

Challenges in the Selection, Design and Implementation of an Online Submission and Peer Review System for STM Journals

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Abstract

Two international scientific publishers collaborated to develop an Online Submission and Peer Review System (OSPREY) for their journals. Our goals were to meet market demand, increase editorial efficiency and streamline the transition from peer review to publishing. One of the publishers (National Research Council (NRC) Research Press, Canada) had previously purchased a third-party system that was subsequently discontinued by the vendor. Because of this experience and its complex requirements, we decided to build rather than buy a new system. The collaboration with the second publisher, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Publishing, Australia, allowed sharing of resources within a common vision and goals. Agile development through the use of iterations allowed us to continuously add functionality, make improvements and incorporate new requirements. The development team included technical staff as well as stakeholders, future users, business analysts and project managers. The architecture chosen was based on open source technologies, with Java servlets and Java Server Pages for the Web interface. OSPREY currently supports 32 journals at the two publishers. Users accomplish all regular tasks in peer review (submission, selection and invitation of reviewers, submission of review, recommendations and decision) through the software. Editorial staff verifies submissions, sends correspondence and assigns customizable roles and tasks. All tasks are accomplished through a Web browser accessing the application on central servers at the publisher, with no special software or configuration required for any users. Currently, the system integrates with the publishing system by generating manuscript metadata in an XML format, although closer integration with a workflow management system is planned. Since OSPREY implementation, the number of submissions has risen, although marketing and higher ranking of the journals are also factors. For the future, we plan to add new functionality for business tasks and for parsing, tagging and linking of article references.

Keywords: on-line peer review; open source technologies; software architecture; workflow transition

1 Introduction

Our Online Submission and Peer Review System (OSPREY) is a web-based manuscript submission and peer review system used by scholarly publishers and societies to automate and streamline the publication process. It supports the submission of articles and the subsequent peer review process within a configurable automated electronic environment.

Communication with authors, reviewers and editors is handled by e-mail using customizable templates within the system. This is one of many features customizable by publisher or journal; others include copyright and reviewer forms and branding. Authors can upload a single file or multiple files consisting of many file types, and an Adobe Portable Document Format (PDF) file is created immediately. Metadata of accepted manuscripts in an XML format is integrated into the publishing system, however; some manual intervention is still required.

OSPREY is developed and maintained in collaboration between two leading Canadian and Australian scientific publishers. These are Commonwealth Scientific and Industrial Research Organisation (CSIRO) Publishing, Australia, and National Research Council (NRC) Research Press, part of the Canada Institute for Scientific and Technical Information (CISTI).

The objectives were to meet market demands, reduce turnaround times, increase efficiency within the editorial offices and to streamline the transition between peer review and publishing.

1.1 Background

Publishing

CISTI is a science library and a world leader in document delivery for all areas of science, technology, engineering and medicine. CISTI's publishing arm, NRC Research Press, has been a traditional publisher since 1929 and currently publishes 16 international print and online STM journals. With its resources and expertise in place, NRC Research Press began offering its print and electronic publishing services to other Canadian publishers in the late 1990s; as a result, NRC Research Press also publishes 15 client journals.

CSIRO Publishing operates as an independent science and technology publisher with a global reputation for quality products and services. Its internationally recognized publishing programme covers a wide range of scientific disciplines, including agriculture, plant and animal sciences, and environmental management. CSIRO Publishing publishes content in print and online. CSIRO Publishing is an autonomous business unit within CSIRO.

NRC Research Press moved into the electronic publishing world by first publishing content in PDF format on the Web for its subscribers in 1996 and later implementing a process to generate SGML metadata for searching, distribution to aggregators and dynamic generation of table of contents and abstract HTML pages on the Internet. NRC Research Press has since implemented an XML publishing system (Fig. 1) in which content is tagged according to a very rich custom Document type Definition (DTD) and published in print, PDF and HTML formats.

