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BrightnESS²

Bringing Together a Neutron Ecosystem for Sustainable Science with ESS

H2020-INFRADEV-3-2018-1

Grant Agreement Number: 823867

Deliverable Report

D4.4 Processes and Procedures for Targeted Access Routes

brightness²

1. Project Deliverable Information Sheet

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3. List of Abbreviations and Acronyms

ESRF	European Synchrotron Radiation Facility
ESS	European Spallation Source ERIC
EU	European Union
FRM-II	Research Neutron Source Heinz Maier-Leibnitz
FZJ	Forschungszentrum Jülich
ILL	Institut Laue Langevin
ISIS	ISIS Neutron and Muon Source
JCNS	Jülich Centre for Neutron Science
LINX	Linking Industry to Neutrons & X-Rays
LLB	Laboratoire Léon Brillouin
MAX IV	MAX IV Laboratory
PSI	Paul Scherrer Institute
RI	Research Infrastructure
RTO	Research and Technology Organisation
SAC	Scientific Advisory Committee
SAD	Scientific Activities Division
SCUO	Scientific Coordination and User Office at ESS
STFC	Science and Technology Facilities Council
TU Delft	Technical University of Delft
TUM	Technical University of Munich
WP	Work Package

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6. Executive Summary

The European Spallation Source ERIC (ESS) is a multi-disciplinary research Infrastructure soon entering initial operation and based on the world's most powerful neutron source built with state-of-the-art technology. The ESS vision is to enable scientific breakthroughs in research related to materials, energy, health, and the environment, and to address some of the most important societal challenges of our time. ESS's core value of scientific excellence will enable the co-creation of value and impact through world-leading neutron science services.

Work Package 4 of the BrightnESS² Project, titled "Innovation & Industry", is looking through these glasses, at the many aspects of the created ESS value and impact.

This report is *Deliverable 4.4: Processes and Procedures for Targeted Access Routes*, of the BrightnESS² project. Jointly, the Science Directorate and the Innovation and Industry function of the Strategy Directorate have looked at the planned access routes for industry as well as the bandwidth of these access routes.

The analysis concept has followed an outset where four main stakeholder groups have been interviewed and used as sparring within two main access routes as defined below, and within the topic of industry outreach and collaboration.

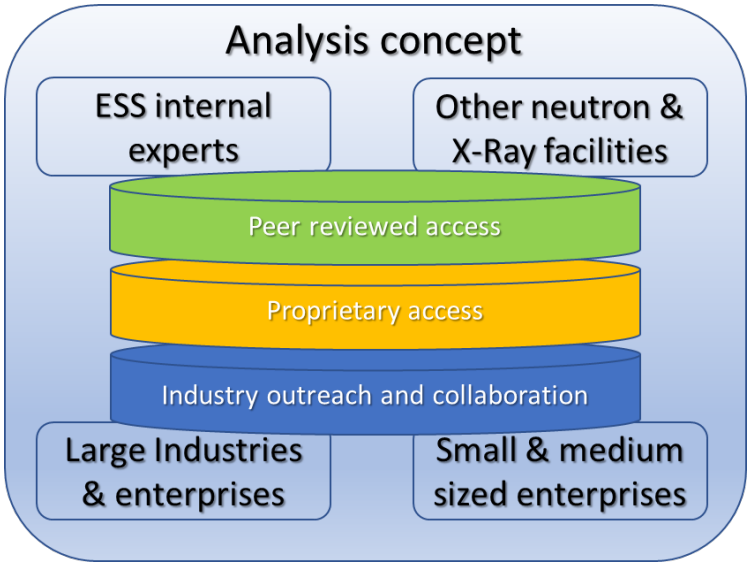

Figure 1 Structure of Analysis Concept

In addition, the project partners of Technical University of Munich (TUM) and Paul Scherrer Institute (PSI) have taken an active role in acting as representatives for operational neutron facilities. This has helped to calibrate the diverse input from the different stakeholder groups and ensured a certain bandwidth in the determination of the most suitable setup.

Another element that has been taking into consideration, is time. ESS will ramp up over years to its final operational objective and it is envisaged that the available and required services will ramp up accordingly.

