Project No. FP7 – 212348

NFFA

Nanoscience Foundries and Fine Analysis

D5.2

Scheme for Users Training Courses

Work Package	**No.5**
Work Package Title	**Schemes of future dissemination activities: a) training at NFFA-RI Centres, b) schools and public conferences, c) NFFA book**
Activity Type	**OTHER**
Lead Beneficiary	**No.3 CSIC**
Estimated P/Ms	**3**
Nature	**Report**
Dissemination level	**Public**
Delivery Date	**Contractual M 24 Actual M 26**
Task Leader	**L. Fonseca (CSIC-CNM)**
Major Contributors	**E. Lora-Tamayo (CSIC-CNM)**
Other Contributors	

Delivery Slip

	Partner/Activity	Date	Signature
From	CSIC	31/07/2010	Luis Fonseca
Reviewed by	NFFA Partners	30/09/2010	All
Approved by	Coordination Board	13/12/2010	All

Document Log

Issue	Date	Comment	Author
0-0			
0-0			

Document Change Record

Issue	Item	Reason Change

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Deliverable D5.2: Scheme for Users Training Courses

1. INTRODUCTION

1.1. Purpose of the document

The purpose of this document is to identify the training needs of the users of the NFFA-RI and describe how they would be implemented in the NFFA Centres.

1.2. Application Area

The targets of this document are the members of the NFFA Project, the EC Project Officers, and the general public.

1.3. References

Description of Work (DoW). See at web site:
http://www.nffa.eu/UserFiles/file/Annex_I_DoW.pdf

1.3.1. Objective of Work Package 5

Develop actions aimed at increasing the amount of competences in nanoscience methods.

Training of NFFA-RI staff to users access. Scientific and technological training of users involved in NFFA-RI activity

Advanced training for nanoscience and nanotechnology operators and researchers.

Dissemination material and writing of the NFFA book.

1.3.2. Description of work broken down into tasks

The following tasks are defined in WP5:

T5.1) Preparation of schemes for Training Lessons/courses for NFFA-RI staff, focused on transfer of know-how to potential users, optimisation of access within the NFFA facility, time sharing and use at LSF. Access to the NFFA-RI facility will require a specialised training of the staff researcher.

T5.2) Preparation of schemes for Training Lessons/courses for potential users, dedicated to the co-ordinated access to existing facilities within NFFA-RI. Specific training, with a full understanding of a common policy within the scientific/technical activity, will guarantee a fruitful use of the sophisticated tools available at the facilities. Researchers from collaborating institutions will, through short term visit/training courses, increase their knowledge in terms of potential use of the NFFA-RI tools. This will take place in the future NFFA-RI operating facility. Schemes for periodic NFFA-RI summer schools and open conferences will be defined in order to reach the widest public and promote the use of the Data Repository.

T5.3) Writing and distribution of a book about the NFFA concept and its roadmap of development in the relevant fields of nanoscience. Publication and distribution of the NFFA book.

2. EXECUTIVE SUMMARY

This document describes the rationale behind implementing training schemes at the NFFA sites. Two communities will meet at those sites: NFFA scientific/technical staff and external users. Both are susceptible of being the target of specific training schemes. This deliverable deals with devising a training scheme for NFFA external users. Dissemination and training activities aimed at potential external users, and even education and training activities for students, young researchers and technicians (that may become future external users or staff of NFFA) are also sketched in this document in an effort of strengthening the NFFA concept in the scientific community.

The external NFFA training is seen to serve two purposes. First, to assure safe and professional operation by the users of the resources made available to them in the NFFA sites. Second, to promote the synergetic view of nanofabrication and Fine Analysis Large Scale Facilities in the established scientific community, and to extend it as well to students and young researchers. Further activities addressed specifically to industrial users and to society in general can be considered.

In addition to generic science communication to society, two main blocks are identified: a focussed training scheme aimed at users at pre-proposal (including outreach activities) and post-proposal stages, and a far reaching training scheme including science seminars, specialised courses, summer schools and possible contributions to masters or doctor schools.

The punctual or periodic nature of different training schemes is discussed. In any case, ongoing NFFA operation should help to refine and update some of the training topics, especially those leading to a 'best practice' approach to users' interaction with NFFA, and to the vertebration of a scientific community well acquainted with the NFFA mission.

