

**The e-Framework for Education and Research:  
An Overview**

**A Paper prepared on behalf of  
DEST (Australia), JISC-CETIS (UK)**

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**[www.e-framework.org](http://www.e-framework.org)**

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## 1 Introduction

This briefing paper provides an overview of the e-Framework for Education and Research (the e-Framework), its strategic context, its aims and objectives, its overall approach, the stakeholders, the benefits and its expected outcomes and impact.

The e-Framework is an initiative by the UK's Joint Information Systems Committee (JISC) and Australia's Department of Education, Science and Training (DEST) (the initial e-Framework Partners). The primary goal of the initiative is to produce an evolving and sustainable, open standards based service oriented technical framework to support the education and research communities.

The e-Framework supports a service-oriented approach to developing and delivering education, research and administration systems. This approach aims to maximise the flexibility and cost effectiveness with which systems can be deployed and enabled to work together at the institutional, national and international levels.

The e-Framework allows the community to document its requirements and processes in a coherent way, and to use these to derive a set of interoperable network services that conform to appropriate open standards. By documenting them in the form of 'reference models' members of the community are better able to collaborate on the development of service components that meet their needs (both within the community and with commercial and other international partners). Thus the e-Framework also functions as a strategic planning tool for the e-Framework Partners, for stakeholder institutions and for developers.

The initiative builds on two earlier initiatives, the e-Learning Framework (ELF) and the JISC Information Environment (JIE), as well as other service oriented initiatives in the areas of scholarly information, research support and administration, and relevant standardisation efforts.

This overview of the e-Framework represents a snapshot of current thinking on the development of a coherent strategy, which is being carried out by the e-Framework Partners in discussion with other interested parties.

## 2 The Partner context

The e-Framework is being developed by an international collaboration partnership. The e-Framework Partners are national agencies responsible for funding the development of Information and Communication Technology (ICT) to enhance learning, teaching, research and their supporting activities.

Currently the e-Framework Partners fund a wide range of software development projects in diverse areas, but often:

- Projects do not relate coherently to any other, let alone work with or build on others.
- There is no coherent record of what has been done.

- There is no way of recording the status of the maturity or level of use of what has been developed.

The e-Framework Partners also recognise the critical role and importance of open specifications and standards, and thus support a range of specification and standards development in diverse areas, such as e-Learning, e-Research e-Libraries and resource management. However, there are two pressing needs currently not met:

- A coherent record of what specifications and standards are available, in what areas.
- A means for recording their current maturity and level of adoption.

The provision of a coherent map is needed to make it easier for the e-Framework Partners to:

- Plan their organisation's programmes and to select projects.
- Coordinate and collaborate with each other.
- Coordinate and collaborate with others working in the same areas.
- Know what development projects have already been done and to build on this work.
- Develop a strategic approach to future development.

A coherent map will also make it easier for projects to work together and build on the outcomes of previous projects, and for stakeholder institutions to know what is available and ready for early adoption or mainstream use. Furthermore, coherence across the software produced will increase its utility, sustainability and wider take up and use.

### **3 Institutional context**

The current typical experience of ICT systems is that while they can provide powerful tools to help in all aspects of the work of Educational Institutions, they are also difficult and expensive to change. In a political, social, technological and economic environment of constant change, existing ICT systems are becoming barriers to strategic adaptation rather than facilitating it, yet they are too expensive and useful to throw away.

At the finer grained level of process improvement or the introduction of new processes, inflexible ICT systems can also act as a barrier.

As ICT is increasingly used in the core activities of learning, teaching and research, many new systems are being introduced and there is a great need to be able to integrate these with existing systems, as well as with each other, but this too is proving difficult and expensive.

Increasingly, Educational Institutions have to be able to exchange information with others, whether facilitating the movement of students entering or leaving, passing information to Funding Authorities or collaborating with other Educational Institutions in regional consortia or as part of international collaborations. Different proprietary systems and platforms make this difficult also.

