4 Overall Conclusions and Outlook

This book started by asking what role the digital social culture triggered by Web 2.0 plays in the academic world at present and what the potentials are of the related platforms. Our main concern is what impact they and the socio-technical practices around them may have. As we stated from the outset, the Internet in general and Web 2.0 in particular are moving targets, and so are the potential roles and impacts they may play in academia. Despite this uncertainty we tried to give an encompassing overview of the present state of affairs in our case studies (section 2), and discussed some of the key impacts of the development in our analysis section (section 3). In this final chapter, we summarize our findings and go one step further by looking ahead. We proceed in two steps: In 4.1 we look at the status quo, asking whether we reached the age of cyberscience 2.0; after negating this, we consider in 4.2 what the future may possibly be like by assessing the influence of key intervening factors playing a role in this development. With section 4.3 we conclude this book with an outlook on and assessment of the likely further development.

4.1 Maturing Cyberscience

In 2011, the vast majority of the members of the scientific communities are indeed cyberscientists: their working lives are heavily influenced by the Internet, and it is hardly conceivable to do without Internet-based communication, such as e-mail, online databases and other resources, which are so easily accessible without even leaving one's desk. Many work flows are completely organized online: for instance, papers are submitted, reviewed and published electronically and they are usually retrieved through online search engines and databases. No doubt, cyberscience is reality. Our study

revealed that those new tools that are generally associated with the term Web 2.0 have already started to play a significant role in science and research: academics blog about their research, communicate via microblogging services, contribute to collaborative wiki resources, activate profiles in social network sites, and some even populate virtual worlds.

Web 2.0 is obviously a forceful trend outside academia with hundreds of millions participating more or less actively. There is no indication that the Internet in general would return to a non-participatory, not interactive, top-down kind of communication space. Could the academic world be different? On the one hand, there is evidence that an increasing number of academics, though still the minority, actively explore how Web 2.0 may help them in performing their tasks. Many academics report favorable experiences. On the other hand, we analyzed throughout this book whether the new tools are functional, whether they satisfy genuine needs of the highly differentiated and professionalized academic world. Our results show that not all of them do and many hindering factors remain. At the present state of development, the problem of multiple channels and information overload, or of lacking participation in evolving processes of bottom-up quality control, for instance, show that there is still need for further development and adaptation, both technically and regarding the social embedding of these technologies. It would be premature to say that the activity of science bloggers today heralds an age in which all researchers are virtually obliged to blog, just like they have to write academic articles in books and journals. Similarly, there is no intrinsic necessity of e-mail being gradually replaced by web-based communication within social network sites. However, we found a number of hints that those proficient in the Web 2.0 actually enjoy some advantages, for instance, when it comes to information gathering, networking, collaborating, self-marketing, and publishing.

Based on our analysis, fully-fledged cyberscience 2.0 would be a very different place from the present:

- It could be characterized by a new quality of transparency and exchange between the inner spheres of academia and its environment.
- Internally, it could be much more communicative with a constant exchange of small pieces of information, queries and statements.
- It could have a much more diversified system of communication and publication channels, from traditional ex-ante peer-reviewed journal articles, written by identifiable authors, to highly cooperative and dy-

namically evolving knowledge resources and new types of transdisciplinary publications.

- In this new environment, the researcher's identity and status might be defined to a lesser degree by traditional offline achievements, such as printed articles and papers given at conferences in person, but more by the totality of one's activities in the world-wide academic social networks, in particular the digital ones.
- The individual researcher would partially lose control over his or her incoming flow of information as the complex Web 2.0 mechanisms order and pre-structure the information and knowledge space in which one navigates. Attention-directing services, triggered by other users or by sophisticated computation on the basis of a user's previous activities, or sorting by search engines according to non-scientific relevance criteria, will have a considerable influence on research activities and even content. On a macro level, popular platforms put pressure on academia as their wide societal impact can hardly be ignored.

All of the above characteristics can, in part, be observed even today—and are indeed, for some actors, reasons for concern and even non-participation. Our conclusion at this point is that some researchers may already rightfully be called cyberscientists 2.0, but, on the whole, we do not live in the age of cyberscience 2.0, but are observers of mature cyberscience 1.0 with elements of "cyberscience 2.0 in the making" in an environment that is increasingly influenced by Web 2.0. So even if researchers do not actively decide to use them, social media and in particular the most popular platforms do affect academia.

