Role of Academic & Research Libraries and International Collaboration on Civil Engineering Education and Its Continuous Professional Development

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ABSTRACT

This paper shows new developments and describes future perspectives about the necessity of international collaboration and the role of academic and research libraries in engineering education and its continuous professional development. Academic and research libraries are expected as a role to provide new functionality while holding traditional library functions, due to the rise of the Internet and digitization of information. Over 90% of journal articles have been digitized for the last 15 years. Meanwhile, open access (OA) initiatives and the provision of "open courseware (OCW)" via the Internet have been advanced. As part of OA activities for digital contents, institutional repositories (IR(s)) have been rapidly proliferating over the past several years to disclose intellectual or scholarly outputs and information created by the institutions. This paper discusses the trends will have a major impact on the engineering education and its continuous professional development.

1. INTRODUCTION

The world social structure surrounding the improvement of social infrastructure has been significantly changed. Technologies being advanced and diversified, engineers are required to have higher levels of skills, knowledge and creativity. Namely, to improve social infrastructure with advanced technologies in consideration with natural environments and to realize a secure and safe society, it should be a civil engineers' mission. The reformation of engineering education is now required to meet the demands of the times and various trials are made by universities and societies worldwide [6].

Particularly in the field of the Continuous Professional Development (CPD) [1,2,3] for engineers' upskilling, the necessity for systematic programs is stressed because engineers' OJT and their individual efforts are necessary but that is not enough.

Recently, a variety of CPD systems for engineers have been developing at the societies' level. In the field of civil engineering, wheels started turning like the organizing of an association of architectural CPD in Japan. However, those are mostly on a country-by-country basis. To provide engineering education to handle earth environmental problems, we will need international collaboration, using innovative information technology and globally open-access information contents.

Meanwhile, digitization of scholarly information and technical information have been promoted, and they have been openly accessible, for instance, through institutional repositories (IRs) which are developing as part of academic and research libraries'

functionality. Academic and research libraries are expected as a role to provide new functions such as those of “digital library” while keeping traditional library functions, due to the development of the Internet for the past 20 years and digitization of information. Especially, over 90% of academic journal articles have become electronically accessible for the last 15 years. Most core journals have been electronically published by commercial publishers and societies, but OA initiatives for those are growing vigorously. At present, OA journals are more than 4,000 in title and also the publication of “Open Courseware (OCW)” has been progressed. Besides, IR has been dramatically evolved over the past several years to disclose all kinds of intellectual outputs and information created by the institutions. The IR is carried out under a lot of international collaboration.

These openly accessible information contents may have a strong impact on the engineering education and its continuous professional development. We can obtain a variety of information for free from remote locations, through using these digital contents. The contents would be essential for engineers not only in developing countries but in the world. Then the openly accessible information could facilitate international collaborations in the area of engineering education and its continuous professional development.

2. NEW DEVELOPMENTS OF ACADEMIC AND RESEARCH LIBRARIES

2.1 Change of Academic and Research Libraries’ Functions

Academic and research libraries vary in different countries, but they in most cases consist of university libraries, societies’ libraries (or special libraries) and national libraries.

With the spread of the Internet and digitization of scholarly information, the scholarly communication has been changed and then roles of academic and research libraries are also changing significantly. Conventional library functions are print-based to collect, organize (catalog) and preserve paper materials, and make them available to users. As new digital library functions, they are required to organize world information and by putting links, make them accessible to users both within and outside library. The provision of information via the Internet or website may be threatening the library role as an exclusive provider of scholarly information. At present, valuable digital data such as electronic journals are mostly charged under a copyright protection and the libraries buy an electronic access mainly through consortium agreements and provide them to users. However, the development of OA movements may change the role of libraries.

Association of College and Research Libraries (ACRL) in U.S. held a round table in 2006 with 29 participants of researchers, university presidents, librarians etc. under the theme of the redistribution of roles, responsibilities and resources in the academic and research libraries for the next 10 years and issued a report in February 2007. The report says that what they should work on in several years is to try to make libraries recognized as the facilities in which various information as well as the libraries’ will be available and to support users in these kind of information above. Namely, they gave the first rank to the appealing of the libraries’ evolution. And then they redefined the roles librarians should take to meet the needs of the age.

At the Japanese-German Symposium on the Future Prospects and Development of the Academic Libraries in Japan and Germany, held in Berlin, February 2008, the author stated the following future prospects of academic and research libraries.

