EuroBioImaging

European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences

WP13 Training

Task 13.1

A pan-European exploration on existing requirements and educational activities for biomedical imaging teaching

Deliverable 13.1

Report on survey on existing activities and key requirements for biomedical imaging teaching

Task leader

IMG/ UPF

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1 Executive summary

This report presents the results related to training activities, obtained through a pan-European survey on biological and medical imaging infrastructure that was conducted between the months of June and July 2011. The training section of the survey was completed by more than 500 participants from 25 countries. Through this survey, we gathered information on requirements and preferences of users for training in biological and medical imaging as well as existing training activities in imaging and their operational rules.

During the preparatory phase of the EuroBioImaging project, the project Consortium will prepare a plan for construction and operation of a pan-European infrastructure of imaging facilities. This plan will be based on the assessment of users’ needs for service, access and training. The results of this survey will help us to shape the strategy on training in biological and medical imaging under the ‘EuroBioImaging umbrella’ by responding to user requirements on training and by building on best practices of existing training activities.

The results obtained from the survey show that there is an overall good balance between demand and supply in training regarding the type of imaging modality (technology). The 5 most requested imaging modalities are:

- **Biological imaging** - laser scanning confocal systems, functional imaging of living cells, spinning disc confocal systems, deconvolution widefield microscopy, electron microscopy.
- **Medical imaging** - MRI 1.5T, MRI 3T, PET-CT, ultrasound: 3D, MRI 7T.

However, there is a gap between the level of training activities requested and those that are currently in place. Training is provided mainly at beginner level because the main training providers are universities (42%) and consequently the main target group are graduate and undergraduate students (36%). Infrastructure users, in contrast, especially demand training at advanced level.

Respondents also requested training actions on specific state-of-art imaging modalities as well as data processing and analysis techniques. Analysis at the macro-regional level indicated that in some macro-regions there are bigger gaps between users’ requirements and available training than in others.

Regarding teaching methods, respondents expressed a clear preference for face-to-face courses (theoretical and practical). Most of the participants were in addition also interested in a centralised e-repository of training activities and electronic training resources.

**EuroBioImaging training activities should therefore focus on face-to-face courses aimed at infrastructure users in the currently offered technologies at an advanced level. With this as main target, the necessary standardization of access and operational rules for training activities under the EuroBioImaging umbrella will be primarily aimed at this type of training activities, which should be a reachable goal.**

Roughly half of the training providers have formal operational rules in place, including access rules, evaluation and quality control. However, operational rules are non-uniform and heterogeneous and depend on the type of institution. This will have an impact on the definition of the operational rules for training activities under ‘EuroBioImaging framework. Access rules are applied by 2/3 of providers. Access to training activities is in the majority of the cases based on the level of the university programme or on scientific excellence of the user application for training.

Due to the relatively small sample of industry respondents no quantitative analysis could be conducted for this group. However, their responses were analysed from a qualitative perspective as they illustrate the type of involvement that industry could have under the future EuroBioImaging framework. When asked about their collaboration with academia, industry respondents expressed a major interest in
continuing the existing collaboration for the joint development of prototypes/imaging methodology/markers.

In conclusion, the survey has confirmed that training in biological and medical imaging should be an essential part of the future EuroBioImaging infrastructure. The findings of the survey will be used to ensure that the training related deliverables meet stakeholders (including users, providers and industry) needs. The report may be also used by training providers, decision-makers, national authorities, funding agencies, industry in biological and medical imaging and all other stakeholders interested in training in biological and medical imaging as it provides a comprehensive up-to date overview on training in biological and medical imaging in Europe.
2 Introduction

This report summarizes the results, related to training capacities, obtained through a pan-European survey on biological and medical imaging infrastructure.

This work was carried out as part of the EuroBioImaging project (Research infrastructure for imaging technologies in biological and biomedical sciences), funded under the 7th Framework Programme by the European Commission. The aim of the EuroBioImaging project is to develop a plan to construct and operate an infrastructure of imaging facilities based on comprehensive assessment of user needs regarding their requirements for service, access and training. To define the needs of the European imaging community and to analyse the current status of provision of imaging technologies in biological and medical sciences, including training, a pan-European survey was conducted between 1st June and 15th July, 2011. General description of the survey and main findings are available in the EuroBioImaging Strategic Inventory Map

The training section of the questionnaire included 22 questions. It took about 15 – 20 minutes to complete this section. The section was divided into two parts. The first part focused on needs and preferences of users, the second part was targeted at existing training activities in imaging and their operational rules.

