

## **Access to scholarly literature via a free knowledge management enabler: an opportunity for scientists in developing countries**

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### **Overview**

The main goal of the electronic Journals Delivery Service (eJDS) [[www.ejds.org](http://www.ejds.org)] is to distribute upon request, via e-mail, specific research articles to scientists working in developing countries free of charge. These scientists are severely hampered by the lack of sufficient bandwidth to directly download material from the Internet. Indeed, they cannot afford the connection and do not have subscriptions to scholarly journals.

The acute lack of access to modern literature in some institutes in the developing world is a persistent problem. Downloading via eJDS can provide a unique mechanism for scientists to remain well informed and carry out their own research. Researchers in developing countries rely also on colleagues travelling abroad as well as personal contacts. Or, in the old-fashioned way, they write directly to authors asking for reprints of their papers.

eJDS is a concrete attempt to bridge the digital and knowledge divides by applying low-cost open source solutions. It bridges, albeit in a limited way, these divides as the users can download recent papers from competitive and prestigious periodicals which they cannot otherwise afford. The system is based on the [www4mail](#) open source software (Cerdeira 2002) which allows the user to navigate and search the World Wide Web via e-mail only—the most popular communication medium—or via a web-to-email gateway.

One can also view eJDS as a knowledge management enabler for managing the process of identification and accumulation of knowledge or intellectual capital across the developing world. On behalf of its scientific users, eJDS collects and encodes specific requests from knowledge repositories distributed over the Internet in cooperation with publisher databases. This cooperation is achieved through agreements with several important scientific publishing companies and societies which include: the American Mathematical Society, the American Physical Society, Elsevier, the Institute of Physics, the Optical Society of America, the National Academy of Sciences and the World Scientific. Our intention is to expand the base of these agreements.

## eJDS framework

To retrieve an article via eJDS, subscribers fill out the details of a given article of interest (such as Title, Author, Volume, Page Number, and Year), using a web search form that is identical to the one available on the publisher's website. A snapshot of the search engine for the publishers of the American Physical Society is shown in Fig. 1. Users then receive a reply of the search via the web pages filtered by eJDS to match the input requested form. These web pages display links to sources of articles (usually in PDF format). The users can then select article links to trigger an e-mail, and the eJDS server automatically replies with the requested information as an e-mail attachment.

eJDS is a free service but there are limits to its usage. Access to the service is controlled by parameters such as maximum quota per user and maximum file size. It also provides access control lists under which certain file types or unauthorized e-mail addresses can be denied. Access to electronic journals is given according to rules agreed upon in the Memoranda of Understanding with the publishers participating in the programme. These rules are specific to each publisher and each country, bearing a relationship to their economics and development index. The assigned user quota sets limits to the number of articles per publisher that can be accessed each day, month or year. This is to avoid possible misuse and massive downloads from the eJDS server. All sessions are logged and the server does not give access to Web sites, online documents or electronic journals to which an eJDS user has not been granted access.

