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Final Report on the Progress and Effectiveness of Expert Groups

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INTRODUCTION

The background to the establishment and operating structure of IRUVX-PP WP3 was laid out in the intermediate progress report [1] which will not be repeated in full here. In summary, a number of Expert Groups (EGs) were set up to advance joint technical development programs. A spokesperson for each group was approved and the groups were encouraged to pursue self-organised collaborative activities to take forward their particular fields of interest. As well as technical development these activities might also involve the establishment of common goals and standards and the dissemination of expertise and best practice. The emphasis was on working *together* to deliver more than could be achieved individually with, where possible, improvements in economy and efficiency. Within IRUVX-PP technical development work was also carried out in WP7 and WP8. The important difference between these work packages and WP3 was that in WP7 and WP8 the primary aim was the *delivery* of well-defined technical objectives. In WP3 the aim was to establish and learn about the *process* of joint technical development. So while the technical outcomes themselves were interesting and valuable, the mechanism for achieving them was also the subject of study. This report concentrates on the process aspects.

The intermediate report was structured around considerations of Progress and Effectiveness, attempting to draw general conclusions from the early phase of the work. This report will again cover general issues but will also look at concrete examples from the individual work packages. It is very important to re-iterate the statement made in the intermediate report that any comments made here reflect no criticism, explicit or implied, of any of the members of the expert groups. They all achieved measures of success and the experiences they had working within the EG structure were just as informative, indeed sometimes more so, when they revealed problems as when they progressed straightforwardly.

EG1: FEL Injector Commissioning – A major component of this EG's work program involved the shared use of a large piece of equipment – an emittance meter - which could be transported between institutes. This raised issues which did not apply in other EGs where the only movements were of people or, in the case of EG4, of relatively compact objects.

A serious problem, noted in the intermediate report, arose because of bureaucratic delays in the accession of two of the partners to the project. One of these was INFN where the EG spokesperson and the emittance meter were both based. At the intermediate meeting (month 19) it was hoped that the delays would soon be resolved but in fact the necessary EU approval was not forthcoming until month 30 ! In the light of this it is remarkable, and a credit to them, that these partners achieved anything whatsoever. Suffice it to say that the emittance meter was transferred and used once and plans are in place to use it again.

As far as the EG process is concerned a notable aspect of EG1 is that it required some standardisation of practices between partner institutes. They would need to agree on the arrangements for transfer, support and maintenance of the meter and of any staff who might be needed to work with it. At the start of the program it was hoped that general agreements for this sort of activity could be produced, to which all of the partner institutes could sign up. In practice the bureaucratic delays slowed progress on this and ad-hoc solutions had to be found to cover the activities which did take place. Work in other areas, however, has shown that progress can be made to resolve administrative conflicts and it seems likely that the same would be true in

this particular area if there was a sufficiently strong requirement and a team of people committed to working on the issue.

The second aspect of the EG1 workplan involved the organisation of training activities and meetings such as the EuroFEL Workshop on Photocathodes for RF Guns. In general the meetings organised under WP3 have all been very successful. More details are given in the EG5 section below but most of the positive comments made there also apply here (and in other EGs). The organisation of EG1 training activities proved to be more difficult. Compared with, for example, the EG5 beam propagation workshop it may be that the EG1 plans were more ambitious than the resources could support. Issues with organising 'participative training' around activities as dynamic as machine commissioning are discussed under EG2. It should be noted though that, despite the difficulties, the view of EG1 is still that training activities are important and worth pursuing.

EG2: Transverse Beam Diagnostics – The title of EG2's activity was rather general but in fact the work program was focused largely on issues related to electron beam viewing screens. This EG was therefore highly specialised and it presents some examples of the challenges faced under these circumstances.

At the outset it should be noted that this is an important and dynamic area in the field of diagnostics and the technical work undertaken by group members is interesting and practically relevant. However this is primarily a non-technical report, so the technical outcomes will not be covered in any further detail.

