the Encyclopedia of Earth, Scholarpedia and Citizendium are much smaller.

Insert table 1 about here

Given the risk of vandalism and corruption of entries, what kind of organizational design is introduced to deal with it? 'Editorial policies' usually delineate roles and procedures for handling incoming content, from the stage of conception to the stage of acceptance. For organizations Fox (1974) introduced the distinction between a high-discretion design on the one hand, with a minimal division of roles and highly decentralized, proceeding as it were from an assumption of high trustworthiness among employees, and a low-discretion design on the other, with an elaborate division of roles and highly centralized, proceeding as it were from an assumption of low trustworthiness among employees. These designs can best be conceived as constituting a continuum. Adapting this distinction to virtual encyclopedic communities (or, for that matter, to collaborative communities in cyberspace more generally) the design choices that present themselves to the management of these communities lie along the following continuum. At one end of the scale one may envisage a highly discretionary regime that maximizes people's access to the editorial process of writing and rewriting entries, and allows the editorial process to proceed on an extremely egalitarian basis. It seemingly departs from the assumption that contributors are extremely trustworthy. The opposite end of the scale is constituted by a lowly discretionary regime that distinguishes various roles, mostly according to criteria of expertise; access to the editorial process is restricted, and moderation of (changes to) evolving entries is mandatory; as a result, the editorial process is highly centralized. Such a regime appears to proceed from the opposite assumption of a lack of trustworthiness among potential contributors.

To what extent can this 'editorial continuum' be observed in our sample? As can be seen from table 2, the open call involved represents by no means the blanket invitation to everybody to come forward with articles and comments as the stereotype of open source would have it. While Wikipedia comes closest to this image, the other projects have recourse to ever more stringent restrictions. For one thing, the open call may be confined to commenting only (Scholarpedia), or may restrict access to experts only (Encyclopedia of Earth). Moreover, real names are often demanded, in an effort to curb the sorts of irresponsible behaviour that anonymity might engender.

Insert table 2 about here

Issuing a call for content is one thing—handling and incorporating incoming content is another. How do the six encyclopedic projects involved handle this issue? To what extent does moderation and review of incoming comments take place and by whom? The encyclopedias that employ wikis (all except h2g2) are discussed first, followed by the non-wiki h2g2 (results summarized in table 3). Wikipedia (at least the English language version) employs the most relaxed and simple kind of editorial policy: all users ('editors') have the same rights to comment, add, and change the content that can be found on its servers. In the wiki, editing results are instantaneously visible ('you-see-what-you-edit'). Users involved in editing a specific entry basically have to sort it out between themselves (apart from several exhortations to remain polite and abstain from 'edit wars'); no moderation of the process by anyone is provided for. Discussion takes place on corresponding discussion pages. Essentially, then, this is a self-steering process of peer review—peers being anyone who cares to invest time in the process.

Insert table 3 about here

Citizendium basically employs the same review procedure. Once registered (as an 'author'), anyone may comment on and change existing entries, which are available as open-access wiki. Here, too, editing is instantaneous. In contrast to Wikipedia, however, the process is moderated (by a so-called 'editor', appointed by the editor-in-chief) due to Citizendium's worries about a possible lack of consensus between 'authors' contributing to an entry. This moderator has to exercise 'gentle oversight' of the wiki, guiding articles to keep on their proper course. Occasionally, he/she may have to intervene and take a stance in edit wars. After a while, when entries have become mature enough, he/she may decide to label an entry 'approved'. From that moment onwards, the public version of the entry is the (unchangeable) approved version. Notwithstanding, the entry continues to evolve, as a draft version, in the same open-access wiki as before.

In keeping with its name, Scholarpedia prefers a more scholarly approach. After reputable experts have delivered their entries, specifically commissioned from them, these are subjected to anonymous peer review in a wiki that is only accessible to personally invited experts. Review in this closed-access wiki goes on until consensus between author and reviewers can be reached; no moderation is provided. Consensus having been achieved, the article acquires the status of 'accepted' and moves to a wiki that is openly accessible to all registered users. So the article is publicly visible only from that moment onwards. This time, the wiki *is* moderated: a so-called 'curator' steers the wiki process and is in charge of approving edits proposed by users. Typically, the original author assumes curatorship.

The Google-initiated Knol provides authors with a threefold menu of reviewing procedures from which to choose. First, they may choose a completely open-access wiki without moderation (à la Wikipedia) (denominated 'open collaboration'). Registered users instantaneously see-what-they-edit. The second option is the same kind of wiki, this time moderated by the author him/herself, who has to approve incoming edits (denominated 'moderated collaboration'). While at first not publicly visible, edits, once accepted, become publicly visible in the knol involved. Finally, Knol authors may choose a closed-access wiki to which only personally invited co-authors have access (denominated 'closed collaboration'). Editing results appear instantaneously in the public version (which can only be seen by the public, not edited). Statistics are unavailable about the choices that Knol authors make in this respect, but a quick, informal scan on my part suggests that the moderated wiki is by far the most popular option (75–80%), while the open wiki is by far the least popular (5%), with closed cooperation in between (15–20%). A possible explanation for the low popularity of the open wiki might be that signing an entry while simultaneously allowing open-wiki collaboration on it does not seem to go comfortably together.

The last encyclopedia to use wiki software in my sample is the Encyclopedia of Earth. Wiki spaces are reserved, however, to registered experts whose credentials have been approved. These are invited to participate as 'leading author' (starting an entry) or 'contributing author' (editing entries). Their collaboration is moderated: an appointed 'topic editor' is supposed to 'settle content-level disputes' and to 'delete mediocre work' if necessary (http://www.eoearth.org/article/EoE_FAQs). Moreover, once this topic editor judges that the entry is of sufficient quality, it appears in a public (non-wiki)

version. All the while, the underlying restricted-access wiki continues to operate in order to revise and update entries, yielding ever newer public versions.

The remaining encyclopedic project is the British h2g2. Possibly because wiki software was just in the early days of its existence when this encyclopedia was originated, its review process relies—and continues to rely—on simple comments on articles. Authors deliver signed, copyrighted articles to h2g2. Without questions being asked, these appear as entries in the ‘unedited guide’. The more ambitious may ask for a peer review procedure—only recommended for articles considered to be in ‘finished form’: the entry is put up for public comment by other ‘researchers’. After at least a week of reviewing and revision, but often much longer, the candidate entry might proceed and appear in the ‘edited guide’. To that end, ‘scouts’ have to recommend the entry, ‘sub-editors’ have to edit the entry, and staff members paid by the BBC (which owns and operates h2g2) have to approve the entry. All can be considered to moderate the reviewing process (table 3). In practice, only 5% of all entries gain promotion to edited status. Debate about them may continue on the site’s ‘conversation forum’.

We have seen that online, open-source encyclopedias employ a considerable range of editorial policies. By no means all of them employ the same policy as the most renowned of all, Wikipedia. That project set the benchmark for unquestioning trust by behaving in a most trusting way towards its users: anyone may provide comments on a talk page, perform instantly visible edits in a wiki, and (upon registration) write new entries from scratch. The other encyclopedias that evolved introduced ever more rules and regulations. For one thing, registration (often also involving the disclosure of real name and/or a biography) can be required; only comments solicited; or only approved experts allowed in (table 2). For another thing, the editing process may come under the supervision of a moderator, or the wiki form omitted (table 3). So both access restrictions and role restrictions are employed. As a result, trustworthiness on the part of users is assumed only to a lesser extent. In effect, a whole range of governance structures has been developing for online encyclopedias, bridging the gap between open source Wikipedia on the one hand and ‘classical’ encyclopedias with an online presence on the other, which do not rely on any form of open sourcing at all. Examples of the latter category are the Stanford Encyclopedia of Philosophy, relying exclusively on invited volunteers, and the Britannica, relying on paid assignments.

Before proceeding to a discussion of the role of expertise, I pinpoint the main distinctions so far by comparing the open source encyclopedias in the sample with OSS as the reference process of open source. OSS has aptly been characterized as ‘peer production’ of knowledge that is ‘commons-based’ (Benkler 2006). For the purposes of this discussion I add the characteristic ‘moderated’ to the peer production process—OSS projects invariably have leaders, either those who started the project or their successor(s). These retain the final say about who obtains access to the code tree and which code is incorporated into it. Using the three parameters of peer production, moderation, and creation of a commons, and combining elements from tables 1--3, our sampled encyclopedias and OSS can be characterized as in table 4. Ordering is intended to represent decreasing degrees of freedom for participating peers.