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Several models for price calculations have been discovered and analysed, as have different incentive models for beamline scientists' involvement in industrial collaboration. Also, the number of staff, at a facility, that are involved in industry access, is directly connected to the amount of industry users. Even the industry users access routes are varying, as industry interests could be involved in as much as 40% of peer reviewed scientific access.

All the different discoveries and scenarios are considered when analysing the different targeted access routes, together with the different service layers that can be applied along the process of access. This all means, that an access route might be within a category but there will be many options and parameters that help tailor the access to a particular user, their experience, and expectations.

This document is collecting input from the different stakeholders, it is making recommendations, and it is trying to define the highest possible common denominators within each area of analysis.

The conclusion of the report is that ESS has several options where the different targeted access routes can be enhanced by making different service layers available, and by defining the level of hands-on support to match the varying experience levels in the user groups.

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7. Introduction

ESS is one of the largest research infrastructure projects being built in Europe today, offering significant innovation opportunities. The Organisation is obliged to contribute to top-level research, technological development, innovation, and societal challenges. This is a declared goal and written into the ESS statutes and is a part of the organisations' DNA.

ESS will provide unique capabilities for the industry users, for advanced and detailed analyses and tests of new materials, full components, products, and methods. ESS has the potential to act both as a provider of advanced analyses, a resource of scientific knowledge, and a node of R&D collaborations. This is seen as an important route for ESS to impact society and push for solutions that are competitive, efficient, innovative, smart, and green.

To be able to deliver on the potential, procedures must be set up, providing industry with access to the capabilities at ESS. The access must be easy, efficient, and combined with access to the required technical and analytical expertise and support. The *ESS Access Policy* draft document defines that access must be available in both proprietary and non-proprietary modes. The aim set for this report is to provide processes and procedures that can be used for handling industry access. This includes the following:

- Industrial use of peer-reviewed access to ESS (non-proprietary):
  - Rules and conditions
  - Terms of reference for peer review assessment based on industrial relevance
  - Performance indicators to monitor
- Industrial use of proprietary access:
  - Rules and conditions
  - Requirements and procedures for IP protection for transparent contract handling
  - Requirements and procedures for allocation and scheduling of beamtime
  - Service catalogue and price list
  - Allocation of facility staff and resources
  - Performance indicators to monitor
- Outreach to and collaboration with industry
  - Routes to reach new potential industry users
  - Models for continually engaging with industry

The infrastructure for industry use of ESS is shown in Figure 2. The ESS organisation will be in touch with industry users directly through the ESS Scientific Coordination and User Office (SCUO), or through mediators such as mediator companies or academic collaborators. Across the world, large-scale neutron and synchrotron facilities follow a range of different implementation models and setups that can be used for inspiration at ESS. For all potential setups, it must be considered how they are able to meet the industry needs and ensure socio-economic impact of ESS. This report covers input from a range of neutron and synchrotron facilities as well as input from industry on their requirements. It highlights the decisions and protocols that must be in place for a successful industry access program to ESS.