Changing requirements can make existing systems no longer a good fit. However, where existing systems have been integrated with other systems, often at high cost, the cost of reintegrating a new or replacement system often means that a change cannot be justified until the problem has grown to be a serious one.

#### **4 Aims of the e-Framework for the Partners**

The primary goal of the e-Framework Partnership is to produce an evolving and sustainable, open standards based service oriented technical framework to support the education and research communities. The e-Framework is being developed in accordance with a set of guiding principles (Appendix 1)

The development of the e-Framework will provide significant benefits to stakeholders including policy makers, managers, institutions, suppliers and developers. The benefits of a service oriented framework are widely known and were explored in a paper developed by the e-Framework Partners: Service-Oriented Frameworks: Modelling the infrastructure for the next generation of e-learning systems.

[http://www.jisc.ac.uk/uploaded\\_documents/AltilabServiceOrientedFrameworks.pdf](http://www.jisc.ac.uk/uploaded_documents/AltilabServiceOrientedFrameworks.pdf)

The e-Framework Partners aim to use the e-Framework to:

- Provide a map of the current state of development, of both software and specifications, in the areas in which they work, as the basis for development programme planning.
- Provide a means of coordinating and collaborating with each other and with other funding bodies, both nationally and internationally, in order to share the tasks.
- Enable the planning and prioritisation of the development of specifications and standards.
- Help ensure that the software produced by funded projects works together, where appropriate, in order to build a coherent set of services and user tools and applications.
- Enable coordination and collaboration between funded projects and between funded projects and commercial developers that supply the education and research communities as well as the library, administration and other support communities.
- Provide a better means of disseminating information about products and specifications to those who need to use them as well as guidance on how to use them effectively to meet their needs.

#### **5 Aims of the e-Framework for Educational Institutions**

In developing the e-Framework, the e-Framework Partners aim to assist their stakeholder institutions by:

- Enabling institutional planners to discover and assess relevant ICT resources available to them that might help address current problems they are facing.
- Helping them adopt a service oriented approach to the problems of systems integration.

- Enabling them to implement this approach incrementally, based on addressing the most pressing problems first.
- Enabling greater use of information locked into existing systems, increasing their value.
- Enabling them to exchange information better with other organisations.
- Enabling them to choose service-providing systems with characteristics that more closely fit their needs and available budgets.
- Enabling sets of services to be configured to support evolving institutional processes.
- In the longer term, to enable them to develop flexible ICT infrastructures that can more easily be aligned with institutional strategies

## **6 Aims of the e-Framework for Developers**

The e-Framework seeks to support developers, whether commercial or open source, in three main ways:

- 'Reference Models' which articulate needs, requirements, workflows and processes in a number of domains, checked against a wide number of users and stakeholders in each domain, together with a mapping of each process to underlying technical services.
- Service definitions, with references to specifications and standards appropriate to particular domains of use.
- References to available software, both commercial and open source, that implements the various service types and which they can build on.

## **7 Proposed solution: overview of the e-Framework approach**

In general, the e-Framework concept has been developed by applying the principles and methods of service oriented approaches, currently being developed by all the major ICT vendors, to the fields of educational and research and their support. It draws on similar work done by others working along the same lines, and adds the experience of the e-Framework Partners.

### **7.1 Why this approach?**

In recent years there has been a shift from monolithic application silos towards service oriented approaches where flexible granular functional components expose service behaviours accessible to other applications via loosely coupled standards based interfaces. When this approach is applied in a systematic way, it is known as a Service Oriented Architecture (SOA).

Both the service oriented approach and SOAs have evolved over a number of years, but more recently they have been integrated with Web Services as the main means of implementing service interfaces, and have since been rapidly gaining in popularity. Web Services are being used successfully in the commercial world both to service-enable existing systems as well as to integrate new systems. Such approaches result in more flexible systems that make it easier to align the ICT infrastructure with institutional strategies.

Web Services, being based on Web standards, provide a means of connecting systems both across organisations and across proprietary platforms. The adoption of Web Services has, for the first time, provided a common solution to systems integration that has been agreed upon by all the major ICT vendors, Microsoft, IBM, Sun, Oracle, SAP, BEA, etc.