Most of the EG's proposed experimental studies inevitably required beamtime on one of the very high brightness facilities operated by the partner institutes. Getting beamtime allocated proved to be more difficult than expected and this caused numerous setbacks for the program. There were several reasons for this, one of which (the particular difficulties that *collaborative* working introduces) is discussed in the section on EG3 below. Among the others were:

- Priority. IRUVX-PP WP3 was a lightly-resourced activity whose aim was to look at process as well as technical delivery. The EG structure was novel and, to begin with at least, its effectiveness was uncertain. So while the partner institutes recognised it as an interesting way to take forward R&D that might otherwise have been difficult to progress, they were not inclined to use it to deliver their highest-priority, mission-critical programs. At the start of the IRUVX-PP project demand for machine time already exceeded supply by a large margin and in this environment it was hard for anything but the highest-priority work to get scheduled.
- Planning. The technical issues that EG2 wanted to address would arise in the context of operational experience on the machines in question. Since the machines were mostly novel this experience was, understandably, difficult to predict. It was hard to be clear in advance what issues would arise and what the best approach to dealing with them would be and this was one of the reasons why several of the EG activities were, at the proposal stage, described rather generally. Example phrases included " … to be planned exactly at a later stage …" and "… experts are invited to participate in …". With hindsight it has become clear that this approach presents serious challenges. In practice it is necessary, despite the difficulties, to prepare concrete, definite plans including objectives, names and roles of those to be

involved and a schedule for the work. Given the operational realities, especially during machine commissioning, changes to the plans will be inevitable. But without such plans it proves difficult to get activities scheduled at all.

A consequence of EG2's specialisation was that relatively few partner institutes and relatively few staff from within each institute were involved in any given activity. In some cases activities involved just two or three individuals. Of course the outcome of these activities can still be valuable, both for the institutes and for the individuals. There are examples of small-scale successes in more EGs than this one and also in WP8 (FEL source) where a great deal of progress has been achieved on e.g. timing and synchronisation by a small number of participants. But it is necessary to run these activities bearing in mind that they are vulnerable to 'statistical fluctuations'. It can be difficult to achieve a critical mass, and changes in the circumstances of a single individual or a single partner institute can affect a whole activity.

EG3: Longitudinal Beam Diagnostics – The title of this EG is very similar to that of EG2, however EG3 is larger and its activities are more diverse. Some of them resemble those of EG2 in that they require facility beamtime and in this case many of the issues and outcomes have been the same, confirming that they are intrinsic/systemic and not a reflection on the groups themselves. In other cases the activities were more like those of EGs 4 and 5. Once again the outcomes have been similar. Most of the related issues have been discussed in other EG sections. One which has not is that of collaborative experimental work during the development of large machines.

Several accelerator-based light sources either are or soon will be operating in two different modes. Part of their available beamtime is given over to user operations. Users typically need ring-fenced beamtime with reliable machine operation and experimental support. This high level of assurance and lack of flexibility imposes some overheads in terms of efficient use of machine time and also of support costs. The other mode of operation may be referred to as 'commissioning' or 'machine development'. Again this often has tightly defined goals, and plans for achieving them. But now a higher level of program risk may be accepted. With the aim of dealing with unexpected problems and also of maximising the output from the beamtime, plans can be finalised relatively late and can change at short notice. Lower priority activities may be 'squeezed in' or removed from the schedule. It was planned to carry out some of the EG3 activities (and some from other EGs too) during commissioning/development time. But these plans were disturbed by two factors. Firstly the activities were not among the highest priority goals for the available beamtime and getting them scheduled could be difficult or impossible. Secondly whereas local staff can respond to short-notice changes in the plans, collaborators who are based in other institutes cannot. They need to make travel and accommodation arrangements in advance and they may also need to prepare equipment. One possible response to this could be for collaborative activities to be awarded beamtime on a basis more like that offered to users. Whether this is possible will depend on whether the facility operator will accept the overheads in return for the benefits of collaboration. Alternatively these activities might be split into two phases. The design and preparation of the experiment and the analysis of results could be carried out off-line in a fully collaborative way. But the actual experiments themselves could be carried out by local staff along with any of the collaborators who could be present at short notice. A third option, that of raising the

priority of collaborative work so that it can be carried out during development time with less disruption, may become more common as joint development work becomes more widely accepted.

