Euro BioImaging
Preparatory Phase II Project

D8.5 Procedure for identifying out-dated technologies in EuBI for de-commissioning

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Abstract

This document describes scenarios when a technology may become out-dated and mechanisms how to detect this. It proposes a procedure for the identification of a possibly out-dated technology using the described mechanisms, how to assess the technology and how to proceed to remove it from the Euro-BioImaging technology portfolio.

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1. Introduction

Knowing how to end something is as important as knowing how to start it. The enormous technological progress in the field of biological and medical imaging has the inevitable flipside that inside the transforming field, established technologies become less relevant or even obsolete. For an infrastructure like Euro-BioImaging (EuBI) this implies that mechanisms must exist to frequently adapt the technology offer not only by addition[1], but also by subtraction at the level of a node offer (affecting the service level agreement of the node) and possibly also at the level of a whole node (affecting the participation of the node in EuBI).
It should also be clearly understood that a technology that should be decommissioned from the EuBI portfolio may sometimes be a very successful technology that has become commonplace so that there is no point in external access provision.
It will be the task of this deliverable to provide suitable definitions for dated technologies and procedures how to deal with them.

2. Considerations for technology dating

The introduction of a new technology has clearly identifiable beginnings in the form of the first publication of the working principle and the first proof of concept, the subsequent first implementations by early adaptor labs and the first commercially available instruments.
The steps of loss of relevance of a technology are gradual and much harder to define, as established technologies and methods may remain essential to specific users while becoming less relevant for the majority. This is very often the case if an established technology is replaced by a method that is significantly more efficient, but isn't fully overlapping with all applications for the established method. In general, a technology becomes dated if a new technology is introduced that performs more efficiently for similar applications. This directly links the activities of technology introduction and removal and should be taken into account in the technology introduction procedure[1] as well.
There are significant differences between different technology fields in the (downward) compatibility of new technologies. In the fields of Genomics and DNA sequencing a wide range of different technologies is applied to a very defined subject (DNA and chromatin). A new sequencing technology may be based on a completely different working principle and be fully incompatible with preceding technologies and through its higher efficiency quickly replace the predecessor. Technology adoption and product cycles may be completed within a few years.

In biological and medical imaging (and specifically in biological imaging) optical principles are applied to a wide and very diverse range of subjects and many different modalities are detected. Even ground-breaking innovations are often punctual inside the illumination and detection path and do not affect the optics at the heart of the system which are using the same principles that were already applied by Hooke type microscopes. Downward compatibility is higher and established technologies are continuously adapted with new instrumentation which makes it hard to clearly define obsolescence.

[1] As described in Deliverable 8.2

In the medical imaging field, the lifecycle and obsolescence of the equipment is not fully defined. Equipment operations extend significantly beyond the amortization time whenever this does not affect the quality of the data, due to the need to make the infrastructures sustainable.
One of the challenges to be tackled is the need to establish well-defined protocols and minimum operational ranges. Some examples already exist in the field of Magnetic Resonance, where credible initiatives propose the use of well-structured quality markers. To achieve this, it is necessary to carry out a quantitative and population study where data quality limits first for the quality of data and then for the technical obsolescence.
The BIMCV node has started such a study to establish those values. Some of the more relevant indexes needed to evaluate the infrastructures in medical imaging are listed in Annex 1.

Another aspect to consider is that in an external access provision infrastructure like EuBI, many technologies are provided for user operation, not as a service. Technology fade-out is therefore influenced by the way that researchers prepare their samples for imaging and to what extent they are capable of making use of the latest technologies. A new technology will only replace an established one (and thus make it obsolete) when a critical mass of technology providers can offer it[2] and it is being applied by researchers, so that it bridges the gap between early adaptors/technology providers and the early majority of users.
Technology adoption and product cycles are therefore longer and especially in their later phases not clearly defined.
A very important consideration is that imaging technologies must be understood as a combination of instrumentation and methodology, not the instrumentation alone. A widefield fluorescence microscope with a film camera is different from a widefield fluorescence microscope with a scientific CMOS camera capable of single molecule detection.

2.1 Cases of technology dating

A technology may become eligible for decommissioning in the following cases:

A. A technology is not used anymore. This case should be covered, even though in most cases this would be caused by the introduction of a new technology (see next case).
B. A new technology replaces an existing one.
C. The technology becomes generally available. This defeats the purpose of external access provision and should lead to the removal from EuBI's technology portfolio for reasons of state of the art provision and economic sustainability of the service offer.

This would require an active adaptation of the EuBI technology portfolio by the procedures described below.

