Innovation Base Project:
Final report

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May 2010
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Executive Summary

This report discusses the results of the Innovation Base project which developed a locus for the community to share models and promoted the use of modelling in the higher education community.

The project addressed the JISC community’s pressing need to share the model-based knowledge that is being created in its institutions, projects and programmes and to grow experience in the community by capturing the narrative of endeavours rather than just final outcomes.

The project successfully developed the Innovation Base ([http://innovationbase.net/](http://innovationbase.net/)) which offers a number of tools to support the sharing of models. In particular it allows users to upload a model in any format that they have produced the model in, whether this is a simple image of a diagram or a fully developed model in some modelling language such as BPMN, Archimate or UML. It also offers a set of tools that enable users to construct models directly in the Innovation Base and to visualise them there. To date we have methods that support:

- Use Case Analysis,
- Process Analysis,
- Service Usage Model Development,
- Information Modelling,
- Reusable Asset Modelling,
- Enterprise Architecture,
- “Open modelling”.

These are discussed in the report (See Appendix 2: Modelling methods supported by the Innovation Base), and each is described and supported on the web site.

Unfortunately the Innovation Base was only ready for submission of models at the very end of the project; however despite this 36 models have already been uploaded into it with minimal support available from the team.

The other part the project was to support modelling in the community. This was done through workshops and some one-to-one support for particular JISC projects. While there was considerable interest in modelling from many people across different projects and programmes there is currently very little expertise in modelling, or understanding of how modelling can make projects more effective.

We found that people had little idea as to:

- What they should be modelling
- How detailed models needed to be in order to be of value
- How to undertake modelling
- The benefits of different types of modelling.

Our workshops demonstrated to users easy ways that they could get started with modelling with the intention that the models would ensure that all stakeholders had a clearer understanding of the domain under discussion.
It is worth sharing the insights and experience of sharing gained through this, and other projects.

A narrow definition of sharing tends to lead to an expectation of direct re-use or repurposing of models or components of models, but most models, in their final form, are highly contextualised and difficult to reuse as a whole or as components. Models are highly contingent, that is a model depends on both the precise local circumstances and the reason that model is being created. Possibly, as modellers gain expertise and the domain matures, modellers may design their modelling with the intention of repurposing but we have not found that level of sophistication at present.

Taking a view that the purpose of modelling is understanding, then a broader definition of sharing would include sharing that understanding: of boundaries chosen, lessons learned and journeys followed in modelling; providing patterns that can be reused or repurposed, rather than individual instances of models. Sharing experiences in modelling is clearly useful, evidenced by the wish of all the people that we have talked to, to see models that they can use in order to give direction on approaches to their own modelling.

Given the current very low level of expertise and the very high level of interest there is clearly scope for supporting communities of practice around modelling, and we recommend that JISC support communities of practice around modelling in higher education.
Introduction

This report discusses the results of the Innovation Base project which developed a locus for the community to share models and promoted the use of modelling in the higher education community. The report addresses the needs of the community arising from the way in which they are working currently. From an understanding of these needs, we have provided some technology to support their work. We evaluate the extent to which we have understood their needs and to what extent we have provided a helpful tool.

In our report we look at:

1. The development pathway of Innovation Base: from HE domain model to knowledge sharing framework
2. A baseline study of modelling capability across the community
3. Identification of the barriers to modelling and knowledge sharing
4. Ways to overcome the barriers
5. If we were to go back to the design phase, what might we do
6. Innovation Base as a bridge to the e-Framework
7. A real innovation: Innovation Base as a Domain Specific Language for modelling by non-modellers
8. Investment needed to make it a real solution for the sector
The development pathway of Innovation Base: from HE domain model to knowledge sharing framework

The project set out to build and populate a domain model driven knowledgebase and find appropriate ways to engage and support users.

The HE Domain Map needed to be developed in a way that could underpin a live operational system to serve planners and managers. It would be the role of the model to support the inclusion of more detailed domain, process, service models, and make clear both where they fit and how they relate to each other. The domain model had to:

- Encompass the core business processes needed to operate the HE enterprise,
- The things (concrete and abstract) used and produced in the HE enterprise and
- The services needed to support the business processes.

The domain model was designed to:

- Permit ongoing extension and refinement,
- Create a shared vocabulary and facilitate communication,
- Provide the basis for navigation mechanisms for multiple roles using the model and
- Lead to development and validation of services and systems to support practice.

The aim was to collect processes, roles and domain models from multiple modelling endeavours and bring them together in an initial general domain model for the HE sector. The model content would then grow and evolve as modelling work continued in the contexts of multiple research and development projects. This living model could then serve efforts to align ICT with business processes and to support the funding organisation in its decisions about the areas to promote. It would also provide an input to projects, allowing teams to learn from other projects in their areas when bidding and in planning the project activities thus reducing repetition of effort, avoiding known pitfalls and making use of prior project recommendations.

A high level model of a general university was constructed in UML. The model addresses the structure and function of the organisation and the fact that it needs to interact and exchange information with other organisations. It considers the need for people, processes and technology for its operation.
Figure 1: A high level model of a general university
A glossary for all forty seven of the elements in the model was created and agreed across the team to ensure consistency of use. It is shown in Appendix 1: The HE Domain Glossary.

The model sub-divides into nine key areas: Motivation, Organisation, Domain, Role, Work, Artefact, Service Quality and Rule.

<table>
<thead>
<tr>
<th>Model Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>Motivation is the rationale and reasons for doing work. It may be expressed as a vision statement, a mission statement, or as the goals of an organisation.</td>
</tr>
<tr>
<td>Organisation</td>
<td>A company, corporation, firm, enterprise or institution, or part thereof that has its own function(s) and administration and that supplies products or services</td>
</tr>
<tr>
<td>Domain</td>
<td>A sphere of activity, concern, or function.</td>
</tr>
<tr>
<td>Role</td>
<td>A role defines the behaviour and responsibilities of an individual (person), or a set of individuals working together as a team, within the context of an organisation.</td>
</tr>
<tr>
<td>Work</td>
<td>What people in roles or services do to achieve their goals (Motivation). Work either directly adds value in the organisation’s value chains or supports the value adding activities. Work is generally expressed in the form of process, practice, workflow, tasks, functions and activities.</td>
</tr>
<tr>
<td>Artefact</td>
<td>An artefact is a work product of processes: roles use artefacts (resources) to perform activities, and produce artefacts (deliverables) in the course of performing activities.</td>
</tr>
<tr>
<td>Service</td>
<td>A service is an implementation of a function or activity. A service has meaningful business value and is aligned with the concept of a ‘unit of work’.</td>
</tr>
<tr>
<td>Quality</td>
<td>The outcomes of quality evaluation activities in work. They will be measurement/evaluation either of instances of work (activities, practices, processes etc) or of things created by work (artefacts like documents, courses, presentations etc).</td>
</tr>
<tr>
<td>Rule</td>
<td>Rules control work by defining specific constraints that must be satisfied. Rules may apply always or apply only under specific conditions.</td>
</tr>
</tbody>
</table>

Table 1: The domain model key areas

From early discussions with potential users of the knowledgebase, it seemed that it would be easier for knowledgebase users to deal with the smaller number of concepts provided by the key areas of the model, rather than trying to identify instances of all the classes included in the key areas.

The key areas would be used as ‘superclasses’ of the knowledgebase, providing collection points for contributed knowledge elements. As well as reducing the impression of complexity of
the model, this also served to remove some of the granularity and terminology issues, particularly around work where it is common for one person’s process to be another’s activity or in the area of services where there is a wide range of things to which the concept may be applied.

This domain model is equivalent to an ontology of an organisation providing its products and services, in this case those of Higher Education such as qualifications, research, library and knowledge curation. The model’s collection of the elements and their interrelationships provides a framework that may be populated by concrete instances from actual universities.

The knowledgebase application was developed, based on the domain model. A number of interfaces to this knowledgebase were built and tested, each providing an individual application or tool. The first of these applications was called “Explorium” and it serves to permit population of the domain model, provide simple retrievals from the knowledgebase and a simple visualisation of knowledgebase elements and their interrelationships. The second application, “Innovation Base”, was designed to support project teams across the sector in modelling. It is a web application with a set of guided modelling activities for people to follow in order to contribute knowledge elements. It is not designed to be used as a primary modelling environment but as a means to capture the outputs of modelling for sharing.


The community engagement team was set up alongside the technical development team in order to disseminate the idea of a community knowledgebase, run workshops to get people started on modelling their areas of interest, encourage the sharing of information and gather new requirements for the knowledgebase applications.

The envisaged types of use of the Innovation Base were captured in a concept map:
Figure 2: Envisaged uses of the Innovation Base
What are the questions in HE/FE that modelling can help us answer?

The Innovation Base will support HE/FE by providing knowledge elements that can be used to address the following kinds of questions:

- In what way are we tackling a particular area of work (processes and practice)?
- What systems do we use to support a particular area of work (software applications and services)?
- What are the things we use and create in our work (work products)?
- Who are the people and what are their responsibilities (roles)?
- What are the skills needed for particular work (competencies)?
- How much is it costing us (costing, pricing and budgeting)?
- How do our institutions communicate with each other (inter-organisational communications)?
- What data is needed in a particular area of work (data and information)?
- Is there a recommended way to do a task (guidelines and good practice)?
- How do I measure how well work is being done (quality criteria, monitoring and evaluation)?
- Can we improve the way things are done (process enhancement, capability maturity)?
- Can I learn from another institution's way of doing things (Shared knowledge and practice)?
- Is there a system to help me in my new area of responsibility (software applications and services)?
  - Can I add to existing systems?
  - Can I make better use of existing systems?
  - Do I need a new system?
- What were the outcomes of the use of an approach or system (quality evaluation)?
- What would be the impact of changing a process or system (quality evaluation)?
  - Who will be affected?
  - What training will I need?
  - How will I know if I've improved things with the change?
  - How do we plan for change?
- How do we encourage collaboration (Goals and motivation)?
  - Where are the relevant people?
  - Where are the experts?
  - How do we share resources and information?
The Innovation Base will provide a structured place for any kind of modelling outputs so that they may be accessed and shared across the sector. It will allow modelling of the structures and behaviours in systems across HE and FE. Innovation Base will not prescribe modelling type or notation, nor will it require any particular level of detail, precision or rigour. It will thus be agnostic to the type of modelling but supportive to people wishing to learn from others’ experience and to share their own.

The JISC funds a considerable range of innovation activities, organised into projects and programmes. In addition to the direct documentary or software outputs of these activities, key overarching desired outcomes encompass the retention and development of capacity in the sector by sharing knowledge and experience. This acts to promote good practice, improve effectiveness, and to save costs. The JISC has a number of methods for sharing the information innovation activities generate, including the use of web sites, repositories, JISCInfonet and the e-Framework. In general, however, these methods have focussed on the capture and dissemination of formal artefacts. There are few, if any, mechanisms for projects to share informal artefacts describing the systems and processes within their projects or institutions, and relate them to more formal approaches.

Where descriptions, diagrams or models are included in the public record they are often buried in the web site or in the final report and are difficult for others to find, interpret or re-use outside the original context. Experience that is of potential value to the sector is therefore in danger of being lost. There is a need for a more comprehensive approach that can be used to capture those descriptions, diagrams and models that are produced and make them available to others.

If this is to be effective it is essential to recognise and work with current practice in the community, whilst also building capacity for more effective methods of describing processes, scenarios etc. To do this we need to be able to capture the artefacts that projects produce, and encourage them to work in ways that support their own thinking and the sharing of that thinking. There is therefore a need to understand why people are producing these artefacts and why they choose the form that they do.

At one end of the spectrum we have more informal ways of capturing knowledge, for example:

- Whiteboard sketches - showing how ‘things’ are connected in a conceptual way
- Personas - a human representation of a Role
- Scenarios - a narrative of a possible use of the system or a process
- Storyboards - diagrams showing screen layouts in the order of interaction

Capturing these informal sketches, diagrams and descriptions is a valuable first step in being able to communicate and share knowledge in a way that lives beyond the moment that the sketch exists on a whiteboard. They can be described as lightweight modelling. At the more formal end of the modelling spectrum we expect less fuzziness or ambiguity, the model has greater precision, and the symbols used have a syntax and semantics. These formal models require knowledge of the modelling technique to interpret them fully, for example:

- Universal Modelling Language (UML)
- Business Process Modelling Notation (BPMN)
- Archimate

Modelling, lightweight or formal, is undertaken for a number of reasons, including:

- To understand a problem domain
• To develop our thinking, including identifying a solution
• To share our understanding
• To communicate – with the team, or other stakeholders in the problem domain

The aims of the Innovation Base are to:

• Enable the community to have conversations around how to create a shared understanding of their domain:
  o How knowledge can be captured and made available to others,
  o How even the most lightweight sketches and diagrams created in the process of innovation are valuable both to themselves and to others.

• Build capacity in the community to capture their knowledge through modelling:
  o Creating confidence in choosing an appropriate level of formality for their needs through patterns, examples and guidance created by the community itself.

• Act as a structured and guided central repository of knowledge captured as models of higher and further education.

• Show a range of shared models, both informal and formal, in such a way that they can be used by others either as a starting point for their own modelling or to be re-used and re-mixed in their own context.

• Encourage the growth of understanding of the use of modelling in the full range of its forms in the community in order to support the more effective development of processes, services and applications.

• Support the capture of HE /FE processes in the full spectrum of modelling from the lightest weight through to the most sophisticated so that in the sharing of the full variety of models the community can reduce duplication of effort and begin to identify common processes that may realise shared services or common actions. The sharing of this knowledge offers the opportunity for organizations to collaborate to share processes and technology.

• Help project teams and programmes to share the outputs of projects which may be currently only available to a few or become invisible over time so that a wider network of people can make use of them.

• Support the identification and sharing of understanding, good practice, design patterns and solutions to common problems.

What makes the Innovation Base different from previous attempts to produce and share models is its agnosticism as to the method or approach that was used to create the knowledge that it holds. For example the Innovation Base can take knowledge that has been generated from role analysis using the Higher Education Role Analysis (HERA) method, information on enterprise architectures from The Open Group Architecture Framework (TOGAF) method or developments using agile development methods. It can also help to expose the connections between these different approaches to provide a richer understanding of the whole HE domain.
The Innovation Base Development

Modelling Constructs

The Innovation Base works through a number of modelling constructs, these are templates for the principal or common modelling activities undertaken by project teams. The templates provide a structure through which users work to describe a modelling activity. At the end of the process they end up with a logical narrative-based description of their work (suitable for dissemination), as well as graphical model showing the key concepts and connections (suitable for more sophisticated queries).

Figure 3 shows a process model in the Innovation Base, presented as both a narrative hypertext and as a graph.

![Figure 3: Innovation Base Narrative Hypertext (left) and Graph-based (right) displays](image)

Throughout the Innovation Base development project we worked to define a number of core modelling constructs (modelling activities) that we believed offered maximum benefit to the community because of their awareness and applicability.

