Towards an Open/Web 2.0 Scientific Publishing Industry? Preliminary Findings and Open Issues*

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Abstract. The collaborative and open way of generating, organizing, and managing knowledge has been growingly seen as an essential activity to foster innovation, economic growth and social development. Interestingly enough, while this model is being applied in several social as well as business sectors, the scientific publishing industry – which is devoted to the production, evaluation and diffusion of scientific knowledge – does not seem to have been much affected by this collaborative revolution. The goal of this paper is that of exploring the current configuration of the scientific publishing industry in order to understand whether and to what extent innovative technologies and open paradigms might change its current configuration. We outline (a) the certification abilities of publishers and (b) the need for reputation of authors as two "soft" drivers of the market that need to be taken into consideration if we want to estimate the impact of the collaborative revolution within the scientific community and, ultimately, in the innovative practices and business models of the scientific publishing industry.

Keywords: scientific publishing industry; open science; Web 2.0, open source systems.

1. Introduction

Since the affirmation of the paradigm of the knowledge-based economy (Drucker, 1993), according to which knowledge is considered a key asset for market competition, scholars and practitioners have more and more focused their attention on knowledge sharing as an essential activity for fostering innovation, economic growth and social development. This is, for instance, well represented by the Lisbon strategy that aims at making the EU "the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010" (European Commission, 2007).

The collaborative and open way of generating, organizing, and managing knowledge has been growingly used in several applied fields. From a pure technical point of view, this was made possible thanks to the rapid evolution of various innovative Information and Communication Technologies (such as, for instance, grid computing, peer to peer file sharing, collaborative authorship of digital content, and so on). Not by chance, the computer science field was the first to be affected by this collaborative revolution: free/open source software initiatives are a well known example of this. Nowadays the WWW represent the most common platform through which people interact and collaborate in order to create, share and disseminate generalist knowledge (e.g., Wikipedia, the online encyclopaedia), co-design and co-produce services and products (e.g., Threadless.com, an online t-shirt merchant *crowdsourcing* its apparel design), connect with other persons, etc.

A related and pervasive phenomenon is represented by the so called "Web 2.0". It considers the web as a social platform (McAfee, 2006), adding a new layer of information interactivity based on tagging, social networks, user-created taxonomies. On the basis of this idea, many distributed tools and applications were born aimed at supporting the collective production, sharing and maintenance of various streams of knowledge such as text, photos, and videos. Some relevant, albeit non-exhaustive, examples in this respect are represented by the blogging platform Wordpress, the social media site Digg, the image hosting site Flickr, the social bookmarking site Delicious, the video sharing platform YouTube, the business-oriented social networking site LinkedIn, the social shopping site Yelp, the Machinima portal, which aggregates user generated movies filmed with *machinima techniques*, etc. These initiatives

share as a common trait the focus on empowering end-users by (i) co-opting them in endeavours which traditionally has been considered as top-down activities (such as, for instance, content production or content categorization) and (ii) by exploiting user-based network externalities (such as, for instance, content sharing and interaction with a large base of peers, and taking advantage of social connections among end-users) (von Hippel, 2002; Smith, 2007).

Overall, there is a growing empirical evidence which seems to support the idea that the "open and collaborative" trend, rather than being a simple Internet fad, represent a major shift of the business setting which calls for closer investigations (see, for instance, the recent Economist Intelligence Unit report on business models for the Web 2.0 – The Economist, 2007 – or the Business Week Special Report on micro-blogging – King, 2008). Interestingly enough, while scholars argue that the open model of producing and sharing knowledge shows several positive aspects, the scientific publishing field – the field which is devoted to the production, evaluation and diffusion of scientific knowledge – does not seem to have been commonly affected by the Web 2.0 collaborative revolution. Indeed, a closer observation of academic and research scholars' current practices shows that, the use of collaborative tools to produce and share scientific knowledge objects is still a marginal phenomenon, since nowadays the Web is still used mostly as a tool to advertising pre-existing academic publications and related activities, circulate professional curriculums, call for papers and job openings, and assessing to databases, science repositories and similar other activities typical of the Web 1.0 paradigm (Casati, Giunchiglia, Marchese, 2007).