1) Realization of the hybrid-library where both digital and paper-based information can be seamlessly accessible
2) Response to the OA and IR
3) Provision of new learning space and functionality as “learning commons”
4) Introduction of and response to the e-Science, and

5) Training and Development of librarians and library personnel

As to the future prospects there described of academic and research libraries, IR is basically for its institutional members, but being publicly accessible, may probably have a major influence on the continuous professional development for engineers. Particularly, recent IRs may contain not only academic articles but course materials like OCW and valuable to the continuous professional development for engineers. The huge amount of OCW [12] strongly promoted by MIT and other institutions are expected to be of great assistance in the field of engineers' continuous professional development because classes or lectures can be taken from anywhere in the world and anytime through the Internet.

2.2 Advancement of Electronic Journals (EJ) and Electronic Books (e-books), and Their Problems

Electronic journals (EJ) have rapidly progressed in number of titles in the 1990s and has spread into academic and research institutions [8,9]. There were less than 110 titles in 1991, and through an experimental phase, the number of titles became 1,465 in 1997 and then we achieved the practical use of EJ. In 1999, it showed an explosive progress with 10,332 titles. In 2002, with 27,083 titles, publishing market experienced overconcentration, that is, in an oligopolistic situation where 15,627 titles belonged to the top 102 publishers. Later as well, EJ was developed rapidly into the stage of "site license" in which "Big Deal" subscription model became mainstream and made all of a publisher's journals accessible.

As to the scholarly journals, EJ publishing market was increasingly dominated by a small number of large commercial publishers, but due to the "Big Deal" contract model, academic institutions could buy an electronic access to several times more titles without much cost increase and survived the so-called "serials crisis" in the 1990s. For instance, at the Japanese national universities, average number of subscribed titles is now around 6,000 and some large universities have over 20,000 title subscriptions. It may be said that the "Big Deal" contract model via the consortium has played a certain role in closing the digital divide among universities. However, the EJ price constantly increases by 5%-10% in all fields as shown in Fig. 1 and so academic institutions are hard to keep the current size of subscribed journals.

And EJ is generally purchased on a site license basis, and non- institution members are not authorized to access EJ articles and it is impossible, due to a copyright issue, for engineers

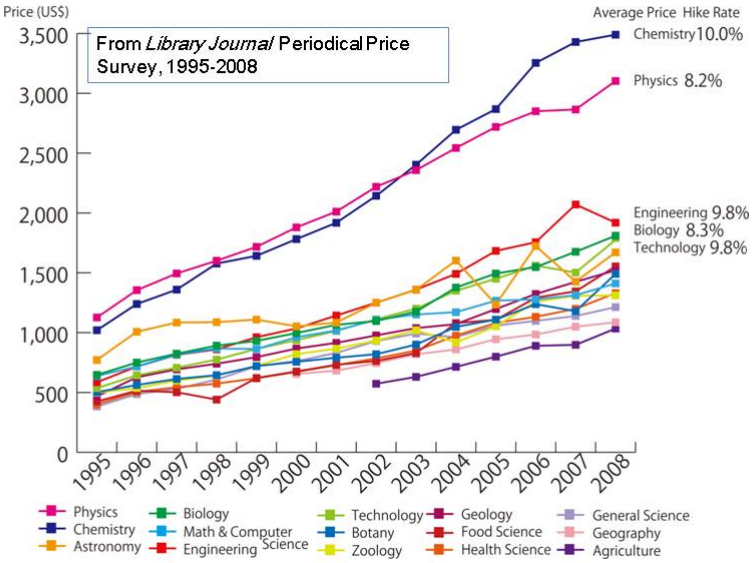

Fig. 1 Average Price Transition for Scientific Disciplines

at the continuous professional development to read EJ articles freely from the remote locations. But of course, EJ articles are available for engineers as "walking users" in visiting their alma maters.

Meanwhile, e-books started to be introduced, but since there are no good business models yet, they are not so much spread as EJ. E-books have the same copyright issue as EJ and they are not freely accessible to engineers' continuous professional development.

2.3 History of the OA Movement and Institutional Repository

One of the aims of the OA movement is to get over the above-mentioned barriers, bring scholarly communication back in the hands of our researchers as creators of scholarly information and make it common property of all humanity. OA movement [10] was started when Stevan Harnad first proposed "Self-Archiving" in 1994. It might be the movement to partly restore scholarly communication from the commercial publishers. In 1999, with the establishment of Open Archives Initiative (OAI), OA became a full-scale movement. In 2000, Eprints was released as software for building open access repositories. OAI-PMH (Open Archives Initiative Protocol for Metadata Harvesting) was developed in 2001 and SPARC (the Scholarly Publishing and Academic Resources Coalition) presented a statement in support of IR in 2002. And then Budapest Open Access Initiative was founded and the OA movement became more active around the world. At this time, MIT released DSpace free which is now widely used as software to build IR. After that, the development of the IR world was evidenced by a rapid increase of the number of IRs and the quantity of data, as shown in Figs. 2 and 3.