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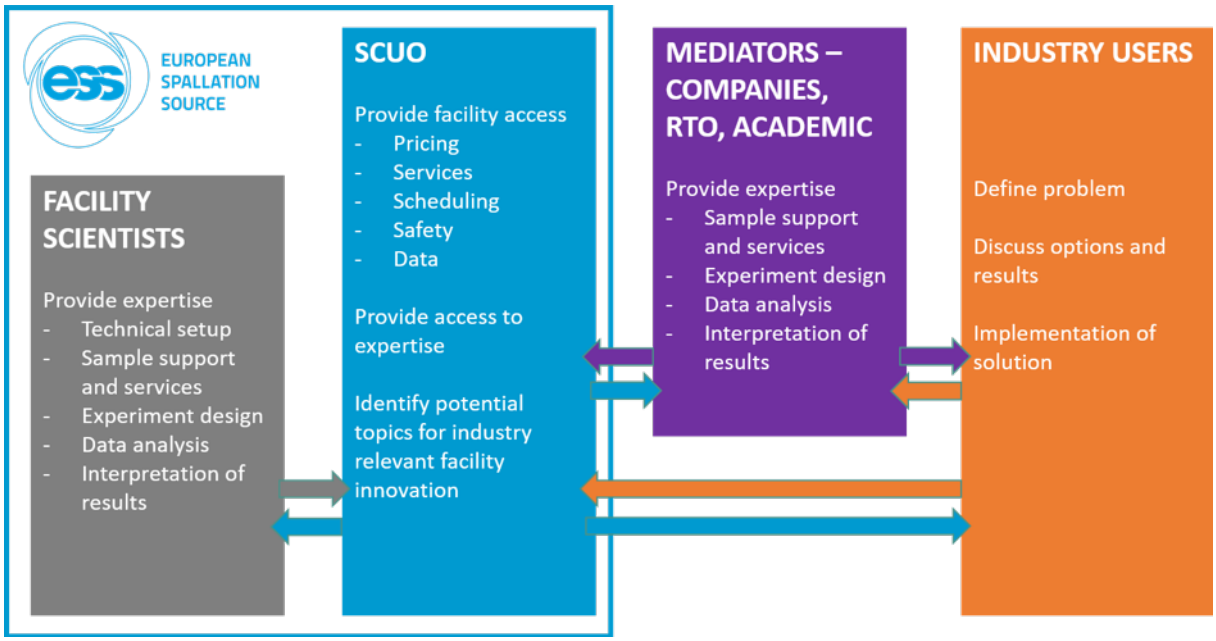

Figure 2 Infrastructure for Scientific Support for Neutron Experiments

8. Background

Industry exploitation of ESS has been an important target of the investment from the outset as a route to support industrial innovation and maximise the socio-economic impact of the facility. To enable this, it will be necessary to provide easy access for industry to instruments and expertise. Any proposed processes and procedures must be in line with the ESS access policy, and with existing policies at the EU and international levels.

8.1. The ESS policy for scientific evaluation and access

An access policy for ESS is under development and has been recommended by the ESS Scientific Advisory Committee (SAC) and will be presented to the Council for approval. It adheres to the European Charter of Access to Research Infrastructures and to the International Recommendations for Access to Research Infrastructures, stating that access should be granted based on scientific excellence, originality, quality, and feasibility, so that institutional, regional, or national affiliation should not be taken into account. The ESS statutes specify that ESS will undertake activities contributing to top-level research, technological development, innovation, and societal challenges (Article 2).

The access policy is based on four leading principles, and industry use of the facility can contribute to them all to various degrees:

- Scientific excellence
- Societal impact
- Scientific method development
- Industrial relevance and innovation

The access policy draft further determines that the ESS management shall strive for a balanced use by the member countries. 80 % of the beamtime for fully commissioned instruments should be available to the users. Industry users can take any of the four access routes:

- Peer-reviewed access
- Quick access

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- Proprietary access
- Discretionary access

Peer Reviewed Access is granted based on applications and is free of charge. It is required that the results be published. Industry will typically access this route as a part of an academic collaboration. It is noted in the implementation guidelines that evaluation in the peer-review should emphasize excellence, which does not only refer to scientific merit. Therefore, the assessment parameters might be defined to accommodate industrial or societal relevance or impact.

Quick Access is for short tests and feasibility measurements or for the collection of supplementary data. In this report it will be discussed as a supplement to the peer-reviewed access and potentially also to proprietary access.

Discretionary access is for urgent, scientifically crucial access, and can be provided through approval from the directorate. It will not be further discussed in this report.

Proprietary access provides commercial access under full IP protection and is therefore highly relevant for industry use. The ESS statutes specify in Article 2 that whereas ESS will operate on a non-economic basis, it will be possible to perform limited economic activities as long as they do not jeopardize the main activities. The access policy determines that it will be possible to introduce caps limiting the use of proprietary access to benefit the over-subscribed peer-reviewed access. Caps can be set by the council after consultation with the SAC. The services that ESS might provide in relation to proprietary access are addressed in the BrightnESS² deliverable D4.5 – '*Service Catalogue and price list*'.

8.2. Connection to the socio-economic impact

Industry use of ESS is closely connected to the socio-economic impact of the facility. Access to new technical and intellectual capabilities for the industry and the innovative eco-system, will not just benefit the individual company, but also society at large. Any suggested setup for industry access and involvement must therefore be assessed by how it might affect the socio-economic impact.