Similar considerations hold at the scientific publishing industry level. While the field has been undoubtedly affected by the Internet revolution, its basic characteristics do not have significantly changed over time: the relationship between its more representative actors (scientific publishers, researchers, end-users both in terms of individuals and of institutions) did not change in a radical way. As a matter of fact, the industry is currently undergoing a great deal of debate: among others, several national and international institutions such as the EU (ECDGR, 2006), OECD (Houghton, 2005), and the English House of Commons (House of Commons, 2004), as well as well known funding bodies (Wellcome Trust, 2003) and journals (Enserink, 2007; Milmo, 2006; The Economist, 2008) have began a close scrutiny of the issues that affect the scientific publishing. For sake of simplicity, the major issues at stake can be divided into economic, social and licensing ones (Ware, 2006; Morgan Stanley, 2002).

From an economic point of view, there is a perceptible market discontent, due to the double-digit price increases of journals. This brought to a fall of subscriptions as libraries (the major customers of journals) have budgetary limitations which cannot easily be overcome. Second, the rate of new journals' launch has decreased as the industry has matured, with fewer journals being started. From a technological point of view, the disintermediation by authors, editors and libraries has become a threat to publishers, as technological tools allowing independent online publishing have improved. Furthermore, current publishes have significantly invested over the last 5-10 years in the transition to digital world. They thus possess very large digitalized knowledge repositories. Finally, from a licensing point of view, many question the publishing paradigm in which commercial publishers make money from government-funded research by restricting access to the research.

Most of the aforementioned reports believe that a more open paradigm of scientific publishing might improve the current state of the issues summarized above. On the basis of these considerations, the goal of this paper is to explore the current configuration of the scientific publishing industry in order to understand whether and to what extent innovative technologies and open paradigms might change the way in which authors (the supply side of the industry), publishers (the intermediaries of knowledge evaluation and dissemination) and users (the demand side of the industry) interact. We look on the current production, evaluation and dissemination processes of "scientific knowledge" by focusing at its supply and demand sides as well as the intermediaries of the industry. Our analysis, which makes use both of second hand data (on the scientific publishing industry) and first hand data (10 semi-structured interviews, made in Fall 2008, with managers from one of the first five multinational publishing firms) shows that authors (the supply side), users (the demand side) and scientific publishers (the intermediaries) bear some interesting peculiarities which are to be taken carefully into account if we want to shed light on the perils and opportunities of the Open/Web 2.0 paradigm applied to the scientific publishing industry.

On the basis of this analysis, we show that the main market drivers appear to be (a) the certification of the quality of knowledge which is granted by editors and requested by users and (b) the recognition (reputation) of who has written a particular piece of "good" knowledge which is closely related to the achievement of a good reputation in the scientific community and career advancements. We claim that we have to take closely into consideration these two drivers if we want to estimate the impact of the collaborative

revolution within the scientific community and, ultimately, in the innovative practices and business models of the scientific publishing sector.

The remaining part of the paper is organized as follows. The second section reviews the scientific publishing market and its main peculiarities. The third section proposes a historical view of the market and outlines its main drivers. The fourth section, aims proposing some preliminary thoughts on the reasons why the Open/Web 2.0 paradigm is hardly shaping the industry. The fifth section concludes the paper with suggestions for future work.

2. Some basic facts about the scientific publishing industry

The science, technology and medicine (from now on: STM) publishing industry is a small part of the scientific publishing sector. As the name says, the term STM identifies the part of scientific knowledge which is concerned with science, technology and medicine while does not include humanities, arts and social sciences. The scientific publishing sector itself is included in the whole publishing and printing industry. Other sub-sectors are represented by the motion picture, the sound recording, and the printing sub-industries. A recent OECD report (Houghton, 2005) states that while the European publishing and printing industry accounted for EUR 234 billion in 2000, the printing sub-sector accounted for EUR 121 billion. The core STM publishing market is estimated between USD 7 and 11 billion, which corresponds to a less than 10 per cent of the scientific publishing industry. The STM market employs between 110.000 to 120.000 people around the world either directly or indirectly (STM, 2008). In the sole EU, the number of employees reaches 36.000 individuals.

North America and Europe with 58 and 26 respectively are the bigger markets of scientific publishing. Nonetheless, it is to be noted that several Asian countries show double-digits increases per year.

2.1 The main actors

As any kind of market, scientific publishing is made of a product, demand and supply sides, and by a set of intermediaries that allow supply and demand to meet. In the specific case of scientific publishing, the product is the output of scientific research (scientific knowledge) while suppliers are researchers acting both as authors and reviewers. Authors supply intermediaries with their research work while reviewers, by judging the goodness of a

research work through a process called peer-review, offer a service to the intermediaries.

