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Recent Developments Concerning Moves Toward Research Papers on E-Journals

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1 Introduction

There are various forms of communications between researchers in science and technology. A researcher can achieve results only after he publishes his research results through some form of media and the results are widely recognized by his fellow researchers. In the case of researchers in science, technology and medicine (STM), they first make a verbal presentation of their research results at a meeting of fellow researchers or study/academic association, write a report and then contribute it to a journal. The editors of these journals maintain a certain level of quality for research papers through peer reviews and organize them in an order in which to publish them in their journal. Universities, academic associations, and commercial publishing companies (hereinafter referred to as publishers) have been in charge of this process since the 17th century. Today, research paper journals are still regarded as important media for publishing research results.

Thanks to the diffusion of an electronic contribution and peer review system that has been around since 2000, in addition to the use of the Internet in distributing research paper information, which began around 1995, it has become common for researchers to contribute their research papers via the Internet and for publishers to publish journals via the Internet. New services peculiar to e-journals, which make use of the Internet and which cannot be achieved in a brochure, have gradually become available. Links of secondary information to primary information on the Internet have already become an essential service for researchers collecting information.

In our previous report,[1] we examined trends in research journals, which have shifted from book journals to e-journals, from the aspect of both information services and business operations. And we have highlighted problems involved in publication by study/academic associations, with global trends in mind. This time, we would like to discuss mainly the advantages and disadvantages of digitalization, while keeping in mind recent e-journals and related trends, study the link between e-journals, researchers, and research funds, and make proposals leading to specific measures.

In this report, as in the case of the previous report, we mainly discuss STM journals and introduce their recent trends spanning from 2007 to the first half of 2009. In the second half of our report, we will discuss research information distribution policies from the aspect of publicly funded research. However, since the method to acquire research funds and the way to present output, including patents, or evaluation methods vary depending on corporations, we exclude corporate research activities and their information distribution methods from the scope of our study in this report, except for some basic researches.

2 Present state of e-journals in scientific communication

2-1 Various attempts transcending existing e-journals

For contemporary researchers, the use of e-journals has become essential. In many fields, e-journals published by publishers that have established good reputations since the booklet era are widely used. With regard to expanded functions of e-journals in and after 2007, attempts have been made to give added value to e-journals. For instance, in chemical journals, efforts to link research papers with chemical compound data

have made progress. In the Prospect Project,[2] which was launched by the Royal Society of Chemistry in 2007, and the Nature Chemistry,[3] which was first published in April 2009, various property data and metadata can be retrieved concerning the chemical compounds contained in the research papers, and the users can also move to other related databases. In other words, studies are being made to provide services to facilitate researchers' understanding by providing links not only to references cited but also to a variety of information on the contents of research papers.

Efforts are also being made with regard to changing peer review methods and evaluating research papers before and after publication. For instance, PloS One, which was published by PloS, combines a minimal peer review function of checking simple scientific errors with a web function to facilitate community evaluation and discussions about published articles. Since it was first released at the end of 2006, the number of articles carried by PloS One more than doubled from 2007 to 2008.[4] The Nature Publishing Group has also inaugurated Nature Precedings.[5] It can be said that Nature Precedings is an expanded version of the pre-print servers that have long been in place in the field of physical sciences. Researchers in physical science secure foresight by utilizing pre-print servers. However, it remains to be seen whether they will penetrate other fields. In research information-gathering activities, it has also become vital for researchers to be able to access primary information from databases retrieved. Therefore, database creators have been making efforts to develop a system to enable researchers and librarians to obtain necessary information from as many documents as possible with less effort.