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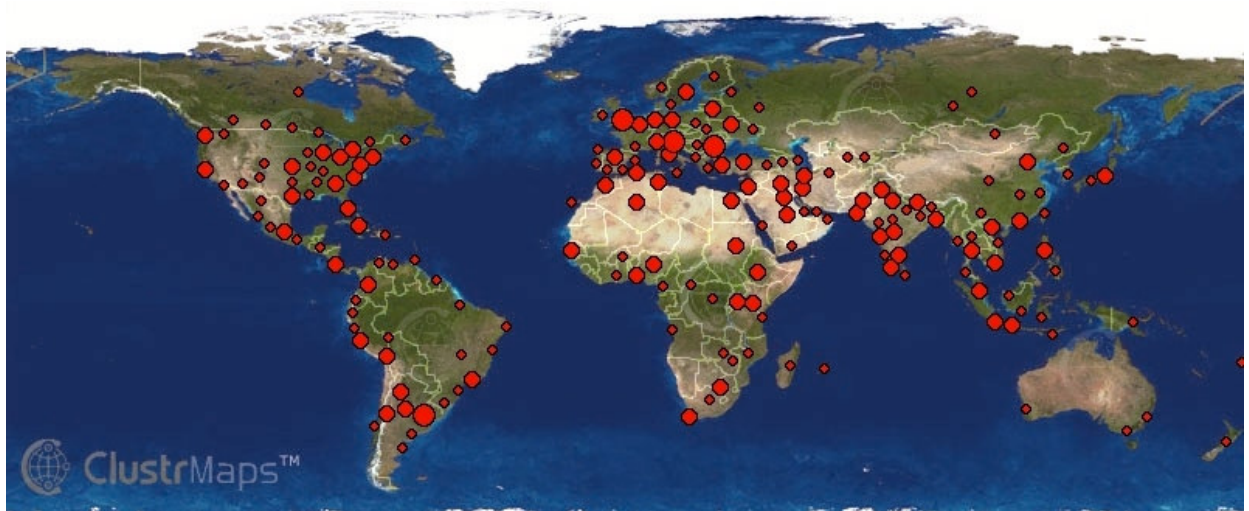
**Fig. 1 Example of search engine used within the eJDS to retrieve articles from a particular publisher**

## eJDS users

Access to eJDS has been available for a few years now ([www4mail.org](http://www4mail.org) – ‘*Web for e-Mail Project*’). As of today, the total number of on-line magazines available through eJDS is in the order of three hundred. Since 2002, the number of registered individual scientists with a unique e-mail account is approximately 4000, while the number of effective users (i.e., users that complete the on-line procedure to be able to use eJDS) is around 2500.

The users of eJDS include young researchers, postgraduate students and professors mainly working in the mathematical sciences and physics. This means that eJDS is mainly directed to support individual scientists rather than institutions. Other scientific disciplines are not covered by eJDS, but this is not a restriction for becoming a user and thus accessing electronic journals which otherwise would not be available.

To demonstrate the global interest expressed in eJDS, we show in Fig. 2 the coverage of visitors in the last seven months to the eJDS web server. The larger red dots represent more than 1000 individual visits to the website while the smaller red dots represent 1-9 visits.



**Fig. 2** The map shows individual visits to the eJDS website in last seven months, clustered within a given distance.

## **Users' comments on the utility of eJDS**

In order to better understand the usefulness of eJDS, a representative sample of effective users was asked the following three questions in May 2006: (1) *How has eJDS been useful for your work?* (2) *Have you published any papers using the articles downloaded via eJDS?* (3) *How difficult has it been to access eJDS in your country?* A review of answers received is provided below.

### **How has eJDS been useful for your work?**

Most users found eJDS to be very useful and highly appreciated its support. This is especially true for departments or universities that no longer subscribe to any electronic journals on physics or mathematics. Even though the rules are clearly stated in the eJDS website, the majority of users would like other journals to be made available to them via eJDS. Their interest is strong not only for reasons of research but also because some publications could serve for pedagogical functions.