The definition of IR varies and Lynch [11] defines IR as follows:

a) A set of services that an institution offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members
b) The institution should have the stewardship of these digital materials, including long-term preservation where appropriate, as well as organization and access or distribution.

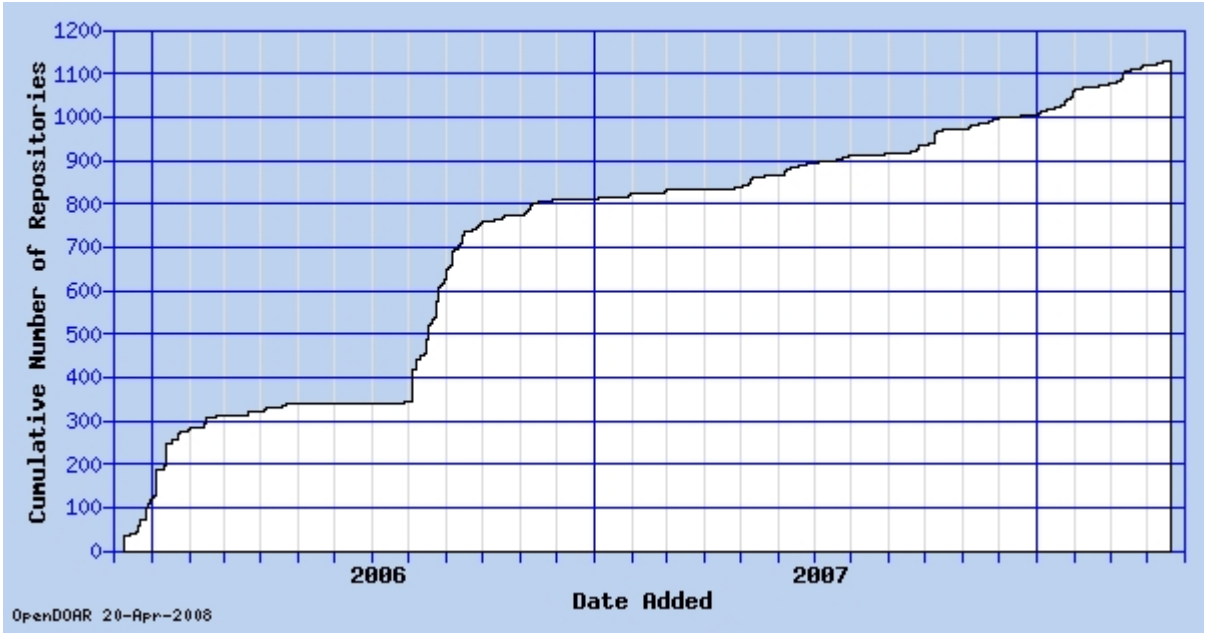

Fig. 2 Growth of the OpenDOAR Database

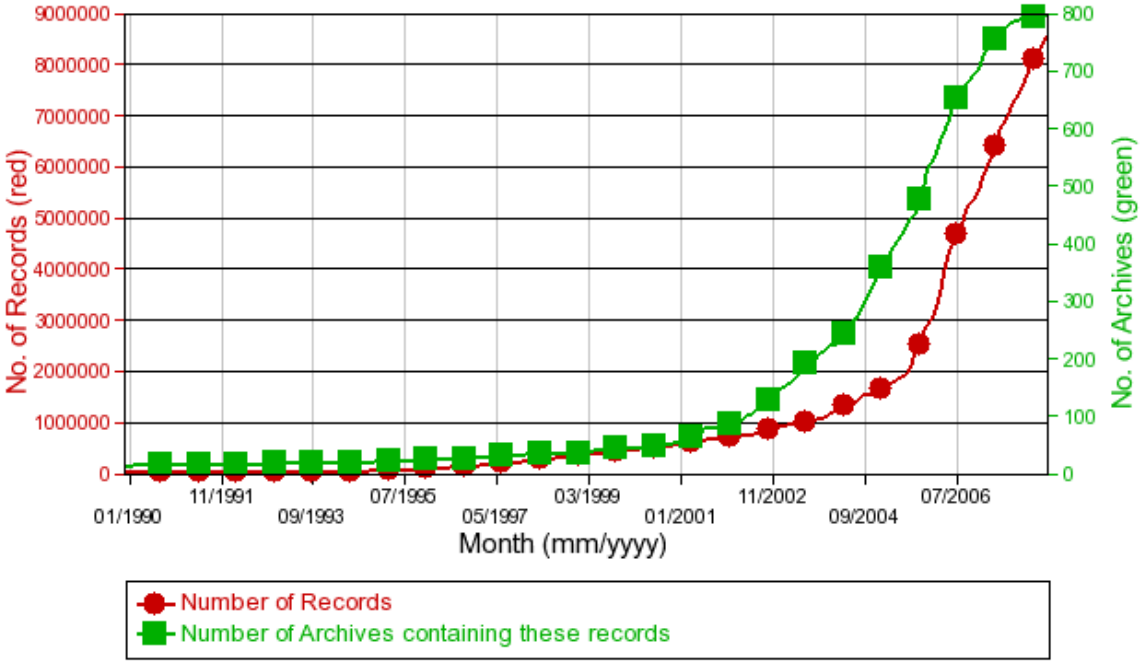

Fig. 3 Registry of Open Access Repositories

IR [7] has features such as, 1) academic institutions' asset management, 2) open access, 3) new method of scholarly communication, and 4) evaluation tool for academic institutions. Namely, IR is an online mechanism for institutions storing and preserving their researchers' outputs, and disseminating them in an openly accessible form to the public, to aim at the increase of institutions' name recognition, the fulfillment of social accountability, and the far-reaching dissemination of research outputs. IRs are not charged unlike EJ and allow academic institutions to ensure the social accountability over their activities to taxpayers. From the standpoint of taxpayers, the right to access research outcomes funded by their tax may be reserved by IRs for the first time. The fact is clearly proved by the statement on the necessity of OA [13] submitted to the U.S. Congress by 26 Novel Prize winners on July 26, 2007.

