



E&I Discussions Summary

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Introduction

- We had a UK Electronics and Integration (E&I) workshop a few weeks ago
 - <https://indico.stfc.ac.uk/event/314/>
 - 50-60 participants connected
 - Discussion led workshop with slides to initiate discussion
 - Much of the discussion around the R&D structures after we had summaries of example funding structures from CERN/INFN/US/German/CMS
 - Note that this will give input to the summary session on Friday afternoon so will not be discussed here at length
 - General community discussion in which people could submit a few slides of thoughts which we then went through and discussed
 - Very fruitful discussion which gave us lots to think about!
- Following this discussion, we decided to setup an E&I “taskforce” to act as a small group through which we could continue these discussions and begin the process of developing PPTAP report
 - Craig Sawyer (STFC) – PPTAP integration
 - Rob Halsall (STFC) – PPTAP electronics
 - Daniel Hynds (Oxford)
 - Laura Gonella (Birmingham)
 - Sudan Paramesvaran (Bristol)
 - Greg Iles (Imperial)
 - Tim Jones (Liverpool)
 - Mark Prydderch (STFC)
 - Nicola Guerrini (STFC)
 - Eva Vilella (Liverpool) – PPTAP solid state
- Here I will go through a summary of the previous workshop and taskforce discussions
 - Very much my own summary so apologies if I have misrepresented anything

General Comments

- Continuity needed in R&D funding for long term developments and knowledge retention
 - Cannot continue to do R&D “on-the-side” of ongoing projects
- Long term aspirations, what about more short term?
 - Combine particle physics research with other fields (xray/electron microscopy?)
 - UK not as leading as it was in E&I in the past
 - Even given a big influx of money would not be able to spend use it
 - Need a way to start bringing up various technologies to the point at which they can be used
 - Needs an R&D ramp and continuation
 - Isn't the role of STFC to prime future developments but let them go when they are ready (eg. commercialisation)
- Effort availability is a big issue with much (most?) UK expertise tied up in delivering current GPDs
- Noted that for some large experiments UK has big contribution to the projects but limited core technology
- What do we want to contribute to the future?
 - Clear target would be to get UK ASICs into FE of future detectors
 - In projects where we do not have control of the ASICs UK can end up spending lots of money but without active control/driving of the ASIC design just end up absorbing delays
 - Need control of core technologies

Seeding R&D Projects

- Clear that we need non-project seed funding for R&D
- Need to strategically develop expertise in the UK via R&D efforts in order to be able to contribute and, more importantly, control projects of the future
- Needs to cover manpower costs as well
 - Develop an active R&D community that is not just current GPD community doing R&D in parallel to delivering current projects
 - Post-doc and permanent posts need to be created with this in mind
- Current project-based funding is an issue as it can take years to bring something to a position from which it can be included in a project

Size of R&D Projects

- Should we be thinking small, medium or large scale?
- If we want the UK to be a big player on the integration stage, we need to start thinking of developing bigger system level things as a community
 - Not just a demonstration of an irradiated sensor on a single chip board
 - Demonstration of the full system chain from FE to readout
 - We have the breadth of expertise for this in the UK but it is tied up in current projects
- Agnostic projects
 - We cannot wait in the UK to find out what the next international projects will be
 - If we wait, we will be left behind and not able to contribute at the level which we might want
 - Need to develop project-agnostics R&D projects now which can develop into elements of whatever projects come to fruition
 - Need to do the detector R&D to get the UK into position
 - Shouldn't matter what project label is attached to detector R&D

What Should the UK Deliver?

- Within the world of GPDs, we are typically delivering parts of many sub-detectors in collaboration with international partners
 - Massively distributed production chains
 - Delays which we cannot control but have to deal with
 - Repetition of expensive equipment in these distributed chains
- In the future, can we as the UK deliver whole sub-detectors on our own?
 - Unlikely to be able to do full ASIC design on our own but should do more than we are doing now to keep control/understanding
 - Minimise interfaces
 - This would be a clear achievable target if we decided to do it
 - Currently we are divided over LHCb/strips/pixels
 - Would need to pull together if we wanted to achieve this
- Need to do all of this in collaboration with Europe
 - RD53 already discussion extension to 28nm
 - UK should not be doing this in parallel given previous success of 65nm collaboration
 - But need to make sure we are involved properly
 - Trickiness can come if labelled for a specific project
 - Must be well plugged in to collaborative R&D if we ever want to be delivering something on our own
- Need to think about what/how we can spinout to industry
 - Cadence license is academic but spinout not impossible (can apply via Europractice to Cadence to ask for use in business opportunity)
 - NDAs with foundries typically restrict application to HEP