Insert table 4 about here

The remarkable position of Wikipedia emerges clearly from the table: it represents by far the most radical approach to users. Anybody is allowed to operate in their wiki spaces on the basis of a *prima facie* assumption of trustworthiness; no review or moderation is deemed necessary. Moreover, commons' licensing is obligatory. In this respect, Wikipedia can be said to be even more radical than OSS, which set the trend decades before. Egalitarian assumptions are carried to their logical conclusions.

Role of Expertise

The next focus of my inquiry is the role of expertise: in which ways do the encyclopedic projects involved acknowledge expertise as relevant to their efforts? To what extent do these conceptions lead to specific responsibilities and/or privileges for reputed experts in the encyclopedic production process? Obviously, the more egalitarian the approach towards contributors is, the more strain is put on the notion of any special role for expertise.

It will be argued that the differences in governance are intimately connected with the issue of expertise. While we are dealing with knowledge production efforts here, the urgent question arises of whether and to what extent expertise—of any kind—should play a special role in producing entries. If the answer is in the affirmative, one has to answer the question how these special considerations should materialize as special procedures and regulations. Note that we are not talking here about carrying out (original) research, whether in the natural or the social sciences. We are talking about *encyclopedic* efforts that focus on a balanced rendering of the state of the art on a wide array of topics. While the role of expertise in original research seems ineluctable and almost a tautology, its role in encyclopedic projects seems more open to debate. *Prima facie* it is not clear at all whether experts are always in the best position to make a state-of-the-art report on some subject matter in their own field of expertise. They may have a particular bias; they may be involved in fierce debates between experts in the field, and so on. One might argue that knowledgeable outsiders are in a better position to produce a balanced view of contested terrain than the protagonists themselves.

The architects of and contributors to the sampled encyclopedias do have their opinions about the matter. Let me analyze the encyclopedic projects in turn. From the beginning Wikipedia has taken a firm stance on the matter, at least officially: who you are does not count, only what you contribute to the project. Expertise does not entitle you to any special privileges or responsibilities. Even the procedures for acquiring the status of 'good' or 'featured' article (see next section) do not grant any privileges to experts of any kind. As it is stated explicitly: 'In a content dispute between a scientist and a non-scientist, the two are on an equal footing' (Wikipedia:Expert_editors/New_draft). If anything, rather than being privileged, experts are more likely to be discriminated against: they 'are regarded with considerable scepticism and suspicion by many editors' (*ibid.*).

This is not to say that experts and amateurs are not distinguished from each other. After all, one of Wikipedia's three pillars is 'verifiability': an article should include reliable sources for assertions that might be challenged (Wikipedia:V). Explicitly, 'academic and peer-reviewed publications' are recommended as being the most reliable sources of all (Wikipedia:SOURCES#Reliable_sources). But Wikipedia places its bets on the amateurs,

hoping to mobilize them in massive numbers to compose entries; the few experts on the topic in question, hopefully, come along later to correct any mistakes that remain. This premise is phrased as follows:

While not everyone can be an expert in all fields, just about anyone can read and reliably report on the work of others. When a Wikipedia article is written to the highest standards, it extensively cites the work of experts. You don't need to be an expert to read and cite the work of experts; though experts in their fields have greater access to published works, in theory anyone could cite these published works, whether a certified 'expert' or not (Wikipedia:RCO).

This translates into equal access and equal rights for all, regardless of expertise. Moreover, no powers of moderation are granted to anyone concerning conflicts over content.

In the Google-initiated Knol experts have no special roles or privileges either. As in Wikipedia, governance is expert-neutral, so to speak. I would argue, though, that the matter of expertise is not addressed but rather eschewed by means of their basic set-up. For one thing, authors are allowed to present their personal point of view of a topic, alongside other possibly competing points of view. In such a beehive, opinions are not forcibly brought into contact. The clash of opinions is evaded. Moreover, in the main mode used, authors choose to exercise moderation powers themselves alone. This may be comfortable for authors, but gives them the lead in any dispute over content with such experts as may show up in their wiki. The authors' own expertise—if any—is thereby given priority from the outset.

In the British encyclopedic variety, h2g2, experts or expertise do not enjoy any privileges, either. Nevertheless, upon closer inspection of their moderation procedure, it can be seen that expertise is honoured slightly more than in the above two cases. Their peer review process of entries, only embarked upon by the 5% of authoring 'researchers' who are ambitious enough, is carried out by three layers: scouts, sub-editors (both volunteers) and h2g2 staff (employees). Most of their supervision seems to be concerned with editing proper (as articles in a newspaper or journal are usually edited). Style, language, consistency, spelling and the like are commented upon and brought in line with the preferred house style.

In addition, however, we see glimpses of the importance of another kind of expertise: intimate knowledge of a specific field of study. This is evident from the sub-editors' home page (<http://www.bbc.co.uk/dna/h2g2/A1035145>). These are primarily described as 'all-round generalists and trivia addicts'. But at the same time sub-editors have each indicated their specialisms—the topics on which they consider themselves to be an expert. Overlap in specialisms between 'subs' is not considered a problem. Although primarily serving as a guide for aspiring authors in order to know whom to address for help, we see the first signs of a need for expertise proper creeping in.

In the remaining three encyclopedias the emphasis on subject expertise becomes ever more pronounced. In the process, editing expertise recedes to the background. From the start Citizendium has been conceived as the better Wikipedia, while it is Wikipedia 'corrected' on two counts: real names are required (supposedly inducing more

responsible behaviour) and subject experts are assigned a proper role. According to its founder, Lawrence Sanger, the latter are needed as arbiters in content-level disputes between contributing participants. One has to overcome Wikipedia's weak point of persistent and prolonged edit wars—with quality taking a 'random walk' around its optimum corresponding to the opinions of the most persistent and aggressive contributors (Sanger 2009; in particular page 64). No wonder the moderators involved (called 'editors' here) have to satisfy expert criteria: academic degrees, peer-reviewed publications, years of professional experience and professional certification are required to varying degrees, as the case may be (<http://en.citizendium.org/wiki/CZ:FAQ>). In contrast to h2g2, these people are not appointed as 'generalists'—only as specialists in specific fields. Notice, moreover, that editing proper is preferably settled on an equal basis between contributors to an entry, not moderated by the 'editor' involved (http://en.citizendium.org/wiki/CZ:The_Editor_Role).

In Scholarpedia experts not only moderate articles but play a decisive role in their creation as well. As described above, articles are not solicited by open call, but by personal invitation of reputed experts. Thereupon entries are peer reviewed in a closed-access wiki, only open to invited experts (who remain anonymous). Upon acceptance the article is published and becomes available for public editing in an open-access wiki—moderated by a curator, typically the author him/herself. This editorial policy, of course, represents the opposite of an egalitarian approach: throughout the process, expert participants are 'more equal' than other participants.

The Encyclopedia of Earth, finally, is also firmly marked by the dominant involvement of experts. In their editorial set-up the notion of expertise is carried to its logical conclusion: only experts are involved, from beginning to end of the production process. In their own words: 'The *Encyclopedia of Earth* is based on the premise that input from scholars is essential to produce trustworthy information about the environment' (http://www.eoearth.org/article/EoE_FAQs). A closed-access wiki, only accessible to experts, is *the* space for submitting and editing entries. Topic editors moderate the process by settling disputes over content and promoting entries to the status of public visibility. The requirements for becoming a topic editor, of course, include being a senior, recognized expert in one's field.

I would argue that these considerations about the nature of expertise to a great extent explain the variety of editorial policies across the various encyclopedias sampled. In particular, these become operative in the erection of barriers to accessing the wiki spaces for creating entries (restriction of access, or by personal invitation only) and in the creation of separate roles of moderation. It is important to distinguish between two kinds of expertise: *editing* expertise, relating to 'journalistic' capabilities of editing entries in terms of style, format and the like; and *subject* expertise, relating to intimate knowledge of a field of study. In our six encyclopedias both kinds of expertise gradually become emphasized as requirements for fulfilling specific roles in a project. In h2g2 we observe 'sub-editors', mainly supposed to be knowledgeable about matters of style; in Citizendium, Scholarpedia and the Encyclopedia of Earth we observe moderators appointed on the basis of subject expertise (roles of, respectively, 'editor', 'author/curator', and 'topic editor').