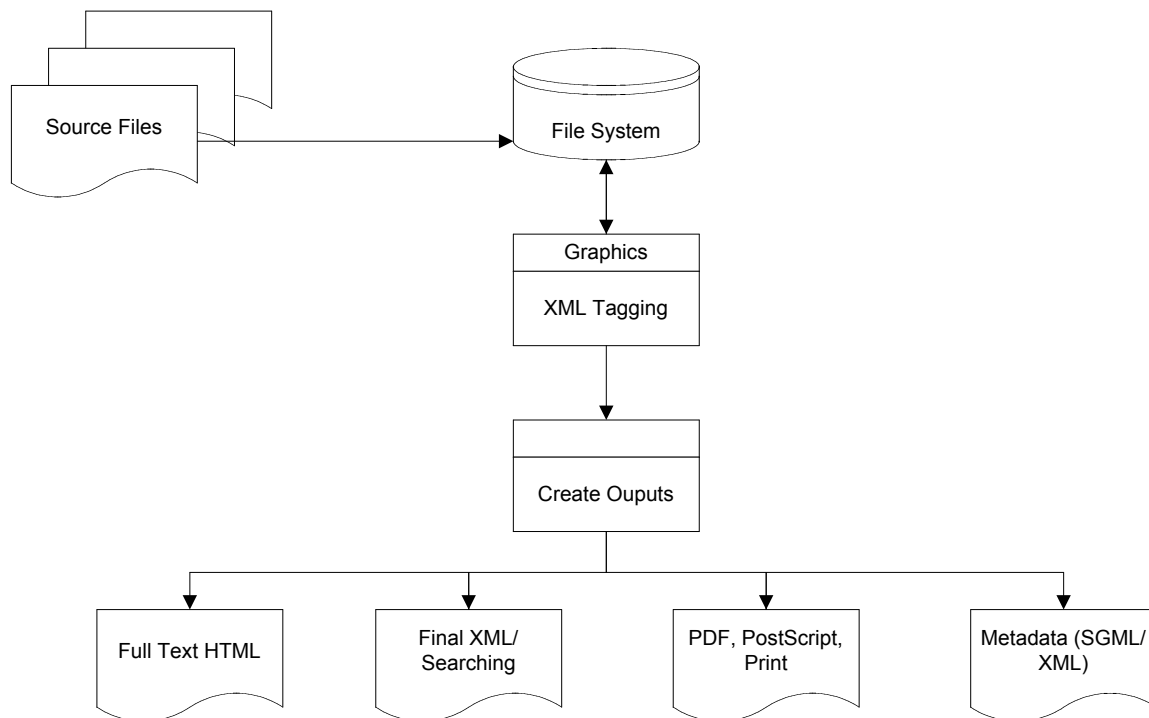


Figure 1: NRC Research Press Publishing Process

Transition to Electronic Peer Review

Traditionally, the submission of manuscripts, the peer review process and the management of the editorial process were paper-based and manual. Authors, reviewers and the journal offices would rely on mail, fax and courier services to deliver manuscripts, reviews and decisions throughout the workflow. Gradually the journal offices moved toward using e-mail for quicker transmission of manuscripts.

In early 2000, NRC Research Press purchased its first online submission and peer review system (PaperPath 2000). This new technology would help bridge the gap in the digital world between the peer review process and publication. It allowed authors and reviewers to submit manuscripts and reviews using a web browser and editorial offices to manage the workflow using third-party client software installed on their desktops. PaperPath 2000 was implemented in 15 journal offices over a 10-month period. In late fall of 2001 the vendor discontinued PaperPath 2000, leaving NRC Research Press with an unsupported product.

