# The repository as service-oriented institutional infrastructure: the RepoMMan project and Fedora

**Richard Green, Chris Awre, Ian Dolphin, Robert Sherratt**
**e-Services Integration Group, University of Hull, UK**

## Introduction

The RepoMMan (Repository Metadata and Management) project (June 2005 – May 2007) has been funded by the UK's Joint Information Systems Committee (JISC) under its Digital Repositories Programme. RepoMMan is closely aligned with the deployment of the Fedora digital repository system within the University of Hull, and has sought to address two areas of functionality that have generated wide interest in the repository arena: workflow and automated metadata generation. See below for further details of work in these areas.

The repository is the latest in a line of infrastructural services that are being assessed and/or implemented within the University to support the educational, research, and administrative needs of staff and students. The majority of these services are based on open source software, where it is recognised that non-commercial alternatives can provide much of the infrastructure an institution requires.

| | |
|---|---|
| Web content management system | HyperContent |
| Collaboration & Learning Environment/Course Management System | Currently under review |
| Virtual Research Environment | Sakai |
| Institutional portal | uPortal |

All these systems make use of digital content and make it available for users in their own way. Each has its own mechanism for managing this content. However, in order to meet future scalability issues and avoid duplication of effort whilst promoting re-use, it was decided to source an additional infrastructural service to underpin flexible digital content management for the other services as well as providing a common source of digital content for websites and services yet to be determined. An analysis of available options led to the Fedora repository system being selected.

## RepoMMan and workflow

Managing a repository underpinning other infrastructural services brings with it the need to provide ease of use across a number of user groups, and establish agreed workflows. In considering how a repository is going to be used in any particular use case there will be a number of steps involved. Each task will have its own series of steps, and these need to be followed to achieve the desired aim. The RepoMMan project is developing an open standards-based, flexible workflow tool through which users can interact with the repository in a configurable way. The tool is based on a combination of technical approaches: it is making use of Fedora's Web Service API interfaces and orchestrating a series of Web Service calls to these interfaces using BPEL (Business Process Execution Language). BPEL allows for multiple individual steps to be combined, allowing users to focus on the tasks that are important to them. Streamlining interaction will facilitate day-to-day interaction and support content creation as well as submission post-creation.

Interaction with the repository will be enabled through the workflow tool, allowing for streamlined ingest and access. The tool will be presented through the infrastructural services it supports: within the portal, the course management system, the virtual research environment, and through direct web access as required. Relevant content can thus be targeted at the systems that require it and made accessible where it is needed.

## RepoMMan and automated metadata generation

One of the steps to be incorporated into the workflow tool is metadata creation. The creation of quality metadata is essential for the proper management and use of an open repository. It is, though, not viable for this metadata to be entirely human-generated in the light of increasing digital content resources. Many different types of metadata can be created automatically. Technical metadata about digital objects can be gathered through tools such as JHOVE, whilst administrative metadata can be gathered through institutional profiles linked to logins. For example, when interacting with the RepoMMan workflow tool through the institutional portal the portal already knows who the user is and can pass this metadata on to be included in digital objects ingested into the repository.

Automated generation of the third major category of metadata, descriptive metadata, is still a holy grail for the most part. Two main approaches have been identified: a document can be analysed via algorithms to extract a useful set of keywords (albeit that the tool may first need to undergo some form of 'training' with related documents); alternatively a document can be analysed against a controlled vocabulary, perhaps subject based, and a list of keywords generated from this. Candidates exist for both approaches: the Data Fountains work at University of California, Riverside, and New Zealand Digital Library's Kea tool, respectively use the analysis and controlled vocabulary techniques. RepoMMan is assessing both approaches. In both cases, however, it is intended that the metadata created will be presented to the user for their own analysis and amendment: this, it is felt, is likely to produce better metadata than asking the user to create it from scratch.

For more information, visit the RepoMMan website
http://www.hull.ac.uk/esig/repomman/

## The repository as service-oriented institutional infrastructure

A major factor in the decisions taken when selecting institutional infrastructure is the ability for new systems to be managed within an overall service-oriented architecture (SOA). Notwithstanding the ability of different systems to offer their own suite of services through their own interfaces, we are keen to identify systems where the services are also available through well-defined Web Service API interfaces. This will provide the institution with the flexibility to adapt systems to meet evolving needs and combine services from different systems as required, especially where services are exposed at a high level of granularity. SOA is a long-term approach and development path and it is accepted that many systems do not yet fully adhere to this model. Development is thus taking part in a hybrid environment. The potential such architecture offers, however, has encouraged ongoing adoption wherever possible.

The flexibility that SOA can provide can support the institution on two levels: at the technical level it provides the tools to build services without major changes in infrastructure; at the user level it allows services to be rapidly delivered to meet changing requirements. SOA enables technology to meet user needs rather than having the needs adapt to meet technology.