A series of recent European projects have proposed how the socio-economic impact can be followed through a range of impact indicators (OECD 2019, ESFRI 2019) or through narratives (ACCELERATE, RI Paths). The BrightnESS project provided a preliminary framework for assessing the socio-economic impact of ESS. Within the current BrightnESS² project, WP5, the preliminary framework was re-evaluated and refined, and an annual assessment routine has been developed. Several of the indicators can be related to industry access and will therefore be considered in this report. This list of indicators, which reflects the strategic objectives (based on the missions and vision) of ESS, acts in part to monitor the effectiveness of services offered to industry, and in other part to monitor the outcomes of industrial use. The list is provided in Appendix 1. It covers both scientific, innovative, social, and economic impact.

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8.3. Contributors

This report has only been possible to make by the access to and input from the following contributors:

Facilities	Industries
Diamond Light Source (Diamond) European Synchrotron Radiation Facility (ESRF) Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II) Institut Laue Langevin (ILL) ISIS Neutron and Muon Source (ISIS) MAX IV Laboratory (MAX IV) National Institute of Standards and Technology (NIST) Center for Neutron Research Paul Scherrer Institut (PSI)	AcouSort AB AstraZeneca BioModics ApS Haldor Topsoe A/S LINX Association – Linking Industry to Neutrons and X-rays Poul Due Jensen Foundation (Grundfos Foundation) RISE Research Institutes of Sweden ROCKWOOL International A/S SARomics Biostructures AB

9. Insight from other projects on RI access

As part of the analysis, past project results have been investigated and incorporated where appropriate. Results from the following completed projects have been taken into consideration:

- NMI3-CALIPSO IAB: Recommendations for industry access (2013)
- Science Link and Baltic TRAM (2012-2014, 2015-2019)
- EUCALL H2020 project: Commercial access to light sources (2015-2018)
- SINE2020 project: Recommendations for facility collaboration (2015-2019)
- NFFA (2015-2019)
- ACCELERATE (2017-2021)
- CALIPSOplus project: Recommendations for facility access and collaboration (2017-2021)
- CAROTS project: Recommendations for collaboration with mediator companies (2018-2021)
- ENRIITC (2020-2023)

10. Methods

The workflow and methods behind the present report are presented in Figure 3. A range of potential setups were first identified, based on interviews with representatives from other neutron and synchrotron facilities, and in line with the ESS statutes and policies. Potential setups were defined within three main topics:

- Peer-reviewed access (chapter 11)
- Proprietary access - including some notes on Quick Access (chapter 12)
- Industry outreach and collaboration (chapter 13)

For each topic, the needs and requirements of the industry were determined through interviews with industry representatives. The potential setups were then evaluated based on ability to meet industry requirements, potential impact, required resources, and ease of implementation. A setup was then proposed together with recommendations for implementation.

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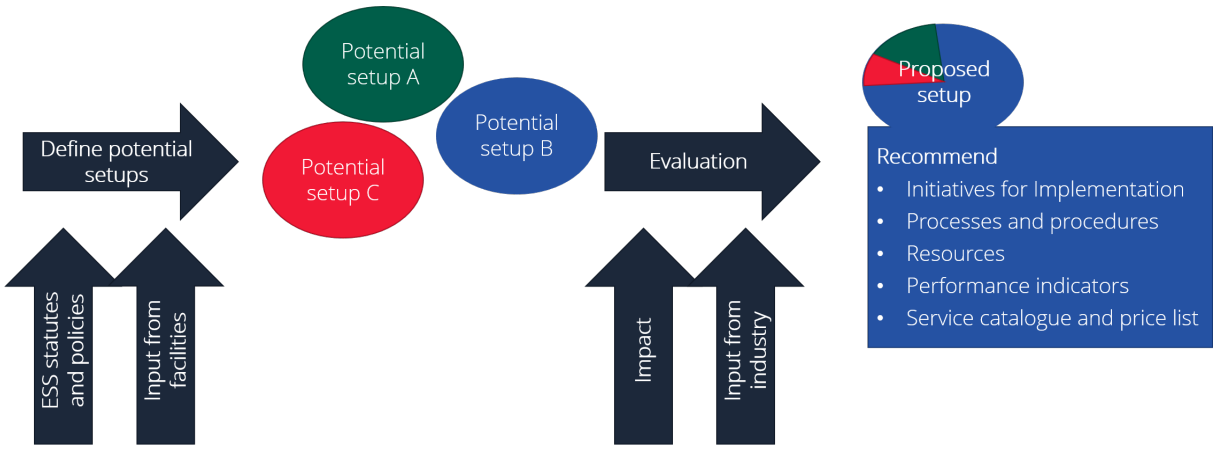