Use Case Modelling

A use case is the specification of a set of actions performed by a system which yields an observable result that is of value to one or more actors or other stakeholders of the system (UML 2.0).
A use case in software engineering and systems engineering is a description of a system’s behaviour as it responds to a request that originates from outside of that system. In other words, a use case describes "who" can do "what" with the system in question (Ivar Jacobson http://en.wikipedia.org/wiki/Use_case). The use case technique is used to capture a system's behavioural requirements by detailing scenario-driven threads through the functional requirements.

Note: For some people, a use case is another name for a scenario, a short description of someone using the system (from Alistair Cockburn http://alistair.cockburn.us/Use+cases,+ten+years+later).

Use Cases can be used independently of a description of a software system as a description of the work that people do in a particular context.

Process Modelling

Davenport & Short (1990) define a business process as—"a set of logically related tasks performed to achieve a defined business outcome."

Business Process Modelling (BPM) is an approach to developing efficient, repeatable processes that can be applied to the business effectively. BPM allows organisations to map visually their current business activities, creating a comprehensive overview of what actually happens (the ‘as is’ process model). This allows stakeholders to look at a process objectively and facilitates identification of areas of concern and possible ways to improve ways of working. Ideas for process improvement may be captured in ‘to be’ business process models.

Business processes frequently cross organisational boundaries and follow the value chains for the enterprise’s products and services. BPM supports the assessment of change impact across an organisation and facilitates change management.

Information Modelling

Information modelling is a branch of software engineering that deals with the representation of concepts, relationships, rules and operations to specify data semantics for a given domain of discourse.

Service Usage Model

Service Usage Models (SUMs) are a core component of the e-Framework. SUMs provide a description of the needs, requirements, workflows, management policies and processes within a domain and the mapping of these to a design of a structured collection of Service Genres and Service Expressions, resources, associated standards, specifications, data formats, protocols, bindings, etc., that can be used to implement software applications within the domain. In other words, SUMs model how services meet business needs.

Enterprise Architecture

An enterprise architecture (EA) comprises a collection of models that describe the decomposition of an enterprise into systems and subsystems, and the relationships between the component systems. Different EA frameworks and tools currently exist. These include TOGAF, MODAF, DODAF, Archimate, etc. A core advantage of EA modelling is its ability to interlink the models of different parts of an enterprise, and connect models that describe different aspects (such as connecting Roles in a Role Hierarchy to Activities in a Business Process Model).
Currently, the Innovation Base provides support for Archimate-based EA models developed using the Bizzdesign tool. Each such model is organised into a set of views, where each view provides a window that reviews different aspects of the enterprise (by focusing on a particular set of concepts and the relationships between them).

A user may import an entire EA model into the innovation base in two ways: first, all views in the EA model are imported into a single innovation base model. The second approach is to import the EA model such that each view is represented by a single innovation base model. These reflect the flexible granularity of this type of EA model, and allow users to easily group their efforts into a single model page, or to include each view as an independent (but linked) model.

Reusable Asset Modelling

Reusable assets provide a solution to a problem for a given context. They can be made up of software artefacts, models, project plans or any kind of document or multimedia files. The solution is packaged with information on its usage and any related assets.

Open Modelling

Open modelling allows the user to create a model that is not determined by any of the modelling methods listed above. It provides access to all the key areas shown in the table below, together with the permitted relationships between them shown in the subsequent table.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Computer software that employs the capabilities of a computer directly to work (e.g. a process, activity or task) that the role wishes to perform.</td>
</tr>
<tr>
<td>Artefact</td>
<td>An artefact is a work product of a process: roles use artefacts (resources) to perform activities (work), and produce artefacts (deliverables) in the course of performing activities. Artefacts are also used to guide the way in which work is carried out.</td>
</tr>
<tr>
<td>Competency</td>
<td>The ability to execute work (process, practice, task or activity)</td>
</tr>
<tr>
<td>Domain</td>
<td>A sphere of activity, concern, or function.</td>
</tr>
<tr>
<td>Event</td>
<td>Something that happens at a given place and time. An occurrence of something to which the system must respond.</td>
</tr>
<tr>
<td>Information Model</td>
<td>The interrelated collection of data artefacts used, produced and exchanged in the work carried out in an organisation or domain.</td>
</tr>
<tr>
<td>Information Transaction</td>
<td>The information provided in response to a request, or received from another role, service or application in executing work.</td>
</tr>
<tr>
<td></td>
<td>The information provided in response to a request from another role, service or application in executing work.</td>
</tr>
<tr>
<td><strong>organisation</strong> or information received from another <strong>organisation</strong>.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Lifecycle</strong></td>
<td>The description of the distinct phases through which an object passes during its life. It is a series of states (<strong>Lifecycle States</strong>), connected by allowable transitions.</td>
</tr>
<tr>
<td><strong>Lifecycle State</strong></td>
<td>A state is a condition of an object in which it performs some activity or waits for an event. An object may remain in a state for a finite amount of time. It is a component part of a <strong>Lifecycle</strong>.</td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td><strong>Motivation</strong> may be expressed as a vision statement, a mission statement, or goals of an <strong>organisation</strong>. It is the rationale and reasons for doing <strong>work</strong>. The vision statement is a shared mental framework for the direction and aspirations of the <strong>organisation</strong>. A mission statement defines the core purpose of the <strong>organisation</strong>. A goal is a desired state of affairs of a system. Goals provide general purpose and direction. They are the end result of ultimate accomplishment toward which an effort is directed. They generally should reflect perceived present and future need. They must be capable of being effectively pursued.</td>
</tr>
<tr>
<td><strong>Organisation</strong></td>
<td>A company, corporation, firm, enterprise or institution, or part thereof (whether incorporated or not, public or private) that has its own function(s) and administration and that supplies products or <strong>services</strong>.</td>
</tr>
<tr>
<td><strong>Project</strong></td>
<td>A <strong>project</strong> is a finite endeavour (having specific start and completion dates) undertaken to create products or <strong>services</strong> which brings about beneficial change or added value to <strong>organisations</strong>.</td>
</tr>
<tr>
<td><strong>Quality Evaluation</strong></td>
<td>The outcomes of quality evaluation activities in <strong>work</strong>. They will be measurement / evaluation either of instances of <strong>work</strong> (activities, practices, processes etc) or of things created by <strong>work</strong> (<strong>artefacts</strong> like documents, courses, presentations etc). Quality Evaluation relies on feedback - the return of a portion of the output of a process or system to the input or the return of information about the result of a process or activity.</td>
</tr>
<tr>
<td><strong>Role</strong></td>
<td>A <strong>role</strong> defines the behaviour and responsibilities of an individual (Person), or a set of individuals working together as a team, within the context of an <strong>organisation</strong>. A <strong>role</strong> is responsible for delivery of its main purpose (<strong>motivation</strong>)</td>
</tr>
</tbody>
</table>
through one or more activities *(work)*.

**Rule**

Rules define specific constraints that must be satisfied.

Rules may apply always (in which case they are called invariants) or only under a specific condition. If the condition occurs, the rule becomes valid, and must therefore be complied with.

**Service**

A service has meaningful business value and is aligned with the concept of a ‘unit of work’.

A service is an implementation of a function or activity *(work)*.

A software service is a single component or assembly of components that aligns to a ‘unit of work’ in a business process. It is packaged as an autonomous unit with a defined interface. It may be deployed as a Web Service.

**Work**

What people in roles or services do to achieve their goals *(Motivation)*. Work either directly adds value in the organisation’s value chains or supports the value adding activities.

Work is generally expressed in the form of process, practice, workflow, tasks, functions and activities.

Table 2: Entity types permitted in the Innovation Base
<table>
<thead>
<tr>
<th>Superclass</th>
<th>Domain</th>
<th>Work</th>
<th>Event</th>
<th>Rule</th>
<th>Artefact</th>
<th>Motivation</th>
<th>Role</th>
<th>Competency</th>
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Table 3: valid class relationships in the Innovation Base
Open Models give users the flexibility to structure a modelling activity in the way that is most natural to them, for example by chronological causal order, or in logical parts. Figure 4 shows a screenshot of an Open Modelling activity in the Innovation Base, in this case an analysis of the bid documents for the JISC Curriculum Design Programme 2009 broken down into logical parts (stakeholder analyses, scenarios, motivations, etc). The Open Modelling approach allows the various models and concepts expressed in the bid to be assembled together in a logical fashion and interlinked in a meaningful way.

Figure 4: Example of Open Modelling in the Innovation Base
A baseline study of modelling capability across the community

As part of this work we undertook a baseline study to see what modelling had been undertaken in JISC projects by looking at the results that the projects had published. The findings were:

- People in general are not knowingly modelling.
- When people do model, they do so inconsistently (levels of precision and detail).
- Models are often superficial and not fully documented or explained. This means that they are not really knowledge elements on their own.
- Models are often highly contextual and not easily reusable, even at a conceptual level.

However, when people do model they find that it does help to clarify their understanding and inform their thinking. For instance, Jill Armstrong – Dean for Learner Development, York St John University said that “I didn’t expect modelling to help but it can provide greater clarity” and “Modelling helps one to see if there are gaps or incoherence in the quality assurance and enhancement processes”.

The baseline study was supplemented by an online survey, which is reproduced at Appendix 3: Survey of use of modelling in Higher Education. Although the sample size is quite small, and other evidence would suggest that the respondents to the survey are very far from being a representative sample of the population and there is huge variance in the responses there are a number of conclusions that can be drawn.

It is clear that there is some modelling is occurring in the community, though there seems to be little pattern in what types of modelling is being undertaken. However, given JISC’s sponsorship of the Flexible Service Delivery (FSD) Programme there is likely to be an increase in the use of enterprise architecture modelling (using Archimate).

However, given that there are no clear patterns in the use of modelling it is likely that sharing and re-suing of modelling is likely to be problematic. There is only limited use of UML or Archimate for publishing models at the moment, which leads to several problems for sharing models. Firstly, people are unlikely to find models that cover the domain that they are interested in. The survey demonstrates the huge range of different domains that this quite small sample of the population are working in, and this represents a tiny fraction of the work that is occurring in the community as a whole. With relatively few people publishing formal models (Archimate, UML, BPMN etc) the chance of finding a model that is relevant is low. Secondly, even if one finds an existing model it may well not be the type of model that the user is interested in (Enterprise Architecture models are of very limited use if what one is looking for is a process model).

Perhaps more worryingly is the low level of expertise in the community. Nearly all the people that responded to the questionnaire are producing models of one sort or another as outputs of their projects, but as Figure 26 shows with the exceptions of use cases and scenarios people have little expertise in the use of modelling. This would suggest that there is a need to develop the modelling capacity across the community.

Identification of the barriers to modelling and knowledge sharing

In order to encourage the use of effective modelling in the community it is necessary to understand the barriers both to modelling and to the sharing of the knowledge created as a result of the modelling. We have identified at least five barriers:

- There is a lack of modelling capacity in the community. We have found at all the workshops that we have run that people are desperate for support for modelling as they do not have the necessary skills.
- There is a tension between wanting to be able to access shared models but not to contribute. That is, while many people express an interest in making use of models that other people have shared very few are willing to make the effort needed to make the models that they create useful for others and share them. Currently there is little incentive for people to share their models, and therefore to make the effort. For instance, while there are many things that JISC projects produce and agree to share with the
community this very rarely includes any models that projects produce. When combined with the lack of modelling capacity people may also not feel that their models are “good enough” to worth sharing.

- Lack of definition of project outputs or of recognition of their value as knowledge assets. This relates to the previous points. Where programmes do not require people to undertake modelling and to publish the models produced the modelling becomes low priority. This is exacerbated by the lack of models already in existence, causing a viscous circle that other people are not sharing models, so models are not important.....

- Formal notations put people off. Many people are put off by the idea that there is a formal notation that they will have to learn before being able to model, or to share those models.

- Within the Innovation Base, the user interface for entering constructs insufficiently intuitive and easy to use. Though, people are entering models as pdf, visio etc.

**Ways to overcome the barriers**

Probably the most important need is to build a community of practice (CoP) around modelling to support efforts in the community. As with any community of practice this would need to be led by experts, supporting the work of the less knowledgeable to build their knowledge and experience. This is not a quick fix, as effective CoPs take time to build and require energy and effort to support. JISC could play an important part in sustaining a community of practice, perhaps focused on the Flexible Service Delivery Programme.

More specifically, relating to the Innovation Base there are five other areas where work would help to overcome the existing barriers. These are:

- There is a need for further work with users to clarify the user interface requirements in order to make the system more intuitive and meet users’ needs.

- In order to help users of the Innovation Base it is essential to work with projects to identify and classify their work outputs. This would look at what type of modelling people are doing, why they have selected those particular types of model and what they are trying to express with them.

- Enhanced visualisation tools would allow users to understand and explore the models in the Innovation Base more easily.

- Support in selecting the most appropriate modelling method. We have developed a tool to help users to select the most appropriate modelling tool to meet their, and the programme’s needs. This is a simple Excel spreadsheet that enables the user to answer a few simple questions and provides a suggestion for the most appropriate modelling tool to use. The instructions for the tool can be found at Appendix 4: Using the Innovation Base Modelling Toolkit.

- As well as sharing amongst a broad community, the Innovation Base provides services that support self-selecting collaborating communities, whether in a single institution or amongst a group of institutions. The Innovation Base allows users to create their own communities, host their models to provide shared access, organise models in domains to develop shared conceptual understanding, and help to build community through personal and group profiles. We believe that future development supporting these collaborations would be beneficial, for instance using web 2.0 social techniques: commenting and discussion tools, improved visualisation tools, tagging. Encouraging users within these communities to use these services would have the effect of making more resources available for the wider community to share. Note that these need not be tools developed specially to support this type of work; the key is that they support the community.
Making the knowledge area visible and navigable

There are many issues that still need to be addressed in order to make the knowledge in the Innovation Base easier to navigate and understand. However, it has been difficult to address these as there have been insufficient models to understand what is important in the models that people are adding, and insufficient users to gain an understanding of what users consider to be essential, important, interesting or a distraction. Without this information it would be difficult to take further steps in developing the interface, and there would be a strong likelihood that they would not be addressing the real needs of the users.

The illustrations below are based on work undertaken at the University of Manchester for another project that uses the same underlying technology to support curriculum development in the medical school.

Figure 3: All the knowledgebase collection
Figure 4: Visualisation of a process model’s elements
Figure 5: Visualisation of the 'work' elements and its connections
The Innovation Base Workshops

In order to enable and encourage contribution to the knowledgebase, people need to feel comfortable in making their interests and issues explicit and articulating them in models. They then need to be able to see their own models in the context of the general domain model. A number of workshops (the complete list is given at Appendix 5: Workshops run by Innovation Base project) were run with a range of participants including: Human Resources personnel, e-learning technologists, school administrators, clinical tutors, academics, Enterprise Architecture modellers, software development teams, repository developers and JISC programme managers.

In these workshops, the general domain model was presented and the idea for a knowledge sharing space described, with some examples of knowledge elements from areas relevant to the audience. The workshops included a modelling activity based on domain modelling cards.