Following on from the success of EG4's standard metrology optics EG3 commissioned a set of standard pyro-detectors for diagnosis of the THz radiation from short electron bunches. The benefits of this type of activity are discussed in the EG4 section below. A point worth noting here, of which there are a number of examples across the other EGs, is that this was only possible because of the flexibility of the groups' work programs. The balance between accepting that some planned activities would not happen, which might be considered a negative outcome, and redirecting a group's efforts to seize an opportunity or to halt an activity which is no longer productive or useful was commented on in the intermediate report. As work programs have progressed this possibility has continued to be exploited and in general EGs have appreciated it.

As well as the concrete elements in the EG3 work plan, and in those of other groups, there were a number of intangible benefits which arose. Working together on a common problem in the close environment of an EG meant that individual researchers got to know one another very well and a comment was made that this type of contact was at a level 'beyond what could by achieved by meeting at a conference'. The resulting interactions were described as 'deep and honest'. EG3 had allowed a feeling of 'community' to develop across its subject area and it was notable that its membership had increased by at least 30% since it began.

EG4: Metrology for FEL Optics – A particular feature of EG4 was that many of its members had worked together before under an earlier EU program. So the core of the group already existed when IRUVX-PP began. This eased the process of deciding the joint activities and judging what would be practical within the timescale and likely resources. Despite the group's pre-existence the IRUVX-PP program had a very significant impact. It enabled activities which otherwise would simply not have taken place and it also had a 'catalytic' effect, turning aspirations into concrete outcomes.

An example of an activity made possible by IRUVX-PP was the procurement of two reference optics which were then circulated around the EG members, allowing them to cross-calibrate their metrology equipment. The testing of short-wavelength optics is a challenging and specialised subject and centres of expertise are relatively few in number and isolated from one another. In this environment it is difficult to verify the performance of test equipment so metrology errors, both systematic and fluctuating, can persist. The round-robin approach using a common reference optic is an obvious way forward. But such optics are relatively expensive making them hard to justify for a single facility, and prior to the start of IRUVX-PP there was no mechanism for jointly funding their purchase. IRUVX-PP provided that mechanism, the optics were procured and the testing was carried out. The results reassured those EG members whose equipment was working well and for those who had issues to resolve it provided the information they needed to carry out improvements. The benefits of doing this work jointly under IRUVX-PP were a) that it would not have happened otherwise, b) that there was significant cost saving since only one set of optics was needed, c) that the metrology community gained a better understanding of one another's capabilities and d) that the separate systems were calibrated to a truly common standard, making it easier for facilities to work together in the future.

One way of organising this particular subject area might be to concentrate expertise in a ‘centre of excellence’. The view of EG4, however, was that in this case the benefits would be outweighed by the costs, so they were reluctant to take this approach. Particular concerns included the loss of expertise in other institutes, the IPR complications that could arise and the buildup of a ‘relationship of dependence’ in the centre of excellence itself. While the group felt that centres might well be appropriate under other circumstances, their establishment and use should be optional.

EG5: Photon Beam Transport and Diagnostics - EG5 was a relatively large and cohesive group again, in part, because some of its members had worked together beforehand. The effective community in this area was, in practice, even larger than the group membership since there was significant overlap with the interests and activities of EG4 and also of IRUVX-PP WP7 (the technical work package ‘Photon Beamlines and Experiments’).