Figure 3 Activities for D4.4 'Processes and Procedures for Targeted Access Route's - and D4.5 'Service catalogue & price list"

The steps are further discussed in the following section. Each of them were internally discussed at ESS, providing valuable input for interview questions, assessment parameters, and conclusions which will help to ensure that the resulting recommendations and procedures match the organisation.

10.1. Potential setups based on interviews with neutron and synchrotron facilities

Industry access might be set up in several ways, including both internal ESS units and external collaborators, such as universities, mediator companies, industry networks or consortia, etc. The present work will therefore identify a range of potential setups, based on interviews with industry officers at other large-scale neutron and synchrotron facilities.

Whereas most neutron and synchrotron facilities have their main focus on academic users, they also actively provide access for industry according to their situation and strategic priorities. For each of the facilities, a person responsible for the industry program or industry office was interviewed. The interview questions were designed to address their setups for both peer-reviewed access and proprietary access, as well as provide input on efforts towards industry outreach and collaboration. The questionnaire for the facility interviews is given in Appendix 2.

10.2. Interviews with industry representatives

The potential setups must be evaluated based on their reflection of industry requirements, which will therefore need to be clarified. A series of interviews with industry representatives have been performed, providing insight into their preferences for collaboration schemes, required levels of analytical assistance, and requirements for confidentiality, timelines, etc.

Nine different industry representatives or stakeholders were interviewed. Four representing large companies with a high or intermediate level of expertise within the application of neutron and synchrotron techniques. Three representing small companies, of which two have some knowledge of neutron and synchrotron techniques, and one is a mediator company with expertise in providing synchrotron-based services for other companies. A large RTO with expertise in providing neutron- and synchrotron-based services for industry, was also interviewed. Finally, an interview concerned specifically with access for SME was performed with a university-based industry association, performing neutron and synchrotron case studies.

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The interviewed companies represent different sectors within pharma, materials, and high-tech devices. All the interviewed representatives are involved with R&D on the tactical or strategic level. The size of the companies' R&D departments range from just over 10 to several thousand employees.

The interviews did not address technical questions but were rather used to collect input on the way industry works with new technologies and external collaborators, and their requirements for such collaborations. The questionnaire that was used as a guide for the interviews can be found in Appendix 3.

10.3. Evaluation of potential setups and recommendations for implementation

The different potential setups are evaluated based on their ability to meet industry needs, as well as their alignment with ESS statutes and priorities. Procedures and setups required for implementation are proposed together with a list of decisions that must be made for each. A list of services for industry, and a price list will also be presented, according to deliverable D4.5."Service catalogue & price list" (M30)

11. Peer-Reviewed Access

Peer-reviewed access is the main access route at most neutron and synchrotron facilities. To have this route ready for ESS industry users, several terms and policies must be determined and implemented. The goal in this report is to determine the following:

- Terms and conditions
- Terms of reference for peer review assessing industrial relevance
- Required facility staff and resources
- Performance indicators to monitor

11.1. Input from facility interviews

A significant number of industrial users of neutron and synchrotron facilities access through the peer-reviewed proposal systems that are in place at all the facilities. Industry officers from seven different facilities were interviewed, providing input on their setups for industry access. A few main conclusions are given in Figure 4 and further described below.

11.1.1. General characteristics of industry users of peer-reviewed access

The specific fraction of industry users accessing through peer-review is monitored automatically at two of the facilities, through a box in the proposal system that can be ticked by the proposer. A couple of the other facilities follow the industrial use manually. Several of the facilities' industry offices are mainly concerned with proprietary access, but with some collaboration with the user office for peer-reviewed access.