There is a growing consensus that SOA's provide the best approach so far to addressing systems integration issues within an organisation, with the added benefits of increasing flexibility, while at the same time as lowering costs.

The e-Framework adopts the less formal service oriented approach (small "soa"), rather than a full Service Oriented Architecture (capital "SOA"), usefully adapting the general approach of loosely coupled services whilst allowing for greater flexibility in the technology of implementation.

Educational Institutions can thus adopt services incrementally as needed, or, if they choose, use the e-Framework to develop a full SOA for their ICT infrastructure.

## 7.2 The e-Framework

The e-Framework will consist of structural, process, informational and community participation components. The structural parts draw together a wide range of information and will be made available through the e-Framework's website. The process component, as well as the policies and procedures for the e-Framework Partnership operations and activities, covers processes for the creation of content of the e-Framework and processes for its deployment and effective use.

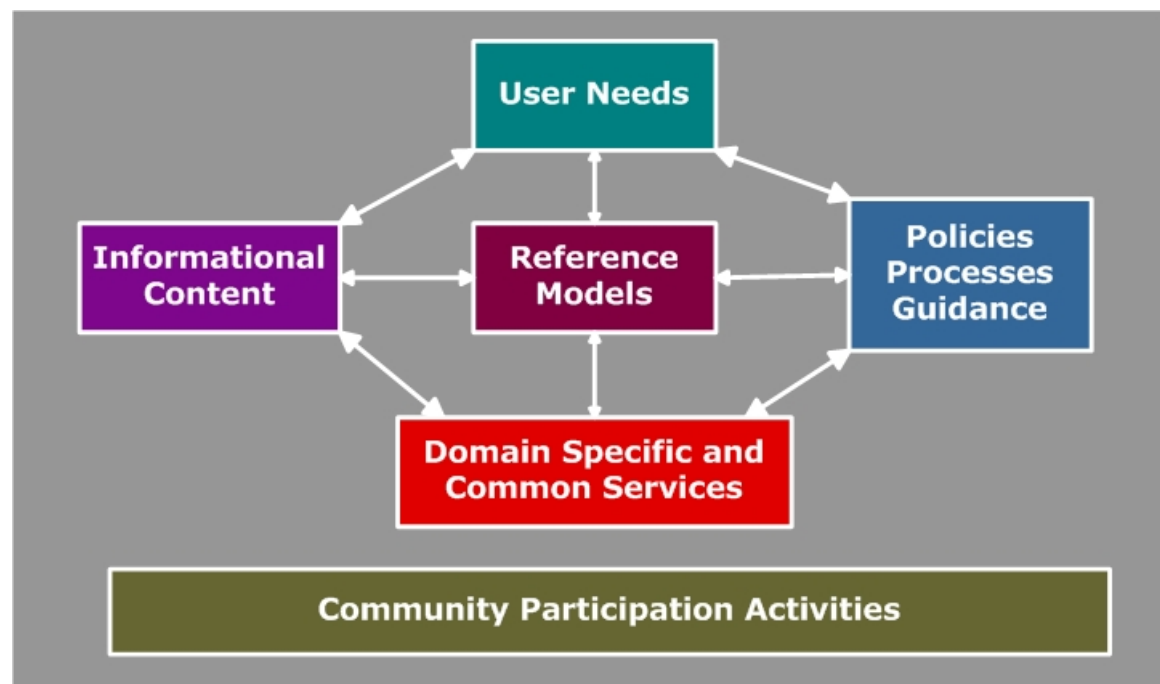
The structural part of the e-Framework has, in turn, two main parts:

- A set of Reference Models.
- A set of Services.

**Reference Models:** A Reference Model identifies a common learning, teaching, research or business requirement and shows how one or more Services can be used to meet this need. A Reference Model also provides cross-links to the Services that it uses in the Service part of the e-Framework. The development of Reference Models is seen as a community based process, involving domain experts and practitioners in analysing existing good practices and problem areas, and in designing the information and process models on which they are based.