[2] See Deliverable 8.1

2.2 Alternative scenarios

A technology may become removed from the EuBI technology offer without a previous adaptation of the technology portfolio:

D. A node wants to discontinue its offer of a specific technology. In case it is the only node offering the technology this means the technology isn't offered anymore within EuBI.
E. A node offering a technology decides to stop operation. In case it is the only node offering the technology this means the technology isn't offered anymore within EuBI.

This is a passive adaptation of the technology offer and the steps needed to execute this are not the same as for decommissioning, but rather affect the agreements between the node and EuBI. Although there may be node-internal reasons for such a step, such an event may reflect that the technology is not relevant anymore.

3. Procedure for identifying out-dated technologies in EuBI for de-commissioning

3.1 Overview of the procedure

In the EuBI ERIC, out-dated technologies will be identified for decommissioning by the following steps, depicted in Figure 1:

- Identification of eligible technologies using four main mechanisms (see 3.2)
- Assessment by the EuBI Hub (advised by the Technology Watch Panel)[3] and the providing nodes (see 3.3)
- Trial period of the eligible technology (see 3.3)
- Conclusion of the assessment by the EuBI Hub and in case of a negative review forwarding of the decommissioning proposal to the EuBI Board (see 3.3)
- Adjustment of the technology offer (see 3.4)

[3] Previously called Technology Watch Board, TWB (D7.2 and D7.3)

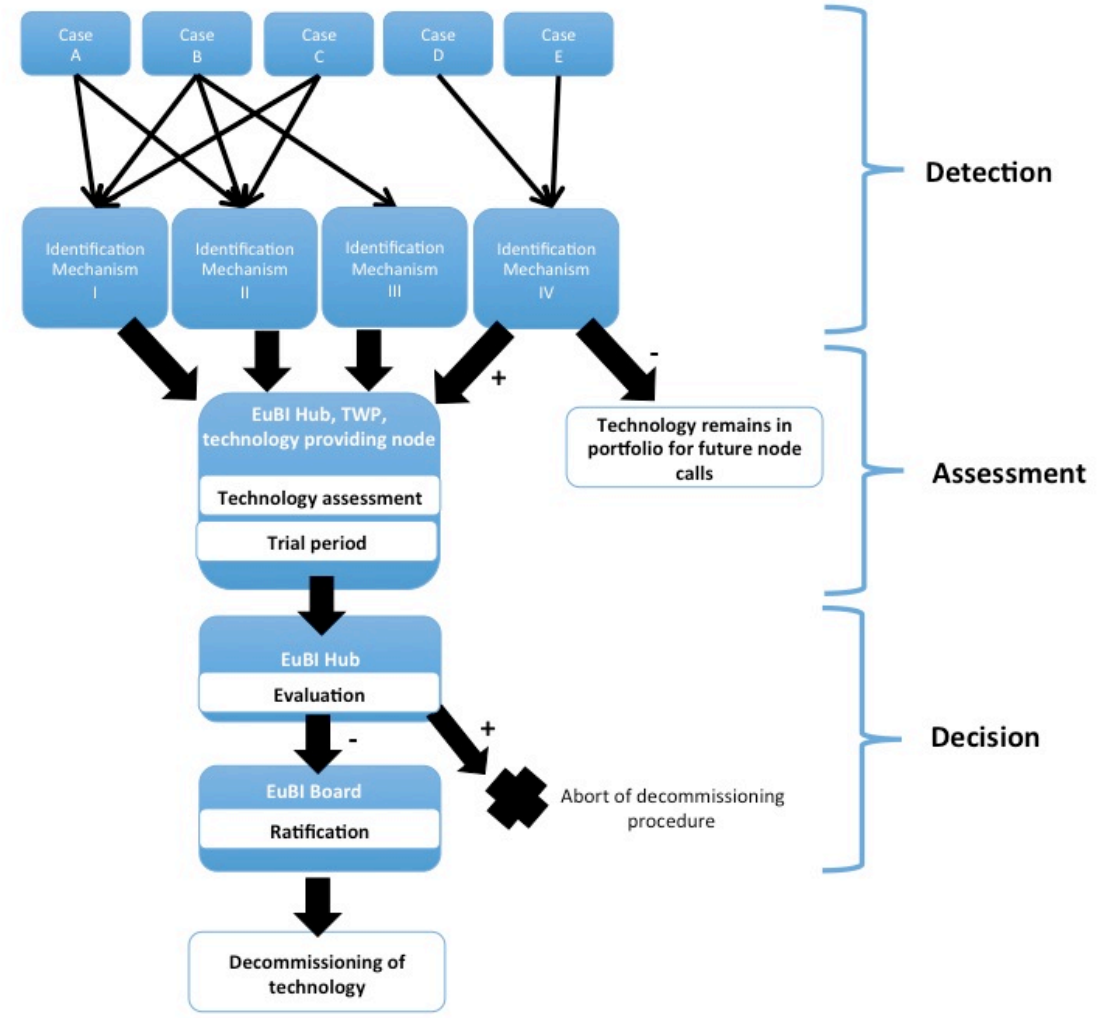

Figure 1: Overview of EuBI technology decommissioning procedure

3.2 Procedure for identification of technologies eligible for decommissioning

The identification of technologies that are suitable for decommissioning will be based on several mechanisms to cover the different requirements of the cases A-E.