Tools to distribute research information that actively utilize web media other than the existing e-journals have also diversified. Among them are accumulation and sharing of knowledge by utilizing a wiki engine (also used in Wikipedia), exchanges and cross-reference of wide-ranging information utilizing blogs, and exchanges of information within a specific number of users utilizing communities within SNS (social network services). In such grass-root activities, information is exchanged as the need arises in various units, such as in a unit of individuals, a small number of researchers, research laboratory or by fields of sciences and topics. For instance, information on the discovery of Higgs boson, a recent great feat in the field of elementary particles, which was exchanged in blogs before the publication of the research paper, is said to have drawn various responses, pros and cons.[6] And, the PLoS One launched "every ONE", a community blog, in March 2009 to promote information exchanges among researchers.[7]

Since image editing and browsing have become easy thanks to the diffusion of broadband and the advancement of processing capacity in PCs, new journals dedicated to images have been launched.[8] The Journal of Visualized Experiments, for instance, uses images to show concisely and clearly various procedures that had been difficult for readers to re-create from textual information alone, such as anatomical and experimental equipment operation procedures.

2-2 Role of research paper journals to "Fix" achievements remain unchanged

Thanks to the emergence and employment of various media, new scientific communications have been made possible. However, many researchers still write research papers and contribute them to well-established journals in order to "fix" their performance. For instance, in the field of system biology, where living organisms are simulated by using individual computers as cells, web infrastructures, such as previously mentioned wiki, are actively utilized. In a project called PAYAO, diversified information on module programs registered online are being exchanged on an international scale in collaboration with other programs and external databases. Still, many researchers contribute their research results to existing journals, such as the EMBO Journal, in order to "fix" their research results.[9]

This may be because research articles carried by journals still account for most of researchers' publication lists, which they use in applications for research funds and earning promotion, and because evaluators place emphasis on such research articles.

Incidentally, the Nature's open peer review, in which many readers evaluate published research articles, which we introduced in our previous report, did not draw much attention and was suspended at the end of 2006.[10] As this incident indicates, trials and errors of new attempts and efforts to select and integrate functions and methods from among existing methods

will be repeated for some time to come.

3 Convenience and problems brought about by distribution of e-journals

E-journals have brought about various conveniences, but at the same time, they have also brought about new problems. Here, we would like to introduce recent hot trends and look at problems we face.

3-1 Research information spreading instantly for comparison

E-journals have not only realized new services that cannot be provided in book form, but have also dramatically increased the speed at which information can be distributed. An alert system, like RSS, if used, will notify readers of newly published research articles. The delivery of separate prints to fellow researchers can be made promptly by e-mail, making it possible for good research articles to be taken up immediately by blogs. Also, depending on e-journals, readers can send their opinions directly to the comment columns of such e-journals, making it possible for researchers to know, to some extent, the reputation of their research articles.

Moreover, once research articles are published, they will be indexed and linked to various databases, making it easy for researchers to reach original documents from various information-collection means, as need arises. Each article is no longer a factor of an e-journal, but an independent unit of academic information on the Internet and will be immediately distributed and evaluated. To this extent, it can be said that the transparency of individual research information has increased.

Moreover, thanks to the digitalization of the whole text of articles, it has become easy to collect great volumes of information on the Internet and compare them. If a data-mining method is used in combination with many text data or a multiple number of databases, such as patents and journals, it is possible to easily analyze the frequency of the use of particular words and their correlations.[11] Furthermore, if they are used along with data mining of basic data, such as experimental data, it is possible to visualize the results of analyses, and this in turn may offer new insight.

3-2 New problems brought about by digitalization

3-2-1 Detection of plagiarism and other inappropriate acts

E-journals, which have brought about the conveniences described in the previous section, have also revealed new problems. The fact that the texts and database of research articles can be easily utilized means it easily allows inappropriate acts, such as plagiarism and contortion of the articles. In fact, cases of double contribution and abuse of other articles have been increasingly detected in the process of editing journals. A survey of a database has found that nearly 9,200 articles published in the past have similarities with other articles. After studying them in detail and checking with researchers and publishers, 200 of them remained questionable and 40 articles have reportedly been withdrawn by the publishers.[12]

Publishers, for their part, have to properly deal with such abuses causing damage to the reliability and brand image of their journals. CrossRef, an agency established by publishers to enable cross-publisher citation linking on online academic journals, inaugurated CrossCheck, an abuse-detection project, in June 2008[13] CrossCheck is a tool that detects similarities in a text with those in other various resources, including data on published articles, by using a technology developed by iThenticate[14] to detect copied and pasted sentences. It is a tool to measure the similarity of texts and is not designed to detect abuses. With regard to articles that have a high degree of similarity, it is necessary to examine the cause for the similarity and carefully determine whether or not they constitute abuses.