NRC Research Press supported PaperPath 2000 for another year and then began its search for a new online peer review system. Many Commercial-Off-The-Shelf (COTS) or licensed products were evolving, however; they did not adequately support a single sign-on, our diverse editorial workflows or our need for a multi-language (English and French) user interface with the potential to expand to other languages. There are many other factors to take into account when deciding whether to purchase or build, after evaluating each option, a decision was made to build in-house. Factors in making the decision were:

- available features in COTS or licensed product
- associated costs (one-time costs and maintenance and support)
- our diverse editorial workflows
- requirement for an English and French interface
- CISTI's technical skills and infrastructure
- storage of confidential data off site
- accessibility to data for customer relationship management
- integration to publishing and subscription management systems
- past experiences with the purchase and implementation of its previous online peer review application

Given the factors listed above we determined that the best approach was to leverage our internal capabilities and ensure our continued access to the source code and systems.

A significant effort was put into developing a solution that would ensure ease of use, minimal overhead and support costs, flexibility, scalability and future growth of features. The system was developed to current standards, using Java and XML for the application and Oracle as its database engine. The system architecture uses a component-based design methodology that enables flexibility and the potential for growth. It supports loose coupling and high cohesion, not only from a functional point of view, but also in the underlying data architecture.

2 Methodology

2.1 Collaboration

A key benefit to a collaborative approach is the ability to share resources (i.e. people and money) and to gather a broader set of requirements. Our experiences have shown us that identifying the roles and responsibilities, following sound project management principles and effectively communicating among team members, users and stakeholders are critical for success.

The two organizations shared a common vision, priorities and goals, helping us to develop ways to work collectively and to communicate effectively. Working together enabled us to draw on the skills and experiences of two scientific publishers. The stakeholders were instrumental in giving the project the priority and support required to develop OSPREY.

2.2 Development Approach

The international collaboration required rapid response to requests and iterations in the development of the user interface. For these reasons, an agile development methodology was chosen [1]. Iterations, which included use cases, analysis, design, implementation and tests, were 6 weeks long. That meant that both sides of the partnership could see new working functionality frequently. This approach made it possible to continuously add new functionality and make improvements. Each iteration could deliver minimal functionality. As new requirements were uncovered, a new iteration would replace the previous one.

Although each organization would install and support OSPREY, the technical development was completed at CISTI by two developers. An infrastructure was put in place to manage concurrent versions of source files and a centralized build function of the application.

The technical project team consisted of two developers, a system administrator, a database administrator and an application architect from CISTI. Representatives from CISTI and CSIRO rounded out the team and included stakeholders, users, business analysts and project managers.

2.3 OSPREY Architecture

There were several options available to deliver a web-based application to clients: Java Applets, Visual Basic, or server-side solutions such as Perl, ColdFusion, ASP or Java Servlets. CISTI's previous implementation of PaperPath 2000 required specific client-side software and hardware which added an additional burden to our technical support team. It was determined early in the project that the best means to meet the objectives was to implement a web-based application, requiring only a standard web browser as the client interface and no additional software on the client side. A Windows platform was chosen for development, however; the application could be ported to a Linux environment if required.

2.3.1 Open Source Technologies

Java, which is platform independent, was used as the programming language. The web interface was implemented with Java servlets and Java Server Pages (JSP), allowing loose coupling with the client-side.[2] CISTI had previously demonstrated the power of these technologies through the development of other successful web applications. The Model View Controller (MVC) design pattern was selected to facilitate rapid development, ease of presentation and consistent application behaviour. MVC is useful in achieving a separation of the business logic, the system control and presentation layer of the application.

The Data Access Object (DAO) pattern is used to allow abstract Enterprise Information System (EIS) independent data access.[3] The OSPREY DAO implementation was designed in the simplest form to allow for maximum speed of development and minimal knowledge to maintain. Consideration was taken to ensure the basic structure of the DAO framework would allow it to be easily extended in future and allow even greater flexibility in selecting DataSources.

Tomcat is used to serve dynamic servlet and JSP pages, while Apache is the web server, serving HTML pages to the user. Using Tomcat for development helped to ensure that the code would be portable and would not use proprietary packages, libraries and classes that are not otherwise available. It has the further advantage of integrating relatively seamlessly with the Apache web server and being open source.