### **Have you published any papers using the downloaded articles via eJDS?**

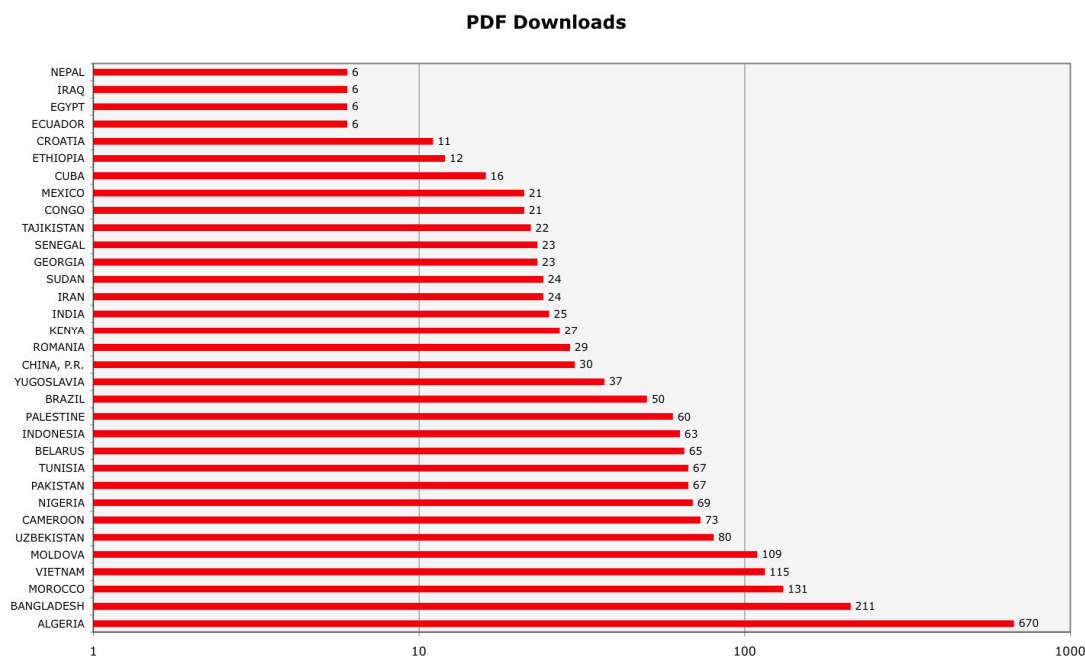
The respondents replied that contributions to international conferences, seminars and Ph.D. dissertations have been prepared using the papers downloaded via eJDS. Several scientific books and physics theses have also been written with the assistance of eJDS. The papers downloaded via eJDS have contributed to the publication of papers in refereed journals. Therefore, eJDS has proven to be a useful source of reference and research material. It is rewarding to find that several hundred scientists have benefited in this particular way from using eJDS since the beginning of the project in 2002.

### **How difficult has it been to access eJDS in your country?**

Only a few difficulties in accessing and using eJDS have been reported and the reasons are the following:

- Lack of confidence with computers;
- Temporary failure of the communication lines (especially in remote areas or places where there is low bandwidth access to the Internet, say 128 Kb VSAT for a whole campus); and
- Lack of desktop computers within a university or department.

Less than 5% of the users were unsuccessful in downloading papers even though the documentation, guidance and help desk were available on the net. In our experience, all those scientists who attempted to access eJDS following the examples given on the website were successful.



**Fig. 3 Number of PDF files downloaded by country in 2005 for all publishers in the eJDS project**

### Achieved eJDS access and use

To give an idea of the number of journals downloaded via eJDS in PDF format, and used by scientists world-wide, we quantify in Fig. 3 the download distribution by country for the past year. In this figure, it is interesting to note that the scientists in countries with very low Digital Access Index (DAI) (from International Telecommunications Union at [www.itu.int](http://www.itu.int)), such as Algeria (DAI: 0.37), Bangladesh (0.18), Morocco (0.33), Vietnam (0.31), Moldova (0.37), and many other countries below the threshold value of 0.5, make the largest use of eJDS for their research work.

A rough correlation of larger eJDS usage for lowest DAI countries is a representative symptom of the digital divide that exists today. The DAI measures the overall ability of individuals in a country to access and use new information and communication technologies (ICTs) built around a country's access to infrastructure, affordability, skill and quality of service with respect to ICTs. Therefore the use of eJDS is a proxy measure of tracking progress towards both improving access to ICTs and getting access to global scientific knowledge in developing countries.

Since the results of the new DAI suggest that affordability and education are equally important factors to measure the overall ability of individuals to access and use ICTs, its

relation to eJDS thus becomes apparent. A longer usage of eJDS by scientists in countries with a lower DAI reflects the fact that the DAI goes beyond the traditional focus on the lack of communication infrastructures but implies that eJDS usage is closely linked to the lack of locally available education resources too.