The training section was completed by more than 500 respondents from 25 different countries. The high number of responses indicates that the subject is of high interest for the biological and medical community. Fig. 1 illustrates the profile of respondents by type of institution and geographical distribution.

![Fig. 1 Distribution of survey participants (training part), by type of institution and by macro-region](image)

1 EuroBioImaging Strategic Inventory Map
The main objective of the training section of the survey was to compile information to undertake an analysis of both the requirements (demand) and existing (offer) training activities for the biological and medical imaging sector. For this, information was gathered about:

- Demand for specific imaging technology (including needed level of training)
- Preferred type of training activity (e.g. face-to-face courses, on-line courses, webinars etc.)
- Need for a pan-European electronic repository of courses and training materials
- Existing training activities (including a short description)
- Inclusion of training activities in higher education
- Imaging modalities and levels of training covered in existing training activities
- Target groups of existing training activities
- Operational rules of existing training activities (capacity, access rules, quality control, evaluation, duration, frequency etc.)

A first draft of the analysis of the survey’s results was discussed internally during the Work Package 13 Training meeting in November 2011. Afterwards main findings were presented and discussed during the 3rd EuroBioImaging Stakeholders’ Meeting in January 2012 and relevant satellite-events (a meeting of the WP 13 International Committee for training portfolio and a common meeting of all EuroBioImaging work packages).
3 Analysis of the survey results

One of the aims of the survey was to explore the current provision of training activities in biological and medical imaging in Europe. Survey questions were designed in a way that would allow us not only to have an overview of existing training activities in this field but also to do a comprehensive analysis of what is the general practice of these activities.

From the content point of view, we focused on imaging modalities that are covered by existing training activities. We divided the modalities into two groups: (1) biological and (2) medical imaging modalities. Furthermore for each modality we asked respondents to indicate the level of the training course/activity provided (beginners, intermediate, advanced). We were also interested in further details such as: type of the training activity (teaching method), target group, duration, frequency and capacity. As regards to operational rules we asked for information on access rules, existence of fees, and evaluation and quality control systems in place.

We gathered information on the content and on the operational rules of about 250 training activities in biological and medical imaging. After an in-depth analysis of the data the following conclusions were drawn:

✓ There is a balance between training activities in biological and medical imaging fields:
  ➔ top 5 biological imaging modalities - laser scanning confocal systems, functional imaging of living cells, spinning disc confocal systems, deconvolution widefield microscopy, electron microscopy
  ➔ top 5 medical imaging modalities - MRI 1,5T, MRI 3T, PET-CT, ultrasound: 3D, MRI 7T

✓ Needs of imaging communities in different European macro-regions are largely similar, with some specific needs:
  - Biological imaging
    ➔ imbalance between provision of training and needs is evident in Central and Eastern Europe; unmet needs for advanced training in Scandinavia and UK/IE; relative balance between requirements and available training in Western Europe
  - Medical imaging
    ➔ provision of training in certain medical techniques is limited, especially at advanced level; needs are met primarily in Benelux and Scandinavia; limited training is provided in Central and Eastern Europe

✓ The majority of training providers are Universities (41,4%), followed by Public research institutions (24,3%) and university hospitals (16,4%). As a consequence:
  ➔ The key target groups of most of current training activities are: graduate students and postgraduate fellows
  ➔ The level of training provided: beginners / intermediate

✓ There is a predominance of face-to-face courses (both practical and theoretical)
  ➔ most frequent capacity - up to 25 participants
  ➔ usual duration < 7 days

✓ Access rules are applied in 2/3 of training activities

✓ Fees are charged by 45% of providers
  ➔ most common fee between 100 – 300 EUR per course/training activity
  ➔ companies charge higher fees
Evaluation and quality control are in place mostly at official education providers (i.e. universities) BUT non-uniform criteria, heterogeneity of internal evaluation

impact on definition of operational rules training activities under “EuroBioImaging framework” – flexible but ensuring the minimum quality criteria