3. SCHEMES FOR NFFA EXTERNAL TRAINING LESSONS

3.1. Rationale of training schemes at NFFA sites

It is advisable that any state of the art user facility has a dedicated training program and NFFA is not an exception. Moreover, NFFA particularities (nano-orientation, geographical distribution and close links to partnering Fine Analysis Large Scale Facilities) recommend thinking about the nature and objectives of such training, and what schemes will optimally exploit those particularities in order to provide the best training and education platform possible.

In the NFFA scenario two communities come together - staff researchers/technicians and external users - with the appointed objective of extracting maximum profit from the available technical infrastructure and shared brain power. To accomplish this goal certain preparation and training is needed for both groups.

A sketch of the type of training topics and actions involving internal staff and external users is depicted in Fig. 1. The goal is to assure a lively environment from a scientific and technological point of view while facilitating to the external users the access to the material and human resources needed for developing their approved projects.

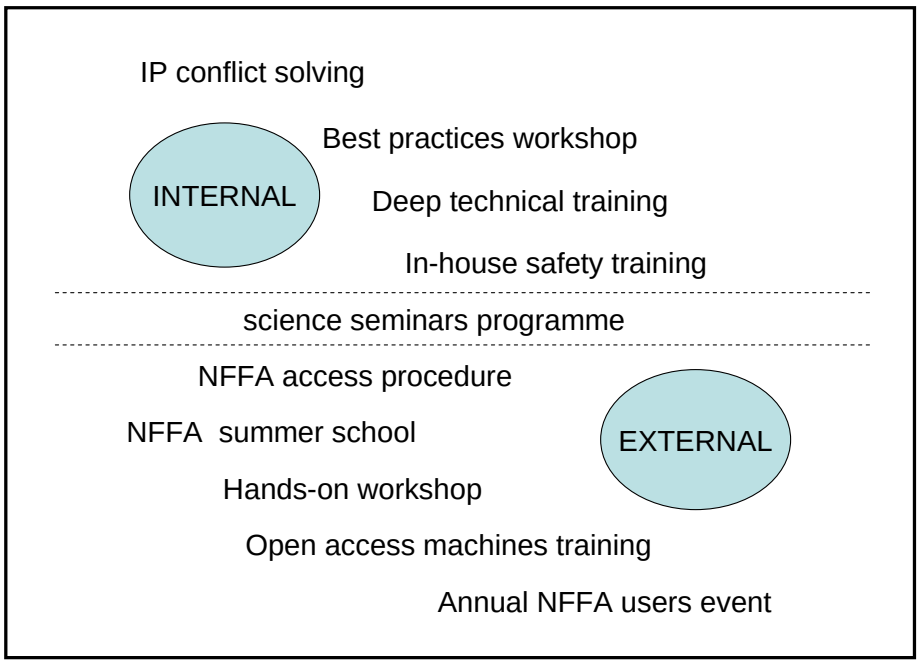

Fig. 1 Generic training topics and events in connection with the NFFA internal and external potential audience

This deliverable deals with training schemes for NFFA users in order to assure an efficient and smooth NFFA operation. A previous deliverable (D5.1) dealt with the training schemes aimed to NFFA staff to achieve the same goal. Additionally, the present deliverable also considers wider outreach and educational actions to better empower the NFFA concept.

Not surprisingly, both, staff and external users will share common training topics in some cases. The basic difference between them will be the periodicity of such courses and the degree of detail attained. Certainly for any common topic NFFA staff will be trained to a deeper level. Nevertheless, the objective is that users are trained to a level enough so as to become good trainers themselves at operational level of untrained users.

3.2. Objectives of an external training scheme

NFFA is being devised as an open access distributed infrastructure oriented to the synergetic relationship between Nanoscience and Fine Analysis Large Scale Infrastructures. As such, two different external training perspectives concur: one more focused in how to make the stay of users at NFFA sites safe and profitable, and another one more far reaching in nature about science communication and promotion in the nano frontier with more global implications.

3.2.1 Background

Before starting to ponder about proper NFFA training schemes two preliminary actions were undertaken in order to set a background of possibilities. One was paying attention to how this matter was dealt by the US DOE NSRCs that with a similar philosophy are in operation since a few years in the US. The other was to circulate a NFFA survey among the scientific community (mostly European) that included questions about the training needs in a NFFA like environment.