One feature of large communities is that the opportunity exists for a wide range of organised interactions e.g. workshops and meetings. Two very effective examples in which EG5 was involved were a concentrated workshop on Wavefront Propagation, held at the STFC Daresbury Laboratory in July 2009 and a larger-scale meeting on Photon Beamlines and Diagnostics held at DESY Hamburg in June 2010. The latter was badged as a ‘EuroFEL Workshop’.

The Wavefront Propagation Workshop concentrated on introducing the nineteen participants to three modelling codes. The importance of such codes is well-established but their usefulness depends strongly on a number or factors. These include the code’s innate capabilities (what it can do and what it can’t), its ease of use (how much instruction is needed to cope with any non-intuitive elements), the immediate technical support (can a user get questions answered and issues resolved quickly and easily ?) and the longer term support (can the code be hosted on a stable, easily accessible site and will it be maintained and supported for long enough to justify the investment involved in adopting it ?). The workshop provided a forum in which these issues were discussed and, in some cases, addressed. Users and potential users of the codes were introduced to the specialists who had written them and were able to gain practical hands-on experience with close-in support, thereby climbing the learning curve as quickly as possible. From the code managers’ point of view the opportunity to work with a relatively large number of users simultaneously made the training process efficient and allowed feedback to be considered as a whole, rather than piecemeal. The workshop spawned some follow-up activities, for example one-to-one training facilitated by the EG, and also established a community who could consider the longer term issues.

The Photon Beamlines and Diagnostics Workshop had approximately 80 participants and published its proceedings as a supplement to the peer-reviewed journal ‘Nuclear Instruments and Methods A’. It was, in effect, a very successful full-scale international conference. Once again it was made possible by the coalescence of the associated community under IRUVX-PP and by the organisational resources that WP3 in particular could provide. The benefits were those which the best meetings always strive to deliver – the strengthening of the community, the dissemination of the most recent work on technical problems, the making of new contacts and the opportunity to discuss potential collaborations.

Without the support of IRUVX-PP it is not clear that either of these very effective workshops could have happened. They are very good examples of the benefits that can be delivered from a relatively small investment in *central* organising capability. Many of the practical aspects of each one (venue, infrastructure, travel support, underpinning funding etc) were delivered efficiently and economically by staff who had developed expertise in doing so under IRUVX-PP. The organisers of both meetings asked explicitly that a way be found to sustain this organisational resource.

EG6: FEL Seeding – EG6 was unusual in two respects. FEL seeding is a rapidly advancing field and a number of experimental successes led to programs being established in several partner facilities during the early phase of IRUVX-PP. A stage was reached when the activity was sufficiently widespread to justify setting up an EG. However this took place rather late (month 24) in the life of IRUVX-PP. The limited remaining resources (both time and funds) meant that the scope of this EG's activities was restricted. But the experience of setting it up showed that a small management team, backed by the IRUVX-PP project's management and with sufficient operational flexibility, could move swiftly to support this increasingly important area of work. Any future program for establishing EGs would ideally retain this flexibility, allowing quick and effective responses.

The second unusual aspect of EG6 was that a major contributor was based in one of the beneficiary partners' institutes. Fortunately the WP3 resourcing scheme was set up to allow participation by contributors from outside the project's core partnership. It was recognised from the outset that in such a specialised field as FEL science the full range of top-flight expertise would not reside wholly within the partner facilities. Achieving the full benefits of joint development would (and will) necessarily involve working with the best in the field and the ability to use the project to support this was very much appreciated by the internal researchers.