Inside Wikipedia: The Problem of Quality

As a prelude to the subsequent analysis of views on testimonial acceptance, this section focuses on the issue of quality of entries, specifically as it occupies the minds in Wikipedia circles. Of late, this issue has become the subject of fierce and ongoing debate. This has mainly to do with the perception that so-called ‘vandalism’ of entries is increasing: small details are changed, nonsense inserted, obscenities or crude jokes added, or whole pages blanked. The credibility of the encyclopedia as a whole is being compromised. Several initiatives are unfolding in order to come to terms with these threats. Software tools have specifically been written for the purpose, and are now (automatically) scanning and patrolling Wikipedia contents many hours a day. Hundreds of bots have been approved for use. Moreover, WikiProjects are formed, each focusing on a specific topic (such as US public policy, Christianity or game theory). They take relevant entries under their wings and promote improvement, e.g. by placing tags that alert readers to quality deficiencies.

In particular, their members are entrusted with the task of grading articles by quality as well as importance (Wikipedia:Version_1.0_Editorial_Team/Assessment). While importance has four degrees, for quality a 7-fold scale is available, from featured and good, via A, B, and C through to Start and Stub class.⁶ The two highest grades (featured, good), though, are not awarded by WikiProject members but by users generally: a lengthy public nomination procedure has to be followed. Any registered user is allowed to review nominated candidates according to certain criteria (like reliable sources and neutral point of view), and decide accordingly (the nomination succeeds, is put on hold, or fails). In addition, anyone may nominate an article for such status. As its mirror image, a public procedure for deletion of entries considered substandard has also been introduced (Wikipedia:Deletion_policy). Currently, over 80% of all three million entries (English version) have been rated by quality.

Trust Metrics

These worries have in addition sparked off a broader debate about the definition and measurement of quality of (Wikipedian) articles. A burgeoning research stream in computer science, enabled and attracted by the Wikipedian practice of making review histories of (about) all their pages available for public perusal, is endeavouring to come to grips with this problem. I shall briefly review these discussions in order to be able to show which lessons can be (and actually are) drawn from them for Wikipedian (editorial) policies. Of course, the quality of encyclopedic articles has many dimensions (such as scope, authority, accuracy; cf. Stvilia et al. 2005). Nevertheless, most researchers operate with just one overall measure of quality. The leading approach is to construct computational *trust metrics* that measure credibility of entries.⁷ This approach is pursued since it would yield a measure of text quality in a very efficient way (automatically, not involving the usual human labour which is so time-consuming).

⁶ The ratings assigned to an entry are visible to all users, albeit in a barely noticeable spot: at the very end of the corresponding discussion page.

⁷ I adopt the convention of exclusively reserving the terms *trust* and *trustworthiness* for situations of dependence on people (and systems), while the term *credibility* applies to the issue of believability of text. I do so since I want to avoid the common practice of using the word *trust*(worthiness) for just about anything under the sun (cf. Tseng and Fogg 1999).

Ideally, the proposed metrics are empirically tested for adequacy by analyzing ‘dumps’ of Wikipedia files and comparing the quality results obtained with quality ratings by humans.

What kind of computer metrics may be considered good proxies for quality? Overall three kinds of metrics have been suggested (classification borrowed from Dalip et al. 2009): textual features, network features and review features. *Textual features*, first, may refer to length (e.g. number of words and phrases), structure (e.g., section count, citation count), style (e.g., conjunction rate) and readability (e.g., Flesch score). Although not studied often in the Wikipedia case, Dalip et al. (2009) claim that such metrics are better quality indicators than the other two groups of features. *Network features*, secondly, refer to the popularity of an entry in the network of other articles in which it is embedded. Proposed metrics are e.g. in-degree and out-degree (respectively number of links from and to other articles; the former is comparable to the PageRank algorithm originally proposed by Brin). Deborah McGuinness and colleagues in particular have pioneered this approach, focusing on links within Wikipedia (McGuinness et al. 2006). *Review features*, thirdly, are extracted from the revision history of a Wikipedia entry. Several aspects can be focused on (like edit age, number of editors, review count). The assumption is that the longer some portion of text remains unchanged, the more mature it has become. Moreover, it is assumed that the greater the number of collaborators, the more balanced an entry has become. Pierpaolo Dondio and colleagues may be considered the pioneers of this approach, in presenting their ‘Wikipedia Trust Calculator’ (Dondio and Barrett 2007).

The third approach is especially interesting for our purposes, while one particular aspect of review histories of entries can be singled out: the survival of individual edits. The sum total of an author’s edits in combination with their survival is then somehow to be measured and used as an indicator for *author reputation* as a trustworthy contributor. The very idea of focusing on survivability for the purpose probably originated with Anthony et al. (2005). Such investigations are usually based on a model that calculates text credibility and author trustworthiness *together*, continuously. Each and every new editing act recalibrates textual credibility and author reputation(s) as a trustworthy contributor. Let me illustrate the model by presenting some important lines of this reputation research.

The main strand centres on Luca de Alfaro and co-workers. Together with Adler (Adler and de Alfaro 2007) he wrote a content-driven algorithm for author reputation and text age which keeps track of the rate of change of entries due to editing. Each round of editing is seen as casting a vote on performed edits that are in sight at that particular moment. The more often text/edits from an author are preserved intact, the more corresponding text/edit age and his/her reputation rise (and conversely for text/edit modification or deletion). Moreover, the (current) reputation of a voting author influences how much reward or punishment is meted out to authors of the entry under scrutiny. De Alfaro and coworkers argue that this measure of author reputation is especially useful for predicting the quality of fresh contributions by an author. In subsequent work they explored this and various other notions of productivity within Wikipedia as to their adequacy for author reputation. They concluded that longevity of all text (or edits) contributed by an author remains the best option after all since it cannot easily be manipulated—text longevity being defined as the product of text size

and text quality (as measured by survival time) (Adler et al. 2008a).⁸ Quite similar in spirit to de Alfaro's approach is a model by scholars from Udine (Italy). Their starting point was a model for scholarly publishing (from Mizzaro), which models peer reviewing of papers as a whole as performed by readers. They adapted it to Wikipedia for the purpose, by substituting the act of contributing an edit to an entry for peer review (Cusinato et al. 2009). The authors propose their own quality measures for both author reputation and entries (as a whole).

As a corollary of these reputational research efforts, practical measures for the Wikipedia enterprise are usually suggested to tackle the 'quality problem'. One class of proposals aims at providing 'transparency' and 'accountability' to Wikipedia users/producers (cf. also Simon 2010). A prominent example is the *WikiDashboard* (Suh et al. 2008). Based on revision histories it displays, for each Wikipedia page, an 'article dashboard' (showing weekly edit trend of the article, and a list of most active users plus their weekly editing activity concerning the article) and an 'author dashboard' (showing weekly editing activity of the author, and a list of his/her most worked-on articles plus associated weekly editing activity). Subsequent research (Kittur et al. 2008) has for the most part confirmed that users are able to interpret these patterns correctly when assessing the credibility of textual entries. Moreover, the dashboards involved may guide the efforts of future contributors in desired directions. In a similar vein a 'social dashboard' is in the making to provide clues about the conflict potential of Wikipedia users (Kittur et al. 2007). Another idea is to *colour entries* (either per word, per line, or per article as a whole) according to their estimated credibility. As an example, 'trust values' per word are calculated on the basis of the content-driven author reputation system (from de Alfaro and coworkers) and rendered in colour to provide an indicator for future (in-)stability (Adler et al. 2008b). The WikiTrust extension is its proposed online implementation, using darker shades of orange as a warning sign.⁹

The other class of Wikipedia proposals aims at '*author management*': based on reputational scores, it conceives interventions in the editorial process. Authors with a poor reputation may be put on close watch: their new edits to crucial or controversial articles are flagged (for closer inspection), or even forbidden (by means of article protection) (Adler and de Alfaro 2007). Kramer et al. (2008) even propose squarely that reputation be used for 'granting or removal of privileges'. Finally, in virtual communities more generally, reputational scores can be used 'to divide revenue, to recognize merit, to award status promotions, and to choose the order of authors when citing the content' (Adler et al. 2008a). A concrete Wikipedia application they suggest is to take the already existing practice of awarding 'barnstars' to prolific contributors

⁸ Kramer et al. (2008) propose a simpler approach to quantifying reputation, focusing on the edit survival rate of an editor's contributions after a constant number of revisions (10, say). In this way they circumvent the measurement problem that occurs when all edits ever performed by an author are taken into consideration at a specific sampling moment: some edits are old and properly tested, while others are still young and relatively untested. In other words: the lifetime of dead edits is known, while this is uncertain for alive edits.

