eIUS Prototype Use Cases[1]

In these examples, underlined elements are based either on the original interview data or on feedback sent by the informants in response to draft versions of the use cases. Key *activity types* are highlighted in *italics* and **relevant ICTs** in **bold**.

Use Case 1 – Engineering Science

Narrative

1. Alex, a researcher working in medical image analysis is phoned up one evening in June by his friend Alison, who the day before *produced a sequence of MRI brain images* from hospital volunteers of an unprecedented high resolution.

2. Alison, who is interested in *researching blood flow* through the brain, is hoping Alex can help through the *use of image analysis techniques* to identify blood vessels, and by *analysing sequences of the images*, the amount of blood flowing through them over time.

> "… these images have been acquired at a very, very high resolution, they are sequences of images, so what we want to do is […] we want to calculate how much the volume of the heart changes."

3. Alex decides he is interested in working with Alison as no one has done image analysis on these types of images before and there is potential for research papers both in the clinical journal Cerebral Blood Flow & Metabolism as well as in the **Insight Journal**, a medical image analysis journal. They agree over the phone to collaborate and write joint papers on any successful results.

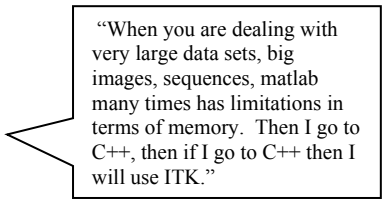
4. Alison *sends Alex the images* in a DVD through the post, and they arrive in a couple of days. Alex sends Alison an email to *arrange a phone conference* to discuss the images. In the meeting Alison *explains what exactly is shown in the images*, and what she wants to get from them.

1 Four use cases were produced for the 'Scoping e-infrastructure' interim report, available online at http://www.eius.ac.uk/scoping/index.xml. They are reproduced here as separate documents to illustrate how researchers in various academic disciplines use e-infrastructure systems in their work

5. After the meeting, Alex does some *preliminary analysis* of the images on his lab's **local cluster** using blood flow analysis code that has worked for lower resolution images. As expected, he finds that the contrast in the image has decreased to the point where his existing code is unable to discern the relevant features. Though a major challenge, developing successful analysis techniques for these images has major implications for his career.

6. Following several unsuccessful attempts to *develop MatLab code* on his workstation to analyse the images, he *phones up trusted friend* to discuss the problem. His friend tells him about some successful image analysis of low-contrast images of nerve cells, which has been published in the **Insight Journal** .

7. Alex *downloads this code* from the **Insight Toolkit (ITK),** which is fortunately supplemented by a series of test images. Over the next three months, Alex works to *integrate this code* into his existing software, *running the analysis* on small sections of the image where high performance computing is not required.



8. In the middle of September, Alex finally produces a code that appears to work successfully on small samples and decides it is time to try the analysis on the full sized images. The memory on his desktop will be insufficient to do this kind of analysis so he is in need of his lab's cluster again. To use the cluster, Alex has to *parallelise the code*, that is, carry out further work to have different compute nodes in the cluster analyse separate sections of the images.

9. An analysis conducted on the cluster is successful and Alex contacts Alison to let her know that he is ready to share some data with her. Alison *validates the analysed images against her previous manual analysis* and is relieved the results are consistent.

10. Over the next two weeks, Alex *carries out the analysis* on further images, yielding invaluable clinical data, which is used by Alison in a paper accepted by Cerebral Blood Flow & Metabolism. Alex *writes up* his new analysis technique and *publishes it* in the Insight Journal, submitting the associated code and images, ensuring others can *reproduce his results* in future.

Relevant ICTs

ICT	Comments
Insight Journal	An open access image analysis journal with associated code repository.
Insight Toolkit (ITK) [2]	An open-source software toolkit for performing registration and segmentation. Code is sourced from submissions to the Insight Journal.
Local Cluster	A high performance compute resource provided locally.
MatLab	A numerical computing environment and programming language.
BrainWeb [3]	A simulated brain database. Not included in use case as reported to be used only occasionally.
Field II [4]	An ultrasound image simulator. Not included in use case as reported to be used only occasionally.
Storage Resource Broker (SRB)	SRB is a technology for managing collections of files distributed across multiple organisations and heterogeneous storage systems. In the use case step 4, Alison could have used Storage Resource Broker (SRB) or Secure FTP to share the images. However, she chose not to, preferring to rely on a DVD sent in the post. Possible reasons for this might include: - Lack of awareness of SRB or Secure FTP. - Lack of access to a supported SRB installation. - Institutional firewall blocks the network ports needed for SRB or Secure FTP. - Lack of urgency.

2 www.itk.org
3 www.bic.mni.mcgill.ca/brainweb
4 server.oersted.dtu.dk/personal/jaj/field

Commentary

In this first example, the research question is loosely based on one of the examples given in the interview data also relating to analysing blood flow, but in the heart. The research methodology, characterised by the analysis of sequences of high-resolution MRI images from hospital volunteers, has been kept exactly as it was described in the interview.

Many other elements of the use case are taken directly from the interview data. These include:

- the means of sharing the images (by sending a DVD in the post);
- the suggestion that test images are not always available within ITK (due to patient confidentiality issues);
- that the analysis of the larger images is not possible on his workstation due to a lack of memory;
- the need to parallelise the code to make it run on the local cluster;
- the use of the Insight Toolkit and Insight Journal for accessing and publishing image analysis code.

Comments by Informant

The informant said that overall the use case was ‘quite accurate’. He did, however, have a number of comments and suggested changes to the use case that were subsequently incorporated. These included:

- the detail about the two collaborators first arranging a meeting to discuss the images;
- the detail about the contrast in the images decreasing to the point where existing analysis algorithms fail (high resolution in itself is not normally an issue);
- the detail about the analysed images being validated against an independent manual analysis.

Other Editorial Considerations

Element	**Usage**
Links to direct quotes?	Yes
Year?	No
Month?	Yes
Time of day?	Yes
Location given?	No
Real institutions named?	No
Real journals named?	Yes
Real conferences named?	No