Even in the field of engineering education and its continuous professional development, free and unlimitedly accessible information contents may take a significant role ever after. We need to positively introduce IRs and make every effort to promote the openly accessible contents in close cooperation between academic institutions and engineers' societies.

2.4 International Collaboration on IRs

Fig. 4 shows a map of IR archives. There are 18 IRs in Africa and 131 in Asia as well as in Europe and U.S.

To incorporate IRs throughout the world, some organizations appeared to manage IRs by crawling their metadata. NDLTD (Networked Digital Library of These and Dissertations) is a unique website for electronic thesis and dissertation, in which Nagoya University is taking part, holding over 170 participating institutions worldwide, especially in North America, to provide electronic and free access to the full-text of digitized version [14]. In Japan, we have some full-text services like NII-ELS by the National Institute of Informatics (NII) and J-STAGE by JST (Japan Science and Technology Agency), openly accessible from all over the world.

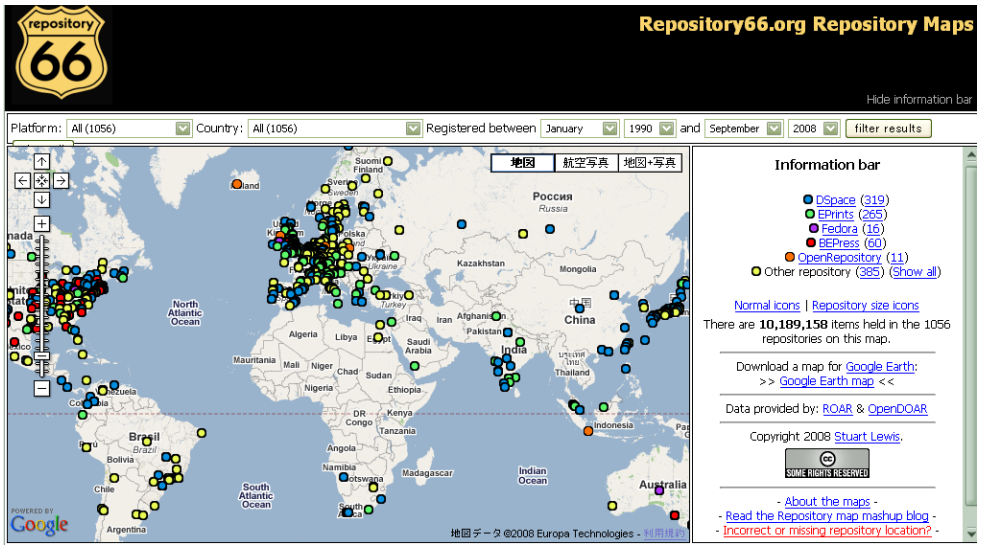

Fig. 4 Repository Maps (http://maps.repository66.org/)