OSPREY was designed to allow a single user to be logged into multiple journals or multiple instances of the same journal from the same HttpSession.[4] This design challenge prompted the creation of a very simple JournalSession framework. A user has one JournalSession for each authentication to an OSPREY journal. Each JournalSession is uniquely identified, holds a reference to the user's name information, and has the basic capacity to store and retrieve attributes.

Reviews and editor decisions are captured in XML and are translated into HTML or plain text format. Metadata in an XML format is exported and imported into the publishing system.

2.3.2 Conversion Service and Software

This service forwards requests to the appropriate servers, performs the transformation, and returns the created PDF to the user. Java Remote Method Invocation (RMI) is used to communicate between the application and the conversion service [5]. It was essential for us to support multiple files and multiple file types in one submission and create a single PDF immediately. To enable this speed and flexibility of conversion, it had to be scalable. The architecture is designed so that the software used to perform the conversions can be easily replaced.

PDF files are created by two different software packages, depending on their file format. LaTeX manuscripts are converted using open source software, MikTeX.[6] Adlib Express Server (third-party licensed software) processes all other file types. Adlib supports up to 300 different file formats and is upgraded frequently to meet the demand of converting newer versions of source files.[7]

2.3.3 Other Technologies

Manuscript data (names, addresses, manuscript data, correspondence, manuscript tracking dates) are stored in an Oracle 9i database, while all versions of the generated PDF and original submitted files are stored in a central Network Attached Storage (NAS) system.

2.3.4 Implementation

Data Conversion

To maintain review and manuscript history, we wanted to migrate as much data as possible to OSPREY. The data were analyzed, and a mapping between the Paperpath 2000 database and OSPREY was created in combination with scripts to extract, validate and import the data. The validation and testing were very time-consuming and should not be underestimated in projects of this type. A trial data conversion was completed prior to moving to production.

The Production Environment

As previously discussed, to fit into the current technical infrastructure of each organization, Windows 2000 was chosen as the operating system and Apache and Tomcat as the web/application server. The OSPREY interface is web based and supports leading web browsers. The file-conversion programs (Adlib and MikTeX) convert several different file types into a single PDF file for reviewing purposes which are not visible to the user.

Four servers and a central storage device support the production environment (Fig. 2) for OSPREY at CISTI. Three additional servers are in place to support development, testing and failover:

- Web/application server
- Database server
- Two conversion servers
- Network attached storage