**Services:** A Service exposes information or functionality through a public interface that other systems can call on and utilise. Service descriptions will include high level abstract service definitions together with references to available specifications and standards for that service. Clients implementing a service consumer specification may call on any service that implements the corresponding service provider specification. Clients and Services are thus only 'loosely' connected, increasing flexibility.

Diagram 1 shows how parts of the e-Framework fit together:



**Diagram 1. How the parts of the e-Framework fit together**

Documents describing processes such as the Governance and Stewardship Model and policies and procedures are under development. For the e-Framework, documents will be produced that provide guidance on how to:

- Develop Reference Models.
- Use Reference Models.
- Factor and develop services.
- Deploy services and their implementations.

The informational components will include links to programmes and projects and to commercial vendors and open source projects that are implementing e-Framework components. It will be used to disseminate the outcomes of e-Framework related activities of the e-Framework Partners and other interested communities. Community participation components of the web site will provide opportunities for discussion and community contribution to the development of the e-Framework and its deployment.

The e-Framework thus seeks to provide:

- A classification of the domains that are important to the e-Framework Partners against which can be mapped both the reference models and the service specifications/standards. These in turn will contain references to the relevant software tools, applications and service implementations, as well as to associated Partners' Development activities.
- A set of processes for developing and populating its structure and content.
- Guidance on its effective use.

## 8 Reference Models

The term "Reference Model" is currently used in the e-Framework as a place holder for the concept of developing models based on learning, teaching, research or business requirements to show how one or more Services can be used to meet the described need. There has been much discussion amongst the e-Framework Partner communities about appropriate terminology, methodologies to be adopted and content of "Reference Models" and reaching agreement about these issues will be an immediate focus for e-Framework activity.

In general terms a Reference Model should provide:

- An abstract task model of what has to be accomplished to meet the needs addressed, described in a way that is independent of how it is accomplished
- The description of the chosen means of implementing this model, including:
  - The roles and activities that humans and computer systems are respectively to play in accomplishing this task.
  - The workflow or processes involved.
  - The use cases involved at one or more points in the process that form part of the computer system requirements at each point.
  - From the use cases are derived:
    - a specification of the service or services called on, together with links to the specifications and bindings used; and
    - a specification of how the various services are co-ordinated in those cases where they have to work together.

A Reference Model can be developed at different levels and for different purposes. Most Reference Models will take on the role of exemplars that provide guidance to implementers and would be adapted to meet local conditions. More architecturally targeted Reference Models may, in whole or in part, be treated as normative by one or more partners, or communities of common interest. The e-Framework Partners may develop a vocabulary around the central concept of Reference Models that helps users of the e-Framework differentiate between the different roles Reference Models can play.

Reference Models play a key role in bridging the world of users with the underlying invisible world of services. They thus also provide a route for institutional planners and users to finding appropriate tools and services that meet their needs.

Reference Models and any accompanying reference implementations provide idealised exemplars that help with deployment and can be modified or adapted to fit particular institutional circumstances. More importantly, they help ensure that development is driven by human and organisational needs rather than by technology.