Fig. 5 shows the transition of IR content growth in Japan. The number of contents is not enough for research and education, but Japanese IRs have been more frequently accessed, particularly as to bulletin and theses & dissertations. Fig. 6 shows the number of visitors to NAGOYA Repository from African cities for the past 2 years. We have 417 accesses from 68 sites. Among them, 21 accesses are from Kenya. As to the access route, as shown in Fig. 7, 3/4 of total are via Google and Yahoo, but the number of accesses via relevant organizations such as NII and direct access to Nagoya University are very small.

This result is because, along with the standardization of metadata, we make our IRs freely crawlable and accessible from search engines like Google. In view of information quality, to be mixed with general web information is not a good idea, but its accessibility is so easy and hard to ignore. IRs in the world have insufficient contents and number of accesses, but they are a highly promising method of scholarly communication and will have a major impact on the engineering education and its continuous professional development.

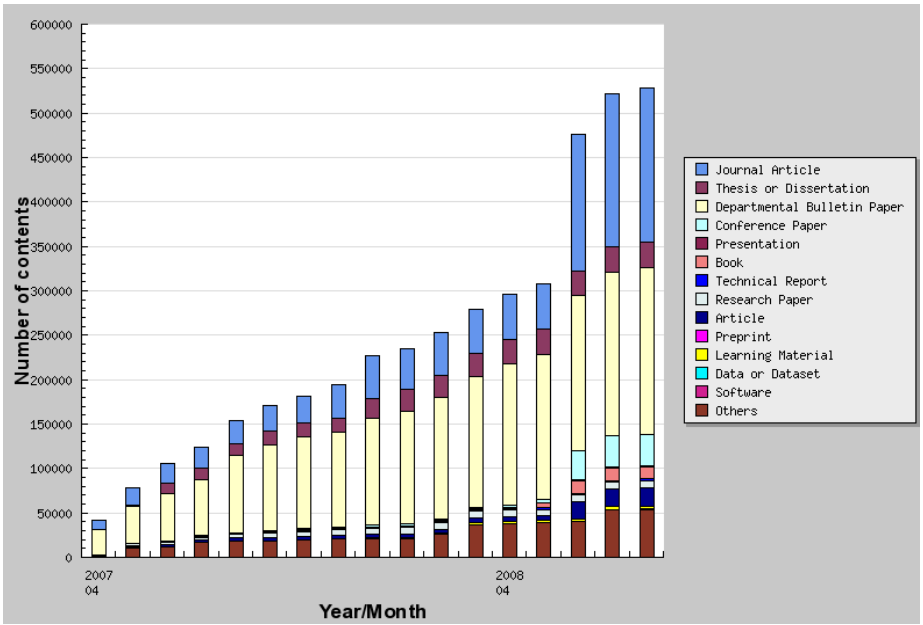

Fig. 5 Growth of Repository Content in Japan
(http://irdb.nii.ac.jp/analysis/index_e.php)