3.1 Most requested and existing training activities in the biological and medical imaging fields

The survey showed that existing training activities cover a wide range of imaging technologies (Fig 2 and 3). The top 5 imaging modalities in terms of training demand in biological imaging are: laser scanning confocal systems, functional imaging of living cells (e.g. FRAP, FRET), spinning disc confocal systems, deconvolution widefield microscopy and electron microscopy. In medical imaging, the top 5 imaging modalities are: MRI 1,5T, MRI 3T, PET-CT, ultrasound: 3D and MRI 7T.

3.1.1 Distribution by macro-region

In addition to analysing the most requested and existing training activities in biological and medical imaging in Europe, we went a step further and analysed the results at macro-regional level too. This analysis will serve as a basis to identify specific training needs in different European regions and to better plan training actions within the EuroBioImaging framework. The following paragraphs summarize our findings by macro-region as illustrated in Figures 2 and 3.

Benelux (BE,NL, LU)

Biological Imaging

In biological imaging the top 5 requested biological imaging modalities are: (1) laser scanning confocal systems (2) spinning disc confocal systems, (3) functional imaging of living cells, (4) fluorescence lifetime imaging microscopy, and (5) deconvolution widefield microscopy. The top 5 modalities addressed by training activities in this macro-region are: (1) laser scanning confocal systems, (2) spinning disc confocal systems, (3) functional imaging of living cells, (4) fluorescence lifetime imaging microscopy, and (5) fluorescence correlation spectroscopy. The need for training in the top 5 modalities match the provision of training activities but we have identified a lack of training actions targeted at other requested technologies, especially for intermediate and advanced level.

Medical Imaging

In medical imaging the top 5 requested imaging modalities are: MRI 3T, µMRI (over 7T), µPET, ultrasound: 3D, and MRI 7T. Training concentrates on these top 5 modalities: µMRI (over 7T), MRI 3T, MRI 7T, µMRI (up to 7T), and MRI 1,5 T. There is a balance between the demand and the supply sides both from the point of view of imaging modality and level of knowledge. However, for some specific imaging modalities training offer is limited.

Central and Eastern Europe (CZ, PL, HU, EE, RO, SI)

Biological Imaging

Training is requested for these top 5 modalities: spinning disc confocal systems, laser scanning confocal systems, functional imaging of living cells, fluorescence lifetime imaging microscopy, deconvolution widefield microscopy. Need for advanced level of training prevails. As regards to current training offer, most popular disciplines are: laser scanning confocal systems, functional imaging of living cells, electron microscopy, deconvolution widefield microscopy, and total internal reflection fluorescence microscopy. Though requirements correspond with requirements in other macro-regions the range of training is limited for the majority of imaging modalities, except for the top 3 modalities. There is also a general lack of training activities for advanced level.
Fig 2 Most requested and existing training activities in **Biological Imaging in Europe**

Total nr of responses received 3,145. All data has been normalized by number of responses in %. Several answers per survey participant possible.
**Fig 3 Most requested and existing training activities in Medical Imaging in Europe**

<table>
<thead>
<tr>
<th>Country Group</th>
<th>Most requested</th>
<th>Existing</th>
</tr>
</thead>
<tbody>
<tr>
<td>FI, SE, NO, DK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CZ, PL, HU, EE, RO, SI</td>
<td></td>
<td></td>
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<tr>
<td>IE, UK</td>
<td></td>
<td></td>
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<tr>
<td>NL, BE, LU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DE, FR, AT, CH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total nr of responses received: 3,084. All data has been normalized by number of responses in %. Several answers per survey participant possible.
Medical Imaging

Most requested modalities cover: MRI 3T, MRI 1.5 T, MR-PET, MRI 7T, and PET-CT. Unlike in biological imaging the respondents expressed their need for basic training in most of the medical imaging modalities. In general the provision of training is very low. Available training activities focus on: MRI 1.5 T, PET-CT, ultrasound: 3D, MRI 3 T, and µMRI (up to 7T).