About the DOE NSRCs, it can be said that they face the user training users issue in a very practical and straightforward way. They follow almost exclusively a *hands-on* users approach and an associated *ad-hoc* users training that,

- Basically consists of **safety training** (that in most cases could be done through the web before the user visit) and **technical training** on the machines to be used.

- The technical training is done **when the user arrives**. Only covers **what the user strictly needs**. There is no generic periods of training when specific courses are done

On the other hand, the results of the survey pointed to a more involving training scheme. It was acknowledged that users should be trained on-site to meet safety requirements and also to avoid users damaging the equipment, but at the same time nano-scale science was considered as broad and difficult, and NFFA sites were envisioned as good places for providing a fairly comprehensive training to graduate students in those matters.

To sum up the survey responses, what people was expecting from a NFFA external training scheme was:

- A general introduction of the **facilities and techniques made available at NFFA centres and associated LSFs** including some appropriate background about how LSF facilities could complement top-down/bottom up nanotechnology approaches
- If users are to be granted direct access to certain machines, there should be practical training courses for the non-experts, focused on the **safe and efficient use of the instrumentation** that is going to be openly accessed
- Even if fabrication is done by foundry staff, training should allow the end-user to **understand the relevant experimental parameters**

The survey results were then in line with the opening paragraph of this section, in which the NFFA training schemes were extended to the broader scenario that theoretically could be conceived and which is summarised in the next figure.

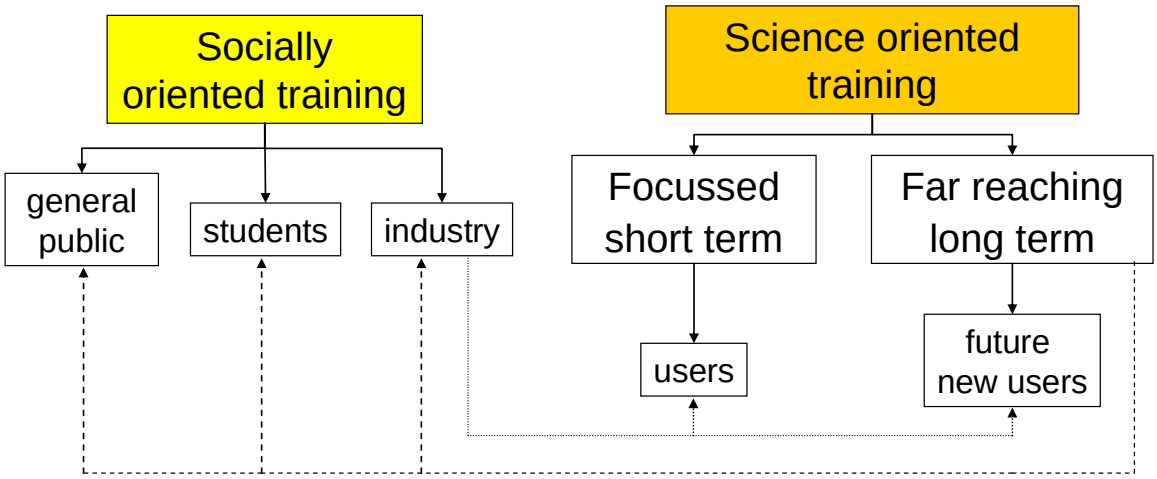

Fig. 2 Overall dimension of NFFA dissemination and training schemes

The ***focused*** **training scheme** addressed to applicant users and granted users is the one configuring the core of this deliverable, since such scheme is the one that should be necessarily in place from the onset of NFFA operation. For completeness, the ***far reaching*** **training scheme**, aimed to gain future new users and assure a sustainable interest on NFFA, is also considered and some concepts are devised for it, but it is certainly a scheme that will be developed along the way.

In both cases, the issues to be sorted out by the training schemes (or more broadly dissemination-education-training schemes) are the following: which are the objectives to be achieved by such training, which information has to be delivered for such purpose, and how and when/how often it has to be delivered to the users' community. The following sections deal with such issues.

In addition to specific training of scientists and engineers in NFFA scientific domains and procedures, NFFA may also play a role in **disseminating nano to society** by contributing to the education in nano of grad and post-grad students, and communicating to the general public the benefits of research in nano. A part of

the return on investment of society in nanoscience and nanotechnology will be in the form of new nano-based products. These products should be developed by the industry, so an important part of NFFA training schemes (of NFFA itself, in fact) is to give an appropriate service to industries already active in the field, as well as mobilise more industry interest in the future.