## 9 Services

Each service has a definition and will, over time, be extended to include

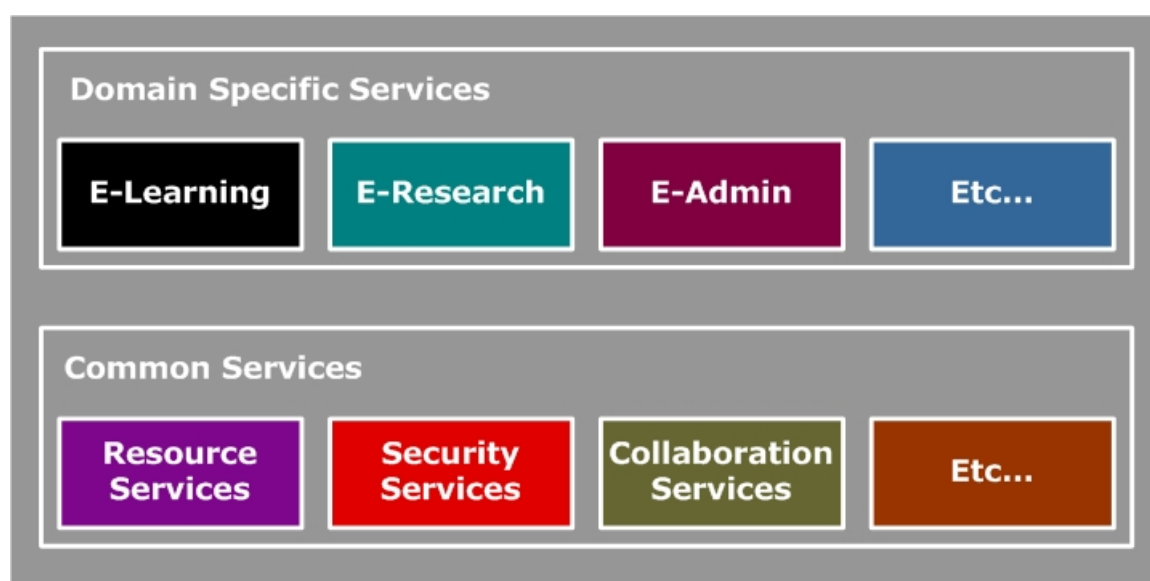
- References to prototype specifications, open specifications and formal standards as they become available.
- References to client and service adapters (such as the JISC service 'Toolkits').
- References to open source and commercial services that implement them.
- References to any Reference Models that use the Service.

Although there will be one underlying set of services, it is envisaged that there will be views of Services which can be broadly mapped to generally recognisable functions of Educational Institutions to help users visualise and navigate the service definitions.

Funded and commercial development projects will be encouraged to implement their software in ways which enable them to build upon, and interoperate with, other software in that area in order to maximise the coherence and potential synergy across the separate development efforts, and to increase the likelihood of their wider adoption by the community.

The main sub-divisions of the set of Services are the Domain Specific Services and the Common Services. Domain specific services in turn are divided into e-Learning, e-Research and e-Admin, potentially with others to be added. Common services in turn are further divided, for example into Messaging, Collaboration, e-Resource Management (including e-Library and general repository management), Resource Management Security, also potentially with others to be added.

The Services within these sub-divisions will have been arrived at by factoring functionality common to several existing applications and reference models and, to a more limited extent, by projecting future functional requirements. The factoring of individual services, particularly the ones that are currently 'empty', is not fixed, but can be expected to change in the light of experience as they become filled out through projects and used in practice. The main sets of services are organised as follows:



**Diagram 2: Main Sets of e-Framework Services**

## 10 Services, User Applications and Tools

Once service implementations become available, lighter weight tools and applications can be built that make use of their functionality. These applications should become quicker and less expensive to produce because they do not have to re-implement service functionality, and because there are relatively standard ways of implementing the service interfaces which can be provided through service adapters. e-Framework toolkit projects may develop such adapters.

Over time, services should become more like commodities, certainly with different characteristics, but all conforming to a standard service interface specification. This should stimulate innovation and adaptation by application developers and end users at the workflow level, as experience has shown that processes are more subject to change than underlying data models. Comparison of reference models will assist in identifying those functions which can be factored out as services to support several applications.

Diagram 3 illustrates the relationship between users, user tools and applications and the underlying services. Lighter weight User Tools, Applications, Portlets, etc. call on domain specific services, such as Learning, Teaching or Research, and either through them, or directly, they call on Common Services.