3-2-2 Importance of author ID and institution ID

As the distribution and analysis of article-by-article information has become easy, the distribution of author-by-author and institution-by-institution information has assumed importance. In other words, it has become relatively easy to find out who or which institutions are writing what articles and to what extent. Such information has become important, particularly in assessing institution-by-institution researches. However, the names of authors and institutions attached to research articles have been viewed as collateral information and therefore have not been strictly organized. Therefore, various problems have been exposed, including problems of identical names, inconsistency in the abbreviation of

institution names, and how to deal with researchers transferring from one institution to another. Many databases have been independently tackling such problems. Serials Solutions, for instance, has Author Resolver to provide author-related information services[15] Thomson Reuter has opened Researcher ID, a contributor ID site, to prompt researchers to tie their research articles to the site.[16] The previously mentioned CrossRef has also been addressing the problem of author identification. In 2007, it began studying ways to tie published research articles to its site by assigning cross-industrial Author IDs.[17] As for identifying institutions, the National Information Standards Organization (NISO) of the United States started creating standards for identification in January 2008.[18]

4 Present state of open access activities and the transparency of research funds

4-1 Trends in open access journals and institutional repositories

With regard to open access activities to realize barrier-free access to e-journals, which we introduced in the previous report,[1] various efforts have been continuing. One of the factors for promoting open access activities is that we must return the information on the outcome of tax-funded research to the public and ensure the transparency of such information. According to the DOAJ (Director of Open Access Journals), readers can access 4,170 open-access journals and more than 280,000 articles for free.[19] According to the Open DOAR (Directory of Open Access Repositories), as of June 2009, the number of institutional repositories with their own servers containing files of the final versions of research articles and allowing access to them for free exceeded 1,400. The number of such repositories in Japan exceeds 100, the fourth highest in the world.[20] With the number of institutional repositories at home and abroad reaching a certain level, efforts are now being directed to enhance the contents of repositories, such as increasing the number of registered research articles. According to the Ranking of the Web of World Repositories, which provides overall evaluation of institutional repositories, including the number of registered articles and their contents, four Japanese repositories — those offered by Kyushu University, Kyoto University, Waseda University and University of Tokyo — made the top 100 list (See Table 1). Moreover, since certain numbers of institutional repositories and articles are now available, cross-searching has become virtually possible. In April 2009, the National Institute of Informatics formally released JAIRO, a system to cross-search institutional repositories. JAIRO allows searching all articles carried by the institutional repositories of each university. It also offers various statistical data, including the number of registered articles and the ratios of each media.[21] (See Figure 1)

Meanwhile, some public research institutes have come to establish institutional repositories, including Max Planck of Germany and the CNRS of France.[22] The

Table 1 : Overall Ranking of Institutional Repositories by Ranking of Web of World Repositories

	Name of repository	Country
1	Hal CNRS	France
2	MIT Dspace	U.S.
3	E'cole Polytechnique Federale de Lausanne Infoscience	Switzerland
4	Institut National de Recherche en Informatique et en Automatique Archive Ouverte	France
5	University of Oregon Scholars' Bank	U.S.
6	University of Saint Gallen Forschungsplattform Alexandria	Switzerland
7	University of Michigan Deep Blue	U.S.
8	CERN Document Server	Switzerland
9	University of Southampton ePrints	UK
10	University of Queensland Espace	Australia
	. . . .	
34	Kyushu University	Japan
35	Kyoto University	Japan
80	Waseda University	Japan
95	University of Tokyo	Japan

As of January 2009 (http://repositories.webometrics.info/)