## **eJDS and knowledge management**

Knowledge management usually refers to a range of practices to distribute available knowledge for re-use, increasing awareness and learning across an entity or individuals. Knowledge management programmes are intended to lead to the achievement of specific outcomes, such as higher levels of innovation and improved knowledge assets. It appears reasonable to think of eJDS in these terms because eJDS is the enabling technology aimed at achieving professional advancement by allowing users to retrieve specific knowledge and become competitive with their peers. Knowledge transfer via eJDS is a relevant aspect of this knowledge management and learning process. On behalf of its scientific users, eJDS collects and encodes specific requests from many knowledge repositories distributed over the Internet, consistent with the databases available from publishers participating in the project.

## **eJDS and the Digital Divide**

Through eJDS, scientists in developing countries can strengthen their scientific foundations and have ready and fast access to scientific data. This is especially so because they are given the opportunity to download articles from refereed eJournals for free in the fields of physics and mathematics, even if the Internet connection is slow at their home. eJDS offers direct access to articles not yet in print on equal terms to their scientific peers in more industrialized countries.

These efforts, based on low-cost open source ICTs, are made to reduce the digital divide in the scientific environment and can be seen as a concrete example of actions oriented to tackle the access to professional information, one of the most pressing 'divide' issues at the centre of globalization's asymmetries. Furthermore, eJDS addresses these main issues of great concern in the scientific community at large:

- *The dissemination of scientific data and information*  
This is necessary for the advancement of research and education in order to provide contents that contribute to the benefit and well-being of society and to promote and participate in international scientific and technological activities. In the absence of adequate connectivity in remote areas, eJDS targets low bandwidth access to help bridging the knowledge and digital divides.

- *Integration of all new and old on-line services to facilitate the transfer of knowledge and exchange of scientific information via the use of ICTs*  
eJDS users can select web links to trigger an e-mail. The eJDS server automatically replies with the requested article as an e-mail attachment.
- *Electronic publishing for development, including copyright issues, e-libraries and the digital contents*  
eJDS is possible through agreements with several important scientific publishing companies and societies.

Future developments of eJDS will continue to keep in mind both the scientific audience and their available computer/network facilities in developing countries. A poor connection to international lines in some cases is not an obstacle for downloading current scientific literature and information. Thus, eJDS can also be seen as a knowledge management computer programme (or enabler) attempting to explicitly manage the process of identification and accumulation of knowledge and intellectual capital across the developing world.

The eJDS approach particularly targets low bandwidth to help bridging the knowledge and digital divides in a rather unique way. To this end, it is important to mention that according to recent active end-to-end performance monitoring of Internet around the world (Cerdeira et al. 2003, Zennaro et al. 2006), it is apparent that most African regions today still have poor to bad connectivity. In fact, many sites supporting hundreds of users appear to have smaller throughput than many homes with DSL, cable, or dial-up modems in developed countries. Even within the same African region, there are differences of more than one order of magnitude in performance between different countries. These realities are not expected to change. Thus, eJDS strategy is in favour of a focused, medium-term vision (Hamel and Prahalad 1994) that offers new opportunities to scientists in developing countries by considering the issue of lack of bandwidth in some parts of the world.

## **Final remarks**

Within the eJDS, the downloading process has been simplified as much as possible. The steps needed to download may differ from one publisher to another because of different on-line services they offer and technologies they use. Their full integration into a common interface has not been possible. Our survey has shown that the majority of users do not face any real difficulty in downloading articles using eJDS. Users enter the eJDS system with their registered e-mail through which they receive automatically the articles requested. This feature simplifies the use of eJDS even further, avoiding recalling passwords and always receiving the sources in one place.

A technical difficulty has been identified in sending downloaded articles that are larger than 2 MB. Sometimes links are slow and users may get error messages. Difficulties may also depend on the period of the day dedicated to eJDS due to traffic congestion on the user's side. Usually, when downloading early in the morning or late in the evening, things generally work more smoothly (a few minutes to retrieve and receive the articles in their mailboxes). It was reported that within office hours, the download process can take more than 10 minutes, or just simply fail in some African countries. Further, some institutional e-mail servers do not allow PDF attachments that are larger than 500 KB or limit the size of the mailboxes to a few MB. However, most users of eJDS have free webmail, such as Yahoo or Gmail accounts, which avoid the constraints of tight disk spaces.