Scandinavia (FI, SE, NO, DK)

Biological Imaging

In biological imaging training, the following top 5 modalities are requested: laser scanning confocal systems, spinning disc confocal systems, high-throughput microscopy, functional imaging of living cells, and deconvolution widefield microscopy. The existing training activities are targeted at the following imaging modalities: laser scanning confocal systems, spinning disc confocal systems, electron microscopy, functional imaging of living cells, and multiphoton systems. There is mainly demand for training at advanced level which may be caused by a wide provision of training at the beginners' level.

Medical Imaging

The top 5 requested modalities in medical imaging are: MRI 3T, MRI 7T, MRI 1.5 T, PET-CT, and µMRI (up to 7T). Training in medical imaging is focused on: MRI 3T, MRI 1.5 T, PET-CT, µMRI (up to 7T), and MRI 7T. For modalities where training is provided, the request for training at advanced level prevails. For specific modalities, where there is only a limited offer of training activities, there is a higher request for beginners' training.

South Europe (ESP, IT, GR)

Biological Imaging

Training is requested for these top 5 modalities: functional imaging of living cells, laser scanning confocal systems, multiphoton systems, deconvolution widefield microscopy, and fluorescence lifetime imaging microscopy. Training is provided most frequently in these modalities: laser scanning confocal systems, functional imaging of living cells, deconvolution widefield microscopy, multiphoton systems, and spinning disc confocal systems. The survey shows that there is a balance in requirements and provision of training as regards to the type of imaging modality. However, requests for intermediate and advanced training are not fully met.

Medical Imaging

The most requested modalities for training are: MRI 3T, MRI 1.5 T, MRI 7T, PET-CT, and MR-PET. There is need for advanced training. Training is provided in MRI 1.5 T, MRI 3T, ultrasound: 3D, PET-CT, and MRI 7T. We can observe that the demand for training for standard modalities, with exception of MR-PET, is relatively well covered by existing activities but requests for training in specific imaging at higher level are unmet.

United Kingdom, Ireland

Biological Imaging

The training demand follows the pattern of the rest of macro-regions, i.e. the top 5 imaging modalities are: laser scanning confocal systems, multiphoton systems, functional imaging of living cells, total internal reflection fluorescence microscopy, and spinning disc confocal systems. From the data received it is evident that needs for advanced training prevails. On the providers’ side the following modalities are the most widely offered: laser scanning confocal systems, functional imaging of living cells, multiphoton systems, electron microscopy, and spinning disc confocal systems. The modalities on the demand and supply side match. The gap is apparent when we compare the level of training, because the provision of training at advanced level is scarce.
Medical Imaging

Training is mostly requested for following modalities: MRI 3T, MRI 7T, MRI 1.5 T, PET-CT, µMRI (up to 7T), and mainly at intermediate and advanced level. The existing training activities focus on MRI 3T, PET-CT, ultrasound: 3D, µCT, and physiological modelling. Provision of training in MR-PET and µMRI (up to 7T) compared with needs expressed by users seems to be insufficient.

Western Europe (DE, FR, AT, CH)

Biological Imaging

This is the macro-region with the most balanced distribution of interests for the different biological imaging modalities. The top 5 requested modalities are: laser scanning confocal systems, deconvolution widefield microscopy, spinning disc confocal systems, functional imaging of living cells, and total internal reflection fluorescence microscopy. We can see an inverse distribution of level of training offered and requested: while most users request training at advanced level, most providers offer training courses at beginner level. Nevertheless, we may conclude that in this region the requirements are matched best with the existing training activities based on the survey results.

Medical Imaging

The top 5 requested modalities are: MRI 3T, MRI 7T, MR-PET, µMRI (over 7T), and MRI 1.5 T. Also the need for advanced training clearly dominates. Training is provided mainly for these modalities: MRI 3T, MRI 1.5 T, µMRI (up to 7T), µMRI (over 7T), and PET-CT. The level of training is balanced for standard modalities but for specific modalities the provision of training remains mainly at basic and intermediate level.

3.2 Analysis of existing educational activities for the biological and medical imaging sector: types of training, areas, duration and methodology

First question we asked was who the providers of training activities in biological and medical imaging are.