⁹ Another type of proposal tries to stay away from computational metrics and continues to rely on human judgment. In order to empower users a 'trust-aware' type of recommendation system is developed which calculates a rating for each entry based on recommendations from one's 'friends'. As in de Alfaro's model, trust values of one's friends are variable: they change according to the proximity of their particular verdict to the verdict of others. As a proxy the system can be installed on the user's own machine (Korsgaard and Jensen 2009).

(Wikipedia:Barnstars) and put it on a more solid foundation by using reputational scores for the purpose.¹⁰

Review and Super-Review

All of these proposals about transparency and author management are in various stages of discussion within Wikipedia. While they usually involve quite a change to existing practices, they do not meet with universal approval; a reluctance to change is apparent. Currently it would seem that apart from WikiTrust having been made available to interested users,¹¹ only the idea of managing poor reputation contributors is really catching on. How does one prevent vandals from polluting entries? The organizational approach under consideration is the call for *review*: all changes to an entry should first be reviewed (for vandalism) before being inserted in the public version of the entry. Many varieties of this basic idea are circulating. Is review only to be applied to sensitive entries like the ‘biographies of living persons’, or to all entries? Are only anonymous users to be reviewed, or all users? Is reviewing itself entrusted to a select group of users, or to all equally?

A review system may introduce inequalities between users that were previously non-existent. Some users may become ‘more equal’ than others as they acquire exclusive rights of review (or ‘autoreview’; cf. below); as a result, the egalitarian assumptions of the encyclopedia come under strain. It is precisely for this reason that such proposals have met with fierce opposition. French Wikipedians overwhelmingly voted the scheme down (80% against; October 2009). For the English version it was at last decided to test such a review system for sensitive entries (upon request) for a two-month period (mid-2010). It was conceived as an alternative measure for the usual practice of ‘protecting’ entries (i.e., freezing the text for some period of time). By means of a poll after the trial period it had first been decided to keep the feature ‘turned on’ until the software involved would be updated substantially. Subsequently, though, consensus has been reached to turn the test system ‘off’ for all entries involved (as of May 20, 2011). Nevertheless, the debate continues. In several other language versions, though, users turned out to be largely in favour of the scheme, as applying to all entries. As a result, it has actually been introduced in them earlier on (from May 2008 onwards).¹²

In order to get a grasp of what such a review system amounts to I briefly discuss the most comprehensive implementation to date: the German one (<http://de.wikipedia.org/wiki/Wikipedia:GSV>). All entries, regardless of topic, fall under the system, so each and every incoming edit has first to be reviewed for vandalism (but see exemption below). Review is carried out by ‘*Sichter*’ (literally: sifters, sighters) who have to approve revisions (and subsequently flag them as a signal of their approval). For

¹⁰ At the same time de Alvaro and coworkers declare themselves to be reluctant to actually *display* Wikipedian author scores since it would excessively disturb ‘the spirit of friendliness and cooperation’ in Wikipedia. To them, it is mainly to be seen as a mathematical tool for computing textual trust and to take measures accordingly (<http://www.wikitrust.net/frequently-asked-questions-faq>).

¹¹ For several language versions a Firefox extension can be downloaded that, for the moment, connects to servers at the University of California at Santa Cruz—not yet directly to the servers of the Wikipedia Foundation (for details see <http://www.wikitrust.net>).

¹² To mention just some larger ones (in chronological order of actual introduction of the review system): the German, Russian, Polish, Hungarian, Chinese (2008), Arabic (2009), and Indonesian (2010) versions of Wikipedia (data taken from <http://meta.wikimedia.org/wiki/FlaggedRevs>).

the public in general (unregistered users) the version of an entry on the screen is the latest sighted version (although the most recent version is available with a mouse click). This is intended to dissuade vandalism, since the immediate gratification of seeing one's disruptive edits showing up on the screen is frustrated. For registered users the most recent version is set as the default version (as is current practice for the English Wikipedia).

A moderation process is set in motion to survey contributions. How may German Wikipedians qualify for this task (<http://de.wikipedia.org/wiki/Wikipedia:GSV>)? The main requirements are as follows. Registered users may apply to become a *Sichter* ('*aktive Sichterrechte*'), as soon as they have been active for 60 days and performed at least 300 edits (or 200 '*gesichtete*' edits)—notice that the same criteria permit users to become entitled to vote within Wikipedia. Less experience suffices for registered users to become exempt from being reviewed themselves and be allowed as it were to approve their own edits ('*passive Sichterrechte*'; in Wikipedian English denoted 'autoreview' or 'autopatrol'): 30 days of activity and at least 150 edits (or 50 '*gesichtete*' edits). So one qualifies for (auto-)review rights by being an active Wikipedian contributor, in the numerical sense. Notice that in future the German Wikipedia intends to introduce a more stringent system of review of quality proper, to be carried out by a kind of super-reviewers, designated *Prüfer* (also referred to as 'über-reviewers' or 'surveyors'). These will have to meet much higher standards of activity and number of (successful) edits performed.^{13 14}

Discussions inside Wikipedia do not end here, though. Jointly inspired by worries about vandalism and quality of entries, several proposals have been put forward for involving *real-world* experts in the process of quality control (English Wikipedia). One modest proposal (Wikipedia:EXPREV) aims to invite verified experts to review 'factual accuracy and coverage' of specific scientific articles. Discussion, however, does not take place in the usual wiki but on associated mailing lists (say for mathematics) which, although accessible to all, only take posts from the coordinator and experts involved. A more rigorous proposal (Wikipedia:EXR) wants to bring in verified experts and give them rights to oversee editing discussions, as well as powers to block pages and ban users. This would apply to say biology, which as a subject is split up into a hierarchical tree of biological subentries. Accordingly, one expert at the top would appoint a hierarchy of biological experts, each of whom would oversee their own specific entry—and no more. Yet another proposal (Wikipedia:EXR) suggests the introduction of two parallel editing spaces for entries. 'Expert editing' of the subject is only open to experts (with a PhD and several publications in reputable journals), while 'public editing' of the same subject

¹³ In the next section on testimony I return to the criteria used for appointing reviewers and/or super-reviewers, interpreting them as indicators, respectively, of good intentions towards Wikipedia and 'interactional' expertise.

¹⁴ In contrast to the English Wikipedia, in the English Wikinews (the journal-that-anyone-may-edit) a similar review system has been functioning for several years now (since mid-2008). After development in the 'newsroom' any new article has to be reviewed before official publication on the 'main page'—it should respect copyrights, be newsworthy, fully sourced, written in a neutral manner and conform to a style guide. The task is performed by editors with reviewer status; one has to apply for it and obtain sufficient favourable votes. The status also allows immediate official publication of one's own new articles (http://en.wikinews.org/wiki/Wikinews:Reviewing_articles). Remarkably enough, the German Wikinews still operates *without* official reviewers, presumably since 'vandalism' does not constitute much of a problem there.

takes place in parallel and open to all. The idea behind this set-up is that the expert edition is expected to pull the public edition in the right direction. Experts remain free to edit without having to fight cranks, while the public at large is still welcome. After lengthy discussions, however, all such proposals have been judged to be a bridge too far. They are not likely to be adopted soon—at least not in the English language version.

Views on Testimony

Above the call for contributions and the review processes for incoming content have been investigated for our sample of open source encyclopedias. A range of editorial policies was uncovered, in which ever more access and/or role restrictions were employed (tables 2 and 3). Discretion granted effectively decreases along this continuum. Translated into terms of trust (as regards both intentions and competences) this reads: trust is granted to potential contributors ever more sparingly. Subsequently it was shown that these variations in governance bear a close relationship to conceptions about the proper role of expertise in producing encyclopedic entries.

These editorial policies designed to cope with the problem of ‘organizational trust’ can be elucidated further, I contend, by drawing a comparison with another field of study: the epistemology of testimonial evidence. This field is concerned with the conditions under which assertions or testimony by speakers can justifiably be accepted as true beliefs. The main lines of argument are either non-reductionist, relying on an *a priori* type of justification for the testimony involved; or reductionist, seeking for epistemic evidence elsewhere (Adler 2006; Goldman 2001/2006). Because of the intersection—even near coincidence—of organizational with epistemological trust in our case of encyclopedias (cf. the introduction), the editorial policies discerned above can be connected with views on testimonial acceptance and usefully interpreted as *implementations* of them.