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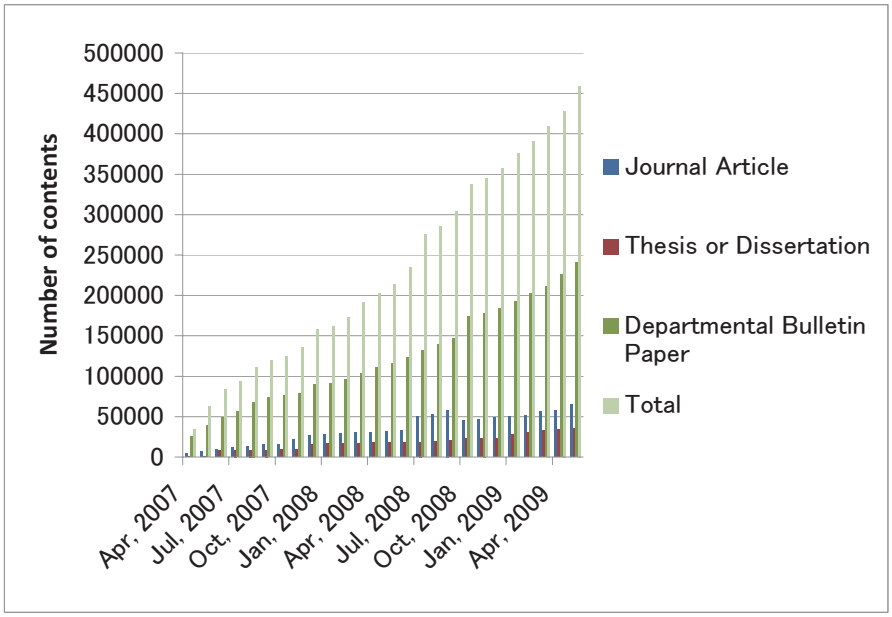

Figure 1 : Number of Contents Registered with Japanese Institutional Repositories

Source: JAIRO, June 2009

Arxiv, an archive for electronic preprints of scientific papers mainly in the fields of high-energy physics, has come to carry research articles on quantitative biology, statistics and quantitative financing.[23] As indicated above, the form of institutional repositories has yet to be fixed. In the future, institutional repositories may begin to transmit information, including peer reviews in the same way seen in bulletin papers[24] and develop environments to support researches, such as management and storage of pre-published document data or management of research data. For instance, National Institute for Materials Science (NIMS) has been actively trying to support the management of researchers' digital resources through the digital library system developed by Max Planck.[25]

4-2 Recent movement of public funding organizations

In the United States and Europe, public funding organizations have been aggressively promoting the open access or public access of research covered by their funding programs. Particularly noteworthy is the movement of the National Institute of Health (NIH). Since 2005, the NIH has been promoting public access (NIH OA policy) by registering and publishing its research funds in the PubMedCentral (PMC). And since April 7, 2008, it has become mandatory to register such research papers. As a result, the number of research papers carried by the PMC has drastically increased. On the other hand, in September 2008, publishers submitted the Fair Copyright in Research Works Act to overturn the NIH policy. Incidentally, there are no formal movements among Japanese research funding organizations to make open access or public access to research papers mandatory.[22]

4-3 Other recent movements

Under such circumstances, publishers have been making various efforts. Among them is the October 2008 purchase of BioMedCentral (BMC), a pioneer in open access journals, by Springer, a commercial publisher. Since its foundation in 2000, the BMC has established its position as an open access journal based on the business model of covering its expenses with contributions from authors and membership fees. Since the main purpose of the open access movement is to counter existing publishers, who reportedly have raised prices of research papers and articles, the purchase of BMC by Springer had a great impact. At present, Springer says it intends to maintain the open access journal as an independent operation, separate from its electronic journal package (Springer Link) operated under a library purchase expense model.[26] With regard to open access journals, ensuring the sustainability of their operations remains the biggest challenge. We are curious to see how Springer will operate in the future and how many libraries that have supported BMC business will react to Springer's methods.

Also a project, called SCOAP3, is underway, in

which high-energy physics-related research institutes and libraries collect funds to purchase core magazines and provide open access to such magazines under the leadership of CERN (European Council for Nuclear Research). More than 20 countries are participating in the project.[27] Japan has not been participating in the project, since SCOAP3's annual contribution is set high at around ¥100 million.