I. Activity reports: As part of the periodic node reporting, the usage of the different offered technologies will be provided to the EuBI community-specific hub sections.
II. Community surveys: The periodic community surveys on required technologies should be shaped in a manner that in addition to the need for new technologies[4], also the required established technologies are assessed. This is similar to the 2011 EuBI technology survey of the Preparatory Phase I that helped to establish the selection of the 36 technologies for the first EuBI Open Call for Nodes in 2013 in already existing fields.

[4] See D8.2

III. New technology assessment: As part of the procedure for the inclusion of a new technology the Technology Watch Panel (TWP)[5] should assess the potential impact of this technology on the existing portfolio. Technologies that could become redundant can be identified and observed more closely.

IV. In case a technology is removed from the offered methods by one or more technology providers (nodes) and especially if this affects a significant part or all of the EuBI service offer of this technology, the community specific hub sections together with the TWP need to assess if this reflects the decreasing relevance of this technology. This should be done together with the respective nodes and independently by reassessing existing survey data and consulting experts.

User project reports are also a useful source of information on the relevance of a technology, but may be too individual to draw valid conclusions. They should be considered as an additional source of information in the decommissioning procedure described in the next section.
Cases A - C should be identifiable by the mechanisms I, II and/or III independent from the nodes' perception and thus provide an important autonomous control at the level of the infrastructure.
If a potentially redundant technology is identified by mechanism III, but doesn't show up in subsequent observation periods in mechanisms I and II it can be considered as continued relevant and the technologies would coexist in the portfolio until identified by mechanisms I and II. There is a necessary and beneficial overlap period between a new technology and a possibly redundant one inside the EuBI infrastructure as only future editions of mechanism I and II can validate the new technology and indicate the redundancy of the old one.
Mechanisms I and II should only be evaluated as positive if the same indication is obtained in more than one round. This will allow to remove natural fluctuations from the identification process.

Identification scenarios:

- Case A may be rare (loss of relevance without replacement), but would be identified by mechanisms I and II.
- Case B should be identifiable by mechanism III, but would then also show up in mechanisms I and II. This is however a potential catch 22 scenario if a new technology is not efficiently integrated into EuBI through the procedure for new technologies[6]. As the community survey (mechanism II) is shared between the procedures for integrating new technologies and for decommissioning them it needs to work efficiently in both. If the need for a new technology is missed in the survey and it is not included in EuBI it may not show up as a decreased need in the existing technology offer in future editions of the same survey. It would only start to show up in mechanism I (decreased usage) at a time when EuBI has failed to provide state of the art methods in the affected field.

[5] Previously called Technology Watch Board, TWB (D7.2 and D7.3). To be further defined in Deliverable D3.3 "Detailed description of the EuBI ERIC executive management (description of all positions, reporting lines, responsibilities and operational procedures in the EuBi ERIC)"
[6] See D8.2

- Case C would be identified by mechanisms I and II, but not be identifiable by mechanism III, as it is a case of a successful technology becoming commonplace without a direct replacement by a new technology in the portfolio. Case A and C would trigger the same indicators, but can be easily separated by subsequent assessment.

Cases A-C could also possibly show up as a justification in mechanism IV. This would however indicate failures of mechanisms I and II that would need to be understood for future editions. Mechanism IV provides therefore a second level detection mechanism that ideally should never be triggered with a positive outcome as it indicates a failure of the overlaying infrastructure.

Cases D and E could have alternative explanations:

- A change of the scientific and technological direction of the node institution(s)
- Economic considerations unrelated to the relevance of the technology
- A change in the science policy of the node-hosting country

These should be identifiable in the process of change of node offer or discontinuation of the node. In that case mechanism IV would not lead to the identification of a technology for decommissioning. As the above explanations could however often be indirect manifestations of a technology losing relevance, this always needs to be assessed together with the node(s) and separately. If mechanism IV indicates reasons unrelated to obsolescence, no further actions are required and the technology remains part of the technology portfolio for future node calls.