But who precisely should be considered to produce testimony here—individuals or groups? In the long run these encyclopedias transform entries from individual testimony into a kind of group testimony that can no longer be reduced to any of its members’ individual testimonies. That is to say: given enough time, users (i.e., readers) who consult Wikipedia (or any other ‘open sourced’ encyclopedia for that matter) are properly confronted with group testimony. The encyclopedia as an *institution* provides them with such testimony. This is basically the argument put forth by Tollefsen (2007), and I can only agree with this position. My focus, however, is not on these ‘outputs’ but on the production processes underlying them that lead to—and account for—their creation. I am, so to speak, opening up the ‘black box’ of producing text in a wiki (or other) space. Individual producers contribute their edits as raw material to this process of knowledge production. The issue of reliability of testimony then presents itself to the ‘knowledge workers’ of any encyclopedic factory with every fresh edit provided as input. On what grounds can testimony from individual contributors be accepted as true belief?¹⁵

¹⁵ So a cycle can be observed involving both individual testimony and group testimony. Individual producers contribute testimony as input to the encyclopedic production process; as a result, in the long run the encyclopedic institution is able to provide group testimony to its readers. Subsequently those readers, of course, can turn into producers again, completing the cycle. Note that my approach implies

Acceptance Principle

The most basic—and radical—*a priori* reasoning can be described as the ‘acceptance principle’: under normal conditions (i.e., unless special reasons exist that forbid one to do so) one is entitled to accept what a speaker asserts as true. Burge (1993) grounds this position in the *prima facie* rationality of both contents and their sources. Other defences for this position (like the ‘principle of charity’ or the ‘cooperative principle’) proceed along similar lines. It is this view to which Wikipedia in particular seems to adhere. This institution invites anybody to contribute without distinction or identification requirement; so it would seem that, effectively (though not necessarily consciously), one *a priori* departs from the default position that all contributions are true assertions.

I want to argue that this epistemic position is indeed typical of Wikipedia—but only at the *beginning* of the enterprise, a decade ago. In all naivety the default position was embraced, in an *a priori* fashion. But soon enough the realities of mass participation forced themselves upon (core) Wikipedians—the wiki format which puts contributions up for public scrutiny does not automatically and unerringly generate quality. As a result, over the years involved Wikipedians took to repairing the damage: by developing an ethic of good faith, respect and civility (‘Wikiquette’; cf. de Laat 2010), crafting editorial policies and introducing quality control schemes (cf. above). As of today, the encyclopedia-that-anyone-can-edit relies heavily on these additional mechanisms.¹⁶ Tollefsen (2009: 220)—stressing that the image of Wikipedia as a reliable source increases because of its ‘policies and procedures for ensuring accuracy and verifiability’—and Simon (2010)—observing that users ‘trust Wikipedia as a system that is based on a distinct process of content creation’—come to essentially the same conclusion.

I would argue that, as a result, the Wikipedian epistemic position has changed. The default rule of accepting all incoming assertions as true is still embraced, but no longer based on *a priori*, but on *a posteriori* reasoning. In epistemological terms: background conditions of their testimonial practice—as created by themselves (!)—provide enough reason to continue to accept the default rule of plain acceptance of testimony (cf. Adler 2006). Obviously, these background conditions do not guarantee that incoming assertions are most of the time true right away, but only that they will most likely become so after a while—after due ‘processing’. Assertions are only provisionally accepted as true—to be refined all along. Needless to say, all other encyclopedias investigated also rely on continuous discussion, whether wikified or not. Here, too, background practices (though as a rule less elaborate than those of Wikipedia) create room for acceptance of individual testimony.

separating the two intertwined components in Bruns’ characterization as ‘producers’ (Bruns 2008): users and producers of content are considered separately while involved in different practices.

¹⁶ Note that by developing such procedures Wikipedia may be said to have ‘encapsulated’ the interests of its readers, namely, that entries are (or become) reliable, precise and complete. In accordance with the views of Hardin (2002: ch. 1) readers may develop a long-lasting relationship of epistemic trust towards Wikipedia in this fashion. Remarkably, that relation is not a direct one between readers and contributors, but between readers and Wikipedia as intermediary quasi-institution.

Assurance View

Another type of *a priori* entitlement is the ‘assurance view’ (Moran 2005): when a speaker manifestly stands behind his/her words and assumes responsibility for them, the hearer is entitled to accept them at face value. Precisely while the speaker gives his/her word to the hearer, the normative relationship between them is altered. The speaker has made him/herself accountable, therefore the hearer may justly complain if the assertions turn out to be false. The epistemic value of the assertions is conferred on them by the speaker who offers a kind of guarantee for their truth. This defence of the default rule of unquestioning trust is the second type of *a priori* reasoning that would seem to be implemented. I am referring here to the registration procedures for participation as described above, asking for username or real name. Particularly the demand to provide one’s real name forces people to stand behind the words they contribute. While anonymity on the Internet dissolves the bond between a contributor and his/her words, the real name demand is supposed to restore this link. In the same vein the practice of signing one’s articles heightens accountability of the author.

Such practices of registration and/or signature (usually prescribed together) have been obligatory from the beginning in all encyclopedias in our sample—Wikipedia excepted (cf. tables 1-2). Usually the leadership involved is well aware of the mechanism. At Knol a product manager remarked: ‘We are deeply convinced that authorship—knowing who wrote what—helps readers trust the content’ (<http://ceoworld.biz/ceo/2008/07/24/cathedral-vs-bazaar-google-launches-knol-its-answer-to-wikipedia>). At Citizendium the real name policy is justified as follows: ‘People do tend to behave themselves better when their identities are known and their behaviour is out in the open.’ Similarly, escaping the rules by taking on a new pseudonym is no longer possible (<http://en.citizendium.org/wiki/CZ:FAQ>). And the Encyclopedia of Earth remarks about their signing-by-real-name policy that it ‘motivates individuals to do their very best work’ and ‘will discourage the explicit acts of sabotage that plague other electronic resources where anonymity is the norm’ (http://www.eoearth.org/article/EoE_FAQs).

What about Wikipedia which, after all, also has a registration procedure? Before answering this question let me first explore the details of their procedure more fully. Registration is not required. As a result, about 2/3 of contributors register as users while 1/3 remain anonymous (‘anons’ in Wikipedian parlance)—amounting to millions of people (all figures relating to the English version). Anons turn out to be much more vandalism-prone (about 20%) than registered users; most vandalistic edits therefore (about 95%) come from them. Nevertheless Wikipedia does not want to force everybody to register since they are afraid that this barrier will chase anons away and so their potentially valuable contributions will be missed—80% of them are bona fide and contribute substantially (cf. Viegas et al. 2004).¹⁷ Some Wikipedians even associate obligatory registration with an ‘air of elitism’ (to be avoided).¹⁸

¹⁷ Notice the substantial difference from talk pages: people posting on them are urged to sign with their username or IP-address. A non-anonymous conversation is strongly preferred.

¹⁸ Number 21 of users who oppose the proposal that only registered users may edit the site; post from August 2006 at http://meta.wikimedia.org/wiki/Anonymous_users_should_not_be_allowed_to_edit_articles.

As a useful approach to exploring the assurance view in the Wikipedian case let me first discuss the matter of *accountability* as it applies to their users. Can they be held to account afterwards if they turn out to have committed an act of vandalism? By virtue of their continued presence, registered users can easily be held to account. But the same applies to anonymous users: they can rather effectively be tracked down by means of sophisticated software like WikiScanner (as part of the background conditions just sketched) and can be held to account as well. These are the reasons for an author like Tollefsen (2009: page 11 in particular) to argue that, after all, the assurance view holds. I think this is a mistaken conception. Accountability for all (*a posteriori*) does indeed hold—but that is not to be confused with assurances having been provided (*a priori*). Assurances may produce accountability—but that is the only relationship between them.

If we move on to the issue of Wikipedian assurances proper, observe that about one third of edits are just provided without any assurances at all. For the remaining two thirds, authors do indeed personally stand behind them. But what does that amount to? These edits are scattered across the universe of Wikipedian entries and are apt to change constantly. Moreover, one does not properly sign one's contributions, and 'authorship' as such is anyway hard to trace in entry histories. As a result we are entitled to conclude that the assurance view is hardly implemented in Wikipedian editorial policy at all.