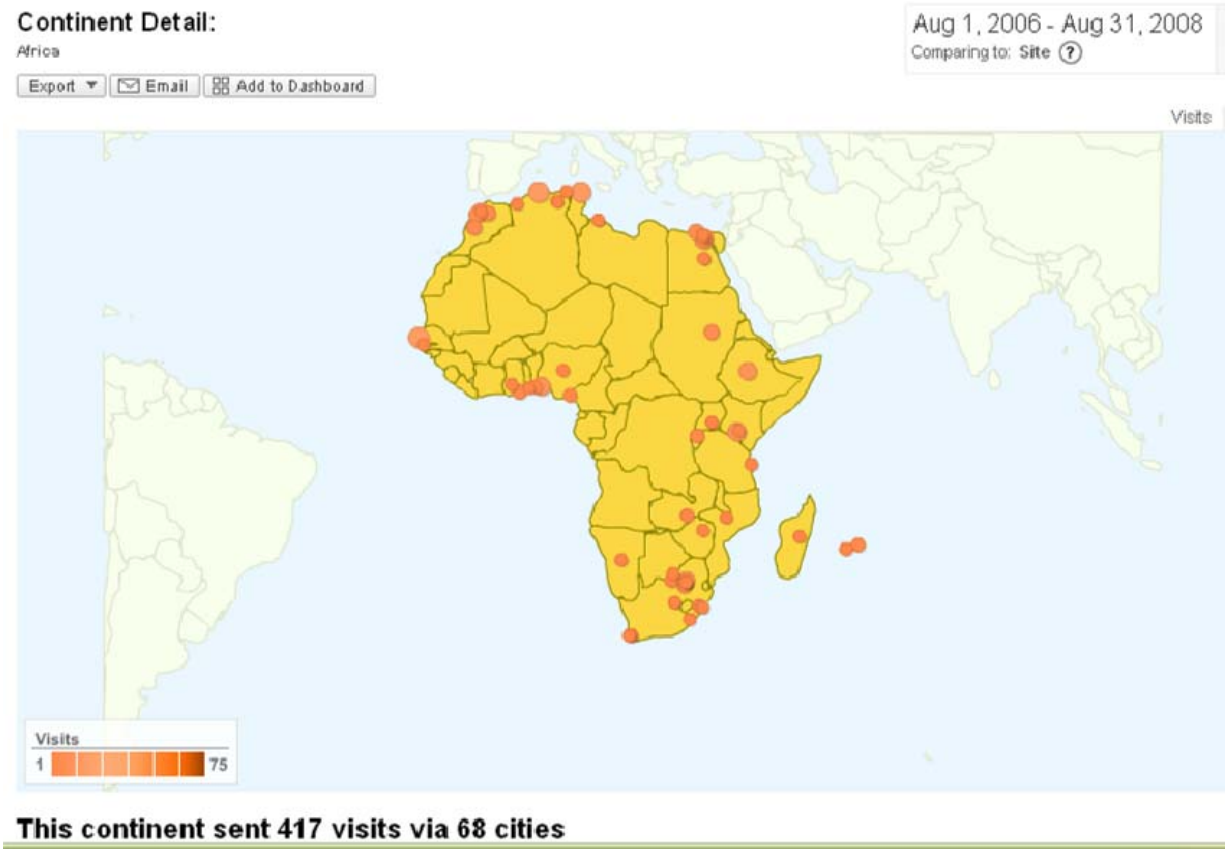

Fig. 6 Number of Visitors to NAGOYA Repository from African Cities for the Past 2 Years

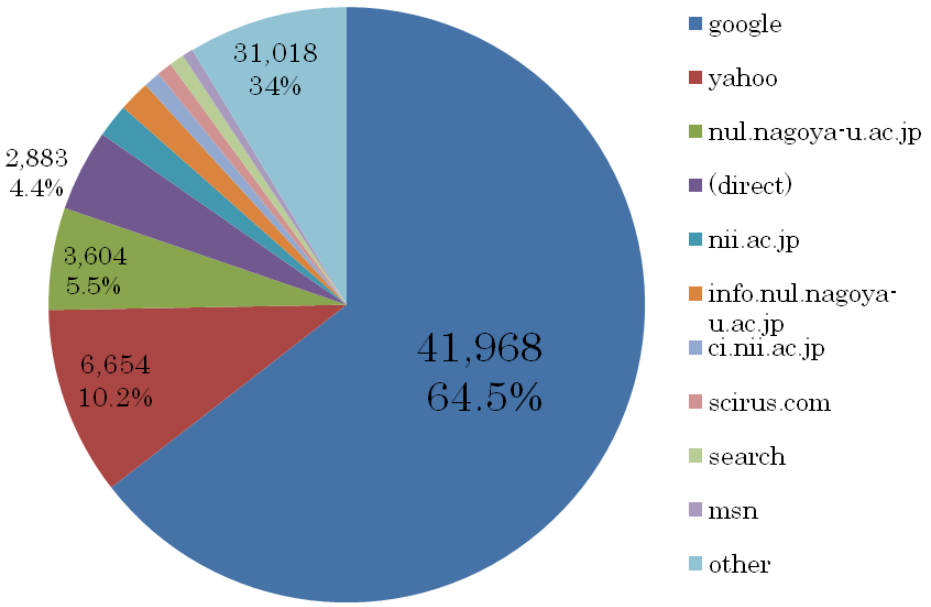

Fig. 7 Traffic Sources

3. NEW DEVELOPMENTS AND CHALLENGES OF ENGINEERING EDUCATION AND ITS CONTINUOUS PROFESSIONAL DEVELOPMENT

3.1 Role of Engineers and Engineering Education

As civil engineering technology advances and has more power on nature, engineers are required to have the ability to judge what influences technology and its constructions will have on the society and nature and also to judge based on an engineer's ethics what to do on their conscience. Particularly, in relation with environmental problems, engineers need to consider reducing the burden on the environment, not only as to regional environments but also as to earth environment like CO_2 emission. For instance, we are requested to make a construction with low environmental burden [15], based on the examination of CO_2 emission at bridges as shown in Fig. 8.