For the modelling activity based on domain modelling cards the workshop participants divided into small groups (four to six people) and each received a blank A3 sheet, a set of domain cards. The domain cards represented the model areas (superclasses) identified from the domain model and defined in Table 1: The domain model key areas and each had its own colour border and an icon suggestive of the type.

The groups were asked to think about an issue with which they were currently concerned, either as part of their job or within a funded research and development project. They were given five key questions to help structure their description of their domain and issues. These were:

1. Where are we? (Domain and Organisation)
2. Who is here? (Role)
3. What are we doing and why? (Work and Motivation)
4. What things do we use and produce? (Artefact)
5. What controls and supports our work? (Service, Quality and Rule)

The model-building process was demonstrated using a simple description of a town library, its involved roles and their responsibilities for carrying out the work of a library. The groups in the workshops were selected by their common interests and concerns and shared language or viewpoint, for example the Human Resources staff who were facing a major exercise in re-defining roles in universities.

The groups discussed their areas of interest using the five questions and filled in brief descriptions in the relevant domain cards. It was permitted to use multiple cards of any type. The cards were then glued on to A3 sheets and any relationships or links between the cards were written in. The groups were also asked to give a meaningful name to their models.

The groups were shown, in the feedback section of the workshop, how each of these cards represents one or more knowledge elements, linked together by their domain and project context and how their documents and models produced in their projects would be uploaded into the knowledgebase.

The set of domain cards used in the domain modelling workshops
Figure 6: Cards used in modelling workshops
The 5 key questions have proved useful in requirements elicitation meetings as well as in these domain modelling activities and seem to provide just enough structure to cue analysis and description of people's concerns. Feedback from the workshops indicated that people found the modelling exercise helped them to articulate issues and gain clarity. Participants also spoke of increased confidence to tackle modelling when it had seemed complex and daunting.

It seems that having physical cards representing the different knowledge elements as a focus for discussing the model with colleagues helped people tease out the different kinds of elements in their models. A number had expressed difficulties in resolving the boundaries between roles and the work activities of those roles or work activities and the work products associated with them. Using the cards helped clarify the different types of things that they needed to consider in their area of concern.

The modelling card workshops seemed to be most appropriate when an area of concern had already been defined, however loosely, but less appropriate for those projects or groups who were at an earlier stage of their domain exploration. This early, preparatory stage concerns scoping and defining the boundaries of the domain of interest. In order to support this preparatory stage we introduced soft systems modelling techniques at a number of workshops for new modellers involved in the Enterprise Architecture and FSD programmes.

Systems thinking (and soft systems modelling) makes people choose and understand their choices of domain boundaries. Systems thinking encourages modellers to examine the 'soft' elements of domain understanding: potential alliances or conflicts between people in roles, the beliefs, values, motivations and attitudes that cause them and the potential impact on the success of domain innovation.

At the workshop we presented a soft systems modelling method followed by an activity for groups of participants to build collaboratively their own soft systems model based on a case study. The tools needed to create the model were simple and technology free: paper, coloured pens, post-it notes, which lowered the apprehension of the participants about 'modelling'.

The Soft Systems methodology we used included ‘critical systems heuristics’. Heuristics, because it uses a framework to discover ‘boundary’ judgments to build a reference diagram (Soft Systems Diagram) which can provide a narrative for the evidence that is collected and shows where evidence and information is missing or unsupported. Critical because the framework encourages critical questioning of legitimacy, ownership assumptions, motivations

The resultant models provided a powerful narrative structure that enabled the team of modellers to share their understanding, discover gaps in their understanding and start to think about the kinds of more formal modelling tools they might need. Importantly, it forced them to recognise where barriers to innovation might lie and where they would need to consider people in roles in the organisation in their plans for innovation.

Slides from the Modelling Journey. Available to download from: http://www.edshare.soton.ac.uk/5669/

Both methods proved to be valuable in supporting informal modelling and were useful in preparation for more formal modelling.

The workshops provided evidence that building a knowledgebase on a domain modelling foundation is a useful direction to take towards increasing modelling capability and the skills for knowledge sharing. In addition, the community engagement team have received positive feedback on the usefulness of domain modelling for gaining a clearer understanding of issues and identification or exposure of problems. There is some indication that having such a knowledgebase, supported by a community engagement team, will lead to more extensive modelling practice and there is evidence from the discussions in the community that people do wish to share materials, ideas and practices. Likewise, they would like to have easy access to such materials when embarking on a task and would value input from others who have experience in the relevant area.
Innovation Base as a bridge to the e-Framework

One of the motivations for funding the Innovation Base was the need to support the e-Framework, and to make it easier for people to contribute to the e-Framework by providing structured support through the use of specially designed modelling activity guides for the various kinds of information held in the e-Framework, such as creating Service Usage Models (SUMs). These guides help people to provide the information that is needed in a more intuitive way and to relate it to models that they may be producing as part of their work. To design the guides we identified the key roles that might make use of the e-Framework and then looked at the ways in which the Innovation Base might intersect with their interactions with the e-Framework.

Identifying the roles using the e-Framework:

Role 1: Analyst/developer
This may be a combined role of analyst/developer or a programmer.
The task is to write a service-oriented solution to a defined problem. It is assumed that there is a policy on architecture in place or that he has his own rationale for choosing SOA.
He will go to the e-Framework to find definitions of services that already exist. That is, he goes from a problem, to analysis and he names the services he thinks he needs. By naming we mean he identifies behaviours.
Alternatively, if he needs inspiration he could go to the e-Framework with whole problem to see if anyone has solved similar problems.
This means that his starting point is either a problem description or a set of needed services for his system.
Issues:
Terminology: The analysis has identified a set of needed services. They are in the e-Framework but their terminology is different and they are compartmentalised differently. Therefore the analyst has to refactor his work if he is to use them. A decision needs to be made about whether it will pay off to refactor the analysis in order to use e-Framework services.
If he does decide to use the e-Framework he downloads service genres or expressions. He is most likely to use expressions and SUMs using expressions.
Future scenario:
The e-Framework will point to code libraries and instances of existing services that people have.
The analyst/developer documents his system and puts it back for others to use (Contribution Scenario).

Role 2: e-Framework Vocabulary Manager
The Framework Vocabulary (possibly addressed as Service standards manager) operates to create and maintain definitions of services to make the e-Framework a glossary or vocabulary for all.
The e-Framework is to become an authoritative source for the community and an e-Framework ‘committee’ would decide what something means. The intention is that consensus will arise from discussion in the community but the e-Framework will be seeded with an initial set of defined terms.
The Genres are this set of terms, providing a vocabulary of behaviours (in services) for the community, for example, searching, logging, alerting. This set of behaviours or tasks covers all the things people in the sector do. The Genres are atomic tasks or behaviours and can be assembled into more complex tasks or behaviours.
The Role needs to grow the concept pool, working as individuals or in groups. Currently this role is held by the ‘interim modelling group’. The task may be one of individual Genre lifecycle management or Genre collection management. Note that Genre names are verbs ie they are chunks of behaviour. In the e-Framework there will be HE-specific Genres and generic genres that would be found in any sector.

**Role 3: SOA Theorist**

The SOA theorist uses the e-Framework for testing theories and developing methodologies. The SOA theorist will also look at using the e-Framework for the alignment of (business) processes with services.

**Role 4: SOA Methodologist**

The e-Framework as a source of common language can be used to support discussion on methods and approaches in SOA. The methodologist can examine practices around the e-Framework used by people who are developing SOA systems. For example, a SUM may be used to brainstorm a solution architecture for a particular issue, leading to identification of a set of candidate Genres. These can be checked against the Genres in the e-Framework or, alternatively, the current set in the e-Framework can be used to seed the analysis.

Future scenario would be to capture this part of the development lifecycle as contextual elements for the e-Framework.

**Role 5: HEI support services manager**

The HE manager uses the e-Framework to gain intelligence on what is being done by organisations similar to his. By looking at SUMs he can see the communities and institutions involved. He can use this information to reach the people involved or to build competitive advantage.

**Role 6: Funding Manager**

The Funding Manager uses the e-Framework to identify areas of work that have been multiply funded. This will be used to inform decisions about future funding. For example it may find that there have been many funded endeavours around searching but no standards exist for this. The e-Framework can be used to identify areas requiring new standards or refinement of standards.

**Role 7: Collaboration Facilitator**

The collaboration facilitator uses the e-Framework to bring people together who have a common interest. Having a common language in the e-Framework further facilitates collaboration. The e-Framework allows discovery of common interests and areas.

**What are the points of intersection of Innovation Base and e-Framework?**

Elements (SUMs, Genres and Expressions) in the e-Framework have some metadata attached. This needs to be revised and extended. The metadata can be used to help people locate and use the elements.

The Innovation Base has a ‘bucket’ for all matters relating to services. Elements which are characterised as Service link to other elements in the Innovation Base by a set of defined relationships. The links between the different elements in the e-Framework and all the different kinds of things in the Innovation Base need to be established. To this end we need to try to define the contextual information that would be useful for each of the element types in the e-Framework. An element in the e-Framework would therefore be an example (instance) of an element in the e-Framework technical model and would map to (have one or more defined relationships to) elements in the Innovation Base model.
Having a set of problem statements that are addressed by elements in the e-Framework may render the e-Framework more useful. Problem statements will link to domains (areas of interest), organisations, business requirements, roles and descriptions of tasks or responsibilities.
Engagement with the Life Long Learning and Work Development Programme

The initial task in this area was to get hold of the bids submitted by the successful projects and extract any models that could be identified within the bids themselves. These models were extracted and placed within the Innovation Base, and can be found in the Lifelong Learning and Workforce Development Community area.

It is worth pointing out that some of the bids had reasonably clear models that could be extracted directly from them, whilst others had little or no information available at all. At the very simplest all that could be said was that there was a project that belonged to an institution and the project was funded by JISC:

![Figure 7: Welsh Centre of Workforce Development (WCWD)](image)

While others had much more information:

![Figure 8: Personalised systems supporting IPD and CPD within a professional framework](image)
It is notable that in the bids themselves there is no correspondence to the degree to which projects have modelling experience or said that they would produce models and the detail that could be extracted from the bids. However, this is not really surprising as there is no requirement to include any models as part of the bid, and may simply reflect people’s preferred style for writing bids.

Having produced these models contact was made with the programme managers for the programme, and via them with the programme support team at Oxford Brookes University. This was followed by a series of discussions, and a suggestion of which projects to support. However, these were either projects that were already expert in modelling and did not need the support available or projects which were not interested in producing models.

An invitation was then made to attend one of the programme support events and take from there, but at the last minute this was rescinded as there was a change in priorities for the projects. Since then it has not been possible to pursue this work. The remaining effort for this work package was therefore used for other parts of the work.
Engagement with Repositories Community and FSD Programme

Two major strands of work funded by JISC are the Flexible Services Delivery (FSD) Programme, and the work done on repositories through the Open Educational Resources programme and Rapid Innovation projects.

Flexible Services Delivery Programme

The CET worked with CETIS and the Strategic Technologies Group as part of the Flexible Service Delivery Programme. Our objective was to identify clusters of common interests and work with these cluster members to explore their existing knowledge models and share them through the Innovation Base.

A number of potential clusters were identified:

- **Enterprise Architecture Practice Group** – this was a group of institutions engaged in Enterprise Architecture Modelling, mostly through TOGAF and Archimate. Key participants were Kings College London (Kings EA Pilot and DARIAH follow up project), Liverpool John Moores (LJM EA Pilot Project), Roehampton University (CAIRO Project) and Cardiff University (Cardiff EA Pilot). Although efforts were made to engage with the whole group (through email conversations, and the initial EA Practice Group meetings) only Roehampton volunteered models for the Innovation Base, helped to define the import process and provided feedback on the presentation.

- **Intelligent Decision Support SIG** – this was a proposed group of projects investigating the issues around IDS, lead by Tony Clarke at TVU (MCMS Project). This group was initially supposed to begin meeting towards the end of 2009, but despite regular email contact and offers of support, the idea was abandoned at the beginning of 2010.

- **Research Management and Administrative Systems** – this was a project led by Deborah Welland at the University of Exeter. RMAS was an analysis project leading to three Pathfinder projects (now confirmed at Exeter, Kent and Sunderland). Exeter did agree for their original materials to be added to the Innovation Base (as the RMAS model), and also provided feedback on their presentation. But were cautious about adding more recent materials as they felt they were not ready for public dissemination.

Through engagement with these clusters the intention was to discover the level of existing modelling activity, to explore the most useful representations, and begin to evaluate the Innovation Base as a mechanism for sharing.

Repositories Community

With an increased emphasis on Institutional Teaching and Learning Repositories and Open Educational Resources there is a need for better understand the processes behind the creation, sharing and curation of digital teaching resources. The CET worked with the Repositories Community to develop modelling capacity to support this activity.

While there is considerable interest in the use of modelling there is a need to develop the modelling capacity in the community. We supported this development with small interventions to help the projects to get started with modelling and support them as issues arise. We also held events to capture and share modelling teams' experiences.

The main aim of this engagement was to establish an early Innovation Base adopter community who have some initial capability to use and promote the Innovation Base, to get feedback into future Innovation Base functionality and interface enhancements, and to promote increased awareness in the sector as to the benefits of producing models, and increased capacity and capability in the eLearning community in creating and sharing model artefacts.
Workshops

Taking evidence from a series of workshops across the community at JISC and CETIS events, (including the CETIS conference in Birmingham, engagement in the EA workshops, Curriculum Design project activities and FSD meetings), the lack of modelling expertise across the community became quite clear. Most participants at these events were seeking guidance on what to model, how to model and how to choose a suitable modelling tool for their problem. The support they were being offered was above the level of their capability, essentially they needed guidance on how to start. We worked with CETIS to provide support for these novice modellers and introduced the Innovation Base as a means of capturing their models and supporting their efforts.

We developed a workshop and a set of resources to meet this need which were used at the following events: CETIS conference, CETIS Modelling Workshop, EA/FSD Practice group ‘Getting Started Workshop’

The aims of the workshops were to:

- Widen the understanding of modelling and its application
- Demonstrate the basic techniques, using a common example of a new student enrolment process
- Illustrate how and when different approaches are used, and how they connect

The main types of modelling described were:

- **‘Soft’**: based on soft system theory and involving Portfolios of evidence and Scenarios and Personas. Soft models are easily constructed using paper & pens, indeed any art materials – and are valuable for communication and decision support. They are underpinned by a Systems Thinking and Soft Systems methodology. They are an excellent way to get started with as-is sessions bringing together IT and non-technical people from the business and teaching side.
- **‘Hard’**: using formal, standardised modelling languages – Universal Modelling Language (UML), Business Process Modelling (BPML) and EA Modelling (Archimate). Hard languages are excellent for technical specification and development, business intelligence, and in the case of EA for supporting process redesign from ‘as is’ to ‘to be’.
- In any modelling approach the first stage is to gather evidence of the things that are taking place in the area of interest, with the evidence is itself being a lightweight model. It is
  - Used to communicate problems
  - Useful as evidence for potential solutions
  - Useful to others as context to help design change

In soft modelling we showed how **scenarios** describe the way in which individuals interact with systems and **personas** add context of age, situation, motivation and so on. While not necessarily appropriate to purely technical exchanges of data most systems will in the end involve people – customers of a service, so scenarios are widely used to ensure architectural work is strongly customer and business driven.