Expertise View

The threshold from assumption to inference is crossed in the last epistemic position that can be seen to be implemented: the 'expertise view' (my terminology). What this view entails can best be developed by reference to an author mentioned above: Hardwig. In his 1991 essay he attempts to bring home the point that science is so vast nowadays that scientists cannot gather all knowledge at first hand and just have to rely on other scientists' testimonies and trust them (as default rule). Otherwise science as an enterprise would break down. I would argue that such considerations point the way to defining an 'expertise view' of testimonial acceptance, in which, on the one hand, testimony of proven experts is taken as reliable, while, on the other hand, testimony of non-experts is only considered to be interesting at best. The default rule of blanket trust is only deemed to apply to experts in their respective specialist fields. Effectively the message is: experts can and will be trusted by default—but the assertions of non-experts will have to be checked and verified.¹⁹

Such a view of expertise as an epistemological guarantee, then, can be implemented in two kinds of editorial practices. On the one hand, experts may be called upon to verify the quality of (evolving) entries and ultimately give them the mark of quality. Expert approval is solicited some time *after* contributions have come in and been processed. Procedures for moderation closely scrutinize both non-expert and expert testimony. This practice amounts to 'professionalization' of the 'background conditions' mentioned above. On the other hand, experts may be considered the only ones worthy of full

¹⁹ Notice that I am not arguing here that qualified experts are the only ones able to perform as experts, or provide expert contributions to an encyclopedia. Obviously, exceptionally talented people can become 'true' experts outside official circles of qualification. I am only saying that encyclopedias may take to this criterion as they consider it an easy and efficient procedure.

participation at all. Expert credentials are simply required as a condition of access; laymen may, at most, post their comments. In this practice, therefore, even *before* contributions come in, credentials of expertise are invoked as an epistemological guarantee.

If both practices are considered together, the expertise view can be seen to have two implementations. On the one hand, it may be implemented in a *weak* sense, as far as experts are only called upon to check for quality afterwards. This is the case for Citizendium. On the other hand, it can have a *strong* implementation, as far as both moderation and participation are decreed to be the province of experts. Notice that in this case tasks of moderation by necessity have to be performed by more senior experts with a proven track record. This strong implementation ('for experts only') is characteristic for Scholarpedia and the Encyclopedia of Earth.²⁰

The three encyclopedias just mentioned rely on expertise in the usual sense of the term, as proven by track record in a specific field of study. Turning to Wikipedia, I want to argue that it is very likely that in the near future a kind of 'expertise view' will start to gain ground as well. It involves an intriguing *novel* way of becoming—and being considered—an expert. Let me begin with the system of review for vandalism, carried out by Wikipedians with a total *edit count* above a certain threshold. What kinds of capabilities are intended to be involved? This revolves around the capability to detect vandalism, being able to distinguish *prima facie* disruptive edits from constructive edits. This primarily represents expertise related to editing proper. On the face of it, this ubiquitous, low-level expertise resembles the capabilities required from moderating 'sub-editors' of h2g2.

In addition, however, and more importantly, this criterion can be interpreted as indicating loyalty to the Wikipedian undertaking. The investment of so many edits (usually several hundred) is taken as a reliable sign of dedication and loyalty. A potential vandal wouldn't take all this trouble. If this interpretation is correct, it is not so much epistemic qualities as *moral* qualities of Wikipedians as producers of knowledge that are gauged by the edit count requirement. This would include getting to know and coming faithfully to adhere to the Wikipedian rules, regulations and etiquette. Besides the German practice of counting '*gesichtete*' edits as up to three times more valuable than just any edit (when applying for the *Sichter* status), this interpretation as 'initiation ritual' is corroborated when we look at how administrators rule on requests to obtain reviewer rights in the English Wikipedia (from summer 2010 onwards; cf. Wikipedia:Requests_for_permissions/Reviewer). Any sign of bad behaviour in the recent past, of violating Wikipedian rules or principles, invariably leads to a refusal of such rights and the advice to come back some time later. Copyright violations, neglect of verifiability, editing with multiple signatures, harassment of administrators, a ban for some period of time, or—indeed—vandalistic behaviour, any of these is enough for the status of reviewer to be denied.²¹

²⁰ H2g2 has not been mentioned here since their 'weak' implementation of the expertise view (with 'editing' experts) is hardly noticeable: the peer review option is voluntary and actually chosen by only 5% of authors.

²¹ About 5% of such requests (totalling more than 1000 as of January 2011) are actually turned down for lack of experience, misbehaviour, or both.

In a later stage Wikipedia (at least the German one as well as some other language versions) intends the system of review to become more ambitious and check the quality of entries *tout court*. ‘Super-reviewers’ will be appointed who have to meet higher standards than ordinary reviewers; in line with the above, one could think of a total *edit count* in the thousands. As recounted above, de Alfaro and colleagues have repeatedly emphasized that to them, raw edit count is a poor yardstick since it simply sidesteps the issue of quality. In addition they argue that it can easily be manipulated by users splitting each contribution in multiple ones or performing gratuitous edits. Therefore they plead for a more sophisticated measure of author reputation, based on total *edit longevity*. This variable measures all items of contributed text, weighted by their survival. It is supposed to reflect more accurately whether or not the author has delivered quality. In a nutshell: whether (s)he can be considered an expert, at least regarding the topics (s)he is writing about. In addition, the measure is more resistant to tampering since it depends to a large extent on the behaviour of one’s co-Wikipedians (Adler and de Alfaro 2007).

Let me speculate on the ways in which the measures of edit count and edit longevity (as based on individual editing patterns) may be used in the future to indicate a reputation as expert. Within the encyclopedic institution of Wikipedia editors may qualify as fully accomplished experts in a two-step process. First they qualify as to their moral capabilities by crossing a (lower) threshold of *edit count* (required for basic reviewing purposes). As such this step hardly provides evidence of epistemological capabilities. In the second, more important, step, therefore, they have to provide proof of those capacities as well by crossing a (higher) threshold of *edit longevity* (the more stringent measure, required for super-reviewing purposes). It is the latter step, indicating the ‘hard core’ of expertise, that completes the qualification procedure. In future it may well be adopted officially in order to produce ‘home-grown’ experts of a specific Wikipediaian flavour. It is such ‘experts’, presumably in full possession of moral and epistemic qualities, that may be called upon in Wikipedia to vouch for the epistemic quality of evolving entries—which amounts to a *weak* implementation of this particular expertise view.

This interpretation of edit count and especially edit longevity as indicator of a kind of ‘expertise’ may seem bizarre at first sight. What is the connection between this virtually certified expertise and real-world expertise acquired within academic and professional institutions of various kinds? Parts of an answer can be obtained by comparing the former to ‘interactional expertise’ as defined by Collins and Evans (2007): by immersing oneself into the linguistic culture of a practical domain one may learn to be able to talk intelligently about it—without for that matter being able to properly contribute to it. The latter is only possible on the basis of ‘contributory expertise’, the province of specialists and scientists proper. I would argue, in a speculative vein, that the second Wikipediaian criterion of high edit longevity (*not* edit count) targets expertise, which may range from low-level to high-level expertise. As far as high-level expertise is involved, it seems close to interactional expertise. After all, by repeatedly surviving several rounds of criticism (preferably also from some knowledgeable specialists), an author seems to prove full competence as a partner in discussions of the domain in question. A Turing test of a kind has been passed. Ideally, with enough ‘true’ contributory experts participating, immersion in the field is taken care of by Wikipediaian procedures; the wiki space functions as a pressure cooker for displaying and developing the competences

required. On this reading Wikipedia, remarkably, offers all of us the chance to become experts—in the interactionalist sense of the term.

Some caveats apply to this conjecture, though. Especially in more specialized areas it takes a lot of effort to become a competent discussion partner, as Collins and Evans stress throughout their book (2007). This seems to be underestimated in Wikipedian circles, where it is maintained that just anyone can ‘read and cite the work of experts’ (Wikipedia:RCO; also cited above). Furthermore, the very real prospect of edit wars launched by overzealous contributors does not seem conducive to the associated learning process with ever-developing competence. Finally, it has to be observed that in case the real contributory experts stay away from some Wikipedian areas, contributors with high edit longevity may only seemingly qualify as interactional experts in them. The indications available do not augur well in this last respect. Even supposedly the best indicator of expertise, edit longevity, is in dispute. In a careful study Brendan Luyt and co-workers conclude that many mistakes are introduced in entries, especially in the early phase of their development. Later on, these early errors remain disproportionately intact and are not corrected by subsequent editors. Their observations cast doubt on the equation of edit survival with quality and any corresponding expertise of its author (Luyt et al. 2008). So for the moment, my conjecture remains a puzzling affair.