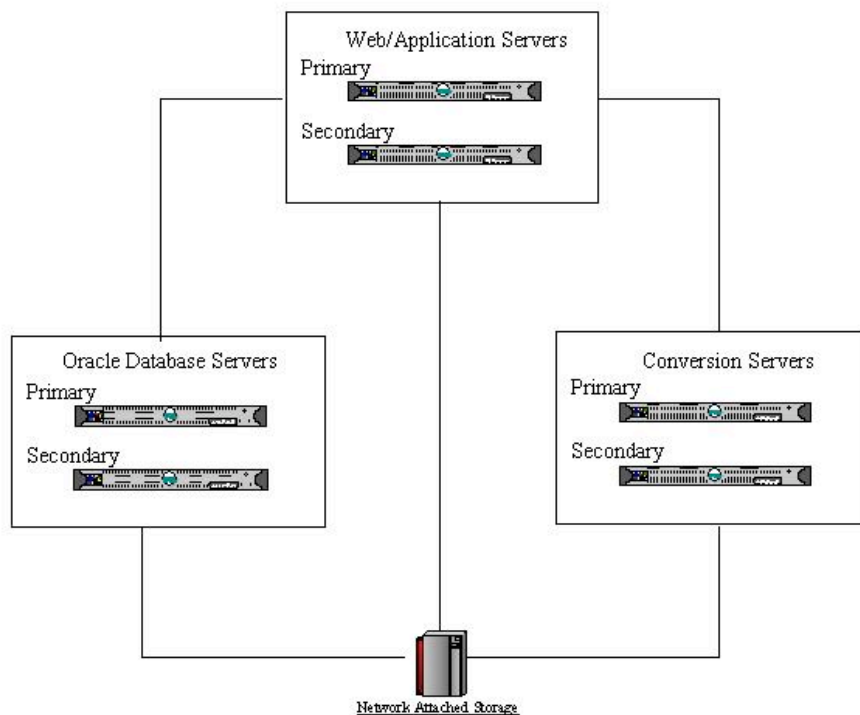


Figure 2: NRC Research Press Production Environment

Integration with NRC Research Press Publishing System

Upon acceptance of a manuscript, an XML file is created and sent to the publishing system (Fig. 3). Some processes are handled manually, while the manuscript, text, figures and supplementary data files are moved automatically to the appropriate file folders on the NAS.

```

<?xml version="1.0" encoding="UTF-8"?>
<EXPORT>
<ITEM>
<ITEM_INFO>
<EXPORT_DATE>13/09/2005</EXPORT_DATE>
</ITEM_INFO>
<MANUSCRIPT>
<TITLE>Life history variation among populations of Canadian Toads in Alberta, Canada</TITLE>
<NUMBER>4727</NUMBER>
<TYPE>Article</TYPE>
<DATE_SUBMITTED>31/08/2004</DATE_SUBMITTED>
<DATE_FINALIZED>13/09/2005</DATE_FINALIZED>
<OUTCOME>Accepted</OUTCOME>
<ABSTRACT>Development of appropriate conservation plans relies on life history information and how
life history traits vary across populations of a species. Such data are lacking for many amphibians,
including the Canadian Toad (Bufo hemiophrys Cope, 1886). Here we use skeletochronology to estimate
size-at-age, growth rates, age at maturity, and longevity of toads from nine populations along a latitudinal
gradient in Alberta, Canada. Size of individual toads within each year class was highly variable, but age and
size (measured as

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Figure 3: Excerpt of Metadata exported from OSPREY

Training and Support

Training was offered to all users prior to implementation with the exception of authors and reviewers. The length of training was dependent upon their user role. Editorial Office Assistants (who coordinate the peer review process for one journal and use the software extensively in their day-to-day work) received up to 4 days of training, while Editors and Associate Editors received 2 to 3 hours. A helpdesk is in place and is supported by one individual on a full-time basis with backup when required. The helpdesk communicates with users by phone or e-mail. The skills required include knowledge of business processes, browser functionality and PDF conversion, as well as an in-depth knowledge of the application and its configuration options and their use.

3 Results

OSPREY has been installed in Canada and Australia, where it is currently supporting a combined total of 32 journals. NRC Research Press began its implementation in 2004, and over several months its journals began to accept online submissions using OSPREY. OSPREY is also used by 5 client journals through a licensing agreement with NRC Research Press.

OSPREY's interface is available in English and French and allows authors to upload manuscripts (Fig. 4), tables and figures, to create a single PDF file, and to check the status of their submissions. Upon the creation of the PDF file, authors are asked to review and approve the PDF file (Fig. 5).

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No files have been attached for this manuscript.

Files
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File	Number to attach
Cover letter	<input type="text" value="0"/>
Manuscript Text	<input type="text" value="0"/>
Figures For Peer review, we recommend uploading low-resolution graphics files.	<input type="text" value="0"/>
Tables	<input type="text" value="0"/>
Supplementary Data	<input type="text" value="0"/>

You may save this submission at this point and complete it later. Important Note: Only the Corresponding Author will be able to complete the submission.

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Figure 4: Upload files