4-4 Argument about the effectiveness of open access

While various efforts are being made to promote open access, as described above, there is a debate in the field of library and information science on whether research articles available through open access are more frequently cited than articles not available for free. There are conflicting reports with regard to the difference in the frequency of citations between the two, with some reports saying that there is a difference and others saying that there is no difference.[28, 29] Since the number of times a research article is cited depends on the content of the article, the frequency of citation differs depending on the field and the kind of articles, even within the same magazine. Moreover, since a research journal is a medium mainly designed to allow researchers to announce their research works, it is difficult to compare the number of citations under similar controlled environments except for the difference of being open access or not. Still, according to a Davis report,[30] an analysis of open access publishing of articles randomly selected from a group of magazines in the field of medical science shows that the open access had no impact on the number of times the articles are cited.[30] However, both reports showed superiority with regard to the number of accesses to e-journals, confirming that the visibility of articles has been enhanced to a certain extent.

5 For better understanding of the distribution and effects of research funding and research results

5-1 Higher morality of researchers and quality control by publishers called for

The above situations suggest that researchers need to enhance their morality. Since it has become easy to check similar researches, it has become all the more important for researchers to give maximum respect to preceding studies and act in good faith. When they quote passages from preceding studies, researchers should properly cite them and, in some cases, obtain approval from the authors and publishers. If a research is similar to a preceding research, intentional or not, it is necessary for the researchers to give more consideration to the similarities. On the other hand, publishers and those who need to ensure the quality of information are always called upon to detect abuses and conduct proper peer reviews. In fact, some researchers claimed that their nonsensical article was carried by an open access journal, suggesting that the journal had not conducted peer reviewing.[31] In another case, Elsevier, a scientific publishing company, put out a total of six publications without peer reviewing them.[32] All these incidents underline the need for publishers to give more consideration to controlling the quality of their publications.

5-2 Changes in information that should be managed by research-funding organizations

In line with increased open access movement, it has become more important for research-funding organizations to study methods for efficient use of research funds by researchers and for returning research results to the public. In other words, more efficient use of research funds and their transparency have been increasingly called for in a research activity cycle, in which researchers apply for research funds, publish their research results through such means as e-journals, and then, after receiving due recognition, apply for next research funds. (Figure 2)

5-3 Building an information infrastructure allowing cross-sectional analysis

When considering more efficient use of research funds, it is necessary to have data designs for individual information elements, such as researchers, research institutes, research articles, and citation data, organized in order. With regard to research funds, research assignment numbers and other identifiers equivalent to such numbers are already available. With regard to the English versions of research articles issued by publishers, it is possible to identify them based on Document Object Identifier (DOI).[33] Unlike English-language research articles, which can be researched and identified in an integrated manner throughout the world by using the CrossRef, the development of

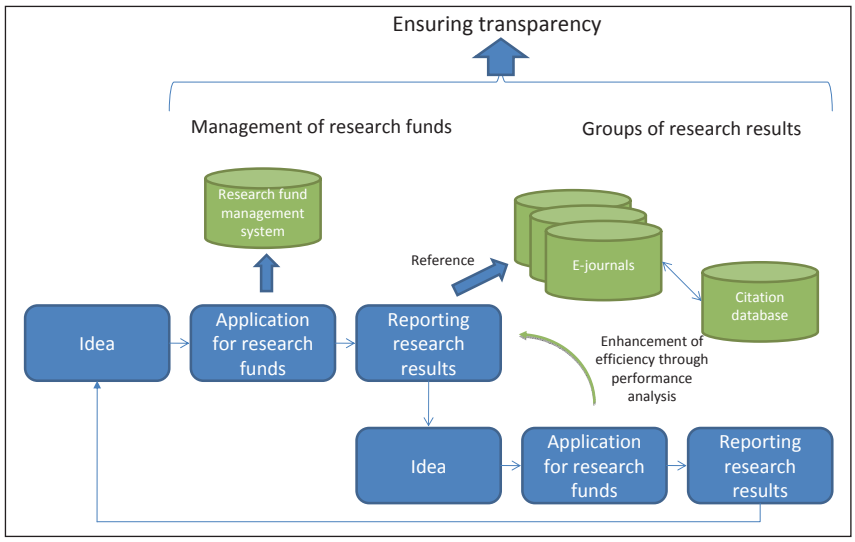

Figure 2 : Simplified Scheme of Research Activity Cycle Based on Research Funds (Relationship between research funds and research results in the form of papers)

