Improving the peer review process with information technology

Munir Mandviwalla [a], Ravi Patnayakuni [b], David Schuff [a,*]

[a] *Temple University, United States*
[b] *University of Alabama, United States*

ARTICLE INFO

ABSTRACT

Peer review is the engine of scholarship where new knowledge is legitimized. Despite technological advances in publishing and communication, the process of review has not changed since it became prevalent over 100 years ago. This paper describes how information technology can be used to improve the peer review process. Taking a combined design science and natural science approach, we design and test a prototype system based on the principles of structured communication. Through an exploratory study, we find that our proposed system is viewed more favorably by both authors and reviewers across several dimensions, including fairness, convenience, and value.

© 2008 Elsevier B.V. All rights reserved.

1. Introduction

Information technology has fundamentally changed the production and dissemination of new knowledge. For example, in academia knowledge producers (authors) create manuscripts on sophisticated word processing software, share drafts and discuss ideas using a variety of communication tools, and produce print-ready journal copy using desktop publishing software. Teams of scientists can share and work on complex projects in ways that were simply not possible a few years ago, while authors of textbooks are now experimenting with electronic delivery mechanisms that will radically change the distribution model of the publishing industry.

Despite these technological advances, the process for evaluating the content of publications remains largely unchanged. The focus of this paper is peer review, the process by which new knowledge is legitimized by its acceptance and dissemination to the wider community. Peer review is often described as an instance of decision making (e.g., [33]), and as an example of knowledge production and dissemination. Peer review is also time consuming and expensive. Editors believe that the largest "cost" of producing a journal is reviewing and editing [22]. Weber [34] estimated a reviewing "opportunity cost" of $24,500 for each published paper in *Management Information Systems Quarterly.*

IT has already impacted the peer review process, most notably in the use of web-based document management tools that can manage the process of submission, review, and arriving at an editorial decision. Yet the peer review process itself is essentially the same as it was since it became prevalent over 100 years ago [28]. Most information technologies simply automate the review process (e.g., [9]). The current peer review process of (often) slow back and forth deliberation among authors, reviewers, and editors continues the legacy of an earlier era defined by infrequent, high-cost communication. Watson [32] argues that though the Internet has improved some aspects of publishing, most of the changes are simple and focus on the tasks of publication ("alpha level"), there has been little to no change to people's roles ("beta change") or a restructuring of the underlying system ("gamma change").

There is, however, a fundamental dilemma in researching how to use IT to improve the peer review process. There is no current literature that fully elaborates the potential problems. Further, there are no comprehensive behavioral models that

---

* Corresponding author.
E-mail address: David.Schuff@temple.edu (D. Schuff).

can explain the impact of proposed IT enabled improvements. Therefore, we propose that both a design science and natural (behavioral) science research approach is necessary to build new utility into the peer review process and understand the impact of such proposed changes [15,20,31]. Cao et al. [5], who build on Hevner et al. [15], March and Smith [20], and Nunamaker et al.'s [24] design science approaches, suggest that a multi-methodological, cross-paradigm research approach that combines design and behavioral science will yield more powerful and insightful results. Research on the peer review process is at an early stage and very little aggregate knowledge has been accumulated, a combined approach will therefore improve the chances that important behaviors are identified early and only the most useful technical artifacts are built. As Hevner et al. [15] argue, truth and utility are inseparable and "an artifact may have utility because of some as yet undiscovered truth. A theory may yet to be developed to the point where its truth can be incorporated into design" (p. 80).

The remainder of this paper is structured using a combined design and natural science approach. First, we provide perspectives on peer review that illustrate the importance of the problem and our approach. Second, we apply the design science perspective to create a process based model to analyze the traditional peer review process and to serve as a baseline for changing the process. We propose a new process based on structured communication and implemented using a prototype system. Third, and in parallel, we apply the natural science perspective to develop a set of behavioral propositions to evaluate changes to the peer review process. The two perspectives of design and natural science come together in an exploratory study to evaluate the impact of the prototype system. In the final sections, the results of the study are discussed.

2. The role and challenges of peer review

Improving the peer review process is particularly important for academic publishing. Worldwide growth in the number of higher education institutions has led to an increase in the number of faculty. There is increased pressure on journals because of the increased volume of material requiring review. Word processing has reduced the time cost of resubmitting manuscripts to different outlets. The result is that there is an increasing burden on the traditional volunteer model of peer review accompanied by increasing dissatisfaction with the process. Readers of peer-reviewed research often complain about lack of quality, sterility of material, and irrelevance [10], and observers believe that the traditional peer review process is currently too slow, and lacking in quality, impartiality, validity, and reliability [2,33]. According to Frost and Taylor [10], there are now questions about whether the centralized control structure of peer review and the publication process has led to a lack of innovation in the conventional outlets for academic scholarship. Journals often become equipped to handle the routine rather than recognize innovation and diversity [23]. More generally, at the policy level there have been questions about the application of peer review in science. For example, McCarty [21] outlines the experience of *The American Psychologist* in which a controversial article was accepted

and then later rejected. The controversy was prominently played out on Internet newsgroups; the editor attributed some of the mistakes to the delays inherently built into a system based on postal mail.

As a reaction to these and other problems, some have questioned the very concept of peer review. Horrobin [16] suggests that the peer review concept is fatally flawed because the people who serve as reviewers are never truly peers in terms of ability and that the process may inhibit truly innovative thinking. Bedeian [2] reports that Nobel laureate Rosalyn Yalow in her acceptance speech noted that "the truly imaginative are not being judged by their peers. They have none!" [35].

Others have suggested that although peer review is viable, various improvements to the process should be considered. For example, Apt [1] proposes a model in which computer science can start new, free, high quality journals that are universally accessible to all on the web and which serve to increase the number of outlets available. Others have suggested an entrepreneurial approach that advocates radical changes to knowledge production with ideas such as self-publishing ("sky writing") on the web and peer commentary, where comments are added to the published article after it has been peer reviewed [14]. Weblogs are the technical realization of this vision though they remain outside the realm of academic knowledge production. Bedeian [2] proposes a number of socially-motivated improvements to the peer review process including allowing authors to submit a note to reviewers with their submission, publishing referee comments, identifying the referees in the publication, rating review reports, and instituting an appeals process. Brown [4] proposes improvements to the process of peer review by advocating the double-blind evaluation process.

In information systems there have been several efforts to improve peer review. Saunders [27] focuses on how reviewers and editors can practice "developmental reviewing" — the idea of providing the author with very detailed and constructive suggestions for revising the manuscript. Lee [19] outlines how information technology can be used to disseminate research and speed the review process. Weber [33] characterizes peer review as an instance of decision making and proposes improvements that include removing anonymity, and using the web to disseminate both papers under review and rejected papers along with their associated reviews. Watson [32] proposes certification and formal training for reviewers as well as restructuring the relationship between authors, reviewers, and editors into a "marketplace" where editors bid for articles based on reviews by accredited referees and authors evaluate review reports.

Peer review is also being increasingly applied outside academic publishing. Grant makers, accounting audits, policy review, software development, and standards review (e.g., IEEE) all apply peer review. Patton and Olin [25] provide a framework for applying peer review to improve regulatory decisions in response to recent controversies in the United States Congress about conflicts of interest. Accounting firms use peer review to evaluate other firms and accountants and there is discussion of how to improve the peer review process to make the results more public (e.g., [29]). Increasingly on the web, user-submitted reviews are used to augment information provided by the manufacturer or retailer (e.g.,