The demand side is instead made of libraries, single researchers, private customers such as research-oriented firms and the government. Currently the largest customers of the market are academic/medical institutions with 60 per cent share followed by corporate customers (25 per cent) and government (5 per cent) (House of Commons, 2004). Individuals do not appear in these figures (individual purchases are negligible) as usually they use the services provided by libraries for free; individuals are thus not customers in the strict sense of the scientific publishing industry.

Finally, publishers work as intermediaries between supply and demand. Their main task is to disseminate certified good knowledge. Most of the publishers fall in one of the following two categories. The first category includes commercial/for profit firms while the second includes not for profit organizations. While the market is populated by a myriad of small size publishers, it is dominated by no more than a dozens of multinational for profit corporations. The first five commercial publishers (Reed-Elsevier, Springer, Thomson, Wolters Kluwer, and John Wiley) account for more than 50 per cent of the whole market (Madras, 2008) while the whole set of commercial firms account for about 64 per cent of market share. Not for profit publishers may be divided in two different sub-categories: learned society's publishers and institutional publishers. Learned societies are prominent networks of scholars and professionals with a common interest in a particular area. Their primary goal is the dissemination of research findings related to their field. Thus societies usually manage journals which are focused on their specific field. The major learned society, the American Chemical Society (ACS) accounts for less than 4 per cent of market share while learned society's publishers account of 30 per cent market share. Institutional publishers are publishers associated with a University or a Research Institution. To mention but a few examples, the main representatives are Oxford University Press and Cambridge University Press. Institutional publishers account for about 4 per cent of the market share.

2.2 Peculiarities of the market

Due to several reasons scientific publishing is quite particular as an industry. This peculiarity might be found in every aspects of the industry, in particular, the type of product sold, the relationships between actors and the characteristics of each actor. We will analyze these

aspects in dept.

Knowledge as a public good. Scientific knowledge as a product is said to be a public good (Wellcome Trust, 2003). In economic terms, a public good is "something" that the public values as positive but the market is not able to allocate: in other words, there is no clear identifiable customer who pays for the product (Stiglitz, 1999). Indeed, once the results of a particular research are made public these results might be beneficial to everyone while no one is legally obliged to pay for it. The debate is particularly strong nowadays in the case of dissemination of publicly funded science.

The decoupled nature of the market. Looking at its configuration, the market might be characterized as having two interlinked parts: an academic market and a commercial market. The academic market is made of researchers (authors, readers) and universities or research institutes. This side is concerned with doing research in current relevant topics and producing/reading good scientific knowledge as well as hiring good researchers. The commercial side is more concerned with gathering good knowledge from the supply side, packing it and providing this product to the demand side (Figure 1). As we will deeply explore in the following sections, this side of the whole market is the one managing certification and dissemination of good knowledge. The academic market is thus shaped by it.

Authors and reviewers do not get paid. While in a "normal" market the supply side gets paid for its product/services, in the publishing industry authors (the supply side) do not usually get paid from providing publishers (the intermediaries) with their products (papers). Reviewers which are often researchers, provide publishers with a "knowledge evaluation and certification" service by means of a process called "peer-reviewing". They also do not get any economic income for it. This is due to the fact that the supply side is made of researchers that gain from their ability to publish their works and providing their peer-reviewing services in well recognized journals. Indeed researchers' career depends on the reputation and visibility they can build over time and through their work. Reputation is thus the main driver of their behaviours and is currently evaluated by means of impact factor and similar metrics. Figure 2, based on information coming from interviews, shows the relationship between goodness of knowledge, reputation of authors and certifying status of a fictional scientific publisher compared to a generalist open encyclopaedia. Publishers want "squared" people to publish on their journals. Should the publisher publish work of "circle" or "rhomboid" people, the

content quality of its journals would decrease. Thus the role of scientific reviewers is essential to publishers. Interestingly enough, this relationship is not regulated by monetary means; rather it is driven by "soft" factors which are barely recognized by the commercial side of the market.

Readers are not the main customers. There are some tricky characteristics on the demand side as well. Indeed usually publishers sell the product (journals and monographs) to libraries which are not the customers that eventually read and use the product. Nonetheless, libraries need to buy products that have high quality and are requested by single users. These latter are mostly insensible to prices and want to have good and updated knowledge. On the other hand, libraries have a limited amount of budget to spend. Libraries and single readers have thus inconsistent needs and goals. In economic terms, the demand side is said to be inelastic to prices as both libraries and single users are not much sensible to price changes. However the reasons for this inelasticity are quite opposite.