It will take more than specialized knowledge for civil engineers to get the recognition of "professional." The civil engineering has a close relationship with arts and humanities and social sciences and may need not merely advanced technology but engineering education and its continuous professional development with diversity and internationality. This point is very significant from the perspective of environmental restoration and creation by civil engineering.

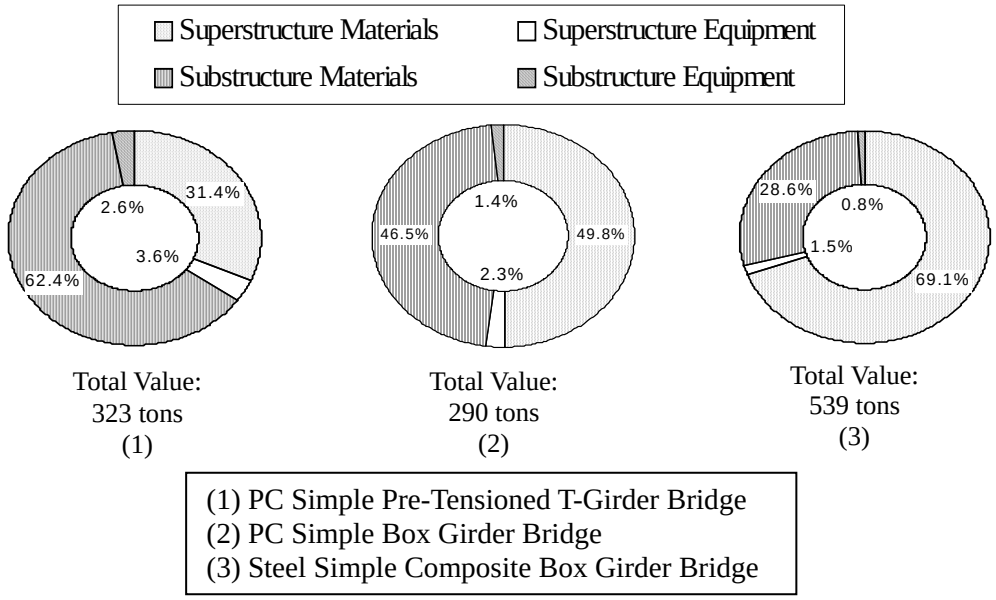

Fig. 8 Proportions of Environmental Impacts from Superstructure and Substructure (CO_2 Emissions)

3.2 Current Situation of the Professional Accreditation System and Engineers' Continuous Professional Development

Recognition system for engineers is a professional accreditation system whereby an outside organization can fairly evaluate whether programs in engineering education conducted by institutions of higher education such as universities reach the levels expected by society and accredit those programs that reach such levels.

Professional accreditation system on a global basis is based on the Washington Accord [5] as follows.

> The Washington Accord, signed in 1989, is an international agreement among bodies responsible for accrediting engineering degree programs. It recognizes the substantial equivalency of programs accredited by those bodies and recommends that graduates of programs accredited by any of the signatory bodies be

recognized by the other bodies as having met the academic requirements for entry to the practice of engineering

JABEE (Japan Accreditation Board for Engineering Education) [4] is a professional accreditation system in Japan, established on November 19, 1999. JABEE is a nongovernmental organization that examines and accredits programs in engineering education in close cooperation with engineering associations and societies. This system is accrediting many of departments of civil engineering and architecture in universities and technical colleges.

Meanwhile, engineers' continuous professional development [1,2,3] has been programmed for various fields of engineering by respective associations or societies. Many societies take a score/point system for participation in their sponsored workshops and academic lectures.

The Japan Society of Civil Engineers has set up the Organization for Promotion of Civil Engineering Technology, JSCE (OPCET) and 4-ranked accreditation system and continuous professional development system. As to the continuous professional development, engineers' competency is classified into 3 categories, professional technical competency, task operational competency and behavioral principles. To renew accreditations, over 250 CPD credits are required for 5 years. As its educational patterns are diversified, one-hour participation in workshops and lectures equals 1 CPD credit and one article publication equals 40 CPD credits. And one-hour self-learning equals 0.5 CPD credit.