3.3. Focused external training

This focused training is the training scheme intended to make the potential users proficient in **applying** for proposals and in **developing** them at the NFFA sites when approved. Therefore two distinct stages can be distinguished: a **pre-proposal and a post-proposal stage** with different needs in terms of training.

3.3.1 Pre-proposal stage

In the pre-proposal stage the goal is double. On the one side, to promote the NFFA concept in the community of potentially interested users. On the other side, to train the potential user in the application procedure. Both goals can be served anyway by the same mix of informative material and outreach activities with the common target of making a proper introduction of NFFA concept and procedures among the potential users, and to ease turning these potential users into eventual users.

The material to be communicated in order to fulfil such goal should cover the following issues:

- **NFFA concept and mission** as an open access nano-oriented distributed infrastructure
- **NFFA portfolio:** both **scientific** and **technological** capacities. For the scientific part, it should include the description of the in-house science programs defined at the different NFFA sites. For the technological part, it should cover not only the nano-technological potential of the NFFA facilities and possible associated external labs, but also the complementary actuation capacity of the neighbouring LSF
- The **different type of users** considered (collective block allocation groups, individual scientists/academic groups, industrial users)
- The **different type of projects** expected (proprietary / non-proprietary research; short term, long term and service projects)
- The application procedure (calls, form filling, review process…) to be followed in each case
- The **different access modes** contemplated (presential, remote, e-access; open or limited hands on / hands off)
- NFFA **Repository** issues
- **Rights and duties of users** when performing a project in a NFFA site. Typical clauses of users' contract

The above issues should follow the guidelines stated in the relevant related deliverables (D2.1 Draft of NFFA scientific program, D4.1 NFFA Mission statement of NFFA-RI, D3.2-D3-6 NFFA facilities, D3.7 Scheme for Technical Synergies, D4.4 Users Access Schemes, D4.9 Scheme for Data/Metadata Repository, among others).

The associated informative material should be permanently available **on-line**, neatly structured and with a clear cut Frequent Asked Questions section. To reinforce the dissemination of this introductory material, periodic **webinars**, including illustrative (promising/successful) examples of the synergetic relationship between nanoscience and LSF, should be performed regularly allowing an interactive Questions&Answers exchange. Specific **outreach activities** at regular LSF users' meetings and major conferences targeting both the nano and the LSF communities should be devised, especially during the first years of NFFA operation, to spread the NFFA concept among potentially interested audiences. Complicity and coordination with the partnering LSF need to be assured.

The role of the NFFA Technological Liaison (see D4.8 *Quality&Standards*) should be instrumental as well at this pre-proposal training stage. In fact, the Technical Liaison is the optimal NFFA body to supervise and update the above training material. A special attention will be paid to **industrial users**, which will be the target of specific outreach activities (see D2.4 *Industrial Liaison Office*).

3.3.2 Post-proposal stage

In this stage an approved user will perform personally some work at a NFFA site for a certain period of time, or will have some work done for him by the NFFA staff. The degree of user personal involvement will depend therefore on the chosen type of access (e-access, remote access , presential access) and on the availability of certain pieces of equipment as self-service accessible or not. The degree of training needs in relation to NFFA equipment will vary accordingly. In the more generic case the external training at this stage will comprise the following issues:

- Preceptive **Safety training** of civil and lab premises (following national regulations as well as official European recommendations – see *D4.8 Quality&Standards*)
- Specific Clean Room / nano-labs **operation protocols**
- **Hands off / hands on training**, going from thorough theoretical knowledge of the capabilities of the available equipment to in deep practical training of the set of equipments that could be used under a self-service approach.
- Training on the repository access and feed

Similarly to the previous section, as much as possible of this training material should be available **on-line**. Certainly, on-line training is all the non presential users (remote and e-access users) will need, but the availability of a comprehensive training material in the web will ease the training demands of presential users as well. For instance, the on-line training about safety and general lab protocols issues will reduce the on-site training of this part to a minimum briefing and a knowledge check, **speeding up the warm-up process after users' arrival**. Even the practicalities of self-service equipment operation should be available on-line. Before being allowed to use it, presential users will be necessarily trained on-site for the self-service equipment they may require to the trainer satisfaction. If a virtual operative tour of such equipment is available on-line for users' self training, the time consuming mandatory on-site training will be sped up as well.