Prepared by the STFC

identifiers for Japanese-language articles is slow. At present, Japanese articles are assigned independent identifiers by sector and database. Therefore, more than one database has to be referred to when putting cross-sectional links to Japanese journals. This is having an adverse effect on the efficiency of creating a database on Japanese journals and articles. In order to provide links to Japanese-language articles, it is desirable to develop a unified search system.

In order to put researcher information in order, it is necessary to develop cross-sectional researcher IDs or integrate virtual researcher identifiers by using technology for integrating multiple numbers of IDs, such as Open ID.[34] Among the major Japanese databases with researcher IDs are e-Rad,[35] which is operated by the Ministry of Education, Culture, Sports, Science and Technology under the leadership of the Cabinet Office, KAKEN, a scientific research fund database, and the Researcher Resolver, both offered by the National Institute of Informatics,[36] and ReaD, offered by the Japan Science and Technology Agency.[37] With the unification of researcher IDs being promoted through e-Rad, certain progress has been made with regard to links to research institutes and research funds. However, the purpose of e-Rad is still limited to helping proper appropriation of research funds by eliminating unreasonable overlapping and excessive concentration of R&D funds in particular researches. It has yet to be used to properly appropriate upcoming research funds by actively analyzing the impact of research articles. Moreover, since some information services provided by overseas databases have independent researcher ID systems, it is still difficult, for instance, to conduct an exhaustive analysis and evaluation of research articles, including the number of times the articles were cited and their impacts.

5-4 Realistic ID operation and cooperation plans

In order to break such situations, it is ideal to aim for integrating various operations or systems and eventually unify element identifiers. However, it is not realistic. Rather than integrating systems, it would be more realistic to unify the protocols for exchanging data with outside institutes by using XML as an intermediate data or release basic data in databases so that the collection and comparison of researcher information and research fund information can be made possible, as the need arises, without impeding the independent activities of each institute.

For instance, the OECD (Organization for Economic Cooperation and Development) has released various raw data along with statistical data to allow analyses by combining the groups of data. The white papers concerning the standards for the release of datasets, which have been released by the OECD, are helpful.[38] Moreover, Serials Solutions, which has developed tools to deal with various digital information resources and has been providing solution services mainly to libraries, has released its XML API (application programming interface),

allowing users free access to a group of basic data in the company database for easy comparison with other groups of data.[39] In this way, it is necessary to build environments to allow users to combine groups of data in order to gain new knowledge, with database service providers offering relatively free access to their databases, instead of trying to control everything.

If possible, it is desirable for public funding organizations to formulate grand designs for science and technology information distribution policies in a cross-sectional manner and reconfirm the positions of each information business on a regular basis. At present, the Japan Science and Technology Agency and the National Institute of Informatics are promoting cooperation in the information business.[40] They are also in talks with the National Diet Library. If public funding organizations efficiently support the production cycle of publicly funded research and accompanying information distribution and become able to analyze the performance of researches, researchers, and research institute with relatively little effort, it will eventually lead to ensuring the transparency and expansion of research funds. From the perspective of connecting researchers, research institutes, research funds, and their results with their impacts, as shown in Table 2 and Figure 3, it would be worth studying cross-sectional collaboration.