The market is an oligopoly as well as an oligopsony. As previously presented, publishers are certifiers and disseminators of good knowledge. This role, tied with the decoupled nature of the market, has made it possible that the market is at the same time an oligopoly as well as an oligopsony. Indeed, over the last decades, current multinational publishers have gained huge reputation as good certifiers of knowledge. This is often showed by the impact factor and similar metrics: publishers are not easily substitutable. Authors are thus very well interested (and are forced too by the academic market dynamics) to publish with them. In economic terms, there are a wide numbers of suppliers (authors) with a few numbers of customers (publishers). At the same time, the market is characterized by huge entry fixed costs (this is particularly true before the birth of Internet). Thus the process of disseminating the product "good knowledge" (acquisition, selection, editing, presentation and selling) has been subject to high economies of scale. Over time this peculiarity limited the entrance of new publishers and brought the market itself to a sort of oligopoly: in economic terms this means that the concentration of power is pun in a small number of suppliers (publishers) in the presences of a wide number of customers. Also, from the 90s' on the industry was subject to repeated series of mergers and acquisitions.

As we have seen the scientific publishing is quite a particular market. It is common thought that this industry is controlled and managed by few commercial publishers. This is

due to several reasons. They do not have a specific research field to foster such as learned societies. As such, commercial publishers get in touch with a wide number of authors and research fields, developing as much as journals as research disciplines there are. Learned society's publishers instead work on specific research topics, they are usually reluctant to endeavour in new research fields if this does not explicitly come from a scientific community request. Publishers do also maintain "soft" relationships with authors and reviewers, none of which materially gain from this. This relationship is essential to the reputation of both publishers and researchers. As one of the interviewed people said, "This relationship is the very investment of the firm".

The next section focus on the main tasks of scientific publishers (certification and dissemination) to show whether and to what extent the Internet revolution has affected their current working practices.

3. Scientific Publishing before and after the advent of the Internet

Scientific journals represent the main channel through which scientific knowledge has been diffused over time. As previously said, starting from the 90s' the market began to be radically affected by the Internet revolution. The industrial and commercial utilization of the Internet resulted for the industry as a means to fasten the dissemination of scientific research and reducing publication costs. We will use the conventional date of 1995 as the cornerstone to look at the extent of the changes experienced by the scientific publishing market.

3.1 Before the Internet: Publishers as "vendors of hardcopies"

Before the wide commercial adoption of the Internet, paper-based scientific journals represented an essential channel for the diffusion of scientific knowledge and their importance had grown over time for the research community, in academia and beyond. This is wide in this phase publishers might be categorized as "vendors of hardcopies". Let us distinguish in the analysis between two major activities performed by scientific publishers.

Certification of knowledge. As previously said, publishers are in charge of the content quality certification of work submitted my scientists. The reputation of a publisher in

this evaluation/certification phase represents a major driver in generating revenues (Figure 2). Indeed, reputation of publishers is based on the ability to discriminate good from bad knowledge. This content quality check process is often made thanks to scientific editors that work on behalf of publishers. This job is usually made for no economic advantage as scientific editors are often other (usually well known) researchers that are in charge of evaluating papers and books. The revenue might be found in the visibility that "collaborating with a well known publisher" might give in the academic market. While publishers do not strictly gain anything from this phase, indeed this is a very costly activity, this stage is crucial for the revenues which are generated in the later phases (Figure 3).

Dissemination of knowledge. In the pre-Internet era, the mostly used way to disseminate knowledge is by means of hard-copies of books and journals which are sent by publishers to libraries. The dominating business model is the "reader-pay" model: here by reader we refer to libraries that actually pay for the subscriptions of journals. Indeed single readers (researchers and other individuals) do not pay anything. More properly, this model has been also labelled as "library-pay". The price of journals is usually based on a "subscription to single journal" principle: the more the journal has a huge reputation, the more it costs. This phase is the one where publishers get revenues from subscription to journals and books sales (Figure 3).

3.2 After the Internet: Publishers as "renters of access"

Since the commercial use of the Internet, the importance of scientific journals has further increased. Indeed, readers can instantly access to journals while publishers can offer a set of new services: citation data, cross-references, etc. in this phase publishers might be characterized as "renters of access" as in the last years the digital remote access to journals rapidly overtook the usage of hardcopies**.**

Certification of knowledge. The certification process has not been really influenced by the Internet revolution if not for the fact that digitalization of the content allows for a faster and more consistent evaluation process.