The data obtained showed (Fig. 4) that the vast majority of courses are provided by universities (more than 40%), followed by public research institutions (more than 20%) and university hospitals (18%). All the other institutions do not represent more than 10% each (private health care centres, non-for-profit organizations, companies, etc).

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**Fig. 4** Providers of existing training activities [Normalized by nr. (644) of responses in %]
Consequently, the main target group (Fig. 5) of training activities are students (graduate and undergraduate, 36%), followed by post-doctoral fellows (21%), staff researchers (17%) and staff technicians (14%).

When imaging training activities are included in a university programme then it is mainly in a PhD programme (38%) or in a Master programme (34%); Bachelor programmes represent only 13% of the total training activities.

Regarding the type of training activities (Fig. 6), it is evident that face-to-face courses dominate the offer in the biological and medical imaging field (64% of activities); from which practical courses represent 34% and theoretical courses 30%. These are followed by congresses and conferences with 18% of the total training activities. There is a wide distribution of different types of electronic teaching materials. In total, this group of teaching materials represent 18%.

The type of training activity usually conditions the capacity of the activity itself. Due to the fact that most training activities are organized as face-to-face courses the most frequent capacity is up to 25 participants (44%). Training activities up to 50 participants represent 28% and activities up to 100 participants represent 18%. Only a minority of training activities are designed for more than 100 participants (9%).

Data on duration of training activities did not bring major surprises. The majority of courses do not last more than one week (less than 3 days – 35% and less than 7 days – 38%). Only 27% of training activities are scheduled for more than one week. Most existing training activities are provided on a regular basis. Almost 50% of courses are organized more than once a year.
EuroBioImaging intends to promote an open access not only to imaging technologies but also to training in this area. The requirements for operational rules of training activities in the EuroBioImaging framework should be defined during the EuroBioImaging preparatory phase. We will strive for open and transparent access rules therefore it was crucial for us to analyse current practice of access rules in existing training activities. It will allow us to build on best practice in that area and prepare a system that would fit in currently applied access rules.

The survey showed that access rules are applied by 2/3 of providers (Fig. 7). However, access rules differ depending on the type of training activity and its provider. In general we may conclude that training activities provided by universities are designed for a concrete level of programme (bachelor, master or PhD) and/or a pre-knowledge (participation in a preceding course) is required in principle.

The second group of access rules is based primarily on competition and scientific excellence. Applicants are usually requested to submit an application form including description of their project and research, a motivation letter, justification of needs for a specific technology (training) and demonstration of a potential to utilize a technology in the future. The third group of access rules covers basic access rules such as a first come first serve principle and a preference to local participants.

Fees are applied by 45% of providers, which means that majority of providers declared that they do not charge any fee. The average fee (Fig. 8) is between 100 – 300 EUR (32% of training activities). When we take into account different types of providers then we can say that there is no substantial difference in the distribution of fees with one exception: companies. More than 50% of training activities provided by companies charge more 500 EUR, whereas the major providers (universities, public research institutions, university hospitals) charge this sum only for 25% of the training activities, on average. On the other side the minimum fee of less than 100 EUR was not indicated by companies and private health care centres at all. This minimum fee reached the highest level at universities and university hospital where it represents approximately 25% of fees applied.
We also examined operational rules of providers. We were especially interested in evaluation systems of training activities and quality control systems implemented by the providers. We found out that approximately 2/3 of providers implemented an evaluation system. The universities are obviously the providers with the most elaborated evaluation systems. The evaluation of a training activity is usually executed independently by the university and/or is part of internal quality management system. In some institutions ISO 9000 standards are implemented. Nevertheless, it is also quite common to use ‘soft’ means of evaluation that go from feedback forms or survey to individual interviews. The evaluation of the outcomes of a training activity is usually in the form of a test or an exam.

Complex quality control systems are not as widely implemented as evaluation systems. Only 44% of respondents stated that they implemented such a system. The pioneers are university hospitals; among those 57% have quality control in place. The most frequently applied quality systems are: internal rules, ISO 9000 standards and accreditation.