Table 5 summarizes the discussion of epistemological views as incorporated in the encyclopedias’ editorial policies. It should be remarked, for comparative purposes, that the open source movement, from its inception, has always clung to a strong implementation of the expertise view of testimony—expertise of the old-fashioned kind. Originators of a project put themselves at the helm as ‘project owners’ and decide on strict meritocratic criteria about hackers’ contributions.

Insert table 5 about here

In Conclusion: The Future of Wikipedia

Guido Möllering has set himself the task of resurrecting the notion of trust as a leap of faith, as originally proposed by Georg Simmel (Möllering 2005: ch. 5). A trustor performs a mysterious leap across the abyss of absent evidence, acting *as if* any conceivable problems of trust just do not exist, for the moment bracketing out all that may go wrong (*‘Aufhebung’*), in a superior act of will. From available accounts one may conclude that, unlike all other encyclopedias analyzed above, the beginnings of Wikipedia can be interpreted as such a leap of faith. Every rational analysis pointed towards employing certain standards of inclusion and exclusion—but in order to attract more visitors, the initiators started Wikipedia as an all-open experiment nevertheless. Precisely by bracketing what common sense tells us, Wikipedia was able to open their doors. And this faith was extended not to some specific persons, but to humanity as a whole. The initial leap took place on a small scale but soon the project turned out to mobilize thousands of people.

In this way an experiment started of building an epistemic community in novel ways. Precisely because of the initial naive leap, the mechanisms of governance had to be invented along the way. The wikified process as it is now is unorthodox, but in the near future it will probably become even more so (at any rate in language versions like the

German one). Let me speculate about its essence by glancing at the internal discussions about what constitutes quality (as recounted above under the ‘problem of quality’ heading). As the quotation at the start of this article indicates, Shapin (1994) argued that trustworthy agents need to be identified for the constitution of any body of knowledge. What he meant was: identification beforehand, as a prerequisite for their participation in the actual formation of knowledge. Such is indeed the case for Scholarpedia and the Encyclopedia of Earth in our sample (as well as more broadly; cf. for example CalFlora, a digital database of Californian plants, analyzed by Van House 2002). For the future Wikipedia, however, Shapin’s dictum will no longer hold in its intended form: trustworthiness remains essential, but it will be assessed *continuously*, as the process of knowledge constitution unfolds.

This dynamic monitoring of trustworthiness will be implemented as follows. By default, one’s reputation (as measure of trustworthiness) is set at some low positive value, to be confirmed or refuted in the editing process later on. Those whose reputations rise are worthy to obtain certain privileges (such as review and autoreview rights, rights of vote, conflict resolution rights), while those whose reputations stagnate or decline are considered ever less trustworthy and are treated accordingly (having their edits flagged for review, and, in worse cases, being put on close watch or being banned from editing—whether on probation or definitely, whether for specific topics or generally, whether for some limited amount of time or indefinitely). This identification may be accomplished by using software tools that keep track of the ongoing evolution of entries and continuously compute text quality and author reputation. Certified epistemic trustworthiness is not taken as the starting point for building the community (*a priori*), but established by the wiki editorial process as it evolves (*a posteriori*). Although reputations do not have to be displayed publicly and may remain in the background, their rise and decline as sketched above obviously create incentives for contributors to behave well.²² Accordingly, the criteria to be used for establishing a reputation will become a critical issue. Is ‘edit survival’ really the epistemologically adequate answer?

References

- Adler, B.T. and de Alfaro, L. 2007. A content-driven reputation system for the Wikipedia. *Proceedings of WWW 2007*, ACM Press.
- Adler, B.T., de Alfaro, L., Pye, I. and Raman, V. 2008a. Measuring author contributions to the Wikipedia. *Proceedings of WikiSym 2008*.
- Adler, B.T., Chatterjee, K., de Alfaro, L., Faella, M., Pye, I. and Raman, V. 2008b. Assigning trust to Wikipedia content. *Proceedings of WikiSym 2008*.
- Adler, J. 2006. Epistemological problems of testimony. *The Stanford Encyclopedia of Philosophy*. Obtained from <http://plato.stanford.edu/entries/testimony-episprob/>.
- Anthony, D., Smith, S.W. and Williamson, T. 2005. Explaining quality in Internet collective goods: Zealots and good samaritans in the case of *Wikipedia*. Obtained from <http://web.mit.edu/iandeseminar/Papers/Fall2005/anthony.pdf>.

²² On behalf of its readers, Wikipedia creates incentives for contributors to display trustworthy behaviour. The quality interest of readers had been encapsulated before in Wikipedia procedures (cf. note 15 above); as a result, readers could trust Wikipedia (with mature articles to be interpreted as ‘group testimony’; cf. Tollefsen 2009). This is now taken one step further in another Hardinian manoeuvre: the quality interest is also encapsulated in the reputational mechanism so that Wikipedia may trust their own contributors (on an individual basis).

- Baier, A. 1986. Trust and antitrust. *Ethics*, 96(2): 231-260.
- Baier, A.C. 1992. Trusting people. *Philosophical Perspectives*, 6, *Ethics*: 137-153.
- Benkler, Y. 2006. *The wealth of networks: How social production transforms markets and freedom*. New Haven/London: Yale University Press.
- Bruns, A. 2008. *Blogs, Wikipedia, Second Life, and beyond: From production to produsage*. New York: Peter Lang.
- Burge, T. 1993. Content preservation. *The Philosophical Review*, 102(4): 457-488.
- Collins, H. and Evans, R. 2007. *Rethinking expertise*. Chicago and London: The University of Chicago Press.
- Cusinato, A., Della Mea, V., Di Salvatore, F. and Mizzaro, S. 2009. QuWi: Quality control in Wikipedia. *Proceedings of WICOW09 2009*.
- Dalip, D.H., Cristo, M. and Calado, P. 2009. Automatic quality assessment of content created collaboratively by Web communities: A case study of Wikipedia. *Proceedings of JCDL 2009*.
- De Laat, P.B. 2007. Governance of open source software: State of the art. *Journal of Management and Governance*, 11(2): 165-177.
- De Laat, P.B. 2008. Online diaries: Reflections on trust, privacy, and exhibitionism. *Ethics and Information Technology*, 10(1): 57-69.
- De Laat, P.B. 2010. How can contributors to open-source communities be trusted? On the assumption, inference, and substitution of trust. *Ethics and Information Technology*, 12(4): 327-341.
- Dondio P. and Barrett, S. 2007. Computational trust in web content quality: A comparative evaluation on the Wikipedia project. *Informatica*, 31: 151-160.
- Forte, A., Larco, V. and Bruckman, A. 2009. Decentralization in Wikipedia governance. *Journal of Management Information Systems*, 26(1): 49-72.
- Fox, A. 1974. *Beyond contract: Work, power and trust relations*. London: Faber and Faber.
- Gambetta, D. 1988. Can we trust trust? In *Trust: Making and breaking cooperative relations*, D. Gambetta (ed.), pp. 213-237. Oxford: Blackwell.
- Goldman, A. 2001/2006. Social epistemology. *The Stanford Encyclopedia of Philosophy*. Obtained from <http://plato.stanford.edu/entries/epistemology-social/>.
- Hardin, R. 2002. *Trust and trustworthiness*. New York: Russell Sage Foundation.
- Hardwig, J. 1991. The role of trust in knowledge. *The Journal of Philosophy*, 88(12): 693-708.
- Kittur, A., Suh, B., Pendleton, B.A. and Chi, E.H. 2007. He says, she says: Conflict and coordination in Wikipedia. *Proceedings of CHI 2007*.
- Kittur, A., Suh, B. and Chi, E.H. 2008. Can you ever trust a wiki? Impacting perceived trustworthiness in Wikipedia. *Proceedings of CSCW 2008*.
- Korsgaard, Th.R. and Jensen, C.D. 2009. Reengineering the Wikipedia for reputation. *Electronic Notes in Theoretical Computer Science*, 244: 81-94.
- Kramer, M., Gregorowicz, A. and Iyer, B. 2008. Wiki trust metrics based on phrasal analysis. *Proceedings of WikiSym 2008*.
- Luhmann, N. 1968. *Vertrauen: Ein Mechanismus der Reduktion sozialer Komplexität*. 4th edition. 2000. Stuttgart: Lucius & Lucius. English translation: N. Luhmann. 1979. *Trust and power*. Chichester: John Wiley.
- Luyt, B., Aaron, T.C.H., Thian, L.H and Hong, C.K. 2008. Improving Wikipedia's accuracy: Is edit age a solution? *Journal of the American Society for Information Science and Technology*, 59(2): 318-330.