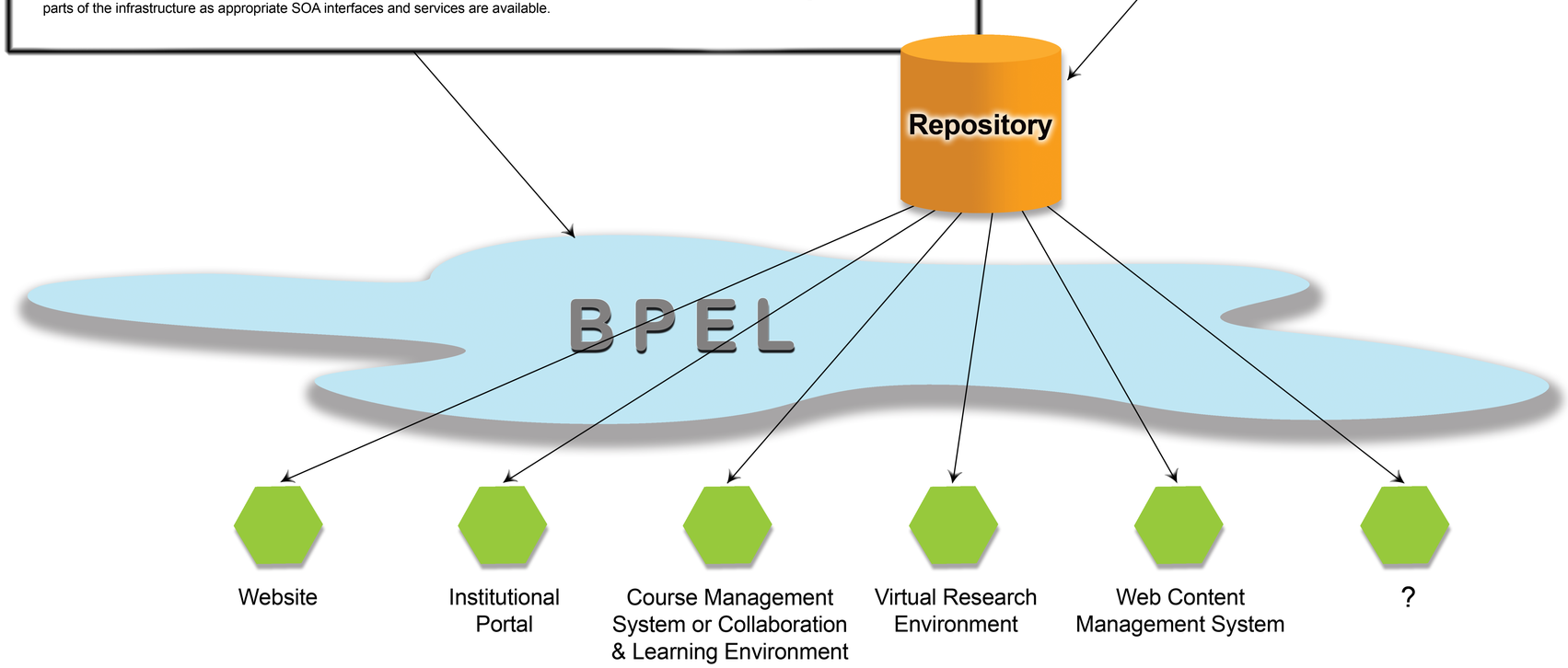
An SOA approach is helping to establish a digital repository as part of our institutional infrastructure. Through orchestration of the Fedora Web Service APIs, BPEL has been used as the basis for the development of a workflow tool to facilitate interaction with the repository. BPEL is an open OASIS standard designed to facilitate the programming of business processes through the orchestration of individual Web Services to achieve an overall task. The workflow tool can be embedded within other infrastructural services such as the institutional portal and streamline interaction with the repository. By delivering access to the repository through an established presentation path, and by facilitating interaction through the use of workflow, it is intended that the repository will avoid becoming yet another system that has to be dealt with and instead become an essential tool in day-to-day activity.

The diagram below highlights the central role the Fedora digital repository is playing in supporting other components of institutional infrastructure. Whilst the emphasis of current work is on using BPEL to facilitate repository integration, it can also enable interaction and integration between other parts of the infrastructure as appropriate SOA interfaces and services are available.

## Fedora

The open source Fedora digital repository system is a framework upon which many repository services can be built. Fedora is built around a powerful digital object model, where individual digital objects can be a combination of any number of data streams: these digital objects may be local to the repository or referenced elsewhere. Because of this high level of granularity within the repository, Fedora allows detailed management of associated metadata and relationships between digital objects. As well as direct access for this management the system has a series of well-defined Web Services interfaces through which all management and access functions can be carried out. This approach, coupled with a detailed security architecture and compliance with the OAIS Reference Model, suited our desire to implement a repository as a key infrastructural service that could be used to support and underpin existing and new infrastructure within the institution.

The Web Service APIs have acted as the basis for the development of the RepoMMan workflow tool, which orchestrates calls to the APIs through the use of BPEL.




Records Management and Digital Preservation
- ▷Regular and timely management of documents
- ▷Online document management, saving space
- ▷Long-term preservation of historical materials

Research
- ▷Open access to e-prints and ETDs
- ▷Long-term record of institutional research
- ▷Management of research datasets

Learning
- ▷Learning materials for re-use
- ▷Access to materials through course management system
- ▷Portfolio development and management

Images/Multimedia
- ▷Marketing collections
- ▷Coordinated management of different multimedia materials
- ▷Research and teaching support

Personal
- ▷Content development area
- ▷Collaboration space
- ▷Personal archive

Administration
- ▷Accurate record of institutional business
- ▷Versioning to support document development
- ▷Coordination across institution

Exams
- ▷Coordinated exam paper development
- ▷Assessment item bank
- ▷Reference point for students

Content dissemination
- ▷Delivery of content where required
- ▷Access to library and archival collections
- ▷Bridging teaching and research