Dissemination of knowledge. The business model remains the "reader-pay" but the opportunity to access to journals from remote pushes publishers to offer bundles of journals to libraries: this method is called the Big Deal. As libraries have usually a limited budget per

year to buy monograph and journals, the current strategy of publishers is that of acquiring the most part the possible of this budget. This strategy implies that the budged of libraries is often spanned among a small number of multinational scientific publishers. Libraries have sought to gain more market power by establishing consortia. Nonetheless, market power is fairly unbalanced: the largest library consortium accounts for 2-3 per cent of global journal purchases, while the larger publisher (Reed-Elsevier) accounts for more than 28 per cent.

In recent times, several scholars and institutions have started to blame the current configuration of the publishing industry that permits commercial publishers to make money from government-funded research by restricting access to the research. This group of research institutes, libraries and charities which refer to the Budapest Open Access Initiative (http://www.soros.org/openaccess/), state that public funded research should be freely available i.e. open to all. This philosophy has been declined in two main routes: the gold and the green routes to Open Access. The first implies the author or author's institution pay a fee to the publisher to publish a peer-reviewed research, the publisher thereafter making the material available "free" to all. No subscription to journals is necessary to read an Open Access" certified journal or paper. It is to be noted that the impacts of Open Access on the economic sustainability of publishers and on the scientific knowledge are still being explored (VV.AA., 2006). As a matter of fact, while several not-for profit publishers as well as commercial publishers have adopted it (10 per cent of the whole journals market), the number of authors who voluntarily choose to pay is still very small. The "green" route to open access states that authors should be free to self-archive on public open archives their articles whether they are grey literature (usually internal non-peer-reviewed), peer-reviewed journal publications, peer-reviewed conference proceedings papers or monographs. This approach has been put under discussion by the International Association of STM Publishers for its unclear economic, legal and scientific follow-ups (STM, 2008).

Table 1 summarizes the key aspects of the scientific publishing industry before and after the internet era.

4. Open/Web 2.0 models and scientific publishing

Albeit mostly still in their infancy and very limited in terms of diffusion there are a growing number of instances of social Web applications and portals which have been developed with

the specific target of scientific communities as the primary user base. Some of them are applications that allow on-line collaborative creation of diagrams, flow chart and mind mapping (such as, for instance, Thinkature[1], Mindomo[2] and Mindmeister[3]), others are collaborative suites offering a good integration between various individual and group productivity applications handling spreadsheet, text documents, notebooks, slides, and so on (e.g., Zoho[4]). Other solutions offer services for reference sharing and the social evaluation of academic articles (see for instance CiteYouLike[5] and LibraryThing[6]) and even online systems for the attribution of reputation credits to reviewer and contributors (see as examples IntenseDebate[7], CoComment[8], and SezWho[9]). Finally, there are examples the collective analysis of data or dataset sharing and basic manipulation by the research community (see, for instance, Dataverse[10], and Swivel[11]).

While some of these examples both seems to draw interest from scientists and to show some convincing directions of development for the collaborative practices of some scientific communities,overall the STM publishing industry seems to be still far from catching up with the rush for collaborative user driven solutions. In this section we aim at summarizing some collected evidence on the current state of the scientific publishing industry to propose some thoughts on the reasons why the Open/Web 2.0 paradigm is still hardly influencing the industry trends.

From the analysis of the current market configuration and its recent evolution dynamics, we shall say what follows. The market might be roughly approximated in two detached relationships: (1) authors vs. publishers and (2) publishers vs. libraries. These three main actors show different and contrasting interests. The relationship between authors and publishers is used both by researchers and commercial publishers to gain reputation as good authors and good publishers respectively (Figure 2).

On the other hand, libraries want to buy good and certified knowledge. Their relationship with publishers is driven by a need of "uncertainty avoidance" meaning that as libraries need to meet the preferences of individual readers (that want certified knowledge and are not price sensible), the formers rely on well known publishers to buy such certified knowledge. Thus we claim that the main market drivers appear to be:

- The certification of the quality of knowledge which is granted by publishers and requested by researchers;

- The recognition (reputation) of who has written a particular piece of "good" knowledge which is closely related to the achievement of a good reputation in the scientific community and career advancement.

These two drivers do not appear to have been fully explored in current Open/Web 2.0 studies. First, by its very nature the certification process of a certain piece of work within the Web 2.0 is left to the auto-adjustment of the market (Giles, 2005). While this approach might work well in an open environment, this has not been fully analyzed in a regulated environment such as the academic market. Furthermore, reputation of users has been often treated as a technological within the Web 2.0. Indeed it allows the social connections among end-users and allows people to share personal points of view and take advantage of other perspectives. This approach is nonetheless still insufficient to manage the role of reputation in the academic market as it embeds very important social and legal effects.