In 2003, the CPD consortium in Construction Engineering Societies and Associations was founded by 11 societies and associations in the field of construction engineering. Respecting the individuality of each continuous professional development, participating societies and associations can share the information and mutually approve other programs and credits.

3.3 Challenges of Continuous Professional Development in the Societies and Associations and the Role of Academic and Research Libraries

Generally speaking, library functions of the societies and associations are so fragile. They only have a collection of their own publications or reports, but unlike academic and research institutions, they have no comprehensive collection of books and journals for research. This is because research itself is conducted by academic and research institutions, and societies and associations need not to hold the functions to comprehensively gather and preserve specialized materials as research infrastructure. Particularly in the field of civil engineering, associated with humanities and social sciences, when a continuous professional development being conducted to acquire a new competency, the materials societies and associations possess may be insufficient.

And then, the societies would hardly establish IRs. They can make their own publications accessible full-text via the J-Stage, but have no chances of storing all of their members' research outputs in IR. As to OCW and e-learning, the societies have the difficulty to do them by themselves. So they will enhance collaboration with academic and research institutions and their libraries.

3.4 Future Problems

The possibility of continuous professional development based on the use of IR and OCW has been discussed, but its weakness became apparent. Namely, it is of great help to engineers' self-learning but has no interactivity which is essential for education. Using the Internet 2.0 technology, we may realize the interactivity on the basis of group intelligence hereafter.

4. CONCLUSION

Some problems in the latest engineering education and its continuous professional development were examined and the new developments of academic and research libraries were stated and then future perspectives of self-learning and information gathering in the continuous professional development were indicated. Main conclusion obtained in this study can be summarized as follows.

1) There should be cooperation between societies and associations, and academic and research libraries in order to establish the environment where intellectual scholarly information is considered common property of mankind and all engineers may have free and simultaneous access to them.
2) The global networking of IRs and OA initiatives has been promoted. Academic and research institutions and engineers throughout the world should support them hand in hand, and they should bring them into the continuous professional development and try to improve the engineers' competency and then should contribute toward people's welfare on their conscience.
3) The information environment to enable international collaboration in the engineering education and its continuous professional development should be constructed on the basis of IRs and OCW.
4) The societies and associations are mostly so fragile in their library functions. To make up for the weakness, they should cooperate with academic and research libraries and drive forward the expansion and usage of IRs.

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REFERENCES

[1] Kawashima, K.: Importance of Continuous Professional Development for Civil Engineers, Constructional Management Technology, No.7, Feb. 2007.
[2] JSCE, Organization for Promotion of Civil Engineering Technology (http: //www.jsce.or.jp/opcet/00_keii.shtml).
[3] Katagiri, M.: State and Suggetion on Continuous Professional Development on Geotechinical Enginnering, Soil and Mechanics and Foundation Engineering, Vo. 52, No. 2, 2004, pp. 34-36.
[4] http://www.jabee.org/english/
[5] http://www.ieagreements.com/Washington-Accord/
[6] http://www.cdio.org/
[7] Y. Itoh, Institutional repository in Japan, Proc. of “Standing on the Shoulders of Digital Giants” Int. Smp. On Institutional Repositories, e-Science and the Future of Scholarly Communication, Tokyo, 2006, pp.113-144.
[8] Itoh, Y., Present Situation and Issues of the Consortia of Electro Journal in Japan, International Advanced Digital Library Conf. in Nagoya, Japan, 2006, pp.97-108.
[9] Itoh, Y., Establishment of the consortia of electronic journals in Japan, IFLA Preconf. 2003, Munich, German, 12 pages, 2003.
[10] Open Access Japan (http://www.openaccessjapan.com/resources/history.html).
[11] Clifford A. Lynch, “Institutional Repositories: Essential Infrastructure for Scholarship in

the Digital Age," 2003 (http://www.arl.org/resources/pubs/br/br226/br226ir.shtml).
[12] MIT: (http://ocw.mit.edu/OcwWeb/web/home/home/index.htm).
[13] The Alliance for Taxpayer Access (http://www.taxpayeraccess.org/bof.html).
[14] Networked Digital Library of Theses and Dissertations (http://www.ndldt.org).
[15] Itoh, Y. et al.: Study on Environmental Impact of Bridges for Type Selection, The Sixth East Asia-Pacific Conference on Structural Engineering & Construction, Taipei, January, 1998, pp. 393-398.