An Early Success Strategy for ESS

Selecting Instruments and Preparing Support for Early Scientific Success

Introduction

ESS will be judged by the science it delivers, and it will be judged early. The suite of 22 public instruments will come on line a few at a time over a period of many years, and they will ultimately cover many research topics and deliver a large amount of high-impact science. However, the output of the first few years of ESS operations will be pivotal to the way the facility is perceived.

Early scientific success will bring scientific and public attention to ESS, declaring it a winner while parts of the facility are still in construction. Such perceptions will enthuse engaged partners and countries, and ensure that the scientific program of ESS continues to be financially supported during construction and beyond.

The scheduling and prioritization inside the ESS Neutron Scattering Systems project determines the likelihood of early scientific success. The Early Success Strategy has two main facets. Firstly, a careful prioritization of which instruments to bring on line first has to be made. Secondly, the support functions necessary to make these instruments deliver to the best of their capacity have to be identified.

Facet 1: Prioritizing Instruments

Instrument concepts for ESS are being developed in labs all across Europe. When these concepts reach technical maturity, they are submitted to ESS as instrument proposals. Following the *Process for the Selection of Instruments for ESS*, which instrument concepts to include in the suite of 22 public instruments is being determined. This open, transparent process involves the scientific community at every step, and is driven by scientific merit. It will result in a portfolio of instrument concepts to be realized at ESS.

Incorporating these instrument concepts into the ESS construction program calls for scheduling and resource allocation, taking into account the needs and capacities of our construction partners. It involves staging of the instrument construction projects, with a program plan that initiates a few instrument construction projects each year. The instrument suite will be prioritized and scheduled in three tranches of eight, eight and six instruments. In the first years of instrument construction, priority will be given for instruments in Tranche 1, but moderated by the schedule of each instrument project. Lower priority for resources in these years will be given to the other tranches, but emphasis will shift clearly to Tranche 2 instruments as the instrument construction program progresses, and then to Tranche 3.

The staging presents an opportunity to make strategic decisions, ensuring that instruments that first come on line are ones that are likely to be successful fast. Using this Early Success Strategy and taking advice from the Scientific Advisory Committee, ESS management can allocate instruments to the tranches in a way that promotes early success for the facility. In

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other words, it is possible for an instrument concept to be accepted for construction early due to scientific excellence, but set to be realized in Tranche 2 or 3 for strategic reasons.

The following guidelines for the prioritization of instrument concepts for early success are under development in dialogue with the Scientific Advisory Committee.

Guidelines for Instrument Prioritization

An instrument is likely to bring early scientific success if it falls in one or more of the following categories.

- *World-class instruments that address the needs of the bulk of the user community*. Currently strong fields in neutron science include magnetism, soft matter and materials science/chemistry. It is important that these keen and experienced user groups are provided with appropriate instruments in the first two years after first neutrons.
- *Instruments that build on the unique strengths of the ESS source.* The spectral strength of ESS lies in cold and cold-to-thermal neutrons. This means that the instrument suite should be focusing on cold and bi-spectral (cold/thermal) instruments, especially in the early years. Instruments that are focused on new scientific opportunities enabled by the brightness of ESS (kinetics, parametric studies, extreme environments, small samples) and the unique advantages of the long-pulse structure should also be prioritized, as this will result in new scientific progress that is impossible today.
- *Instruments catering to science communities with limited neutron usage today, but with clear potential to bring large scientific impact.* Specialist communities that do not have neutrons as a core method tend to require reasonably simple but specialized instruments. The uniqueness and science impact rather depend on sample environments or support facilities that allow for break-through science, such as pressure cells or purpose-built high-field magnets, or deuteration support for biological samples. Bringing these communities on board does not only enable them to carry out high-impact science, but they also enable other groups that do not have the neutron expertise to benefit from these advances. The high pressure and fundamental physics communities are examples.

Facet 2: Adapting Technology, Data and Science Support Plans to Instrument Prioritization

Instruments alone do not deliver scientific success, and a robust Early Success Strategy must include instrument technologies, data management and software, sample environment, and science support laboratories. In order to ensure success, these must be mature enough in the early years to reliably support commissioning and experiments on the first instruments. As different instruments have different technical needs and scientific support needs, instrument prioritization (as per Facet 1) will dictate which segments of these supporting functions need to be brought on line first.

Instrument technologies are pivotal to instrument installation, cold and hot commissioning, and must be able to serve the early users effectively. Many aspects of instrument technologies need to be functional two years before first neutrons. Which aspects to prioritize will depend in part on the technical solutions employed by the early instruments.

Data management and software is an inherent part of any scientific experiment, and the maturity of data handling solutions has great effect on the user experience and scientific output. Upon first neutrons, these solutions must be functional enough to support

commissioning activities. The year after first neutrons, software solutions need to be up to full scope, serving the first users.

Sample environment and support laboratories are key to successful scientific output, and they are closely connected to different science cases. Therefore, the instruments chosen to go on line first will dictate which sample environments and which support laboratories have to be functional first. Sample environment solutions need to be mature enough to support commissioning activities following first neutrons. The year after, they need to be ramped up to fully support the first instruments. The support laboratories associated with the first instruments will be commissioned the year after first neutrons, to be ramped up during the following year.

When the first instruments open for all users through the peer-review proposal system, anticipated on the third year after first neutrons, all systems associated with these instruments have to be up to full specification, delivering the support necessary for scientific output and a good user experience.

Through this holistic view of a scientific user facility, we create the best possible conditions for scientific success during the early years of ESS. By paying attention to the support efforts, we ensure that the instruments deliver fully on the promise of a next-generation neutron source.

Concluding Remarks

Putting these facets together in practice, we can envisage that work-horse and highly focused instruments with high potential of scientific returns can be prioritized in Tranche 1, excellent instruments that can not be easily accommodated early on in Tranche 2, while specialist instruments or limited science-case instruments that meet the excellence criteria, and later ideas that are not apparent right now, will be accommodated in Tranche 3. Prioritization of developments in instrument support, data management and software, sample environment and science support laboratories will be adjusted to match the step-wise installation of the instrument suite.

In the capped budget environment of the ESS project, placement of an instrument in a tranche is as much a prioritization for resources as for funding. We envisage at the current limits of budget and contingency that additional sources of funding will be required to complete Tranche 3. These funds could either come from operational funding of ESS, as additional funds from the partner countries, or as new funds from various agencies. The community will need to continually support these funding efforts to ensure completion of the 22-instrument suite.