We state that if we want the collaborative revolution to work within the scientific community and in the whole industry we are urged to take into consideration the aforementioned peculiarities of the market, the incompatible drivers of each actors, and the decoupled nature of the industry. To cite but a few examples, we state that new and clear new mechanisms for ranking journals and authors should be adopted by the researcher community. These new mechanisms should take into account very traditional reputation processes and some more technology based ones such as trust and reputation models used by e-auction systems (as in the cases of eBay or of Amazon auction platform), or agent based reputation systems, page/paper ranks, and similar technologies. (Sabater and Sierra, 2002).

5. Conclusions and future work

This paper sought to explore the current configuration of the scientific publishing industry in order to understand whether and to what extent innovative technologies and open paradigms might soon change its current competitive layout. By recognizing the peculiarities of the scientific publishing industry and the crucial role in it of some very important "soft" drivers (certification and reputation), we argued that any Open/Web2.0 approach to scientific publishing needs to take these drivers into consideration as important aspects of the collaborative aspect. Otherwise a collaborative approach could hardly be applied. Thus a lot of effort should be invest, from a technically point of view, to integrate various Open/Web 2.0

applications in one common platform which can be used as a boundary object by the actors of this field, and to define innovative certification and reputation methods (see, for instance, the achievements in the field of digital libraries (Resnick, *et al.*, 2000; Rana and Hinze, 2004)). From a more economic/social point of view, scientific communities should refine their reputation systems overcoming the traditional one based on the journal ranking index, and should take into consideration also online knowledge objects (such as blogs, wiki, digital libraries, etc.). Finally, publisher should adopt innovative business models which take advantage from the open model, offering more flexible and competitive services of certification.

Figure captions

Figure 1 Supply side, intermediaries and demand side of the STM publishing industry.

Figure 2 Reputation triangle of the scientific publishing market.

Figure 3 The two phases of scientific publishers work: Certification and dissemination.

Endnotes

1. http://thinkature.com

2. http://www.mindomo.com

3. http://www.mindmeister.com

4. http://www.zoho.com

5. http://www.citeulike.org

6. http://www.librarything.com

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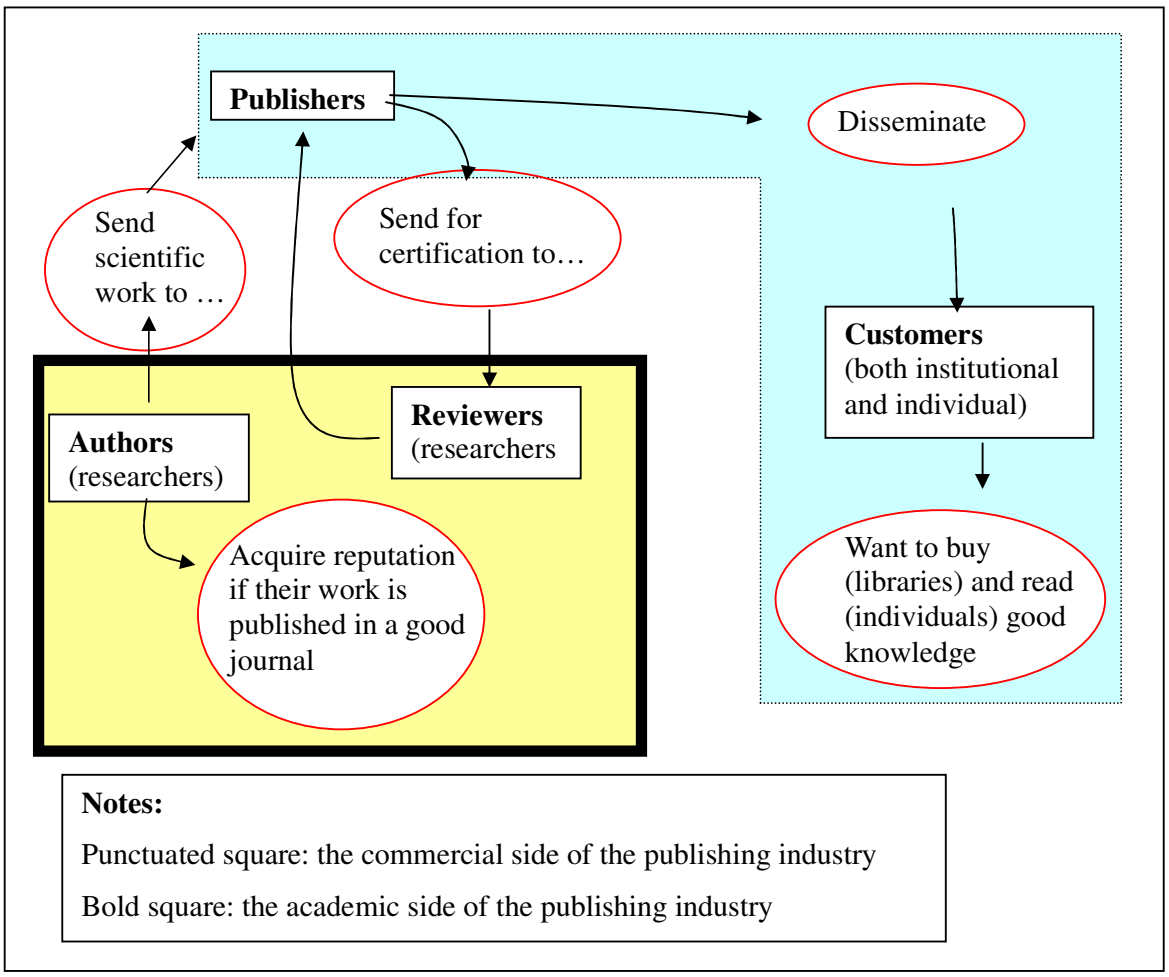
Tables