Of the **hard modelling** approaches and languages we showed where it is appropriate to use:

- **UML** as a visual language for developing software systems, with **structural** and **behavioural** model types
- **BPMN** for modelling workflows of objects triggered by events or messages
- **Enterprise Architecture** for modelling how a whole business fits together

In the practical exercise, groups created a soft model for the appraisal, submission and contract negotiation of a JISC funding call. Besides providing practice in soft system modelling it demonstrated how building a model jointly led to discussion and debate about the process being modelled and how the discussion triggered ideas about process improvement and innovation.

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These start-up workshops seem to have met the needs of ‘pre-modellers’ showing a spectrum of modelling from informal to formal with simple guidance on where to begin. The participants’ evaluation responses included:

‘I found your session extremely valuable, as a modelling novice, and I think the energy levels during the soft modelling exercise reflected that’

Activities

As part of this engagement work we developed a number of engagement activities that could be used to inform people about modelling and the Innovation Base work, and encourage them to start sharing their own modelling work. This included:

CETIS modelling support material

As part of CETIS work to develop modelling skills in the JISC community we developed and delivered material on the Modelling Journey. This was an exploration of lightweight modelling, and its relationship with more formal approaches, and included a simple introduction to UML.

Figure 10: Slides from the Modelling Journey. Available to download from: http://www.edshare.soton.ac.uk/5669/

Topics covered included:

- Portfolios of Evidence
- Scenarios and Personas
- Soft Systems Methods
- UML Use Cases
- UML Activity Diagrams
- UML Sequence Diagrams
• EA modelling with Archimate

As part of the session we also undertook a significant soft systems modelling exercise. Participants were asked to create a soft systems model of responding to a JISC call and setting up a project in a HE institution. They were given a complete soft systems diagram as a guide, and a portfolio of evidence including an example call, conditions of funding, costing guides, JISC strategy summary and example University strategy document.

Figure 10: Soft Systems Diagram stage 2: showing System boundary, inputs and outputs

Figure 11: Completed Systems Diagram of Student Induction
Community for Higher Education Resources Exchange Repositories Group

Community for Higher Education Resources Exchange (CHERE) is an emerging interest group involved in Teaching and Learning Repositories and educational resources. The members, from institutions across the HE sector in England reflect interests in both subject community and institutional repositories. They represent many JISC funded projects from the Repository and OER programmes.

At one of the group meetings we asked the participants to explore the domain of their repository projects in a structured but informal way.

The group used stakeholder analysis to identify the stakeholders in their domain and then used agile techniques to explore personas for each role represented by the stakeholders. They recorded their models in coloured pens on posters, using images and post–it notes.

By developing personas, the group moved beyond role definition and naturally began to think about the attitudes, beliefs and motivations that might affect their ability to innovate in their domain.

The group used their models in a ‘show and tell session’ to create a shared understanding of their domain with the other participants. It was clear that the modelling activity enabled them to structure their knowledge and understanding which aided communication with the others.

Roehampton EA models

A key part of the FSD engagement was to take part in the emerging EA Practise group and to approach the EA Pilot projects as examples of EA models in the Innovation Base. This involved developing an import tool for the Innovation Base, and agreeing on the best ways to present highly complex models on the Innovation Base pages.

Archimate models can be thought of as a complex network of concepts and relationships. Seen as whole they can look overly complex and tangled, so Archimate tools such as Bizzdesign support views into the network that selectively filter certain types of concept and relationships, or which look at particular parts of the model (for example, in a HE EA model a view might show the Admissions process, or Job family hierarchy).

When importing a Archimate model it is necessary to decide whether the whole network becomes a single page, or whether the model is split into multiple views. In consultation with John King at Roehampton we developed an import tool that took the later approach. Figure 11 shows the models that were imported, and Figure 12 shows one of the views as both a hypertext and graphical page.
Figure 11: Models imported from Roehampton

Figure 12: Hypertext and Graphical pages of one View
Although the import system functioned well, our evaluations showed that the Archimate models were surprisingly poor once within the IB. This is because much of the meaning of Archimate is conveyed visually, often with an implicit narrative that exists outside of the model (for example, when presented at a meeting by the modeller, or when used within a larger design document). When imported this narrative is missing and the paucity of the actually model is revealed (with only names and type information remaining). The import tool was slightly restricted in that it did not map all Archimate relations into Innovation Base relations, but even so there were surprisingly few key relations in the Roehampton models.

If the original model was attached as a graphic (to the top level view page) then this was valuable but our import experiments show that while Archimate is useful conversational tool for managers and modellers, its raw outputs are not appropriate for dissemination without additional descriptive effort.

Outcomes

Based on our interactions with the repository and FSD communities we have drawn a number of conclusions about the state of modelling activity in these communities, and the appropriateness of sharing those models through a tool like the Innovation Base:

- **Low expectations of modelling need to be addressed** – throughout our engagements we have seen that modelling is often perceived in a negative way. Complex modelling is seen as high cost and difficult, and simple modelling is seen as low benefit and trivial. Engagement with the community (such as our CETIS events) can begin to change these low expectations, but what is needed is as much a change in culture as it is a change in skills.

- **Softer modelling is a good way to get people who have either no or little experience started**. There are many situations where people will need to model but do not have technical skills in formal modelling notations. Rather than excluding these people and their work, we can lower the barrier to take up and provide an entry point by using softer modelling techniques. Softer modelling uses familiar techniques, reduces technical notation and has a constructed narrative that captures context in a holistic, rich way. The outputs may not be re-usable but are useful for sharing.

The resultant models provide a powerful narrative structure that enables the team of modellers to share their understanding, discover gaps in their understanding and start to think about the kinds of more formal modelling tools they might need. Importantly, it forces them to recognise where barriers to innovation might lie and where they would need to consider their plans for innovation in a holistic way.

The outputs may not be directly re-usable but are useful for sharing in the wider concept of sharing. Including sharing that understanding: of boundaries chosen, lessons learned and journeys followed in modelling; providing patterns that can be reused or repurposed, rather than individual instances of models. Sharing experiences in modelling is clearly useful, as all the people that we have talked to want to see models that they can use in order to see how to go about their own modelling.

Providing an entry point for early stage modelling in the Innovation Base will mean that the Innovation Base will be able to reach a wider population than just of the small population of formal modellers and the Innovation Base will be open to and contain many more of the sharable lessons resulting from JISC projects. In order for these lessons to be shared, less formal more social web 2.0 tools will be required to encourage collaboration and discussion amongst this group of modellers.

- **Deconstruction of models can lead to loss of key details** – in our experiments to capture existing models, we have discovered that deconstructing models (so that they can be uploaded as a network of concepts into the Innovation Base and interlinked with other models) can often damage key details, or corrupt a significant message (for example, in Archimate layout can be a key factor for clarity). Often parts of a model do not make sense, or are not well enough defined, to act as well-rounded concepts in their
own right without the context of the other elements in that model (for example, actors in use case diagrams are often underspecified). This indicates that software to support model sharing should focus on allowing its users to express themselves in a way that is most natural to them (for example, individuals who have engaged with the Innovation Base often use it as a plain repository, uploading models as a single package such as a word doc).
Lessons Learnt: If we were to start again, how we might do it differently

It is worth discussing some of the lessons that we have learnt during the project, and may be useful to others who are working in this, or similar areas. Firstly we need to look at the benefits of the Innovation Base, or something like it.

Benefits of Innovation Base

Some of the benefits of the Innovation Base relate to those of modelling in general, but by bringing modelling to the fore people will be more likely to undertake appropriate modelling.

By supporting modelling the Innovation Base can:

- Help people to make better decisions of what they will build, what they will fund by having a clearer understanding of how what they are thinking of works and how it fits into the broader landscape.
- Help people to understand their environment better and to explore the implications of their decisions
- Allow people to model without having to model using a formal method or language, and still be able to share their materials in a natural way that meets their conceptual framework.
- Lower the barrier to analytical and strategic thinking by enabling the user to view their domain and any models therein.
- Provide a meeting place that people can use to have conversations that cross boundaries
- Allow people to work at a suitable level of abstraction and work with real (inconsistent) views of the world
- Support change management around JISC programme and project management.
- Support marketing and dissemination of project results.
- Bring about change in the way people manage their projects so that the knowledge assets are recognised and their production for reuse resourced.

Lessons learnt

Some of the lessons relate to modelling such as

- The constructs that were used in the Innovation Base are not as closely aligned to authentic modelling activities as they need to be to support modelling in the community.
- However, it is also necessary to consider how people actually use the various modelling languages and tools that are available in order to identify patterns of model construction. This should be done through observation of teams’ modelling – looking at both the processes they undertake in the modelling and the artefacts that they produce.
- Make the interface more sophisticated in its support of the user and more graphical. For example, allowing drag and drop.
- Considerably more work is needed to improve the knowledge visualisation in order to present the models in ways which are readily understood. This might include the use of smart filters so that the right number of elements is presented, arranging the material on the screen better, better use of colour to provide additional support.
- Improve the mechanism supporting the different modelling activities so that it will be simple and for users to introduce new modelling activities.
- Enable report production from the Innovation Base and output of models in html (like BizzDesign). However, this would be a very significant task
- In order to ensure that projects make appropriate use of the Innovation Base it would be necessary to train programme managers so that they can advise projects on drawing on
the content of the Innovation Base and help projects to determine what to deposit in the Innovation Base.

- From the start of the project it would be advisable to put significant effort into marketing the benefits of modelling and the benefits of contributing models to the Innovation Base. The key benefits that need to be marketed are:
  - Clarity around the issues being modelled
  - Articulation of issues,
  - Making knowledge explicit
  - Creating a shared understanding with users.

- A lesson learned from engagement with The Roehampton EA project is the importance of capturing the contextual information around the model, particularly as narrative in order for others to be able to find value in the model. This may include documentation or explanation of models by their creators as short videos.

- For novice modellers, even lighter weight modelling needs to be encouraged and recognised as useful modelling. A lightweight Innovation Base interface making use of social, collaborative tools with informal tagging, tied to but hiding the complexity of domain knowledge may encourage and widen take up.

Other lessons relate to the design of the Innovation Base:

- Produce “wizards” to start people off with their models. It would question the user and show where to place the answers. The basis would be the 5 key questions (in the way that we have used them in workshops).

- Influence JISC processes so that projects deposit their outputs in Innovation Base as part of their work. This would need to be monitored by the programme managers in the same way as project reporting and publication of code is managed.

- Recognise the population that can be supported by this technology. Sophisticated modellers will not wish to use the constructs to build their models but can be encouraged to upload whole models. They will not re-model for Innovation Base.

- Recognise that people who do no modelling and work in areas where this seems like an alien culture will not readily take advantage of this tool. It is the middle section who do ‘some’ modelling at various levels of formality, precision and detail who can benefit from the tool and make contributions for others.

- Recognise that modelling is a collaborative, social activity and include more social tools for discussion, and collaboration.