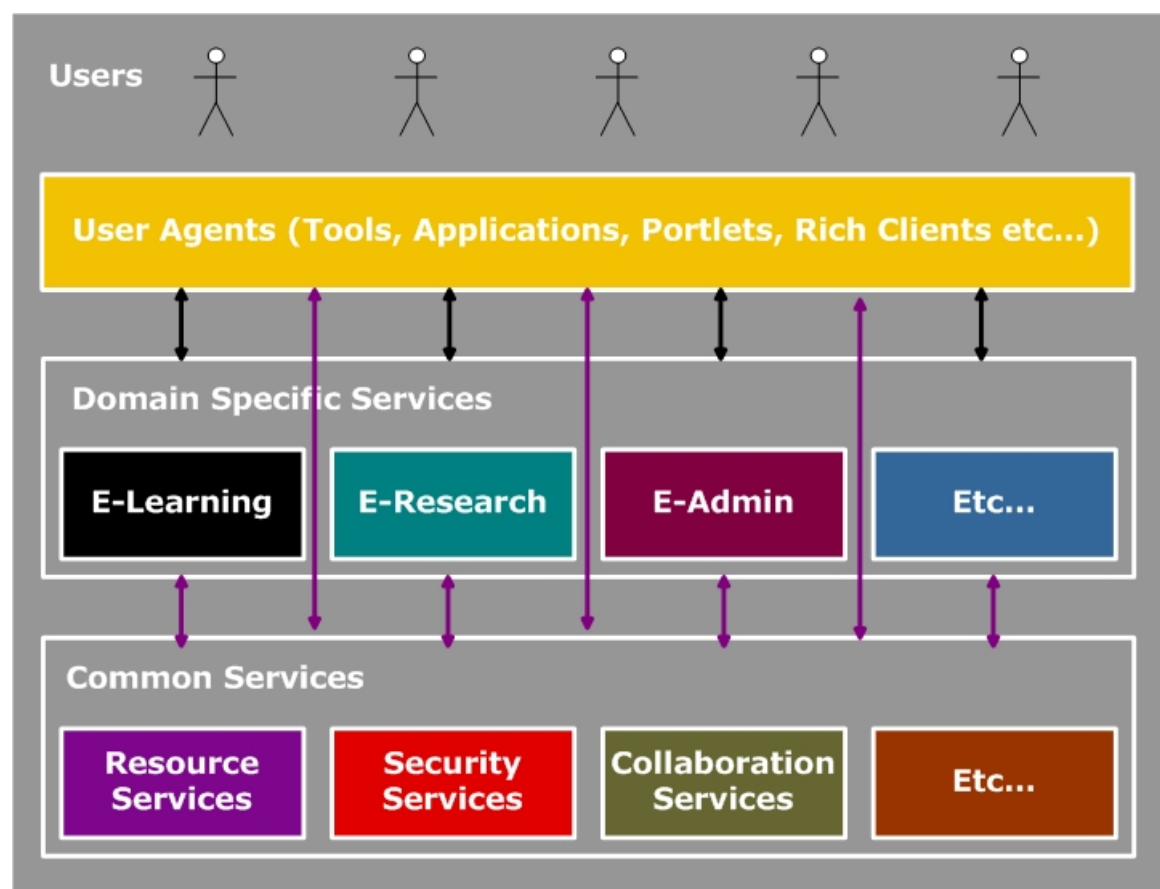


Diagram 3. How the User Agent and Service layers work together

In the future it is likely the e-Framework will be extended with a User Environment / User Agent layer. This would consist of specific plug-in platforms into which tools and service adapters can be added and configured.

## **11 Deployment**

While the e-Framework seeks to provide a coherent map of the territory as a whole, its development, implementation and deployment will necessarily be incremental. In particular, it is not expected that any institution will deploy the whole of it, but will only take advantage of those aspects that address the most pressing problems at any given time.

Further, rather than seeking to replace existing systems, the approach is to provide existing systems with service interfaces to specific parts of their functionality so that these can be used by other applications, or so that the data they provide can be integrated with that of other 'silos' to provide higher level functions. Thus, from the early stages, greater value can be derived from existing systems.

## **12 How e-Framework Partners plan to use the e-Framework**

The e-Framework will be used by the e-Framework Partners to map what is already available and what is currently under development.

The e-Framework will also serve as a means of dissemination for the outcomes from funded programmes and projects.

In the light of policy directives and user experiences from the development programmes and the wider community, the e-Framework Partners will use the e-Framework to help analyse shortcomings in current provision as a basis for planning future programmes.