It is important to optimise the staff-time and the machine-time invested in the on-site users' training since it will divert such resources from real work. In addition to on-line user self-training, other measures directed to this aim could be to train presential users when staff trainers are using equipment for remote users projects, and to use successful trainees as trainers themselves of newly arrived users (who will always have to prove their dexterity to an appointed staff trainer in the end)

3.4. Far reaching external training

NFFA sites will be born with special traits that may preconfigure them as privileged scenarios where to perform far reaching dissemination and training activities for the benefit, not only of users themselves, but also for students, young researchers and technicians. Some of these traits are:

- a lively science program,
- an international environment
- built-in cross–disciplinarity
- state of the art fabrication and characterisation facilities
- local connection to Large Scale Facilities
- accessibility without the need for extensive travel time

Cutting edge nanofacilities in the vicinity of large science icons such as Large Scale Facilities make NFFA sites prime locations for generic science communication to society as well.

High level education in Nanoscience and Nanotechnology is acknowledged to need **a European approach** to have the necessary force and impact, since developing key educational aspects is not at the level of a single university, nor at the level of a unique research site. The NFFA **distributed** sites throughout Europe will offer their capacities to contribute to the raise of a **nano educated scientific/engineering workforce** and to the **nano literacy of general public**, thus complementing any other initiative that European authorities may devise within or in parallel to the EU Nanoscience and Nanotechnology Action Plan.

In this way, NFFA will make its share in fighting the risk of Nanoscience progress being hindered not by resources, but by talent and knowledge. Moreover, it will contribute to it without forgetting the NFFA trademark of intertwining the Nanofoundry and the Fine Analysis Large Scale Facility concepts as an enabling future line of action in the progress of science at the smallest scale.

3.4.1 Science seminars

A Science seminars program has been foreseen in D5.1 *Scheme for NFFA-RI staff training* as one of the advisable periodic actions to be set in place in order to promote the continuous technical and scientific training of NFFA staff. It can take the form of a monthly set of short informative talks dealing with science pressing issues in the NFFA areas of interest. Such seminar program should be linked to the local science program of each NFFA site and although driven by staff researchers, it will take advantage of the NFFA environment and be addressed to the NFFA community, thus involving external users, as well as visiting experts and guest speakers.

An overarching scheme for all NFFA sites may be advisable, though, for those issues of common interest: science developments aligned to the NFFA vision, arising metrology or fabrication techniques, etc.

3.4.2 Specialised courses / Summer Schools

The extensive NFFA infrastructure and the associated technical expertise, as well as the intensive and groundbreaking scientific labour it will concentrate should be put into use for the education of new scientists *and R&D engineers* in the coming nano-applications. This may take the form of specialised courses and summer schools.

The participants in the **summer schools** will be exposed for a few weeks to the whole nano-technological offer of a NFFA site, the basics of the fine analysis enabled by the Large Scales Facilities, and will be lectured on the relevance of such interaction. The summer schools at the different NFFA sites may share quite a bit of the educational material, but will keep a distinct nuance depending on the predominant scientific topics of the site.

The **specialised courses**, shorter in time (from a few days to a week) will focus with a larger degree of detail in the different nano-technological areas covered by NFFA. Many specialised courses can be devised for the different technological blocks defined in D3.1 *Design of NFFA infrastructure* (nanolithography, nanosynthesis, nanometrology…). They will have a distinct practical edge. In fact, after the course the attendees should be able to operate at least the self service equipment that within the technological area of the course is offered routinely in a NFFA site. The interest of the industrial sector in training their technical staff for such complementary specialisation will be checked.

The fact of having at the different NFFA sites the same (to a large extent) common infrastructure makes possible to run those courses in an itinerant way to have them available at different European regions during the year. Special courses dealing with the capabilities and operation of more complex machines that NFFA may possess at any site may be organised if enough academic and industrial demand is identified.

In order to set up these instruments, a couple of inspiring and long tradition approaches are the HERCULES (Higher European Research Course for Users of Large Experimental Systems - five weeks, hercules.grenoble.cnrs.fr) and HSC (Hercules Specialised Courses - one week, www.esrf.eu/events/conferences/HSC) courses held in Grenoble in the field of Neutron and Synchrotron Radiation for condensed matter studies, and the itinerant specialised periodical courses (1-2 days) of the FSRM (Swiss Foundation for Research in Microtechnology, www.fsrm.ch) in the micro and nanotech fields. In any case, the idea is to merge these two specialisations in a common NFFA scheme in an attempt to substantiate the unique NFFA approach.