- More support for early stage modellers at the informal end of the modelling spectrum, particularly in lightweight modelling, Systems Thinking and Soft Systems Modelling.
### Appendix 1: The HE Domain Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Activity</td>
<td>An <strong>Activity</strong> (or Key Activity for role) is executed by a <strong>role</strong>, has an identifiable outcome, contributes to a <strong>purpose</strong> and comprises <strong>tasks</strong>. It may be a discrete action, executed by a <strong>role</strong>, within the flow of events (<strong>process</strong>) of a <strong>function</strong>.</td>
</tr>
<tr>
<td>2. Actor</td>
<td><strong>Person</strong> or system component (<strong>service</strong>) fulfilling the responsibilities of a <strong>role</strong>. A primary <strong>actor</strong> is generally identified for a function. An <strong>actor</strong> is the same as a <strong>role holder</strong>.</td>
</tr>
<tr>
<td>3. Application</td>
<td>Computer software that employs the capabilities of a computer directly to a <strong>process</strong>, <strong>activity</strong> or <strong>task</strong> that the user wishes to perform.</td>
</tr>
<tr>
<td>4. Artefact</td>
<td><strong>Activities</strong> have input and output artefacts. An <strong>artefact</strong> is a work product of the <strong>process</strong>: <strong>roles</strong> use <strong>artefacts</strong> (<strong>resources</strong>) to perform <strong>activities</strong>, and produce <strong>artefacts</strong> (<strong>deliverables</strong>) in the course of performing <strong>activities</strong>.</td>
</tr>
<tr>
<td>5. Competency</td>
<td>The ability to execute a <strong>task</strong> or <strong>activity</strong>.</td>
</tr>
<tr>
<td>6. Complex Role</td>
<td>Roles may be assemblies of <strong>Simple Roles</strong> (atomic) and <strong>Complex Roles</strong>.</td>
</tr>
<tr>
<td>7. Deliverable</td>
<td>Is an <strong>Artefact</strong>. <strong>Roles</strong> produce <strong>artefacts</strong> in the course of performing <strong>activities</strong>.</td>
</tr>
<tr>
<td>8. Domain</td>
<td>A sphere of <strong>activity</strong>, concern, or <strong>function</strong>.</td>
</tr>
<tr>
<td>9. Event</td>
<td>An occurrence of something to which the system must respond. <strong>Events</strong> are used to trigger <strong>process control</strong> mechanisms and to signal changes of state.</td>
</tr>
<tr>
<td>10. External Organisation</td>
<td><strong>Organisation</strong> outside the boundary of the HEI that interacts with the HEI.</td>
</tr>
<tr>
<td>11. Federation-holding</td>
<td>A management <strong>organisation</strong> for a group of member <strong>organisations</strong>. The degree of autonomy of the federated organisations varies.</td>
</tr>
<tr>
<td>Organisation</td>
<td></td>
</tr>
<tr>
<td>12. Feedback</td>
<td>The return of a portion of the output of a <strong>process</strong> or system to the input, especially when used to maintain performance or to control a system or process. The return of information about the result of a <strong>process</strong> or <strong>activity</strong>; an evaluative response.</td>
</tr>
<tr>
<td>13. Function</td>
<td>The <strong>function</strong> describes what the <strong>actors</strong> (<strong>people</strong> or <strong>services</strong>) do to achieve their <strong>goals</strong> (aims and objectives). The <strong>function</strong> will contain flows of events (<strong>process</strong>) that show how value is obtained from that <strong>function</strong> for the <strong>actor(s)</strong>.</td>
</tr>
<tr>
<td>Term</td>
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<tr>
<td>14. Goal</td>
<td>A goal is a desired state of affairs of a system. Goals provide general purpose and direction. They are the end result of ultimate accomplishment toward which an effort is directed. They generally should reflect perceived present and future need. They must be capable of being effectively pursued.</td>
</tr>
<tr>
<td>15. Guidance</td>
<td>Is an artefact. Additional information related to roles, tasks (activities), and work products (deliverables). Examples of guidance are: Guideline, Template, Checklist, Tool Mentor, Supporting Material, Report, Concept, Practice, Reusable Asset, Term Definition, White Paper, Example</td>
</tr>
<tr>
<td>16. Guidance Usage Principle</td>
<td>The way in which a knowledge (guidance) artefact for an activity is used in a particular process context</td>
</tr>
<tr>
<td>17. HEI</td>
<td>Higher Education Institution. Organisation that provides learning products, primarily for higher education.</td>
</tr>
<tr>
<td>18. Interaction Content</td>
<td>The information provided in response to a request from another organisation or information received from another organisation. This information specification contributes to the domain information model.</td>
</tr>
<tr>
<td>19. Lifecycle</td>
<td>The description of the distinct phases through which an object passes during its life (Lifecycle States). This includes phases such as requirements definition, concept design, production, operation, maintenance, etc. It is a series of states, connected by allowable transitions.</td>
</tr>
<tr>
<td>20. Lifecycle State</td>
<td>A state is a condition of an object in which it performs some activity or waits for an event. An object may remain in a state for a finite amount of time. It is a component part of a Lifecycle.</td>
</tr>
<tr>
<td>21. Mission Statement</td>
<td>A mission statement defines the core purpose of the organisation</td>
</tr>
<tr>
<td>22. Operational Plan</td>
<td>Deals with the internal operations and equipment necessary to produce the organisation’s products and services. The operational plan is derived from the strategy.</td>
</tr>
<tr>
<td>23. Organisation</td>
<td>A company, corporation, firm, enterprise or institution, or part thereof (whether incorporated or not, public or private) that has its own function(s) and administration, that supplies products or services</td>
</tr>
<tr>
<td>24. Organisational Development</td>
<td>Organisational development is the process through which an organisation develops the internal capacity to be the most effective it can be in its mission work and to sustain itself over the long term.</td>
</tr>
<tr>
<td>25. Organisational Unit</td>
<td>Named subdivision of an organisation with defined responsibilities.</td>
</tr>
<tr>
<td>26. People Service</td>
<td>A people service is an implementation of a function or activity by a role (individual or team or organisational unit). A people service has meaningful business value and is aligned with the concept of a ‘unit of work’.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>27. Person</td>
<td>A human individual.</td>
</tr>
<tr>
<td>28. Process</td>
<td>Sequence of <strong>activities</strong> that implement <strong>functions</strong>.</td>
</tr>
<tr>
<td></td>
<td>A <strong>process</strong> is a set of linked <strong>activities</strong> that creates value by transforming an input into a more valuable output. Both input and output can be <strong>artefacts</strong> and/or information and the transformation can be performed by human <strong>actors</strong>, machines, or both.</td>
</tr>
<tr>
<td>29. Process Control</td>
<td>A decision point in a specific location in a <strong>process</strong> (workflow) which may branch based upon guard conditions. It is a decision point with a set of possible outcomes.</td>
</tr>
<tr>
<td>30. Purpose</td>
<td>The value to an <strong>organisation</strong> to be brought by a particular role. A <strong>role</strong> has a (main) purpose which includes reference to its key <strong>activities</strong>.</td>
</tr>
<tr>
<td>31. Resource</td>
<td>Is an <strong>artefact</strong>. <strong>Roles</strong> use resource <strong>artefacts</strong> to perform <strong>activities</strong></td>
</tr>
<tr>
<td>32. Role</td>
<td>A <strong>role</strong> defines the behaviour and responsibilities of an individual (<strong>Person</strong>), or a set of individuals working together as a team, within the context of an organisation.</td>
</tr>
<tr>
<td></td>
<td>A <strong>role</strong> is responsible for delivery of its <strong>main purpose</strong> through one or more <strong>activities</strong>.</td>
</tr>
<tr>
<td>33. Role Holder</td>
<td><strong>Person</strong> or component (<strong>service</strong>) fulfilling the responsibilities of a <strong>role</strong>. A <strong>role holder</strong> is the same as an <strong>actor</strong>. A <strong>role holder</strong> has contractual responsibility to fulfil a <strong>role</strong>.</td>
</tr>
<tr>
<td>34. Rule</td>
<td><strong>Rules</strong> define specific constraints that must be satisfied. <strong>Rules</strong> may apply always (in which case they are called invariants) or only under a specific condition. If the condition occurs, the rule becomes valid, and must therefore be complied with.</td>
</tr>
<tr>
<td>35. Service</td>
<td>A <strong>service</strong> is an implementation of a <strong>function</strong> or <strong>activity</strong> and thus the concept applies equally to software development and to other operations within the organisation. A <strong>service</strong> has meaningful business value and is aligned with the concept of a ‘unit of work’.</td>
</tr>
<tr>
<td>36. Service Framework</td>
<td>The systematic format and technical structure that supports metadata, concepts, contents and controlled vocabularies for managing the provision of <strong>services</strong>.</td>
</tr>
<tr>
<td>37. Service Implementation</td>
<td>The execution in code by a <strong>software service</strong> or by people in a <strong>people service</strong> of the operations declared on the <strong>service</strong> interface.</td>
</tr>
<tr>
<td>38. Service Specification</td>
<td>A description of the <strong>service</strong> operations and the way in which they may be accessed and requested through its interface.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>39. Service Usage Model</td>
<td>The relationship between a process and the set of services required for its execution. It provides a description of the needs, requirements, workflows, management policies and processes within a domain and the mapping of these to a design of a structured collection of Service Genres and Service Expressions, resources, associated standards specifications, data formats, protocols, bindings, etc., that can be used to implement software applications within the domain. Service Usage Models (SUM) model how services meet business needs.</td>
</tr>
<tr>
<td>40. Software Service</td>
<td>A single component or assembly of components that aligns to a 'unit of work' in a business process. It is packaged as an autonomous unit with a defined interface. May be deployed as a Web Service.</td>
</tr>
<tr>
<td>41. Stakeholder</td>
<td>An individual or group with an interest in the success of an organisation in delivering intended results and maintaining the viability of the organisation’s products and services.</td>
</tr>
<tr>
<td>42. Strategy</td>
<td>The plan and means by which an organisation intends to meet its goals.</td>
</tr>
<tr>
<td>43. Subdomain</td>
<td>Also called work area. An area of control or a sphere of knowledge, identified by a name, within the domain sphere of knowledge.</td>
</tr>
<tr>
<td>44. Subdomain Subdivision</td>
<td>A defined part of a subdomain, often relating to a particular function or activity.</td>
</tr>
<tr>
<td>45. Sub-Process</td>
<td>A process can be decomposed into a number of sub-processes, which have their own attributes, but also contribute to achieving the goal of the overall process.</td>
</tr>
<tr>
<td>46. Task</td>
<td>Component part of activity.</td>
</tr>
<tr>
<td>47. Vision</td>
<td>A shared mental framework for the direction and aspirations of the organisation.</td>
</tr>
</tbody>
</table>

Table 4: HE Domain Glossary
Appendix 2: Modelling methods supported by the Innovation Base

The Innovation Base supports the

Open Modelling

Open Modelling allows you to create your own structure and add content of any type. Use the Open Modelling technique if none of the more structured techniques fit the way that you are working.

Add Use Case Analysis

A use case analysis is the primary form for gathering usage requirements for a new software program or task to be completed. Through the analysis we construct a set of Use Cases, which are often presented using a UML Use Case Diagram. The primary goals of a use case analysis are: designing a system from the user's perspective, communicating system behaviour in the user's terms, and specifying all externally visible behaviours. Another set of goals for a use case analysis is to clearly communicate: system requirements, how the system is to be used, the roles the user plays in the system, what the system does in response to the user stimulus, what the user receives from the system, and what value the customer or user will receive from the system.

Process Analysis

Business Process Modelling (BPM) is an approach to developing efficient, repeatable processes that can be applied to the business effectively. BPM allows organisations to map visually their current business activities, creating a comprehensive overview of what actually happens. Davenport & Short (1990) define a business process as "a set of logically related tasks performed to achieve a defined business outcome."

This allows stakeholders to look at a process objectively and facilitates identification of areas of concern and possible ways to improve ways of working. Ideas for process improvement may be captured in “to be” business process models.

Business processes frequently cross organisational structures and follow the value chains for the enterprise’s products and services. BPM supports the assessment of change impact across an organisation and facilitates change management.

SUM Development

Service Usage Models (SUMs) are a core component of the e-Framework. SUMs provide a description of the needs, requirements, workflows, management policies and processes within a domain and the mapping of these to a design of a structured collection of Service Genres and Service Expressions, resources, associated standards, specifications, data formats, protocols, bindings, etc., that can be used to implement software applications within the domain. In other words, SUMs model how services meet business needs.

Simply put, SUMs show the interoperability requirements, support the functional process requirements and show how various technical components can be used to support them. In some cases SUMs indicate how an application may be developed. Ultimately, other application developers may be able to take advantage of the collection of SUMs that are included in the e-Framework to create new applications.

Information Modelling

An information model in software engineering is a representation of concepts, relationships, constraints, rules, and operations to specify data semantics for a chosen domain of discourse. It
can provide sharable, stable, and organized structure of information requirements for the domain context.

**Enterprise Architecture**

An is the science of designing an enterprise in order to rationalize its processes and organisation. Most of the time, the highest level of rationalisation lead to automatisation. Enterprise architecture is both the process and the product of this process of rationalisation. As a complex process, enterprise architecture must repose on a framework, methodologies and tools [Wikipedia].

**Enterprise Architecture (all)**

An is the science of designing an enterprise in order to rationalize its processes and organisation. Most of the time, the highest level of rationalisation lead to automatisation. Enterprise Architecture (all) is both the process and the product of this process of rationalisation. As a complex process, Enterprise Architecture (all) must repose on a framework, methodologies and tools [Wikipedia].
Appendix 3: Survey of use of modelling in Higher Education

Introduction
A survey of the use of modelling was carried out as part of the Innovation Base Community Engagement activity to gauge the current use of and interest in modelling in the higher education development community.

The survey was carried out using the SurveyMonkey⁴ survey tool. The survey was advertised on the following JISCmail lists:

- E-FRAMEWORK
- ENTERPRISE-ARCHITECTURES
- JISC- INNOVATION
- JISC-REPOSITORIES
- ALT-MEMBERS

The request to complete the survey was also sent to the JISC Institutional Innovation projects by the support team.

Respondents were self-selecting, so that the data cannot be considered to be a representative sample of the community. In all 47² valid responses were recorded when the survey was closed. There is no data available to determine why the response rate was disappointingly low, but possible reasons include:

- Timing – the survey was launched on 8 December, which may be getting close to the Christmas break, and re-offered in mid-January
- Little interest in modelling in the community,
- General unwillingness to undertake surveys,
- Inappropriate selection of places to advertise the list.

However, 45 responses is sufficient to undertake some analysis.

All the questions in the survey were optional, in order not to put people off answering the remainder of the survey if they did not have a response they wished to make against any question; however most people answered most of the questions. The number of respondents is shown against each question.

Analysis

As will be noted in detail against some of the questions there are some issues with the quality of the data derived from this survey. We noted in the introduction that the respondents were self-selecting and therefore not a random sample of people undertaking projects in the community. There is a clear bias towards those who are doing modelling, given that we have evidence of the very low level of the use of modelling from other sources.

There may also be some problems with the quality of the data. For instance, only half the respondents reported users as a significant stakeholder in their work. There are several reasons why this may be so:

- Many of the projects do not have users, or at least users who are significant stakeholders (conceivable, but unlikely – for instance a project to improve a network might see the users as beneficiaries rather than active stakeholders).

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² An additional two "responses" were recorded with no valid data, and have been excluded from the analysis.
• Respondents do not consider users to be stakeholder. This is quite possible as some people take stakeholders to mean some form of governance responsibility for the project and do not include users in the term (there are users and stakeholders).
• Projects have not done a stakeholder analysis and therefore the information is incomplete. Unlikely, as even a rudimentary analysis would include users.
• Presented with a blank slot people pick the first things that come into their head without too much thought. Again, quite likely, which would suggest that the tick box data may be more accurate than the blank box data.

However even with these concerns about the quality of the data there are some interesting points that can be seen from the data.

The respondents
The first part of the survey was about who was responding to the survey.

Project involvement
40 respondents listed the projects that they were responding on behalf of, this amounted to over approximately projects, with a range of zero to eight projects per respondent, and a wide range of project types from those intimately concerned with modelling (Enterprise Architecture / Service Oriented Architecture) to resource development projects with little or no modelling components in the project.

Roles of participants

![Figure 12: Roles of respondents](image)

34 people responded giving their roles, with nearly a third having more than role and nearly a third being project managers. Only 8 of the respondents were analysts, which together with one enterprise architect suggests that a relatively small proportion (less than 20%) would have modelling is a core part of their role. As we were particularly interested in the use of modelling by learning technologists the low response rate (six) by learning technologists was especially disappointing, and is too small for us to be able to draw any conclusions about the use of modelling by that group.

Area of activity
We asked people to say what areas (domains) they were working in, using the same list as that given in the e-Framework, but allowing people to assign their own as well. There is a fairly even spread between the various domains. The other domains offered were:
• Identity and Access Management
• Modelling tool supplier
• conceptual modelling for interoperability specification

The first of these could possibly be classified under Information and communications technology, whilst the others are not higher education domains.

The full set of domains covered by respondents is shown below. Where an item was cited more than once the total number of citations is given in parentheses:

Learning and Teaching
• Admissions (2)
• Adult learning
• Agent-assisted collaborative learning
• Assessment (2)
• Bespoke training
• Blended learning
• Course and program management (2)
• Courses information management
• Curriculum design
• Curriculum development
• E-learning (3)
• E-learning development
• Enrolment
• E-Portfolios (5)
• Induction
• Instructional design
• Learner mobility
• Learning design
• Monitoring student behaviour
• Registration (2)
• Skills and competences (2)
• Student experience
• Student intervention
• Student retention
• Teaching (2)
• VLE / LMS (8)
• Work-based learning (2)

Research
• Research (2)
• Research activity data
Management and administration

• Added value.
• Administration
• Admissions (2)
• Campus management
• Capabilities
• Course management
• CPD Course Administration
• Efficiencies
• Enrolment
• Enterprise Resource Planning
• Governance
• Institutional change (2)
• New models for higher education
• Procurement
• Quality enhancement
• Registration (2)
• Subject/course management (2)

Information and communications technology

• Federated Access Management
• Identity Management
• Interoperability
• Online data bases
• Role-based access
• Shibboleth
• Web development

Information management

• Application profiles
• Authority Control
• Bibliographic Referencing Systems (2)
• Content sharing
• Courses information management
• Data mining
• Data sharing
• Data warehouse
• Digital preservation
• Digital preservation
• Digitisation
• Dublin Core
• Dublin Core Application Profiles
• E-literature
• (institutional) repositories (6)
• Knowledge management
• Libraries (2)
• Metadata
• Metadata schemas
• Names
• Ontology
• Open access / Open content (2)
• Portal
• Registries
• Semantic web (2)

Business and community engagement

• Bespoke training
• Business and community engagement (3)
• Employer engagement (2)
• Relationship management (2)
• Schools liaison
• Work-based learning (2)

Other

• Concept mapping
• Conceptual modelling
• Educational system mapping
• Enterprise Architecture (2)
• Mind mapping
• Modelling cognitive mapping
• Policy
• SCORM
• Service Oriented Architecture (2)
• Standards development
• Support
• Synthesis
• Taxonomy
Note the large range of topics that people are working on, with only repositories, e-portfolios and virtual learning environments having five or more people working in them. In part, this reflects the way that people think about the domain that they are working in. The finer grained the area that is given the fewer people are likely to be working in it, but the more accurately that it may be defined. For instance, e-learning encompasses all the other things included in the learning and teaching domain, and blended learning may well be the same as e-learning (in that most people do not use e-learning to mean exclusively technology based learning).