3.3 Procedure for decommissioning technologies

If a technology has been positively identified by one of the above described identification scenarios (which always combine more than one identification mechanism), the EuBI Hub can start the decommissioning procedure that should contain the following steps:

1. Assessment of the technology together with the technology providing nodes: The EuBI Hub should state to the nodes that the technology is considered for decommissioning and invite an assessment of the need for this technology by the technology providers. Especially in a possible case A or B scenario, this would help in understanding if e.g. a drop in usage may be temporal or caused by technical limitations and how it could be addressed. The assessment should also include the analysis of user project reports that used the technology. This assessment should be provided to the TWP for evaluation.
2. The EuBI Hub should start a confidential half-year trial period (equivalent to the feasibility tests of new technologies) that gives the opportunity to address possible issues with the technology offer.
3. If the outcome of the trial period is evaluated negatively, the EuBI Hub should with the help of the TWP and the EuBI Industry Board assess the relevance of the technology and the future market development, identify possible alternatives already in the portfolio or for inclusion and the impact of removing the technology from the infrastructure (especially in the case of interdependence between nodes).

4. If the decision is taken to remove the technology, the EuBI Hub forwards the recommendation to the SAB for information and the EuBI Board for approval. After approval, the technology will be removed from the technology portfolio for future node calls and the process to remove it from the existing service offer is started.

3.4 Adjustment of the technology portfolio

If the decision has been taken to remove the technology from the EuBI portfolio, this needs to be executed at the infrastructure level. Adjustments may take effect at the following levels:

A. At the level of the technology offer of one or several nodes
B. At the level of the node in case it is the only technology offered or the node would otherwise become unsustainable.

In adjustment case A, the service level agreement between the node and EuBI is modified accordingly following the procedures established for node management in WP3.
In adjustment case B, the procedure for discontinuation of node services is implemented as established for node management in WP3.
To make the winding down of the technology offer or the node foreseeable for all participating parties, these procedures should be implemented at the time of periodic node revision.
In the case of a new technology replacing an existing one, options should be explored how to include this technology in the existing node and to make it eligible in the next open call for nodes.

A very important consideration is how to restructure resources shared at the EuBi level in case of a technology being decommissioned. These include the EuBI WAP associated databases[7], the Imaging Resource Portal (IRP) and the Image Data Resource (IDR)[8]. User project tracking until after data publication would require the existence of reporting tools years after the initial creation of the project data. The permanence and status of public and reference datasets of decommissioned technologies in the IDR and of processing tools in the IRP needs to be defined as part of the scenarios for data removal in WP5 and WP6.

4. Conclusion

It is important to understand that EuBI aims to provide external user access to state of the art instruments and technologies and does not aim to represent the whole field of biological and medical imaging, which can be better served in other formats. This requires a constant process of assessment and adaptation of the service offer that needs to be a high priority of the infrastructure. Even though fading out technologies are harder to identify than new ones, it is important to fully control this aspect of the infrastructure. Even though demand and supply mechanisms for external access to instrumentation may be passively helpful in adjusting the technology portfolio, active technology assessment and decommissioning is necessary for the

[7] See WP5 (Technical preparation for user access)
[8] See WP6 (Delivering Usable Data Resources for EuBI)

provision of state of the art service provision in the field of biological and medical imaging. It will define EuBI's usefulness and quality.

Annex 1:

Main targets for the quantification of the Quality Assessment Protocol in structural imaging.

- ***Signal-to-Noise Ratio (snr):*** The mean intensity within the anatomical structure to study divided by the standard deviation of the values outside this structure. *Higher values are better.*
- ***Contrast to Noise Ratio (cnr):*** The mean of the anatomical structure intensity versus the mean of the second structure intensity values (eg. In brain it will be Green matter vs White mater) divided by the standard deviation of the values outside the anatomical structure. *Higher values are better.*
- ***Foreground to Background Energy Ratio (fber):*** The variance of voxels inside the anatomical structure divided by the variance of voxels outside the anatomical structure. **Higher values are better.**
- ***Percent Artifact Voxels (Qi1):*** The proportion of voxels outside the anatomical structure with artifacts to the total number of voxels outside the anatomical structure. *Lower values are better.*
- ***Smoothness of Voxels (FWHM):*** The full-width half maximum of the spatial distribution of the image intensity values in voxel units. *Lower values are better.*
- ***Entropy Focus Criterion (EFC):*** The Shannon entropy of voxel intensities proportional to the maximum possibly entropy for a similarly sized image. Indicates ghosting and anatomical motion-induced blurring. *Lower values are better.*