Reviewers enter their reviews online or upload files. Editors select reviewers, vet the reviews and make recommendations or decisions on manuscripts, while editorial staff interacts with the system to verify submissions, send correspondence and assign roles and tasks.

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Create PDF File(s)
Your manuscript (including tables and figures) will proceed through the editorial process in PDF format.

After attaching or deleting files, click on 'Create PDF'. The process of creating PDF file(s) may take several minutes. Upon completion, the page will refresh and a link to the PDF file(s) will be displayed below.

Please click once. Create PDF may take a few moments to initiate. Do not re-click.

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Please review the PDF file(s) to ensure that they are of adequate quality. Adobe Reader is required to view the PDF files.

File Name

*I have viewed the PDF file(s) and I approve their quality. If the quality of the PDF file(s) is not satisfactory, [please let us know](#). The Journal Office will contact you upon receipt of your message.

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Figure 5: Create, Review and Approve PDF file

The system is role-based, which allows journals to limit functions to appropriate users and restrict access to sensitive data. Users have a single sign-on; once logged in, they are presented with links to assigned tasks for each role [Fig. 6].

Each journal may be separately configured and many options are available including branding, workflow and selection of roles and tasks. To meet a journal's workflow requirements, each journal chooses tasks, and the order in which they occur, from a predefined list. In addition, OSPREY provides the flexibility to customize the term used to identify editorial staff roles (editor, editor-in-chief, associate editor, section editor, co-editor).

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[Editor \(1 tasks\)](#)
[Reviewer \(1 tasks\)](#)
[Author \(1 tasks\)](#)
[Editorial Assistant \(0 tasks\)](#)

Your Account
[Change Your Details](#)

Reviewer Work Area

Actions
[View Completed Reviews](#)

Task	Manuscript Number	Title	Date Assigned	Date Due
Submit Review	5881	The use of multiple den sites by Eurasian badgers, Meles mel...	10/04/2007	25/04/2007

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Figure 6: Roles and Assigned Tasks

3.1 Impact

Since the implementation of OSPREY, the number of submissions has increased significantly at NRC Research Press. Overall, they have risen over 32% (Fig. 7). Improved marketing and a rise in the Thompson ISI ranking of some journal titles have also contributed to the increased number of submissions. Subsequently, the total number of manuscripts accepted and rejected has also increased (Fig. 8).

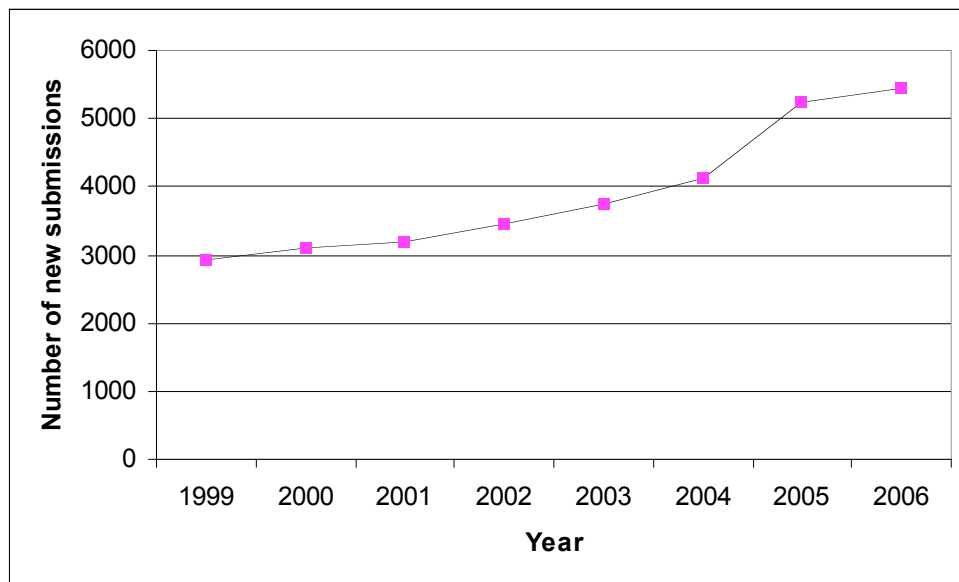


Figure 7: Total number of manuscripts received at NRC Research Press

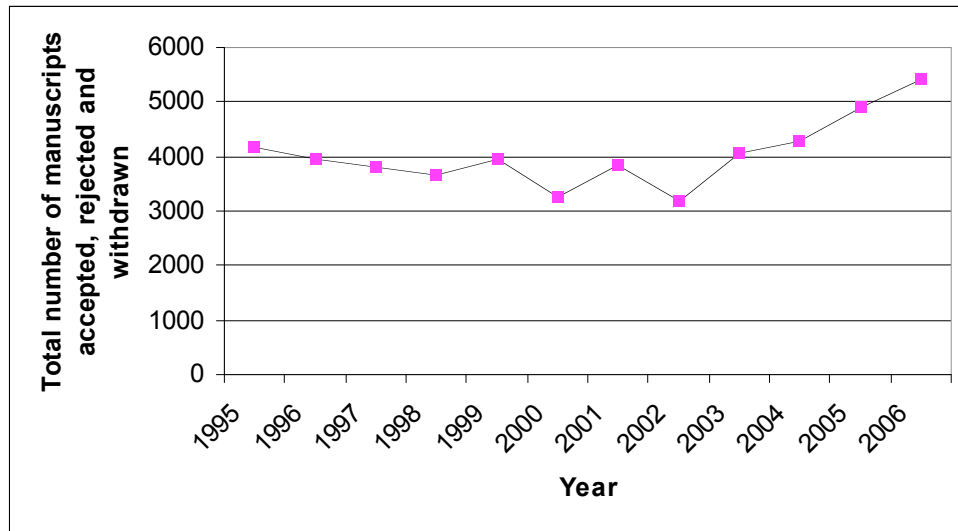


Figure 8: Total number of manuscripts accepted, rejected and withdrawn at NRC Research Press

Thanks to the use of an online system, there have been many changes in the way that authors, reviewers and editors work. Editorial staff now check PDF files for completeness and provide support to authors and reviewers using the system. Authors now receive an automatic acknowledgement of receipt of their submission immediately upon completion, and the paper is in the hands of the Editor faster. All correspondence is saved within the database for easy access. Prior to using an online system, acknowledgments would be sent by mail or e-mail and manuscripts would have to be delivered to the Editor by courier or expedited mail.