It should be noted that the definition of domains does create significant taxonomic problems. Firstly there is “splitting” versus “clumping”. Some people prefer to divide things up as much as possible into the smallest separately defined concepts, while others prefer to group things together if possible. Neither is in any sense “correct”. However it does cause problems in attempting to categorise information. Secondly, people use different terms to describe the same (or very similar) concepts (teaching; teaching and learning; learning and teaching; learning are all used to cover the same territory without much distinction (though distinctions can be made between teaching and learning)). This can be dealt with through the use of synonyms, but they do all have to be mapped onto each other (should pedagogy, andragogy and mathetics be mapped to each other as synonyms?). Thirdly, people cannot agree how terms should be organised – even looking at the list above you can see that some of the terms have been repeated under different headings (for instance I have classified work based learning under both “teaching and learning” and business and community engagement and Admissions under both “teaching and learning” and “Management and administration”). There is therefore clearly a tension between allowing users to classify for themselves and other people being able to find it later using potentially different terms.
Knowledge of the domain

The majority of the respondents were domain experts in the area that they were working on, with almost none of them being novices. This in part reflects the type of people who replied to the survey; which was mostly project managers. A significant number of these are from relatively small JISC projects where the bidder is both a domain expert and the project manager. For many JISC, and other small projects in the sector, unless projects are very large and a professional project manager has been brought in one would expect the project manager to have significant knowledge of the area they are working in. Whereas analysts and developers might be expected to move from domain to domain as required and therefore have less expertise in the domain they are currently working on – as their expertise lies in analysis and development. However, both the novices in this survey were project managers, and those that knew the domain "quite well" were spread evenly across project manager, developer and analyst.

Stakeholder involvement

Part of the reason for modelling is that it is an effective way to share information with stakeholders – to gather requirements, share ideas and solutions and to develop a common language and set of metaphors for discussions.
We asked projects to name up to five of the main stakeholder groups that they were working with, and these have been grouped under the headings shown in the chart below. There is a fairly even spread amongst the various different types of stakeholder, with senior managers, perhaps surprisingly, the most common group, with 28 out of the 30 responses including senior managers as one of the stakeholders, though this is mostly in the form of governance (see table below).
Respondents were also asked what the involvement of each of the stakeholder groups was, and the three most important areas were governance, requirements gathering and as users, with funders and team members being the only other common forms of stakeholder involvement in the projects brought out in this survey.

Perhaps it is more interesting to look at the way in which the various stakes are distributed across the different stakeholder groups. From this three things stand out. Firstly, as already mentioned, senior managers are primarily involved in the governance of projects with this accounting for 23 of the 28 stakeholders concerned with governance, or 23 of the 27 roles played by senior managers. Secondly, requirements and users are drawn from all the groups of stakeholders in approximately equal (but low) numbers, with the exception of administrators and teachers who are more commonly represented. Thirdly, librarians figure more as providers of requirements than as users (suggesting that they are being used as a surrogate for the users) and that students and administrators are users who are not always being consulted in requirements gathering. However, it would be dangerous to draw to many conclusions from this data as people tend to fill in surveys and questionnaires quickly and more reflection might be expected to change the relative weightings of some of the stakeholders and their involvement in the projects.
Table 5: Involvement of stakeholders in projects

To some extent the spread of stakeholders (especially for requirements and as users) is a reflection of the spread of projects represented by the respondents.

**Interactions with stakeholders**

One of the areas that we are particularly interested in is how project staff gather and present information with stakeholders, and in particular to what extent models of one sort or another are used for that purpose. As can be seen, documents, presentations and demonstrations are the most common methods of presenting information to stakeholders, with models not far behind and other forms of presentation not widely used.
However, when it comes to gathering information from users there is a very different picture, with documents, presentations and meetings predominating and models barely used at all. This large difference is interesting and raises some interesting questions as to how models are being used in projects. While we might not expect that stakeholders would be producing models using modelling tools we might have expected them to, for instance, annotate models that they have been shown in order to express their requirements. It is possible that these have been expressed in the survey as using meetings. However, in that case one might expect models to be treated in the same way in presenting information to stakeholders.

This is an area where more work is needed in order to understand how models are being used in projects. This could include looking at the types of models being produced, where in project life-cycles they are being produced, who they are being produced for and what they are actually being used for.
Figure 18: Methods of gathering information from stakeholders

Next we asked about the methods used to organise the information that has been gathered. This was a free text response, and the responses have been grouped under the following headings. As can be seen, a significant number of respondents use more than one method for organising their responses, but there is not a common pattern amongst the respondents. However, what is striking is the lack of correspondence between the methods used for presenting and gathering information with those used for organising the information gathered from stakeholders. In particular, only six of the respondents use documents to organise their input, and only two use models to organise their input despite 18 using models to present information. This disconnect between the use of models to present information and to organise information is surprising, and perhaps worrying. If modelling is not being used to capture and organise the information from users then what is it being used for?
When it comes to exploring ideas with other people we asked people to select from paper sketches, online sketches, concept maps, mind maps and other. Maps (combining concept and mind maps) vie with paper sketches as the most popular methods for exploring ideas, though a couple of respondents mentioned that they use models. It is interesting to note the much greater use of relatively informal methods such as mind maps compared with the use of models with their greater semantic content.
We also asked what diagramming tools people used, if they did use tools, and as can be seen a variety of tools are used, with the more informal tools such as PowerPoint and Visio being widely used and just over a third using modelling tools. It is also interesting to note that 28 of the 31 respondents said that they produce different diagrams for different audiences.

Producing different views of the same model is something where modelling tools can, of course, save much effort as they are designed to be able to produce multiple views, whereas with PowerPoint and Visio it is necessary to draw the different views as the tool has no understanding of the semantics of the model. This might be a fruitful area to look at why people are using the tools that they are using and what the benefits of alternatives might be. Are they currently using the optimal toolset for their needs? And if not what needs to change for them to do so? Is it a lack of awareness of the alternatives? A lack of available training in the tools and methods? Or something else?  

Figure 20: Methods used for exploring ideas with others

We also asked what diagramming tools people used, if they did use tools, and as can be seen a variety of tools are used, with the more informal tools such as PowerPoint and Visio being widely used and just over a third using modelling tools. It is also interesting to note that 28 of the 31 respondents said that they produce different diagrams for different audiences.
Glossaries and definitions

In our experience it is not uncommon for different stakeholders to use similar or identical terms to mean potentially different things. We have therefore found it useful in our work to produce a glossary or set of definitions for the project. Even some of the most widely used terms may be used in very different ways. For instance, in a recent study of the induction process at one university it became clear that different people had radically different understanding of the term induction itself. For some it meant what happens during induction week, while for others it started as soon as someone applies to be a student, or accepts a place. For some it also covered much of the work in the first semester (or year) while students are being inducted into academic practices. Similar problems can be encountered with almost any term that is being used, hence the desirability of having a shared set of definitions for use in a project. Of course, having a shared set of definitions is not, by itself, enough. It will only be useful if people use it (or at least make clear where they are not using it), at least for the purposes of the project.

Given the importance of shared terms it is therefore perhaps surprising that nearly a quarter do not have a set of shared terms that they use as part of their project.

Figure 21: Diagramming tools used

![Diagram showing the use of various diagramming tools for 31 respondents. The tools are: PowerPoint (22), Visio or other drawing tool (17), Modelling tools (13), Other (9), and None (0).]
Given the previous comments it is clear that terms need to be, as far as possible, those that are used by the community itself, thus it is, perhaps, not surprising that the majority of projects that produce sets of definitions primarily define their own. This does highlight one of the difficulties between projects. If the same term may mean different things in different projects and different terms may be used for the same concept then it is difficult to create a shared understanding and to re-use models without going through each item in detail and checking what it means in each system. In this case it may be easier and quicker to start afresh rather than understand someone else’s terminology and then translate it. It also suggests that it is extremely important to publish and glossaries alongside the models to aid understanding of the model.
For those that had used definitions from elsewhere a wide variety of different sources have been used, some to define the terms themselves (JISC themes and topics, Wikipedia) and some to define the structure into which those terms fit (Dublin Core, TOGAF).

Listed sources include:

- JISC themes and topics
- Dublin Core Metadata terms
- the data service (www.thedataservice.org)
- standards (British standards) and some TOGAF and IAF terminology
- publication from Elith et al, Guisan and Zimmerman
- Functional Requirements for Bibliographic Records (FRBR)
- Functional Requirement for Authority Data (FRAD)
- No specific glossary: just common usage of terms which are already understood by the community
- Not so much glossaries as using industry-accepted terminology
- e-Framework service genres; JISC Standards Catalogue
- Wikipedia; JISC; Google search.

**Modelling expertise**

Having looked at what respondents are doing in terms of producing models and sharing information with stakeholders it is time to turn to their expertise in modelling.

**Analysis and design methods**

Apart from Entity modelling none of the analysis and design methods are widely used, with most methods only have a couple of people who are either good at them or experts, and only five
people who are expert in a method (two in entity modelling, one in RUP and one in agile methods and one in soft systems methodology). The others who reported themselves in experts in others stated:

- Various proprietary models based on recognised standards
- None
- Niche Models, Statistical Prediction Models
- I may have used some of the methods above, but not been formally introduced to them
- Systems failures

Figure 24 shows includes those who reported that they have no expertise in a particular technique, while Figure 25 excludes that group, and clearly shows that there is considerably more expertise in entity modelling than in all the other methods combined.

![Levels of expertise in modelling techniques](image)

**Figure 24: Expertise in modelling techniques**
Interestingly, in comparison to the low levels of expertise in analysis and design methods there is a high level of reported expertise in a wide variety of modelling methods, with a clear majority of respondents having at least a good understanding of scenarios, use cases and process modelling, and a majority having at least a basic understanding of each of the techniques.
Project outputs

Given the high level of modelling expertise amongst the respondents it is perhaps unsurprising that models are the most common output from the respondents. However, it should be noted that this is strong distinction to our analysis of previous JISC projects, where surprisingly few projects produced (as outputs) models of any description whatsoever.
As can be seen a wide variety of different types of model are used varying from the informal (in text documents, diagrams, spreadsheets and presentations) through to more formal ones in UML or Archimate, though there is a dominance of informal models.

The projects that said that they would be using other formats than those listed will be producing outputs using:

- Databases, mind maps, concept maps
- Statistical packages
- Implemented ontology; FLex prototypes
- Mindmaps, Semantic Models
- GIS maps
- Software
- Online economic model
- Web application
- E-Framework templates and methodology

It is interesting to note the wide range of methods used for sharing models, ranging from the informal (text and diagrams) through methods for structuring models (concept maps) to more formal modelling methods such as Archimate, UML and BPMN.
Further, apart from the use of Web 2.0 technologies to engage with stakeholders (where only one of the respondents mentioned the use of Web 2.0) there is a close correlation between the outputs used and the methods for working with stakeholders.

![Figure 28: Types of model produced by projects](chart.png)

**Conclusions**

It is difficult to draw conclusions from the survey for a number of reasons. Firstly, the sample size is quite small, secondly other evidence would suggest that the respondents to the survey are very far from being a representative sample of the population and thirdly there is huge variance in the responses. However, there are still a number of conclusions that can be drawn.

It is clear that there is a reasonable amount of modelling occurring in the community, though there seems to be little pattern in what types of modelling is being undertaken. However, given JISC’s sponsorship of the Flexible Service Delivery (FSD) Programme there is likely to be an increase in the use of enterprise architecture modelling (using Archimate).

However, given that there are no clear patterns in the use of modelling it is likely that sharing and re-using of modelling is likely to be problematic. There is only limited use of UML or Archimate for publishing models at the moment, which leads to several problems for sharing models. Firstly, people are unlikely to find models that cover the domain that they are interested in. We saw earlier the huge range of different domains that this quite small sample of the population are working in, and this represents a tiny fraction of the work that is occurring in the community as a whole. With relatively few people publishing formal models (Archimate, UML, BPMN etc) the chance of finding a model that is relevant is low. Secondly, even if one finds an existing model it may well not be the type of model that the user is interested in (Enterprise Architecture models are of very limited use if what one is looking for is a process model).
Perhaps more worryingly is the low level of expertise in the community. Nearly all the people that responded to the questionnaire are producing models of one sort or another as outputs of their projects, but as Figure 26 shows with the exceptions of use cases and scenarios people have little expertise in the use of modelling. This would suggest that there is a need to develop the modelling capacity across the community.
Appendix 4: Using the Innovation Base Modelling Toolkit

What is this toolkit?
This toolkit presents an approach to modelling that will support the development of models for inputting into the Innovation Base for re-use.

The toolkit contains templates to support you in gathering information, analysing and designing models of your problem domain to enable you to develop and formalise a structure to aid further understanding.

Aims
This toolkit is designed to enable those interested in the use of modelling in their organization to:

- Understand modelling concepts and how they can be applied to solve specific problems
- Provide facilities for applying modelling techniques to their problems
- Identify useful resources for further study and application of modelling techniques
- Provide a route to storing modelling artefacts within the Innovation Base
- Provide guidance to those tasked with developing a modelling capability within their organization.

Target Audience
This toolkit is designed to be accessible to a wide range of users. Experts in modelling may find the techniques useful as a precursor to constructing technical models in the Unified Modelling Language (UML). End users who are new to modelling will be able to use the techniques as an introduction to modelling using informal (but still precise) language. All users will be able to use this toolkit to support the inputting of models into the Innovation Base for subsequent re-use and reference by the wider community.

What is a Model?
Quite simply, a model is a simplification of some aspect of reality. The act of modelling is something that all of us do all the time to make sense of our complex world and function in our homes and places of work. In the context of Higher Education (HE), we are surrounded by models that often are mostly textual in form. For example, we have extensive rules and regulations that govern the design of courses, handling of student complaints, the way we might enrol students and so on.

More often than not a model provides the “blueprint” of a system from the real world– it can contain general plans, detailed plans and accommodate different views or perspectives that can support further investigation.

When creating a “blueprint” in many cases a visual modelling notation will be used. Modelling languages have grammars which can be expressed in text or visual notations.

Modelling Language
Models that don’t have any form of modelling language can create problem because there can be ambiguity of meaning, difficulty in defining precision which can make it harder to create a shared understanding between different users and so limit interchange and subsequent re-
A modelling language is a way of expressing the elements of a model and their relationships. Often the same model can be expressed using a different language (exactly the same parallel with spoken languages) where each language is suited for a specific community. In HE, a common task in academic departments is the design of an assessment such as an exam. The activities involved in designing that exam could be expressed – "modelled" in simple text, flow charts (showing the ordering of activities), mathematical models, or even in a programming language. The choice of language will determine the extent of ambiguity, precision and the re-usability of the description.