The peer-reviewed access route is mostly used by industry users in collaboration with and driven by academic partners, and the level of hands-on industry involvement is often low. The exception is industry users who have strong internal capabilities within scattering techniques and can therefore independently compete for beamtime on scientific terms. These capabilities are obtained by the companies by hiring in experts. However, in cases where facilities engage in advanced training of industry staff it is also seen that the companies mature as facility users, submitting proposals and performing data analysis more independently.

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Facility interviews – Industry use of peer-reviewed access

The users
- Some are able to independently compete for beamtime on scientific terms
- Most apply in collaboration with academic partners
- Many are only involved in the experiement to a limited degree

The terms
- Corresponding to the terms for the general academic user
- No fee for awarded beamtime
- Results are openly available and published

Recommendations
- Provide free test/feasibility measurement
- Use industry relevant parameters for proposal assessment
- Use industry network or consortia for reaching new potential users

Figure 4 Facility input on industry use of peer-reviewed access

11.1.2. Terms for industry use of peer-reviewed access

For all facilities, the terms and conditions for industry use of peer-reviewed access are identical to those for academic users. No charge is made for rewarded beamtime, and there is a requirement to publish the results. In most cases where reimbursement of travel or accommodation costs is in place, these also apply to industry users. Facility staff assist during the setup of the experiment and can participate in the scientific project on collaborative terms.

11.1.3. Impact and promotion of industrial use of peer-reviewed access

The industrial use of the peer-reviewed access programs is seen as an important contribution to facility impact. In many cases it is not tracked, but the number of industrial applications are seen as a good measure for industry impact – and also of the maturity of the industry users.

The peer-reviewed access is generally not heavily promoted to industry, but it is included in the general information on facility webpages etc. and is included in discussion with industry partners whenever relevant.

Several of the facilities, however, provide free access to simple test measurements, which can help to increase the certainty of the feasibility of an experiment and indicating the results that might be obtained. Most facilities do provide this in a relatively informal way, available for industry upon approaching the industry user office with a request.

11.1.4. Programs and modes supporting increased industry use of peer-reviewed access

A couple of neutron facilities have industry-specific peer-reviewed access schemes. And most facilities agree that it would be beneficial to include industrial, technical, or economic impact into the

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assessment parameters for peer-review of beamtime proposals. However, it is also pointed out that industry is indeed able to compete for beamtime on scientific terms, and that they often access in academic collaborations and are therefore fairly assessed by scientific excellence. For this reason, at least one facility does not consider including more industry-relevant assessment parameters.

At the neutron facility ILL, a trial period of 2.5 years for the instrument SALSA (mechanical stress mapping) allowed industry and technology relevant proposals to be extracted from the regular proposal peer-review to undergo an additional review by an internal panel. Several good proposals were received, and new industry users were reached that led to publication and/or long-lasting collaboration through externally funded projects. The program has been significantly reduced to allow a more equitable balance of beam time with the user program, but its positive outcomes will be pursued.

The ISIS Neutron and Muon Source runs a proposal-based access scheme, Industrial Collaborative R&D – ICRD, where industry-led proposals are assessed based on their economic impact. This has enabled ISIS to closely monitor and quantify the economic impact of its industry use. The scheme is further tailored to industry needs by allowing for running intake of the proposals and faster access (typically within a month). Most industry users through this route still access ISIS in collaboration with academic partners, but with the emphasis in the proposal on economic impact requiring closer and more formal industry involvement. After the experiment, the company can choose to protect the intellectual property by not publishing the results and instead, paying the commercial access fee for the beamtime. This rarely happens, as most results can be published in some form without exposing key intellectual property. However, this flexibility appears to decrease the level of commitment by the company, reducing the barrier to become a facility user.

At NIST, an industry consortium is built around specific capabilities and problems within the soft matter area. Here, industry members, typically large R&D-heavy companies, pay an annual fee to participate in the consortium, which includes access to training and education, inspirational meetings, and participation in development projects. The projects target the members' problems and the development of sample environments that are relevant to the members. The aim is to improve the technical capabilities of the general user program and also to educate competent and independent industry users of the peer-reviewed access route. On several occasions, consortium members have proceeded to submit proposals for peer-reviewed access, either independently or in academic collaborations, which is therefore seen as an indication of success for the consortium.