4.2 The Cyberscience 2.0 Prospects

In such a dynamic and complex environment, it is certainly highly speculative to predict whether fully-fledged cyberscience 2.0 will ever become reality. Nonetheless, we shall try do find a tentative answer, applying our well-tried conceptual framework (as outlined in 1.3). The framework's core is a model of change in which three types of intervening factors play a crucial role: institutional (general, cultural, economic), actor-related, and functional/technical factors. In principle, all types of factors may serve both as drivers and impediments. We shall briefly discuss them in turn.

Cultural factors: From an institutional perspective, the overall trend towards Web 2.0 in modern societies is an important cultural factor. Even without direct links, such a forceful societal trend may certainly indirectly influence the developments in the academic world, as all of its members are also part of wider society; in addition academia is increasingly connected to its environment (cf. 3.2). It seems safe to say that the popularity of these interactive platforms is likely to trickle down. Already today we can observe parts of academia moving towards such popular platforms. Since they also provide a prominent space for communicating science, academia has a vital interest in being properly represented on these platforms.

Economic factors: Most of the general social media platforms are run by enterprises with strong commercial interests that are not necessarily compatible with those of the academics using them. While some of the science-specific Web 2.0 tools are of a non-commercial character so far, this may change in the long run. The big players may have the resources to enter the academic market—just as they did with regard to citation analysis or scientific journals, which are to a large extent under the control of a few profitable enterprises. An early example in this respect is Google Scholar. Furthermore, many of the now not-for-profit platforms may see the necessity to switch to income-generating activities at some point. Both developments may have a considerable influence on how these platforms are further developed, either taking or not taking account of academic concerns. Another economic factor that will play a role is the research field's closeness to economic application and its competitiveness (Nentwich 2003, 160ff.)—both characteristics act against the Web 2.0-typical transparent and open communication modes in the early stages of research. A more general conclusion in this respect would be that the concrete shape of cyberscience 2.0 will be specific for each discipline, perhaps for each specialty—as we have seen in the case of cyberscience 1.0.

Actor-related factors: As previously noted in the original cyberscience study, actors are crucial in any diffusion process. So far, most researchers are mainly passive observers. While there are only very few outspoken adversaries of the development, we observed some "cyber-entrepreneurs" who actively experiment with the tools, shape them, and involve others. Whether they will be successful in generating enough activity to attract a sufficient number of fellow researchers to reach the tipping point, is an open question, but a demographic development may work in their favor:

the younger generation of researchers grew up with the Internet and they are more likely than the older generation to take the Web 2.0 way of doing things for granted, including research-related communication. Other important actors are the academic institutions, such as universities, but also the learned societies. Their appraisal and whether they give incentives or disincentives for certain academic activities in the Web 2.0 may be crucial. While so far only a few have actually been active in this respect (such as supporting university-based SNS or issuing microblogging guidelines), this may change as the general impact of social media on society becomes ever more obvious.

Technical factors: Looking at the development from a technical perspective, we observe that many of the platforms are obviously sufficiently developed enough for very widespread use. However, we found some shortcomings of the general purpose platforms for academic purposes (such as archiving of messages; technical reliability and limitations of some tools; non-transparent functionalities). Also with regard to the academically oriented platforms we can find technical flaws (e.g. lacking integration of a writing environment in multi-purpose SNS; citation analysis in Google Scholar). In some cases the providers try to solve these technical difficulties. For example, Google Scholar will be increasingly adapted to academia's needs because its (economic) success depends on this main target group. But since academics play only a minor role in more generally oriented platforms, there is little incentive to accommodate this rather specific target group.

Functional factors: As we have seen, many of the tools seem indeed functional for academic purposes, e.g. for world-wide networking, long-distance collaboration, swift information gathering and so on, while others seem to be inimical to academic work, e.g. the proliferation of resources of unknown quality or the distraction from a researcher's core tasks. Probably, the concern of information overload may be the single most important issue when it comes to individual decisions whether to adopt the new bundle of tools. From a broader perspective, that is for academia or a discipline as a whole, the issue of quality seems paramount. The current system of hierarchical and organized quality control is, despite all shortcomings, well-established and widely accepted. So any competing systems, such as open peer review, still have to prove their worth. The inherent transparency-enhancing character of most tools seems to be useful for science as a whole—not least because it serves the interest of the funders of research in

society to obtain information and to be involved. By contrast, data and privacy protection is an important concern in some circumstances. We assume that this "mixed bag" will lead to differentiated usage practices, with some functions being adopted and others discarded in the long run.