They will use it as a basis for identifying where further specification work is needed, both to improve early version of specifications and to initiate work in areas of need where no specifications are currently available.

They will also use it as a basis for working with other bodies that have adopted the e-Framework, as a basis for identifying areas of common interest and dividing up the tasks and sharing the results or collaborating on tasks where appropriate.

## **13 Overall approach to development and deployment**

Currently, the e-Framework is more like a sketch of the territory than a detailed map. It is very incomplete, with some parts more detailed and many others empty. It is the function of the empty parts to indicate where work still needs to be done.

Recognition of this is the major reason for seeking collaboration and forming partnerships, along with the recognition of the key role of standards and interoperability specifications which also require international consensus.

During the initiation phase, the areas of the e-Framework that are developed will be prioritised according to the various policy interests of the e-Framework Partners.

Within those areas, the specific services and reference models that are developed will depend on the selection of particular projects, but overall it means that the e-Framework will be developed incrementally over time.

The need for project deliverables to be both interoperable and widely applicable, together with the impact these will have on work practices, necessitates a much higher degree of stakeholder community involvement than has been the case. Stakeholder community participation in the development of the e-Framework will thus be an important new focus for developing the e-Framework.

Domain experts and other stakeholders will need to be involved in the development of reference models.

Given the relationship between the Reference Models and the Services, work in these two areas will mutually influence each other. Reference Models identify services and service specifications that are needed. Reference Implementations either implement services that are available or prototype those that are not. Usage will debug or refine the services and these will then be further tested in the software development project and the use of systems in practice. Thus any service area will go through a number of development iterations until it stabilises and is considered mature enough for general use.

In addition to extending and completing service definitions, and extending the factoring of services from e-learning into the e-Science, e-Administration and Common Services domains, complementary software development projects will be funded, for example:

- The production of client and service adapters, or 'Service Toolkits', designed to be used by other developers to service-enable their systems as they provide the translation to and from the standardised, network-facing, service protocol and the internal language of the application used.
- The implementation of services themselves, where no existing implementations are available.
- The development of reference implementations of services and reference models.

At the User Agent level, the commercial world is already developing graphical tools for composing services into workflows or processes, based on higher level workflow specifications that are emerging for Web services. This will allow more rapid development and evolution of processes which in turn will enable much greater flexibility in ICT provision. Such tools, geared to the particular needs of Educational Institutions, for example with specific support for learning activities and 'learningflows', or workflows for e-research processes, will be another generic development focus.

Effective use of the service oriented approach will require an updating of skills and understanding in the community and therefore, along with community participation, there will also need to be capacity building programmes, both for developers and for users, carried out in parallel.

The e-Framework will also allow the e-Framework Partners' projects and programmes to know about, and build upon, reference models, services and tools being developed by others.

## **14 Outcomes and Impact**

The e-Framework will be developed and detailed gradually over time according to priority and need. This will include:

- Reference Models.
- Service definitions and Specifications.
- Guidance and associated materials.
- Informational materials (such as case studies) references, links to related projects and programmes.
- Service Toolkits.
- Service implementations.
- Reference Implementations.
- Tools and applications that make use of the services.
- Community participation mechanisms and tools (e.g., consultation activities, discussion fora).

The accumulation of resources will support institutions in their development of more flexible ICT infrastructures which can speed up ROI for new developments.

A clear map of the complex domain areas will facilitate planning.

Increased community participation and capacity building will help ensure that:

- Development activities are more closely aligned with the needs of the community.
- The community has the skills and understanding needed to make effective use of the technology.

The e-Framework should ensure more cost effective and sustainable products from development activities.

## **15 Uptake of the e-Framework**

Consultation with the community will be essential to the evolution and uptake of the e-Framework approach.

Engaging with Educational Institution ICT system suppliers and vendors will be necessary for the approach to be broadly effective.

International partners will be essential to the undertaking a task of this scale, as well as to the adoption of common standards.