Reviewers are now sent an invitation to review a manuscript, as well as automatic reminders to submit their reviews. In the past, the manuscript would be sent to the reviewer by mail, courier or e-mail and a separate system would have to be in place to track the e-mails and any follow-up required. Reviewers can access manuscripts immediately and submit their reviews electronically, allowing Editors to have access to the reviews faster. Reviews and editorial decisions are tagged in XML and can be displayed in HTML or plain text format.

Editors now have access to all data required to process a manuscript from their desktop, regardless of their geographic location. They can now search for reviewers by expertise taxonomy keyword. Each journal has its own set of keywords, assigned to reviewers based on the reviewers' area of expertise. This functionality allows reviewers to be found quickly and their reviewer history, availability and performance, is available immediately.

One of the downsides of an electronic system is the learning curve. Editorial staff had to learn to work differently; instead of having stacks of mail on their desks, they now have an inbox full of e-mail. For convenience and backup, a paper record is still maintained in some cases, however; OSPREY is the primary repository for all manuscript data and correspondence.

3.2 Usability

One of our key design objectives was ease of use. We have received mixed reviews from users; some find the system very intuitive and others have difficulty uploading files during submission and finding links to files for download. Some users have also suggested that the number of clicks required to perform a function should be minimized. The usability issues will be addressed in the future.

3.3 Troubleshooting

For the architectural reasons presented previously, it was the right decision to make OSPREY distributed, accepting that the more distributed the system, the more complex the troubleshooting. OSPREY contains many components and troubleshooting can be very time-consuming. A recent investigation into a problem identified that certain types of corrupt source files could crash the conversion server. In this particular instance, the source file was not of a typical file type. Our testing procedures for conversion now include a thorough test of valid and corrupt files of all accepted file types.

4 Discussion

We recognized that there will be continuous maintenance and product enhancements when developing an in-house system. However, by building in-house we control the product lifecycle, features, priorities and release schedules. Maintenance includes such issues as supporting new versions of content-creation software (e.g., Microsoft Word), new web browsers, and updating the underlying software infrastructure (e.g., Apache web server), while product improvement enhances the application with new features and functions.

Online submission and peer review systems on the market today have been increasingly adding new functionality over the past few years. In other systems, editorial workflows are also customizable, parsing of references and linking to PubMed and CrossRef is now available, and some vendors are offering complete services from peer review to publication. Integrated database searching is also available in some products.[8]

4.1 Future Work