3.4.3 Contribution to masters / doctor schools

It is the intention of NFFA to explore the possible collaboration with academia in order to identify and rearrange in a structured way whatever training content that may be found useful to be included in **masters and/or doctor schools**.

During the NFFA project we have been receiving hints (i.e. survey results, or the low LSF involvement in DoE NSRCs) that what the techniques offered by Large Scale Facilities can do for Nanoscience is not well known in a big part of the scientific community (especially among the non-LSF users). Improving this situation may require a **leverage action at academic level** in order to better educate the new generations of scientists in the **synergies of both worlds.** In this context the NFFA contribution to masters will be certainly a natural way to achieve it.

A questionnaire has been devised as a starting point to prospect the masters relevant to both disciplines ("synchrotron"-like science and nanotechnology) available in Europe and catalogue its degree of NF↔ FA interaction in order to clarify the current scenario and the possibilities to act upon it. This task was not previously contemplated in the work plan. The questionnaire is attached to this document as an annex, and results may be available by the end of the project.

3.4.4 Science communication to Society

In addition to schemes to train a high qualified scientific and technological workforce, appropriate science communication approaches to raise public awareness and understanding of nanoscience and nanotechnology are also needed. The ultimate objective is to illustrate nanoscience and nanotechnology real possibilities, and their place in the big scheme of Science as tools to address the Grand Societal Challenges of our time (Global Warming, Food and water supply, Energy issues, Public Health, Ageing Societies, Security, etc.) by providing a advanced new materials and devices enabling improved energy efficiency, greener transportation, personalised medicine, reduced resources consumption and environmental impact.

Some of the above key issues will indeed be part of the in-house science programs of the different NFFA sites, and they may have a say on them. As a whole, NFFA wants to contribute to the **nano literacy of well informed citizens** and to convey the idea that science gives answers to the above challenges, and does it in a way that is **socially relevant** in terms of jobs and economical added value.

Common open days with the neighbouring Large Scale Facilities addressed to the general public and schools can be the adequate tool to make the societal impact of 'Nano' understood, as well as its economic impact (and entrepreneurial opportunities). Additionally, exploiting the 'wow factor' to attract students into science/engineering careers is something to have permanently in mind. The edition in a digest format of rigorous scientific material can be also considered for wide communication purposes, as entries for instance in Wikipedia, the *de facto* encyclopaedia of the 21st century.

3.4.5 Users annual meeting

As a user oriented facility, the users' opinions will be important for improving NFFA operation. Hearing regularly the voice of users will allow among other things getting their feedback regarding the training procedure effectiveness and fine-tune NFFA training schemes by successive Iterations. The annual user meeting will not only be useful to improve the pre-proposal and post-proposal training stages, but also it will be a valuable forum where to discuss the extent of the far reaching schemes. It, itself, will be in fact a far reaching training event, since NFFA management will abound in the exploitation of the synergetic NFFA approach, and users will be exposed to the views and projects of the rest of the users' community. The annual users meetings could be used, as well, as a seed of another far reaching actuation: an hypothetical NFFA international conference

4. SUMMARY AND CONCLUSIONS

Training schemes addressed to the NFFA users and interested nano-community are described in this deliverable. The objective of such external training is manifold: to make public the NFFA mission, access procedures and its technological/scientific portfolio, to assure a safe, flexible and up to internal standards and up to users expectations operation of the facilities, and to extend in the scientific community the NFFA concept of the synergetic relationship between nanotechnology and Fine Analysis Large Scale Facilities as a enabling tool for Nanoscience progress. The training schemes are divided in more focused and short term actuations, and longer term and far reaching schemes, with a balance of technical and scientific aspects addressing the needs of nano-oriented researchers (and engineers in an attempt to appeal to industrial users as well).

In comparison to the more practical training schemes, the far reaching activities as a whole may be regarded as a kind of accompanying measures. However, they may prove instrumental for the sustainability of the NFFA concept. Among all of them, the collaboration with academia in general and the contribution to masters in particular is probably the one contributing more strategically to the integrity of the NFFA approach and its long term sustainability.