Distributed/Centralised Effort

- How to distribute design efforts (discussed specifically regarding ASICs but generally applicable to the “larger” E&I efforts)?
 - Distributed effort can get more traction from funding agencies and university investment
 - But distributing effort can result in struggles of maintaining long term positions rather than fixed term posts
- Complex R&D projects needs degree of certainty of involvement in a program over a long period which is typically longer than a standard fixed term appointment
- Can we build an RD53-like collaboration internal to the UK?
 - Already effort in UK for developing MAPS/ASICs but is fragmented
 - Universities are well placed to provide a lot of effort (student/postdoc) for chip characterisation, possibly less well placed for long term design effort (?)
 - Should always look to free up central designers from beamtests/characterisation
 - Do you need a good number (2-3?) designers in a single location for design efficiency?
 - Need everyone to feel involved in design
 - Collaborations need to be formed with well defined tasks
 - Competition but too much fragmentation
- Critical mass is not there for lots of different technologies
 - At some point we need to choose a technology and concentrate on it as a collaboration
 - Hubs or detector centres?
 - Exchanges to CERN or national labs to get knowledge exchange & developments and get skills in place?
- See CERN/INFN acting as single centralised organisations, could be better at this in UK?

Cost of R&D Projects

- As R&D projects become larger, associated kit gets more expensive
 - How do you bring together FPGAs, cooling, low mass equipment etc.
- Large infrastructure items at national labs that can be loaned?
 - Two sizes of things
 - Expensive “small” kit that can be loaned out – take kit to R&D setups
 - Large “facilities” that cannot be moved – take R&D setups to kit
- Need kit for non-project specific use if agnostics R&D is possible
- Big testing cannot be distributed, design/development can?

Consolidation

- Acknowledge that there are advantages to having influence/involvement across a range of different detectors
- Need to look at how we consolidate this going forward
- What is the balance between having small fingers in lots of pies or a big hand in a single pie?
 - To answer this need to understand our UK priorities
 - If we want a UK-dominated ASIC in future detectors, we need to consolidate R&D efforts
- Particularly, if we want to be involved in the big things (integration etc.) or deliver whole sub-detectors ourselves some degree of consolidation will be necessary
- The more distributed the UK is, the less direct influence we may have on future projects and the more we will just have to react to everyone else rather than leading the way ourselves

Returns

- UK needs to get “back on the horse”
 - Need to demonstrate that there is a return on investment
- If we are to do this we need to build up a consistent R&D community which also provides skills and training which can go into industry
- Large number of people working on things but people are currently able to go off picking cherries
 - Need to be ruthless and make sure the community moves together to get the best returns from R&D money

Linking efforts together

- Apart from linking R&D efforts within E&I together in a more coherent manner, need to also capture “external” interfaces
 - For example, often the link between mechanical integration and alignment/simulation software is missing
 - Proto-collaborations making medium scale system demonstrators could help this link and could be built with this in mind
- Clusters working on R&D projects with well defined tasks?
 - Optimises parallel work and repetition
 - If done properly better for infrastructure too
- Hub/spoke model could work well
 - Hubs have to be carefully chosen for this to work
 - A hub has to actively involve all its spokes
- Evolving specifications during R&D are a big challenge
 - Can be a lack of communication between engineers in the UK so creating synergies can be tricky
 - Need a system level roadmap for how everything fits together

E&I Headlines

- UK needs to reinvigorate E&I R&D efforts now in order to not be left behind
- Need reliable funding with which to seed non-project specific (agnostic) detector R&D efforts and create effort which is not tied to projects
- Should look to build proto-collaborations to build medium-scale system demonstrators
- Need to find balance between distribution and centralisation
 - Increased centralisation will be required for coordinated R&D
 - Can we form sensible hubs around which efforts can be effectively built?
- Community efforts must be more coherent towards shared UK goals



DISCUSS...