More broadly, given the scale of the task, it is necessary to open up membership and participation in the e-Framework development processes to the wider world and ensure the e-Framework develops as a best practice approach to the development of ICT infrastructure to support education and research.

## 16 References

For a non-technical introduction to the e-Framework see:

<http://www.elearning.ac.uk/features/nontechguide1>

which covers service orientation and Web services

<http://www.elearning.ac.uk/features/nontechguide2>

which covers their application to e-Learning

These both contain further references

A significant paper setting out the thinking of the e-Framework Partners by JISC, DEST in Australia, Industry Canada and Dan Rehak (Advisor to ADL on SCORM and CORDRA) about the Framework is:

Service-Oriented Frameworks: Modelling the infrastructure for the next generation of e-learning systems Wilson, S, Blinco, K, Rehak, D July 2004

[http://www.jisc.ac.uk/uploaded\\_documents/AltilabServiceOrientedFrameworks.pdf](http://www.jisc.ac.uk/uploaded_documents/AltilabServiceOrientedFrameworks.pdf)

(The concept of a service oriented framework has been extended rather than superseded by development since this paper was prepared)

the e-Framework

<http://www.e-framework.org>

the e-Learning Framework (ELF)

<http://www.elframework.org>

the JISC Information Environment (JIE)

<http://www.ukoln.ac.uk/distributed-systems/jisc-ie/arch/>

To join the e-Framework for Education and Research discussion list go to <http://www.jiscmail.ac.uk/lists/E-FRAMEWORK.html> and click on "join or leave the list"

## **APPENDIX 1- The e-Framework for Education and Research Partnership** (the e-Framework Partnership)

### **Statement of Principles**

#### **Primary goal**

The primary goal of the e-Framework Partnership is to produce an evolving and sustainable, open standards based service oriented technical framework to support the education and research communities

This document outlines the principles that underpin this goal.

#### **Principles**

The e-Framework Partnership intends to operate in accordance with the following guiding principles:

#### **1. The adoption of a service-oriented approach to system and process integration**

- A service-oriented framework provides significant benefits to stakeholders including policy makers, managers, institutions, suppliers and developers and is a business driven approach for developing ICT infrastructure that encourages innovation by being agile and adaptive.
- A service-oriented framework currently provides the best means of addressing systems integration issues within institutions, between institutions and across the domains within education and research.
- The definition of services is driven by business requirements and processes.
- The factoring of the services is a key to the effectiveness of the framework.
- A high level 'abstract' service definition should not duplicate or overlap another service.
- An abstract service definition is a description of a service that is independent of the language or platform that may be used to implement the service.
- The e-Framework activities will strive for technical excellence and adoption of co-developed good practices.

#### **2. The development, promotion and adoption of Open Standards**

- Open Standards are key to achieving integration between systems, institutions and between domains in the education and research communities.
- Open standards are defined for the e-Framework as those standards that are developed collaboratively through due process, are platform independent, vendor neutral, extensible, reusable, publicly accessible, and not encumbered by royalties.
- Open standards achieve impact through international collaboration and consensus.

### **3. Community involvement in the development of the e-Framework**

- Open and transparent processes are essential for the development of the e-Framework.
- Collaboration between technical and domain experts, practitioners, developers and vendors will be essential to the evolution and uptake of the e-Framework approach.
- Capacity and capability need to be developed in communities to enable effective use of the e-Framework.

### **4. Open collaborative development activities**

- In order to support on-going evolution of the e-Framework, results will be made publicly available.
- Engagement with communities of use will be essential in the development of the e-Framework.
- Sustained international development of the e-Framework cannot be undertaken by a single organisation and collaboration between organisations is required.
- Where possible and appropriate, Open Intellectual Property licensing approaches (such as open source, creative commons, royalty free patent licences) will be adopted.

### **5. Flexible and incremental deployment support**

- The e-Framework supports and promotes flexible deployment by stakeholder institutions.
- The e-Framework facilitates incremental deployment and change.
- The e-Framework will accommodate both open source and proprietary implementations.
- Institutions will decide whether to use open or closed source implementations in deploying the e-Framework