Access to physics and mathematics periodicals in some developing countries is restricted and often practically absent due to the financial difficulties or lack of modern facilities. The articles retrieved using eJDS as e-mail attachments can be stored in the computer and reused later. In this way, both time and bandwidth are saved, a feature especially useful when connecting from cybercafés in developing countries.

The pioneering eJDS model could well be adopted for the alternative delivery of eBooks and expanded to other disciplines beyond physics. The articles made available to users require the permission from publishers who give the electronic contents for free. Under present arrangements between eJDS and participating publishers, scientists from developing countries have access to a much wider range of current scientific information and findings than before. However, the typical requests by eJDS users are essentially two: (1) increased access to more journals (in addition to those assigned by negotiated agreements with publishers), and (2) increased downloading quota. These issues need to be tackled soon.

By means of eJDS, publishers can reach scientists who do not have either the technical or financial means to access information from their journals in a timely fashion. Alternative projects like HINARI (Health InterNetwork Access to Research Initiative at [www.who.int/hinari/en/](http://www.who.int/hinari/en/)) and AGORA (Access to Global Online Research in Agriculture at [www.aginternetnetwork.org](http://www.aginternetnetwork.org)) offer an integrated web interface for libraries and institutions around the world. They provide online articles through direct connection to websites of some publisher partners, promoting cross-disciplinary browsing and searching. As a main difference, eJDS is directed to individual scientists working in institutions of developing countries who do not have sufficient bandwidth to download articles from the web. There are no limits to the number of scientists from a given institution that can use eJDS.

Alternative approaches for providing free or highly discounted rates to on-line journals include the Programme for the Enhancement of Research Information (PERI) [[www.inasp.info/peri/](http://www.inasp.info/peri/)] managed by the International Network for the Availability of Scientific Publications (INASP) and the Electronic Information for Libraries (EIFL) [[www.eifl.net/](http://www.eifl.net/)].



This paper deals more with an original mean of access to scientific information (which is copyrighted by publishers) rather than the process of knowledge management itself. It covers, in general, the access to knowledge resources and users' satisfaction with the system, which is a major issue in knowledge management. From a comparative angle, open access electronic journals, in which all contents are freely available on the Internet to anyone, are an alternative possibility for libraries and scientists towards retrieving information. See, for example, the 'Directory of Open Access Journals' [[www.doaj.org](http://www.doaj.org)]. However, their financing is still an open problem (Canessa et al. 2006). Thus free knowledge management enablers, like eJDS, remain useful for reviewing the recent scientific literature in copyrighted scientific journals and in the case of low-bandwidth access to the Internet. All of this is in support of the research generated in developing regions.

In general, open access to scholarly publications, as a model for enhanced knowledge management, would substantially benefit developing countries. The steps necessary to achieve this goal are not limited to policy changes or funding programmes targeted at institutions in those nations, but also require stakeholders in many countries to undertake initiatives to remedy the global imbalance in access to academic findings. From the results and statistics discussed here, we believe that eJDS provides an opportunity to individual scholars and scientists in developing countries to continue their studies. eJDS can be seen as a novel alternative practice of knowledge management, at least until there will be enough connectivity available to all.

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## Abstract

An overview of the goals and achievements of the electronic Journals Delivery Service (eJDS), provided freely to scientists in developing countries by the Abdus Salam International Centre for Theoretical Physics (ICTP), Italy, is presented. The

implementation of eJDS, based on low-cost and open source software, is a concrete example of how one might reach a world-wide community whose access to scientific literature is otherwise limited. The effort has been made possible by the generous collaboration of publishing companies and scientific societies that donate the electronic contents of their periodicals in physics and mathematics. eJDS can also be seen as a Knowledge Management Enabler that attempts to manage the identification and accumulation of knowledge or intellectual capital of the developing world. A larger eJDS usage from countries with the lowest DAI (Digital Access Index), consistent with the digital and knowledge divides that exists today, is reported.

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