Table 1 Key differences of the publishing industry before and after the Internet

	Before 1995	**Since 1995**
Business model	The dominating business model is the "reader-pay": libraries as key buyers High fixed costs to enter the market as publisher (entry barrier)	Mainly "reader-pay" Experimentations of alternative business models: - Full open access (green route) - Author-pay (gold route) - Reader-pay (pay per download) Fixed costs to enter the market decrease
Customers	Single libraries and public institutions Libraries choices are based on their budged	Birth of libraries' consortia as key buyers
Pricing models	Pricing is based on subscription to single journals' series	Big Deal pricing: bundles of journals' series are being offered together to libraries
Publishers	Publishers as vendors of hardcopies	Publishers as renters of access

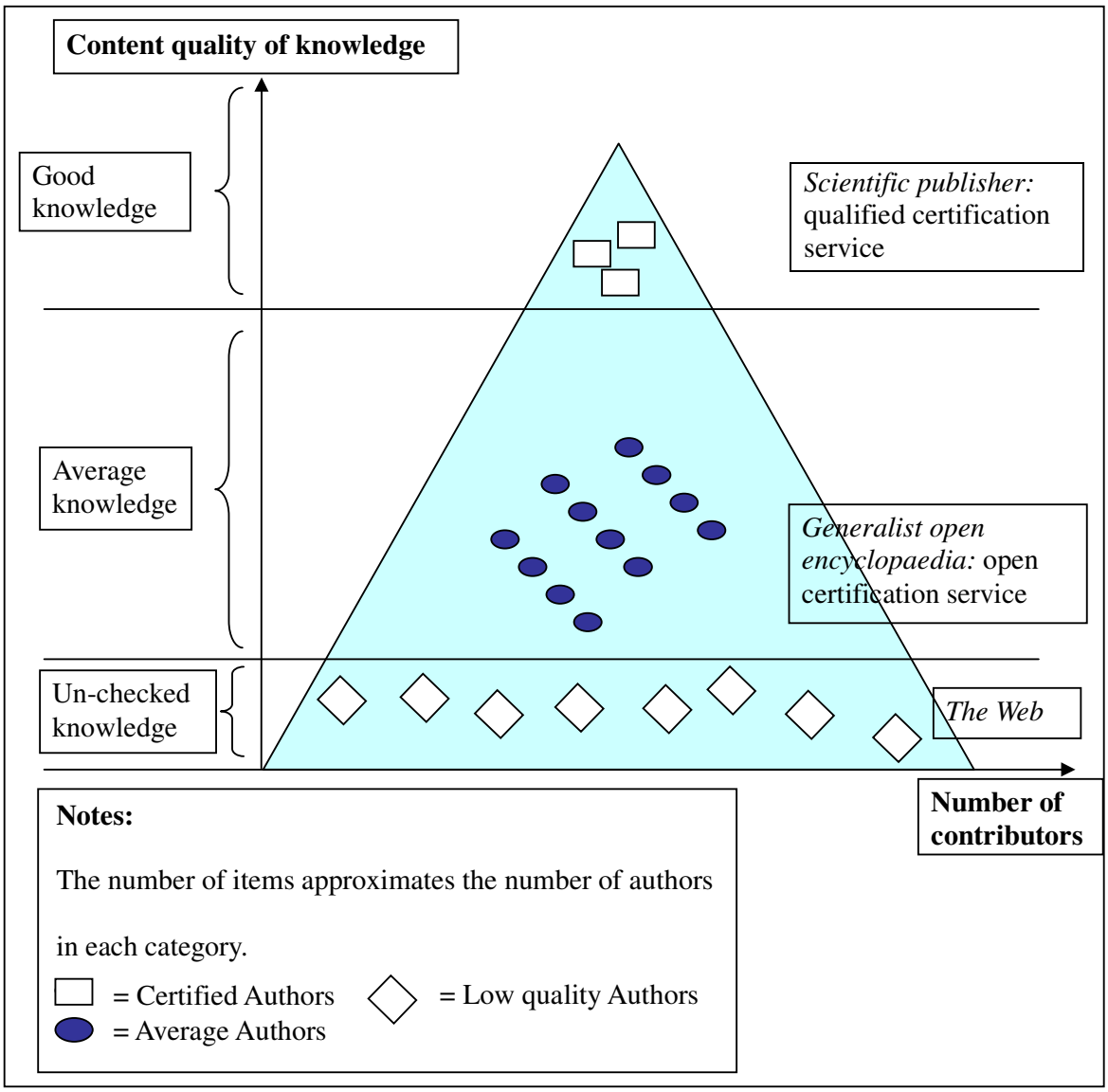
Figures

Figure 1 Supply side, intermediaries and demand side of the STM publishing industry.



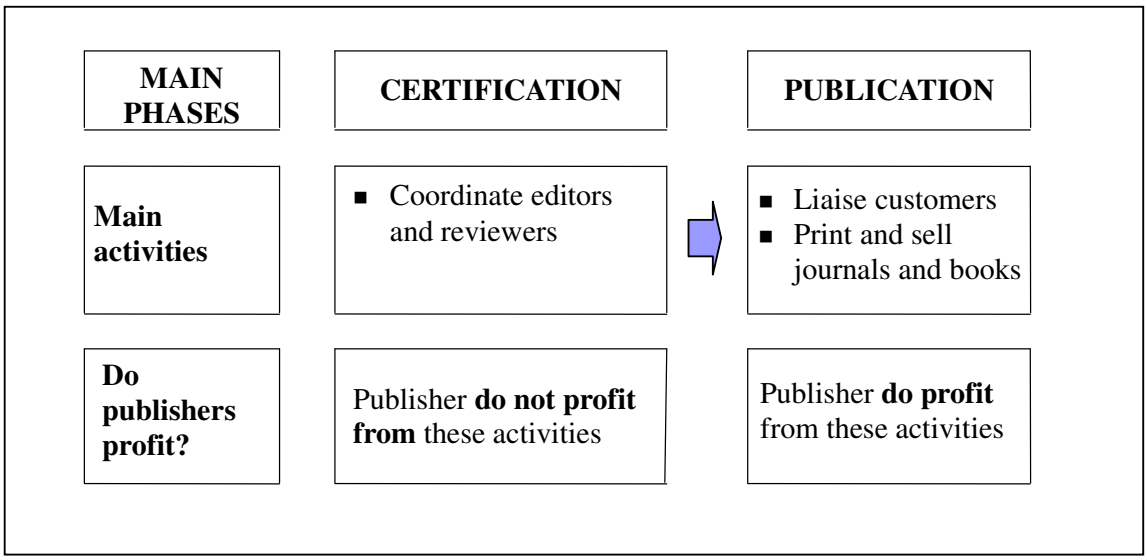
The image shows the main authors of the STM publishing industry, their main goal and the relationship between them. The G further shows the two sided nature (academic and commercial sides) of the publishing industry.

Figure 2 Reputation triangle of the scientific publishing market.



Relationship between goodness of knowledge, reputation of authors and certifying status of a scientific publisher compared to a generalist open encyclopaedia. Publishers want "squared" people to publish on their journals. Should the publisher publish work of "circle" or "rhomboid" people, the quality of its journals would decrease. Thus the role of scientific reviewers is essential to publishers. Nonetheless this relationship, as well as that with authors is based on "soft" drivers and not on monetary values.

Figure 3 The two phases of scientific publishers work: Certification and dissemination.



The figure shows the main activities publishers perform within each of the certification and dissemination phases and whether they gain from them or not.