In this example, we all understand the meanings of the coloured lines representing tube lines, interchange stations and those stations where interchange is not possible. Similarly, stations supporting disabled access are immediately obvious. Clearly, the tube does not travel in straight lines – it follows the geography of the London roads but we can conceptualise a model of the London Underground by virtue of this map.

The production of a model realizes multiple potential benefits by facilitating:

- Clearer understanding of issues leading to a better identification or exposure of problems;
- Communication and convergence on shared understanding;
- Recording ideas to support decision making;
- Creating different views of the problem at the required depth and detail;
- Harmonisation of different aspects and view points;
- Making things unambiguous;
- Saving resources by trying out ideas through models to test feasibility and get feedback.

**Concepts**

In order to facilitate modelling activity – the following key concepts are regarded as essential. These concepts form the modelling language that we recommend for expressing and inputting models to the Innovation Base.
Domain understanding is a necessary pre-requisite to developing systems.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="domain.png" alt="Domain Diagram" /></td>
<td>A domain is an area of knowledge or activity characterized by a set of concepts and terminology understood by practitioners in that area. Typically, an organization is composed of multiple domains.</td>
</tr>
</tbody>
</table>

**Examples:**
A business area in the HEI such as ‘Teaching and Learning’, ‘Information Resources’ or ‘Research’.

**Additional Help:**
A domain helps you locate where your focus of attention should be. More often than not, any planned system intended or being analysed will be primarily located in a particular domain.

Domains are generally identified by looking for cohesive areas of knowledge or activity.

It is often convenient to view domains as a conceptual hierarchical structure – and to map it to functions – however such a simple model does not always work as activities that appear to be located in a single domain may be spread across multiple domains. This basic premise is the core principle underpinning the Business Process Re-engineering activity in the late 80s and early 90s.

---

**Figure 30: Explanation of Domain**
### Role

<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A role defines the behaviour and responsibilities of an individual (Person), or a set of individuals working together as a team, within the context of an organisation. A role is responsible for delivery of its main purpose (motivation) through one or more activities (work).</td>
</tr>
</tbody>
</table>

### Examples:

Roles can be large such as "Finance", "Registry" etc or they can be transient, e.g. a lecturer (one role) is an expense claimant (another role – transient) in another business process. Sometimes roles are a unique functional position, e.g. Vice-Chancellor or it may be a generic functional position such as Head of Department. A similar dichotomy exists with functional groups, Registry is unique – there is only one while there may many campuses where a University is located.

It is important to distinguish between role and job title.

### Additional Help:

Individuals perform work not as individuals (say Ramesh in Registry) but rather because they have a responsibility. Often they will have more than one responsibility and as a consequence they will participate in activities according a particular "hat" (or role) that they are wearing.

Roles can be identified by looking at activities within a domain – and then seeing who is doing that activity.

---

*Figure 31: Explanation of Role*
### Work

<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>What people in roles or services do to achieve their goals (Motivation).</td>
</tr>
<tr>
<td>Work directly adds value to an organization in meeting its objectives.</td>
</tr>
<tr>
<td>Work is generally expressed in the form of process, practice, workflow, tasks, functions and activities.</td>
</tr>
</tbody>
</table>

### Examples:

An example of work can be large: “Handle Assessment Design” – this is business process that is a sequence of activities that relate to the design of a piece of assessment in a department.

Individual activities within that process are also examples of work – “Prepare Draft”; “Scrutinize Assessment”.

### Additional Help:

In an organization (such as an HEI) people do work and that work is invariably an activity or task that is part of a business process. As part of this work, individuals may collaborate or interact with others to achieve goals so some actions are carried out together. Examples of interactions are: You and I discuss something; I contract you do something; I pass information to you; and last but not least, you and I jointly approve on an action etc.

When work is performed, it is done so by following rules which may be detailed and extensive where strict governance is required. We have rules for example that state when we appoint an external examiner for a programme we can only do so for a maximum of four years (extended to five under certain circumstances). Sometimes there are rules which are mainly about ordering of work. Thus, a University level committee will only approve the appointment of an external examiner after the Faculty has approved the appointment. Our rules are often encoded in a smorgasbord of policy and procedure documents (such as student handbooks, quality handbooks and the like). The modeller may also need to capture tacit knowledge. Both tacit and explicit knowledge the role of modeller is to establish and document knowledge.

*Figure 32: Explanation of Work*
Artefact

<table>
<thead>
<tr>
<th>Artefact</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>An artefact is a work product of a process: roles use artefacts (resources) to perform activities (work), and produce artefacts (deliverables) in the course of performing activities. Artefacts are also used to guide the way in which work is carried out.</td>
<td></td>
</tr>
</tbody>
</table>

Examples:

A piece of assessed coursework is an example of an artefact that has been produced as a result of a business process such as “Handle Assessment Design”.

Additional Help:

The best way to identify an artefact that is significant to an organization, process or role is to first identify the key concepts that reside in a particular domain. For example in the “Teaching and Learning” domain, concepts might include: Module, Assessment, Learning Outcome and so on. Typically such concepts are referred to as Business Types – but some of these types are critical to the operation of the organization and these are likely to correspond to artefacts in some way.

Figure 33: Explanation of Artefact
## Rule

<table>
<thead>
<tr>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rules define specific constraints or enablers that must be satisfied.</td>
</tr>
</tbody>
</table>

Rules may apply always (in which case they are called invariants) or only under a specific condition. If the condition occurs, the rule becomes valid, and must therefore be complied with.

### Examples:

- The number of CATS points awarded at each level for a degree programme.
- The conditions under which a module result for a student may be condoned or not.
- The percentage change allowed on a module curriculum before it needs to be re-validated.

### Additional Help:

A rule determines operational guidelines governing behaviour, actions executions and procedures within an activity.

In higher education, many documents such as Calendars, Regulations around course design and assessment contain a wealth of rules which any planned or intended system must support. Rules are usually captured in natural language but can sometimes be manifested as a diagram. A flow chart for example determining the stages of a student’s complaint process is an example of a business rule.

---

**Figure 34: Explanation of Rule**
**Motivation**

<table>
<thead>
<tr>
<th><strong>Definition</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation may be expressed as a vision statement, a mission statement, or goals of an organisation, unit, team or project. It is the rationale and reasons for doing work.</td>
</tr>
<tr>
<td>The vision statement is a shared mental framework for the direction and aspirations of the organisation.</td>
</tr>
<tr>
<td>A mission statement defines the core purpose of the organisation</td>
</tr>
</tbody>
</table>

**Examples:**

A University might have a motivation to reduce the cycle-time for validations from say 6 months to 3 months in order to become more adaptive to competitive environments.

Similarly, a department may locally decide that they might wish to organise and make more efficient the review processes conducted by their external examiner with respect to design of assessments.

**Additional Help:**

It is probably best to view motivation as a set of goals organised around some specific purpose. By identifying goals first and making sure they are aligned to a vision statement it is easier to arrive at a rationale for doing work.

Note that vision statements can exist at multiple levels – at an over-arching organizational level and also at domain / functional level.

*Figure 35: Explanation of Motivation*
How to use the Toolkit

Case Study

Assessment Design

High Ridge University

High Ridge University has developed robust quality assurance processes to support a number of academic business processes. These processes have been designed so that the organization is able to meet its long term vision of improved and efficiently delivered services to students and staff. These processes consume time but in general lead to quality assured artefacts. The University has now a strong desire to automate as many of these services as possible as a means to reducing costs in line with the recently announced cuts in Higher Education. One such process is the assessment design process within the Computing Dept.

Here, just before the beginning of each new semester when a new module is about to be delivered the module leader of a module or course (such as Software Engineering) designs an assessment (an exam or course work). They ensure that the assessment has been moderated / verified by a member of the academic staff (perhaps part of the module delivery team, but certainly someone who is familiar with the subject).

Once the assessment has been through a cycle with the moderator, the assessment along with its cover sheet is sent to the Scrutiny Panel. The scrutiny panel meets at a fixed schedule and reviews assessments at each level to ensure that the assessments are appropriate and comparable. If the panel is happy with the assessment design, it either approves the assessment or it requests further work – either re-design or editing errors. The assessments that have been scrutinized for each level are collated by the department administrator and sent to the external examiner for approval and further comments if appropriate. Once the feedback from the external examiner has been received it is circulated back to the module leader who designed the assessment.

Sometimes the process of scrutiny can take a long time – but assessments need to be issued within three weeks of start of the semester. These assessments are issued in draft form and are subject to approval. Each assessment is accompanied by a tracking sheet that provides evidence that the assessment has been moderated and scrutinized before it goes to the external examiner.
### Worked Example

<table>
<thead>
<tr>
<th>Cards</th>
<th>Organization</th>
<th>Domain</th>
<th>Motivation</th>
<th>Role</th>
<th>Work</th>
<th>Artefact</th>
<th>Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEI</td>
<td>Teaching and Learning</td>
<td>Improved Delivery</td>
<td>Course Designer</td>
<td>Assessment Design Process</td>
<td>Module</td>
<td>All Assessments must be subject to scrutiny</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assessment design</td>
<td>Automated Services</td>
<td>HoD</td>
<td>Review Assessment</td>
<td>Assessment</td>
<td>Assessments must be issued within 3 weeks of the start of the semester</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Department Administrator</td>
<td>Design Assessment</td>
<td>Coversheet</td>
<td>Unapproved assessments must be noted as such</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scrutiny Panel</td>
<td>Update Assessment</td>
<td>Feedback</td>
<td>Cover sheets must be completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>External Examiner</td>
<td>Collate Assessments</td>
<td>Module Instance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Submit Assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Provide Feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distribute Feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 6: Worked example of completed cards**
Modelling Decisions

For those beginning out on the modelling journey – the options available can be quite daunting. This section aims to help you identify some of the key decisions that you need to make and suggest the best modelling option available to you.

A toolbox for making modelling decisions

In order to make the right decision – i.e. to choose and commit resource to the most appropriate modelling approach – it is useful to consider each decision criteria and to provide a response (scale 5 to 1). The attached spreadsheet tries to compute the decision for you. In the yellow box – enter your values.

Figure 36: Worked example of modelling selection tool

This is a screen capture of the spreadsheet. While the rules for weightings of each of the approaches to modelling are abstracted from the user, it is still possible for the user to perform two tasks in the process of selecting the right approach. Firstly they can enter a response to each question based on their need. Secondly, they can alter the priority of the question itself by amending the “Relevance” column. However, it is recommended that initially, users do not make changes to this column.

Modelling notation options

JISC projects have used or are experimenting with a variety of modelling techniques and approaches. Here we summarise the main approaches that we think are relevant to projects within the wider UK HE community.
<table>
<thead>
<tr>
<th>Approach</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Archimate</td>
<td>Archimate is a modelling language for describing enterprise architectures (EA). It presents a clear set of concepts within and relationships between architecture domains, and offers a simple and uniform structure for describing the contents of these domains. Enterprise architecture is seen as an important function in helping sustain and grow an organization and Archimate views EA as coherent whole of principles, methods and models that are used in the design and realization of the enterprise’s organizational structure, business processes, information systems, and IT infrastructure. The challenge is to address how different types of enterprise architecture (each with their own concepts) can be integrated as coherent whole. Thus Archimate presents a unified way of modelling architectures and integrating the various domains and describing them in a easy and readable way. Archimate as a specification is supported by the Open Group and there are efforts at standardization. However, tool support is limited and there is no open source tool implementations supporting Archimate currently. <a href="http://www.archimate.org/en/about_archimate/">http://www.archimate.org/en/about_archimate/</a></td>
</tr>
<tr>
<td>UML</td>
<td>The Unified Modelling Language (UML) is a standard language for specifying, visualizing, constructing, and documenting the artefacts of software systems, as well as for business modelling and other non-software systems using family of graphical notations underpinned by a single meta model. Using the UML helps project teams communicate, explore potential designs, and validate the architectural design of the software. The UML is an open standard controlled by the Object Management Group (OMG) and has gone through a number of iterations to its current version UML 2.0. UML focuses on the provision of a language and as such it does not mandate particular methodologies. However, the enforcing meta model ensures that the language is used consistently. The scope of UML is broad in that it can be used at all stages of the software lifecycle and is widely supported by both commercial and open source products. The leading open source implementation of UML for the Windows platform is StarUML. <a href="http://www.uml.org/">http://www.uml.org/</a></td>
</tr>
</tbody>
</table>
### BPMN

**Business Process Modelling Notation BPMN 1.0**

The Business Process Modelling Notation BPMN is a standard for documenting and describing business process models. The notation provides a graphical language based on flow charting techniques for specifying business processes.

The original goals of BPMN are to provide a standard notation that is accessible to both business stakeholders and designers implementing business processes. The notation is sufficiently rich to support direct execution semantics to support model driven analysis, design and execution of business processes. The standard is being maintained and developed by the Object Management Group.

Currently BPMN is constrained to support only those concepts that are applicable to process modelling. There are at least 40 implementations of the notation from both commercial and open source vendors for most computing platforms.


### Innovation Base Modelling

The Innovation Base provides a modelling approach that provides a limited but sufficiently rich set of concepts and a light weight methodology to enable basic modelling to support understanding and communication. The concepts are supported by an on-line web presence that allows the collection and organization of models particularly at domain level to encourage re-use. In additional any of the models that you may produce using any of the other approaches can be stored in the Innovation Base and shared with others.

### Informal

Models that do not have precise concepts and semantics can easily be captured and shared using a range of standard office desktop tools such as Powerpoint, Word and Visio and so on.

---

**Table 7: Modelling techniques supported by selection tool**

<table>
<thead>
<tr>
<th>Approach</th>
<th>Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPMN</td>
<td>Business Process Modelling Notation BPMN 1.0</td>
</tr>
<tr>
<td></td>
<td>The Business Process Modelling Notation BPMN is a standard for documenting and describing business process models. The notation provides a graphical language based on flow charting techniques for specifying business processes. The original goals of BPMN are to provide a standard notation that is accessible to both business stakeholders and designers implementing business processes. The notation is sufficiently rich to support direct execution semantics to support model driven analysis, design and execution of business processes. The standard is being maintained and developed by the Object Management Group. Currently BPMN is constrained to support only those concepts that are applicable to process modelling. There are at least 40 implementations of the notation from both commercial and open source vendors for most computing platforms. <a href="http://www.bpmn.org/">http://www.bpmn.org/</a></td>
</tr>
<tr>
<td>Innovation Base Modelling</td>
<td>The Innovation Base provides a modelling approach that provides a limited but sufficiently rich set of concepts and a light weight methodology to enable basic modelling to support understanding and communication. The concepts are supported by an on-line web presence that allows the collection and organization of models particularly at domain level to encourage re-use. In additional any of the models that you may produce using any of the other approaches can be stored in the Innovation Base and shared with others.</td>
</tr>
<tr>
<td>Informal</td>
<td>Models that do not have precise concepts and semantics can easily be captured and shared using a range of standard office desktop tools such as Powerpoint, Word and Visio and so on.</td>
</tr>
</tbody>
</table>

### Key Decisions

A number of surveys on the use of modelling have informed these key decisions. These include:

- A CACM paper on how UML is used (ref).
- A review of JISC projects and how UML has been used in those projects (for the PSPEX project).
- A recent survey conducted for the Innovation Base project to assess how modelling approaches are currently used within the HE community.