6 Comprehensive research performance indicator combining research funding and accomplishment report

If the aforementioned comprehensive analysis tools for cross-sectional database is made available, it will make it possible to gauge the performance of researches, researchers, and research institutes more accurately. For instance, it will make it easy to correctly compare per-research unit numbers of research articles, times the articles cited, and their hits on the Internet by individual and research institute. Basically, research evaluation should be conducted voluntarily by a group of researchers with a high

Table 2 : Major Government-Run Database with Own Researcher ID

Service name	Operating organization	Main identifiers		
e-Rad	MEXT	Researcher	Research institute	Research fund
KAKEN Researcher resolver	NII	Researcher	Research fund	Research results
ReaD	JST	Researcher	Research institute	Research results

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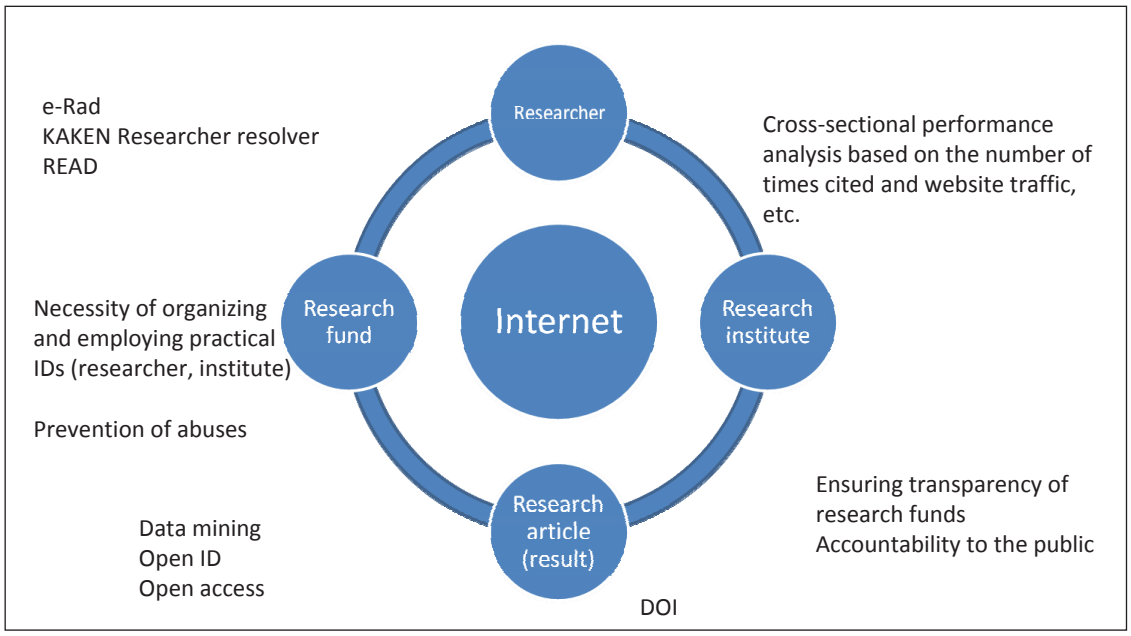

Figure 3 : Environment Surrounding Research Funding

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level of knowledge (peer review). The performance indicator like the above, if properly utilized, may become an objective indicator for research evaluation. It may be useful when, for instance, evaluating a large number of young researchers in a wide range of fields or when evaluating research outside of one's field. It is hoped that such an indicator will be used on a supplementary basis, with the drawbacks and advantages of the indicator kept in mind. The question of what impact a continued use of new indicators will have on peer reviewing is likely to draw attention in the future.

Lastly, as of this writing, the importance of the existing, well-known research journals as a means to fix research achievement remains unchanged. However, we should keep a close eye on when and in which field the information exchanges using new communications, such as the one described at the beginning of this report, may establish a new status and eventually become an effective achievement-reporting medium for researchers to obtain research funds and gain promotion.

Acknowledgement

In writing this report, I have received a great deal of cooperation and advice from many people, including the Japan Science and Technology Agency and the National Institute of Informatics. I would like to express my appreciation to them.

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Profile

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Mr. Hayashi has been engaged in promoting English e-journals since he was a graduate student. He has a great interest in trends and the future of e-journals and academic information. He is a member of the infrastructure development project for international academic information distribution (SPARC/JAPAN). He is also a member of the Science Council of Japan.

(Original Japanese version: published in July 2009)