3.3 Collaboration with Industry

Due to the complexity of engaging industry in this type of surveys, the participation and number of responses that correspond to industry representatives (32 respondents, 4,25% of total number of survey participants, see Fig. 1), is too low to consider them significant from the statistical point of view. Nevertheless, we deem it relevant to include in this report a summary of the responses received from the private sector as they qualitatively illustrate the kind of involvement that industry could have under the future EuBI framework.

First question asked to industry participants, was whether they collaborate with academic imaging facilities. The majority of survey responses were positive (84%) or declared that they intended to do so in the future. This high percentage of positive responses may as well reflect the fact that it is precisely industry that currently collaborates with academia that participated in the survey. However, what is clear is that those who are engaged in this collaboration do find enough benefits to be interested in maintaining this relation in the long-term, as will be explained in the following paragraphs and in Fig. 9.
One of the main advantages for the private sector of industry-academia collaborations is the identification of scientists’ needs. This inside knowledge that stems from day-to-day work, can later be used in the development of new products and services (or improvement of existing ones) to be commercialised. Therefore it is a way to early identify tendencies and necessities that industry needs to cover to make their business sustainable and aligned with sector needs.

At the same time, the collaboration with the academia gives industry access to the patent portfolio of research institutions, frequently becoming their business partners. This gives a competitive advantage to private partners as they have preferential access to R&D results before their business competitors.

On the other hand, through industry-academia collaborations, academia benefits from licences and preferential access to first-class equipment, at no cost or reduced prices for the development of their research (Fig. 10). In the current difficult economic situation, this can have a significant impact in the progress of R&D activities in the public sector. In return, this preferential access gives industry first-hand feedback on the use of their equipment that can be then integrated in their development line for the improvement of their products. Academia sometimes acts as “test-beds” for the validation of equipment.
Finally, Industry respondents were asked about the type of future collaboration with academia that would be beneficial for their companies under the EuBI umbrella. As shown in Fig. 11, responses follow a similar pattern as the existing cooperation. Thus, it can be concluded that industry is satisfied with the current set-up for industry-academia collaboration that could be extended to the pan-European level under the EuroBioImaging future framework.

Fig. 10 Industry Contribution in industry-academia collaboration [Normalized by nr. (76) of responses in %]

Fig. 11 CURRENT vs FUTURE collaboration between industry and academia [Normalized by nr. (32) of responses in %]
3.4 Future needs

Survey respondents were asked to identify the training needs that they considered as particularly urgent or that they anticipated that will need in the future. This was an open-ended question and responses received were of diverse nature. For analysis, answers were grouped into different categories as shown in Fig. 12.

Most of the responses received (52.8%) referred to training in biological and medical imaging acquisition techniques. This is in line with the findings summarized in page 8 of this report, section 3.1 (Most requested and existing training activities in the biological and medical imaging fields) regarding the general demand across Europe for training activities of advanced level for both the biological and medical imaging sectors. Second to this, were imaging and data processing (14.2% and 6.5%) techniques. This reflects the need of users for specific knowledge on how to extract information from the analysis of the data gathered through acquisition techniques and how to translate this into knowledge that can at the same time improve the acquisition processes themselves (better, faster and more accurate process).

One of the issues identified within the responses received, is the existence of distributed and non-processed information repositories coming from different level and sources that independently do not provide a high added value. One of the main current challenges of this field of knowledge is to integrate this information and allow interoperability between systems so that the imaging data can be combined to provide new and relevant conclusions that could lead to future research lines within the field.

Regarding the respondent’s preferences for training schemes for new biological and medical imaging techniques, there is still a major inclination towards face-to-face courses both for practical and theoretical subjects (see Fig. 13). However, a cross analysis taking into account age of respondents, revealed that younger generations are more prone towards online training, although in this age range also face-to-face courses were regarded as the most essential. These findings will be especially relevant for designing the activities of the future EuroBioImaging Training Office.
Fig. 13 Preferred training scheme for new biological and medical imaging techniques [Normalized by nr (3238) of responses in %. Several answers per survey participant possible]

Finally, all survey participants were asked whether they would make use of a pan-European centralised repository of high quality training material. Over 88% of respondents answered positively, which illustrates the interest of the sector for a unified repository.