GENERAL CONCLUSIONS ON PROGRESS AND EFFECTIVENESS

The experience so far with the Expert Group way of working has been gained under unusual circumstances. Much of it took place during the groups' 'start-up' phase. Later activities may also have been influenced by uncertainty over the future of joint technical development. Under IRUVX-PP there was, again unusually, ring-fenced centralised funding for the EGs. All of these aspects may change under future resourcing models. However despite this lessons have been learnt which should be of value for future activities whatever their organisational structure will be. Summarising the findings from the EG examples above, it appears:

- That for larger-scale pieces of work there can be a need for agreed administrative processes (common legal, contractual agreements etc). This can be more difficult to deliver than might be imagined but should, at least, only need to be done once,
- That training activities are easier to deliver if they are more tightly focused and if they are responding to a clearly expressed need from a focused community,
- That activities which are very specialised will be faced with issues arising simply from the small number of participants. These issues may be unexpectedly difficult to resolve but if they *can* be resolved then small groups can still be very effective at making progress,

- That there are particular challenges faced by EGs who need beamtime on large facilities. The priority of their work needs to be agreed with the facility operators and their experiments must be carefully planned if their success depends on the presence of visiting collaborators. A general intention to 'invite collaborators to participate' in such activities seems rarely to bear fruit,
- That experiments which can be carried out wholly off-line, or at least which involve only local staff in the on-line parts, may well be easier to make successful,
- That the 'intangible' outcomes of collaboration are difficult to evaluate but may be surprisingly valuable, particularly in the longer term. The environment within an EG leads to close working at a level which 'conference encounters' cannot reach. This environment is just becoming and established and needs to be preserved,
- That the flexibility to change an EG's work plan can result in some goals not being achieved but can also allow a rapid and effective response to changing circumstances. EG spokespersons came to value this flexibility,
- That when members of an EG had worked together before it was easier for them to plan and deliver their program. This suggests, in turn, that EGs will become more effective the longer they work together,
- That a relatively small amount of central funding and organisation can have catalytic positive effects with disproportionately large benefits,
- That joint technical development can indeed deliver the foreseen benefits of economy, improved mutual understanding and agreement on common standards,
- That the administrative burden of organising workshops can easily be sufficient to prevent researchers from doing so,
- That if the organisational barrier can be overcome, which it can with the appropriate level of support, then workshops can be extremely effective, both on smaller and larger scales. The EG spokespersons unanimously and vociferously called for this support to continue if at all possible, with the continuation of the EuroFEL Workshop series being highlighted,
- Likewise, that the provision of small amounts of support (money and organisational assistance) to enable researchers to travel can be very effective at enabling them to do so,
- That flexibility in the process of *establishing* EGs can also allow a rapid and effective response to changing circumstances,
- That including experts from outside the core partnership in joint development work also delivered significant benefits. EG spokespersons were enthusiastic about this aspect of the program and wished to see it continue.

Further observations were made by the WP3 leadership team:

- Issues might arise if EG members are at different phases of their project development. In particular the need for members at an early stage to maintain a range of options might conflict with the need of more advanced members to narrow specifications down so that procurement can begin. These issues

have to be recognised and ways of managing them have to be found. They should not prevent a research area being included in the EG scheme.

- An option for continuing the workshops could be to organise EG satellite meetings around a larger scale, centrally organised event (perhaps an Annual Meeting ?). It is clear that not all EG workshops would suit such an environment. Some, for example, need access to specialist facilities (e.g. high power computing). But others might readily be concentrated in one place at one time. The advantage of easier delivery of common administrative support is clear. And the higher profile of a larger scale event would ensure that the EGs' activities get the appropriate level of recognition.
- The need for clear, effective communications within the EGs and also from the EGs to the wider community is clear. But the best means for delivering it is not. Under WP3 a Wiki website has been provided and EGs have found it useful in some respects but not in others. Whether it becomes more useful or less will depend on the future arrangements around the EGs. If they become involved with more 'concentrated' activities where communications are more frequent and detailed then the Wiki may well become the communications tool of choice. Regular use will improve members' familiarity and increased usage could start a 'virtuous circle' of increasing quality and completeness.

REFERENCES

1. *Intermediate Report on the Progress and Effectiveness of Expert Groups*, IRUVX-PP Deliverable D3.4, G J Hirst and C Gerth, 2010