### The Experience of the team:

The quality and “trust worthiness” of a model improves based on the increasing levels of experience a modeller. More experienced modellers can also learn new concepts and notations readily (along with their supporting tools if any) and apply them quickly. Conversely, an in-experienced modeller may find the range of concepts, diagrams, options available in UML for
example, particularly daunting. So one key question is to establish the level of the experience of team members involved in the modelling activity. Related to this question is:

**The importance of availability of supporting material:**

Different techniques are at different levels of maturity. Since its introduction in 1997, the UML has accumulated a vast library of published work including books, research papers, tutorials and websites devoted to its usage. Similarly, there is ready availability of commercial courses giving easy access to training. Modelling techniques such as BPMN are also now experiencing similar attention. In contrast, Archimate is relatively new and while there is a developing presence, it is immature and certainly open source material is limited. The Innovation Base being a bespoke approach under development by JISC is again relatively poorly supported. However, it is worth noting that much of the techniques described by the Innovation Base (see earlier section) can easily be supported by UML based training.

**The Purpose of Modelling**

If you cannot identify why and for whom you are creating a model then why bother? What are valid reasons to create a model? Often you need to understand part of an organization or a system. Perhaps there is a need to communicate your understanding to either your manager or a development team. Sometimes there is simply a need to document an aspect to support subsequent maintenance. You should not be modelling because your process dictates that you must. So an important step in modelling is to identify a valid purpose for creating the model and to establish the audience for that model.

Given this – the key reason for modelling are:

1. Modelling to understand
2. Modelling to share/communicate
3. Modelling to design/implement a system

**The Modelling level**

We are interested in primarily two levels of modelling: Enterprise level– that is understanding the organizational context of systems, in terms of roles, goals /objectives of the organization, the organizational business processes and how they manifest themselves at a system level. This is also called enterprise architecture. At an system, process or application level – we wish to model the usage of an application or system, the internal design and implementation of the system and how it integrates with the organization at large.

**The need for developing a community around a model**

Often the purpose of sharing a model or communicating information from a model is to develop a consensus around key knowledge. One way of doing this is to develop a community of interest that is faced with similar problems/issues. This need then becomes an important element in the overall criteria.

**Exercising the Toolkit**

This section introduces a simple case study derived from a recent call for proposals issued by JISC (http://www.jisc.ac.uk/fundingopportunities/funding_calls/2010/04/510fsd.aspx). Three hypothetical organizations are described and depending upon their background they provide answers to each of the key questions in the toolkit.
The Case

JISC has issued a call as part of the Flexible Service Delivery Programme. One part of the call is about Business Process and ICT Change. In this part of the call, prospective bidders are expected to demonstrate how a business process within the institution will be subject to re-engineering/re-design and to also identify how integration with other systems in the organization will be managed. Bidders are expected to report on the value of using appropriate tools to baseline and forecast impact of the change that arises as a result of the business process re-engineering. One aspect of the call focuses on how any planned process change is part of wider institutional ICT change programme. Although the call is ostensibly about process change, there are implications for other enterprise architecture issues - such as integration between processes; duplication of activities across processes and shared information needs across the institution. If bidders wish, they can combine a response to this call with a rapid innovation bid which requires implementation of aspects of the processes that have been re-designed.

Three organizations are preparing to develop bids for this piece of work.

University of Angleside

The Learning and Information Services unit at the University of Angleside is excited about submitting a bid to the recent FSD programme call from JISC. The Team lead at LIS has access to: Business analysts who have are familiar with entity modelling, writing requirements specifications and working with users to define requirements; Developers: who develop ad hoc extensions to their Oracle based student systems; The LIS director who is responsible for overall enterprise architecture of the university. Should the need arise, the team can also utilize expertise located in the Computing Science department where there are academics who teach various types of development methodologies. The LIS unit know that they can put in a strong bid because they have very clear business case and really want to move to an open source Student registration system such as that developed by the Kuali Foundation. They are concerned that help is readily available and at low cost.

<table>
<thead>
<tr>
<th>Question</th>
<th>Importance of</th>
<th>Score (5 high, 1 low)</th>
<th>Informal</th>
<th>IB</th>
<th>BPMN</th>
<th>Archimate</th>
<th>UML</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Experience of Team</td>
<td>5 3 1 4 2</td>
<td>63 48 32 94 32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Importance of Availability of supporting material</td>
<td>3 1 5 4 2</td>
<td>52 37 18 15 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Modeling to understand</td>
<td>1 1 1 1 1</td>
<td>15 15 9 12 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Modeling to design/implement</td>
<td>0 0 3 9 0</td>
<td>6 15 9 15 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Modeling: how general description</td>
<td>1 2 1 1 1</td>
<td>15 15 9 12 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Modeling type: work, processes work flows, activities</td>
<td>3 2 4 4 3</td>
<td>18 45 9 9 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Contribution from the community</td>
<td>3 2 4 4 3</td>
<td>18 45 9 9 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 37: Worked example of modelling selection tool

Based on the information selected, it would suggest that Archimate is a primary candidate for this organisation as they prepare the bid.

University of STEM

The Business School at STEM are under pressure to increase their research and third stream income as a result of their subject areas being regarded as less favourable to HEFCE. The
team of academics are reasonably happy with process modelling - they teach business process modelling - but the tools they use are mostly drawing tools - such as Visio. However, members of the team have been playing a bit with tools that support the new process modelling standard BPMN. One concern however is the need to show integration with other systems. They can access some support from Computing Science to perhaps advise them on more data modelling aspects that might be required. As academics they are reasonably adept at locating useful resources to support their work.

**Figure 38: Worked example of modelling selection tool**

In this example, because a key element is the desire to construct a community around the model, the Innovation Base is a good strategy to utilize.

**Vquick software services inc.**

Vquick is small software house specialising in developing bespoke software packages for higher education. They have had several projects with JISC before and have a reputation for a solid understanding of the HE domain and expertise in many relevant technologies. Their small dedicated software team includes ex-Computer Science academics and are able to learn most new technologies quickly. Within the team, they have staff who have high quality modelling skills including using a range of modelling techniques from UML. They are particularly keen to exploit the potential of additional funding via the rapid innovation grant and so want to develop software from any models they produce.

**Figure 39: Worked example of modelling selection tool**

The key decision for this organization is the desire to access additional funding by developing implementations so their preferred modelling approach would be the use of UML because of its better support for design and implementation phases of projects.
### Appendix 5: Workshops run by Innovation Base project

<table>
<thead>
<tr>
<th>Date</th>
<th>Run by</th>
<th>Participants</th>
<th>Activity</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/10/2008</td>
<td>Tom Franklin Hilary Dexter</td>
<td>Senior Human Resources Management staff</td>
<td>Described the Innovation Base (Explorium in those days) Undertook a modelling exercise Reviewed parts of the ontology</td>
<td>Proposed changes to the ontology, demonstrating that they had no difficulty understanding it Agreed that this type of modelling would help them in their work Had some follow up discussions</td>
</tr>
<tr>
<td>05/12/2008</td>
<td>Richard King Phil Nicholls</td>
<td>Dr. Haytham Siala</td>
<td>Supported Dr. Siala to write a SUM describing his project (Course Configurator SUM)</td>
<td>Produced the Course Configurator SUM and submitted it to the e-Framework review process.</td>
</tr>
<tr>
<td>09/12/2008</td>
<td>Tom Franklin Richard King</td>
<td>A joint meeting of “Innovation and Environment” and “E-Research” programme managers.</td>
<td><a href="http://cet.jisc.ac.uk/2008/12/presentation-to-ie-and-er-team-meeting/">http://cet.jisc.ac.uk/2008/12/presentation-to-ie-and-er-team-meeting/</a></td>
<td>Took the attendees through a short exercise to introduce the topic of modelling. The group then discussed practical ways in which [the JISC e-Framework programme] can support programmes and their projects to create, document and use models.</td>
</tr>
<tr>
<td>Date</td>
<td>Run by</td>
<td>Participants</td>
<td>Activity</td>
<td>Outcomes</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------</td>
<td>----------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>08/01/2009</td>
<td>Richard King, Yvonne Howard</td>
<td>Simone Spencer, JISC Executive</td>
<td>Discussed the relationship between PIMS, the Innovation Base and the e-Framework, and the potential for mutual benefit through cooperation.</td>
<td>PIMS now produces monthly data exports in .xls format which can be imported into the CET planning tool. Identified points during the programme and project lifecycles at which PIMS could notify the CET about developments of interest to the Innovation Base and e-Framework via the planning tool.</td>
</tr>
<tr>
<td>24/03/2009</td>
<td>Phil Nicholls, Richard King</td>
<td>JISC conference attendees</td>
<td>Ran two e-Framework drop-in surgeries for attendees of the conference.</td>
<td>None</td>
</tr>
<tr>
<td>24/10/2008</td>
<td>Richard King, Tom Franklin, Phil Nicholls</td>
<td>WoCRIG - from 24 Oct 2008 to 15 April 2009</td>
<td>Advised on documenting WoCRIG-supported projects in the Innovation Base and e-Framework. Drew up the necessary documentation in many cases. Reviewed other documentation. Liaised with projects directly.</td>
<td>12 e-Framework artefacts submitted for review and publication 27 projects described for the Innovation Base using the &quot;cards&quot; method.</td>
</tr>
<tr>
<td>20/02/2009</td>
<td>Richard King, Phil Nicholls</td>
<td>DepositPlait (a CRIG project)</td>
<td>Provided advice on producing e-Framework documentation to describe the project</td>
<td>Parts of the project were documented as e-Framework artefacts, which were submitted for review.</td>
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<tr>
<td>Date</td>
<td>Run by</td>
<td>Participants</td>
<td>Activity</td>
<td>Outcomes</td>
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<tr>
<td>26/02/2009</td>
<td>Richard King</td>
<td>Phil Nicholls</td>
<td>Provided advice on producing e-Framework documentation to describe the project</td>
<td>Parts of the project were documented as e-Framework artefacts, which were submitted for review.</td>
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<td></td>
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<td>EMLoader (a CRIG project)</td>
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<td><a href="http://www.jisc.ac.uk/whatwedo/programmes/reppres/interoperabilitydemos/emloader.aspx">http://www.jisc.ac.uk/whatwedo/programmes/reppres/interoperabilitydemos/emloader.aspx</a></td>
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<tr>
<td>27/10/2008</td>
<td>Phil Nicholls</td>
<td>SWORD team (a CRIG project) from 27/10/08 - 26/01/09</td>
<td>Provided advice on producing e-Framework documentation to describe the project</td>
<td>Parts of the project were documented as e-Framework artefacts, which were submitted for review.</td>
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<td><a href="http://www.jisc.ac.uk/whatwedo/programmes/reppres/tools/sword.aspx">http://www.jisc.ac.uk/whatwedo/programmes/reppres/tools/sword.aspx</a></td>
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<td>27/03/2009</td>
<td>Richard King</td>
<td>Phil Nicholls, Bill Olivier, Hilary, Dexter, Tom, Franklin, Dave, Millard, Yvonne, Howard</td>
<td>Discussion of how access to the Innovation Base might benefit Oracle, and how Oracle technologies might help HEIs and the IB.</td>
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<tr>
<td>21/04/2009</td>
<td>Richard King</td>
<td>The JISC OUT team</td>
<td>Presented the CET planning tool and its relationship to the Innovation Base, e-Framework and JISC programmes</td>
<td>Discovered we need to more closely align the CET’s engagement processes with those of JISC programmes and projects.</td>
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<td>06/05/2009</td>
<td>Richard King</td>
<td>Meeting of the JISC IRET programme and projects.</td>
<td>Workshop explaining the IB. New version of the &quot;cards&quot; were used.</td>
<td>Some projects interpreted the Innovation Base as a mechanism by which JISC can check up on them and see whether they've met their objectives - some kind of audit tool! Need to take this into account.</td>
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<td></td>
<td>Dave Millard</td>
<td><a href="http://www.jisc.ac.uk/whatwedo/programmes/emergetech.aspx">http://www.jisc.ac.uk/whatwedo/programmes/emergetech.aspx</a></td>
<td>Explanation of how the Innovation Base ties into an e-Framework SUM was given.</td>
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<td></td>
<td>Yvonne Howard</td>
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<td></td>
<td>Richard King</td>
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<tr>
<td>25/02/2009</td>
<td>Phil Nicholls</td>
<td>SEEEGEO</td>
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<tr>
<td>26/02/2009</td>
<td>Phil Nicholls</td>
<td>Kuali Student</td>
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<tr>
<td>27/04/2009</td>
<td>Phil Nicholls</td>
<td>Edina</td>
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<tr>
<td>14/04/2009</td>
<td>Phil Nicholls</td>
<td>David Flanders / JISC developer community (UKOLN).</td>
<td>Content development lifecycle meeting.</td>
<td>Interest in contributing and getting some support in domain modelling. Agreement from George Roberts about coordination of gathering outputs from projects and feedback of ideas.</td>
</tr>
<tr>
<td>23/04/2009</td>
<td>Hilary Dexter, Tom Franklin</td>
<td>Lifelong Learning and Workforce Development</td>
<td>Overview of Innovation Base in the context of new projects kickoff.</td>
<td>Outputs from Planet and Streamline projects</td>
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<td>Explanation of the role of IB. Linking Innovation Base to the synthesis and support project.</td>
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<td>20/04/2009</td>
<td>Hilary Dexter</td>
<td>John Gray</td>
<td>UIDM project outputs - discussion of harvesting elements for IB.</td>
<td>Further discussions with John King who expressed interest in contributing to Innovation Base a little further into the project at Roehampton.</td>
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<td>This was a follow on from the UIDM workshop</td>
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<tr>
<td>27/04/2009</td>
<td>Hilary Dexter</td>
<td>Enterprise Architecture projects and others</td>
<td>Open Group workshop on doing enterprise architecture with Archimate</td>
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<td>19/05/2009</td>
<td>Hilary Dexter, Tom Franklin</td>
<td>Curriculum Design projects(6) and EA pilots (2)</td>
<td>CETIS workshop. Presented Innovation Base, a comparative business process model in UML, BPMN and Archimate. Innovation Base cards activity on EA</td>
<td>Ongoing discussions with the BPM team at Bolton, general interest in Innovation Base for supporting EA models</td>
</tr>
<tr>
<td>9/09/2009</td>
<td>Hilary Dexter, Tom Franklin</td>
<td>Attendees at ALT-C 2009</td>
<td>Presented the Innovation Base and a modelling exercise using the cards</td>
<td>Ongoing discussions with some of the participants</td>
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