Fig. 14 Would you make use of a pan-European centralised repository of High-quality training material? [Normalized by nr. (521) of responses in %]

4 Conclusions

The high response rate confirmed the important role of training within the EuroBioImaging infrastructure. In general we received extensive feedback from the biological and medical imaging community that allowed us to map the current situation in training both from the demand and supply side at European level.

When we analysed the data obtained from the survey we observed a balance between demand and supply in training regarding the type of technology, but an unbalanced distribution in the level of training activity. Requirements for training activities on 'standard' imaging techniques prevail and this need is matched with those technologies on which existing training activities focus. In addition to this, users specifically asked for establishing additional training activities on:

- **Biological imaging field:** Super –Resolution Microscopy, Correlated Light and Electron Microscopy, Single Molecule Imaging Techniques, Single Plane Illumination Microscopy.
• Medical imaging field: 7T MRI, MR-PET, mMRI-PET, Physiological Modelling, Technologies and Instrumentation for Image Guided Therapy.

Nevertheless we should be aware of the fact that a higher demand for the most innovative techniques is not always based on real necessities of operational practice in everyday research but may be attributed to personal interest for innovative and state-of-art imaging technologies.

Based on our findings from the survey, training activities under the EuroBioImaging framework should preferably focus on:

• Providing face-to-face training schemes for infrastructure users at the advanced level. There was a clear preference for both theoretical and practical face to face courses at advanced level among respondents.

• Creating an e-repository of electronic training resources. There is a high interest in a centralized, standardized and quality controlled repository of training activities and materials and we also observed a higher tendency towards online resources in the younger generations.

Analysis of operational rules of existing training activities revealed that operational rules, including access rules, evaluation and quality control are in place in roughly half of the training providers, mostly at official education providers (i.e. universities). The operational rules are non-uniform and heterogeneous affected usually by the type of training provider (type of organization). This will be taken into account in the definition of the operational rules for training activities under the EuroBioImaging framework. The EuroBioImaging criteria will have to have a certain degree of flexibility depending on the training provider, while ensuring a high quality standard of its training activities.

Analysis at the macro-regional level indicates that in some macro-regions there are bigger gaps between users’ requirements and available training. Although the survey sample sizes were in some cases relatively limited, the data allowed us to draw fairly accurate picture of the current situation in these macro-regions. We believe that this analysis may help national authorities to better shape the provision of training at national level and there is also room for the future EuroBioImaging training activities to create a repository of available training activities in Europe and to promote transnational open access to training.

As we received a relatively small number of responses from the industry sector conclusions in this area should be regarded only as indicative. Nevertheless, industry represents an important stakeholder group and the data may help to understand what potential role industry would have in future training activities organized by EuroBioImaging training office. Major interest of industry (current and future) is in the collaboration with academia for the joint development of prototypes/imaging methodology/marker.

5 Next steps

This report on the outcomes of the EuroBioImaging pan-European survey in the area of training in biological and medical imaging will serve as a solid base for the development of the rest of the EuroBioImaging training related deliverables. It aims to be a first comprehensive document covering both the requirements of the biomedical community on training in imaging as well as the existing training portfolio in biological and medical imaging in Europe.

Based on it, Work Package 13 members will address the needs of the imaging community in a follow-up document on the EuroBioImaging strategy for a pan-European educational portfolio based on medical imaging infrastructures (Deliverable 13.3). Through this document we aim to establish a coordinated multi-level training system that will contribute to bridging the gap between the unmet requirements and currently available training activities for the biological and medical imaging communities.
Information on operational rules of existing training activities we gained from the survey is of crucial importance for a proposal or rules and requirements for the training program in medical imaging (Deliverable 13.2). We will build on best practices identified from survey respondents’ institutions – training providers - and universalize them in the way that operational rules are on the one hand flexible enough to be implementable by different types of training providers and on the other, ensure that high quality standards for training are fulfilled.

The survey results will also help us to define the role and responsibilities of an EuroBioImaging training office (Deliverable 13.5). Already now we may deduce that its role will be key in the coordination of training activities, compliance with minimum standards of training activities assigned with ‘EuroBioImaging stamp’, promotion of training in areas where there is no sufficient offer and maintenance of an e-repository of training activities.