So where do we go from here? What will the future development look like, considering those factors? What has been said of the "mixed bag" in the previous paragraph may be the core of our overall answer: It is most likely that today's cyberscientists will pick and choose specific platforms for specific purposes. The ideal "fully-fledged" version of cyberscience 2.0 will probably never become reality. Instead, the likely "real" version of it will consist of a combination of novel Web 2.0 elements alongside the well-known Internet tools cyberscientists use today on a daily basis. Since Web 2.0 applications mainly depend on the interactivity of their users, the usefulness of cyberscience 2.0 and its success will vary drastically from person to person, platform to platform and somewhat from discipline to discipline. The multiple communicative possibilities from SNS could potentially replace many channels from cyberscience 1.0. But due to the remaining problems and fragmented usage, this is unlikely to happen in the near future. Some researchers will keep using these channels for specific purposes, mostly public relations and self-marketing—the most common form of usage we observed. Microblogging fulfills similar functions and might increasingly be combined with SNS, as it is done already in a number of cases.

Whether cyberscience 2.0 will prevail also depends on political decisions within academic institutions. So far, most engagement in cyberscience 2.0 occurs bottom-up. As mentioned above, providing incentives may drastically increase interactivity on the platforms and hence directly influence their success. In addition, academic institutions may not only act as passive technology users, but also as active contractors and initiators promoting the design of "tailor made" platforms for specific needs, thereby possibly addressing a number of the current problems. Either way, there is still a lot to learn in this early transformation process. Therefore we shall see many promising experiments fail. Second Life appears to be one of them, despite the early enthusiasm it received. In contrast, not even its founders believed in the later success of Wikipedia, which exceeded all expectations. Therefore, the future developments have to be studied very carefully, avoiding unfounded optimism as well as fear mongering.

4.3 An Ambivalent Overall Assessment

In summary, our analysis of potential impacts of Web 2.0 on science and research is ambivalent. On the one hand, some of the platforms and services have become an integral part of the academic workaday life. This is especially true for the search engines of Google, but Wikipedia is also intimately connected with academia. Even scientists who do not use these services cannot deny their relevance for students and the wider public. These platforms operate, however, on the basis of a functional logic that is usually distinct from scientific logic, for instance regarding indicators for relevance or reputation—whereas academia has no direct influence on these mechanisms. Consequently, impact on the science system is beginning to show, for instance when novel publication forms, such as blogs, are cited in academic papers, or when academic journals ask their authors to contribute to Wikipedia. On the other hand, many of these platforms still fall short of their potentials, whether welcome or not: for instance, social network sites or virtual worlds are today apparently used rather experimentally within academia. All things considered, we may be only at the beginning of a broad and lengthy transformation process, which may result in a novel institutionalized form at some point.

We do not doubt that the current evolution of cyberscience 2.0 will lead to increasing professionalization in dealing with the new media. This will mean two things: first, academic institutions, including universities, will discover these platforms for their own purposes, for public relations as well as for internal communication with staff and students. There are already examples: universities started blogging to reach a wider public, institutional SNS emerged, etc. In the long run, this will drive us away from the present experimental and exploratory environment towards standardization and suitability for daily use.

Second, some kind of Web 2.0 literacy is likely to emerge. The authors of this volume do neither believe in the dystopian scenario of shallow minds caused by intensive consumption and use of Web 2.0 tools, nor in the optimistic scenario that all will turn out for the best. We rather reach the conclusion that scientists will be confronted with a new environment, which challenges some of our traditional ways of doing research. In order to cope with these challenges and to profit most from the digital social networks, a novel kind of literacy is mandatory and has to be built up individually. To give a few examples of topics to be included in this learning

process: how to update and select one's peer group (whom to follow); how to avoid becoming distracted by the steady flow of Web 2.0 messages; how to use search engines most efficiently without getting trapped in unwanted artifacts; how to interact with the public the "Web 2.0 way"; etc. While most of these activities have to be performed on an individual level, it rests with the academic institutions to provide an auxiliary framework. This may mean offering advanced training courses as well as elaborating guidelines.

Whether or not one comes to the conclusion that cyberscience 2.0 is a desirable or even likely future, each researcher and each academic institution has to deal with this ongoing development towards increased use of ICT and Web 2.0 in particular. While passively ignoring it is a theoretical option, it seems advisable to address the issue actively as we are confronted with it every day. So far, only a number of individual "cyberentrepreneurs" and trail-blazing institutions actively shape the emerging cyberscience 2.0 landscape, while the majority is only observing or even ignoring. We assume that taking part in the design phase, both in technical and organizational terms, is worthwhile given the potential advantages of interactive and networked digital formats for external and internal scientific communication and collaboration. Following this line of thinking, some academic organizations may come to the conclusion that actively promoting certain forms of doing research in a Web 2.0 mode would help to avoid inconsistencies with the present system and induce desirable impacts. And on the individual level, we see no reason to fear the emerging cyberscience 2.0 environment.