- McGuinness, D.L., Zeng, H., da Silva, P.P., Ding, L., Narayanan, D. and Bhaowal, M. 2006. Investigations into trust for collaborative information repositories: A Wikipedia case study. *Proceedings of WWW 2006*.
- Möllering, G. 2005. *Trust: Reason, routine, reflexivity*. Amsterdam etc.: Elsevier.
- Moran, R. 2005. Getting told and being believed. *Philosophers' Imprint*, 5(5). Also published in *The epistemology of testimony*, J. Lackey and E. Sosa (eds.), 2006, pp. 272-306. Oxford: OUP.
- Riegelsberger, J., Sasse, M.A. and McCarthy, J.D. 2005. The mechanics of trust: A framework for research and design. *International Journal of Human-Computer Studies*, 62: 381-422.
- Sanger, L.M. 2009. The fate of expertise after Wikipedia. *Episteme*, 6(1): 52-73.
- Shapin S. 1994. *A social history of truth: Civility and science in seventeenth-century England*. Chicago and London: University of Chicago Press.
- Shneiderman, B. 2000. Designing trust into online experiences. *Communications of the ACM*, 43(12): 57-59.
- Simon, J. 2010. The entanglement of trust and knowledge on the Web. *Ethics and Information Technology*, 12(4): 343-355.
- Stvilia, B., Twidale, M.B., Smith, L.C. and Gasser, L. 2005. Assessing information quality of a community-based encyclopedia. *Proceedings of the ICIQ 2005*.
- Stvilia, B., Twidale, M.B., Smith, L.C. and Gasser, L. 2008. Information quality work organization in Wikipedia. *Journal of the American Society for Information Science and Technology*, 59(6): 983-1001.
- Suh, B., Chi, E.H., Kittur, A. and Pendleton, B.A. 2008. Lifting the veil: Improving accountability and social transparency in Wikipedia with WikiDashboard. *Proceedings of CHI 2008*.
- Tollefsen, D. 2007. Group testimony. *Social Epistemology*. 21(3): 299-311.
- Tollefsen, D.P. 2009. Wikipedia and the epistemology of testimony. *Episteme*, 6(1): 8-24.
- Tseng, S. and Fogg, B.J. 1999. Credibility and computing technology. *Communications of the ACM*, 42(5): 39-44.
- Van House, N.A. 2002. Digital libraries and practices of trust: Networked biodiversity information. *Social Epistemology*, 16(1): 99-114.
- Viegas, F.B., Wattenberg, M. and Dave, K. 2004. Studying cooperation and conflict between authors with *history flow* visualizations. *Proceedings of CHI 2004*.
- Viegas, F.B., Wattenberg, M. and McKeon, M.M. 2007. The hidden order of Wikipedia. *Proceedings of HCI 2007*.

References to the English Wikipedia in the text above have to be prefixed by <http://en.wikipedia.org/wiki/>.

All websites mentioned in this text were last accessed on May 14, 2011.

Table 1: Sample of six online encyclopedias that employ open source production methods: core data (in chronological order of foundation)

	H2g2	Wikipedia (English)	Scholarpedia	Encyclopedia of Earth	Citizendium	Knol
Year of foundation	2001	2001	2006	2006	2007	2008
Site	www.bbc.co.uk/dna/h2g2	En.wikipedia.org	www.scholarpedia.org	www.eoearth.org	www.citizendium.org	Knol.google.com
Focus	General	General	Natural sciences	The earth, its natural environment and society	General	General
Point of view	Neutral	Neutral	Neutral	Neutral	Neutral	Multiple points of view
Signing of articles	Signed	Unsigned	Signed	Signed	Unsigned	Signed
License terms (based on copyright)	All rights reserved by author	By-sa license	All rights reserved, CC-license, or GFDL	By-sa	By-sa	All rights reserved or CC-license (by license as default)
Use of wiki software	No	Yes	Yes	Yes	Yes	Yes
Number of articles*	246 000 total 10 000 'edited'	3 530 000 total 10 700 'good' 3 390 'featured'	1 700 'reserved' 697 'accepted'	7 680	15 500 'live' 1 050 'developed' 156 'approved'	Over 100 000 **
Number of reviewed articles***	10 ⁴	10 ⁶	10 ³	10 ³	10 ³	?

*Rounded off to 3 significant digits.

**End of 2008; no more recent figures available.

***Order of magnitude, estimated by means of the row immediately above.

CC: creative commons.

GFDL: GNU Free Documentation License.

Sources: most recent data obtained from the encyclopedias' websites (as of January 2011).

Table 2: Parameters of the open invitation for content for sampled open source encyclopedias (in order of increasing restrictions)

<i>Encyclopedic project</i>	<i>Open call for</i>	<i>Issued towards</i>	<i>On the following conditions</i>
Wikipedia	Comments ('edits')	Anyone	None
	Entries	Anyone	Registration as 'editor' (username, email)
H2g2	Comments and entries	Anyone	Registration as 'researcher' (username, email, birth date)
Knol	Comments	Anyone	Registration (username, email)
	Entries	Anyone	Registration (<i>real</i> name, email)
Citizendium	Comments and entries	Anyone	Registration as 'author' (<i>real</i> name, email, bio)
Scholarpedia*	Comments	Anyone	Registration (username, email)
Encyclopedia of Earth	Comments and entries	Experts in the field**	Registration (<i>real</i> name, email, CV)
<i>Open source software (reference)</i>	<i>Comments, bugs, source code</i>	<i>Anyone</i>	<i>Registration (username, email)</i>

*Entries are solicited exclusively by personal invitation of experts.

**As approved by their Stewardship Committee.

Sources: the encyclopedias' websites.

Table 3: Review procedures for sampled open source encyclopedias (in order of decreasing access and increasing moderation)

	<i>Format of review</i>	<i>Moderation by</i>	<i>Status distinctions to be obtained</i>
<i>Wikipedia</i>	Open-access wiki (continuous)		Good article Featured article
<i>Knol</i>	Choice between: 1. Open-access wiki (continuous)		
	2. Open-access wiki (continuous)*	Original author	
	3. Invited-access wiki (for author and invited co-authors only; continuous)		
<i>H2g2</i>	Open-access space for comments, no wiki (continuous)	'Scouts', 'sub-editors', h2g2-staff	Edited entry
<i>Citizendium</i>	Open-access wiki (continuous)	'Editor'	Approved article
<i>Scholarpedia</i>	Invited-access wiki (for invited author and invited reviewers only; temporary)		Accepted article
	<i>Upon acceptance of article:</i> Open-access wiki (continuous)	'Curator' (= original author)	
<i>Encyclopedia of Earth</i>	Restricted-access wiki (for experts only) (continuous)	'Topic editor'	Public version
<i>Open source software (reference)</i>	<i>Open-access project space (with tools like version control system, tracking tool, wiki) (continuous)</i>	'Project owner'	<i>Incorporation in the official code repository</i>

*Main mode used.

Sources: the encyclopedias' websites.

Table 4: Essential characteristics of the mode of production employed by open source encyclopedias (sampled) and open source software (reference), in order of decreasing degrees of freedom

Wikipedia	Unmoderated peer production in a commons
Citizendium	Moderated peer production in a commons
H2g2	Moderated peer production (not in a commons)
Open source software	Author-moderated peer production in a commons
Knol	Author-moderated peer production in a (voluntary) commons*
Scholarpedia	Moderated peer commenting in a (voluntary) commons
Encyclopedia of Earth	Moderated peer production among experts in a commons

*Main mode used.

Sources: based on data from tables 1-3.

Table 5: Epistemological views on testimony as implemented in editorial policies of sampled open source encyclopedias

	Acceptance principle	Assurance view	Background conditions (of editorial processing)	Expertise view
Wikipedia initially currently in future	•		• •	w
H2g2		•	•	
Knol		•	•	
Citizendium		•	•	w
Scholarpedia		•	•	s
Encyclopedia of Earth		•	•	s

W = weak implementation, S = strong implementation (see text).