NFFA technical and scientific staff will be in charge of most of these training actions. Nevertheless, personnel from associated labs and, on occasions, users themselves will contribute to them.

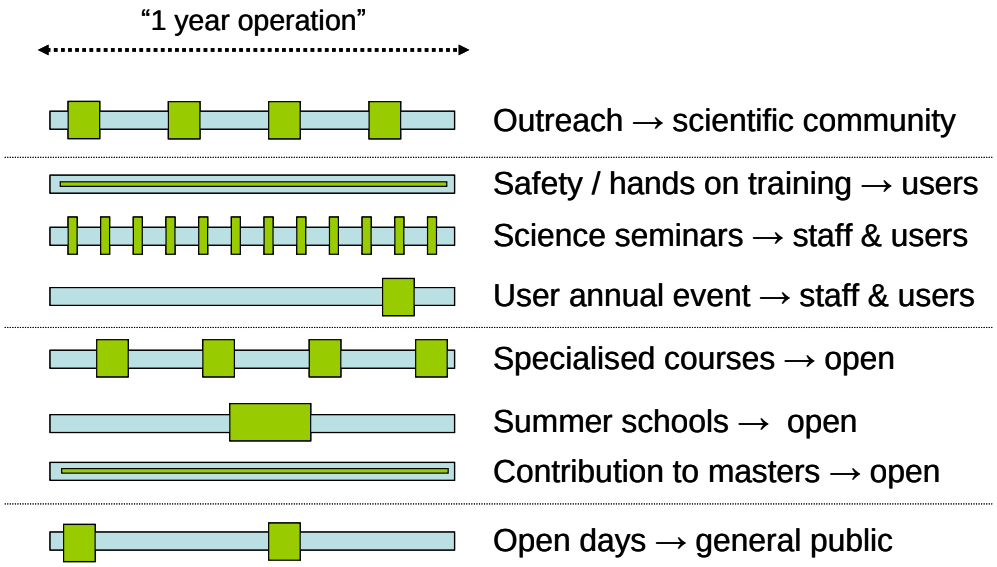

Fig. 3 Possible temporal lay-out of the different external dissemination and training activities

The periodicity of the proposed training approach is sketched in Fig. 3. Although all activities will be periodical, some of them will be 'punctual' from the point of view of a user (safety training, specific machine training), while others can be seen as a continuing education route (science seminars, specialised courses).

Since NFFA is a multi-site infrastructure, part of the training offer can be itinerant in nature (specialised courses) or tailored to local science programs (summer schools), whatever is found more interesting in terms of wide scientific coverage and/or wide European audiences. In any case, a distributed infrastructure as NFFA is well situated to contribute to any wide European nano-education strategy of future researchers and engineers, and to contribute to the nano-literacy of society in general.

As much as web support as possible will be implemented for the different training possibilities to facilitate easy access to relevant information and to enable self-training.

ANNEX: POST GRADUATE EDUCATION QUESTIONNAIRE

Text of the Questionnaire presentation letter:

…….

"The **NFFA project** (FP7-*Grant Agreement nº 212348* // www.nffa.eu) is a Design Study of a distributed European network of advanced nano-oriented labs co-located in the vicinity of Large Scale Facilities (Synchrotrons, Neutron sources, Free Electron Lasers…) in order to foster the new frontier research that the synergetic combination of both fields will enable.

In such a case, future NFFA centres could be an excellent platform to educate/train young researchers in those fields. The purpose of this survey is to gather information about the degree of interaction between *Large Scale Facilities* and *Nanoscience and Nanotechnology* that is currently present in the education and training academic framework. This will help us to know to which extent NFFA may contribute, by itself or with the appropriate partnership, to this goal.

The questionnaire is divided in three parts, depending on which framework this interaction may be taking place at your site:

1- in the framework of existing **specialised Large Scale Facilities** educational programs

2- in the framework of existing **specialised Nanoscience and Nanotechnology** educational programs

3- in the framework of existing **generic Science** educational programs

We are especially interested in those cases where such interaction has found a place at *master (or doctor school) level*, but we will be interested to know about any examples of such interaction even if at non official courses."

……..

The questionnaire structured can be checked at:

http://www.icmab.es/bnc-b/post-graduate-education-questionnaire

or visiting www.nffa.eu and clicking the questionnaire box in the Highlights section of the web home page.