CISTI is currently implementing a workflow management system to manage the XML publishing process. Once this key component is in place, accepted manuscripts and metadata will flow seamlessly from OSPREY to the publishing system and will appear in the appropriate staff work areas automatically. Manuscript metadata and management data will be captured, and manuscripts will be forwarded to pre-editing. Upon publication, OSPREY will be updated with appropriate data (volume, issue, page number, date of publication).

The development and enhancement of OSPREY has opened the door to new opportunities. NRC Research Press currently has service agreements with 5 journals and plans to continue marketing OSPREY through its publishing services programme. A usability study is currently under way and will include interviews and an online survey of the user community. We will focus on ease of use and new functionality.

In addition, we are considering exploring the following functionality:

- parsing and tagging references to provide a link to abstract databases or full text (e.g. PubMed, CrossRef, and user organization link resolver)
- interfaces to allow authors to purchase paper and electronic reprints
- option for authors to identify papers for open access and supply payment or funding
- approving page proofs of accepted papers
- ability to access tasks directly from e-mail
- integration with external databases
- troubleshooting of common graphic file problems

OSPREY is a component-based system which offers us the flexibility to expand and enhance its functionality by changing components. Our current plans include replacing the existing conversion component. The next implementation will make use of web services instead of Java RMI.

5 Conclusion

There are many considerations when moving from a paper-based manual process to an online automated peer review and manuscript submission system or from one online system to another. When purchasing a commercial solution, or developing an in-house system, the impact on authors, reviewers and editorial staff must be considered and managed. Resources required to maintain a system are considerable, not only for software development but for upgrading hardware and software. Systems must be robust and flexible in their design to accommodate new requirements. Adequate training and user support must be put in place early in the project.

References

- [1] SCHUH, P. Integrating Agile Development in the Real World. Charles River Media, Inc of Hingham, Massachusetts, 2003.
- [2] KURNIAWAN, B. How Servlet Containers Work [Online]. May 23, 2003. [Cited April 10, 2007]. Available from the World Wide Web at http://www.onjava.com/pub/a/onjava/2003/05/14/java_webserver.html

- [3] Core J2EE Patterns - Data Access Object. [Online]. Sun Microsystems, Inc. [Cited April 10, 2007]. Available from the World Wide Web at <http://java.sun.com/blueprints/corej2eepatterns/Patterns/DataAccessObject.html>.
- [4] HUNTER, J.; CRAWFORD, W. Java Servlet Programming. O'Reilly & Associates, Inc, 1998. pp. 207-231.
- [5] An Overview of RMI Applications. [Online]. Sun Microsystems, Inc. [Cited April 10, 2007]. Available from the World Wide Web at <http://java.sun.com/docs/books/tutorial/rmi/overview.html>.
- [6] Miktex 2.5. Release August, 2006. Available from the World Wide Web at <http://www.miktex.org/>.
- [7] Adlib Express Server 3.8. Release February 15, 2007. Available from the World Wide Web at <http://www.adlibsoftware.com/ExpressServer.aspx>
- [8] WARE, M. Online submission and peer review systems. A review of currently available systems and the experiences of authors, referees, editors and publishers. United Kingdom: Association of Learned and Professional Society Publishers, 2005.