Another approach to educating and including new industry users is facility participation in industry networks or even co-founding of new networks with the facility as a key player. The networks are typically based around a certain industry sector, of a specific type of problem. This type of engagement provides access to industry and a better understanding of the problems that they face. They also act as a platform where the companies can be inspired by the facilities and by each other to use neutron or synchrotron techniques.

11.2. Industrial use of peer-reviewed access – Potential approaches for ESS

The conditions for general peer-reviewed access are set by the ESS access policy draft, which states that access is provided based on availability and allocated by an expert panel that will assess and grade the in-coming proposals based on excellence. Beamtime is provided free of charge, independent of the nationality of the proposers. Results must be openly available and published as determined by the council.

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At the interviewed facilities, in general, the same conditions apply to industry as to other users of the peer-reviewed access modes. This is also expected to be the case for the ESS. Specific approaches might be considered though, to promote the industry use of peer-reviewed access. Based on the interviews with facility representatives, three main potential approaches have been identified. They are schematically presented in Figure 5 and in the following paragraphs. They represent increasing levels of required staff resources and an increasing timeframe before an effect on industry use can be expected. The three levels are not mutually exclusive but can be applied either alone or in combination, depending on priorities.

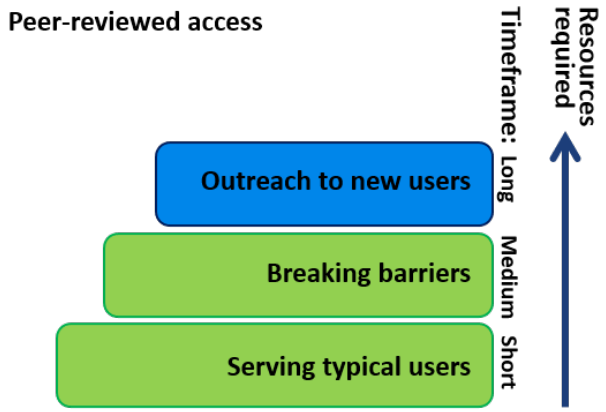

Figure 5 Potential approaches for serving industry users of general peer-reviewed access

11.2.1. Serving of the typical industry users

This approach covers the industry users that are already able to apply for general peer-reviewed access. A few large, R&D-heavy companies have the required internal expertise and can more or less independently prepare beamtime proposals. In other cases, they have strong connections to academia and participate in collaborations to apply for beamtime together with experts in academic research groups. In this case, it is sometimes observed that the direct involvement and engagement by the company is limited.

This approach requires the least resources since there is no specific effort to reach new industry users – other than what might be covered in the general outreach and dissemination from the facility. It is also an approach that is automatically included in the construction of the general peer-review access program.

The success of this approach can be followed through indicators that correspond to those for the general peer-review access, that is, the number of industry users, the number of returning users, the number of publications with industry authors, and the number of citations.

11.2.2. Breaking barriers

This approach involves an effort by the facility to reach potential industry users that would benefit from running experiments through the peer-review access route but are held back by several barriers. Based on the input from the facilities, the following efforts are suggested to address some of the barriers for industry use of general peer-reviewed access:

- **Uncertainty of the outcome of an experiment** is a barrier for the industry to commit the significant resources required to submit an application and run the experiment. This barrier can be addressed by the access to feasibility measurements. The *ESS Access Policy* draft describes a Quick Access route with running intake of proposals that could be used for this purpose. It is not defined, however, how quick the access must be, but the ESS policy does indicate that an expert panel must evaluate proposals also for this access mode.

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Case studies, presenting how other (similar) industrial users have used neutron techniques, is also a powerful tool to lower the barrier of uncertainty. Therefore, running programs providing case studies to industry for free or at reduced price should be considered.
Another option is to take the approach to allow for flexibility of the peer-reviewed access so that it can be turned into commercial beamtime if certain results appear that the industry user does not wish to publish. This approach is not recommended by all facilities.

- **Assessment of proposals based on scientific excellence** is the generally rule for peer-reviewed access, but it is also widely considered to be problematic for many industrial users. Instead, most facilities suggest defining a set of assessment parameters that cover the industrial, technical, and societal relevance and impact. The number of proposals might be limited, especially to begin with, so that it could make sense to either have only one annual proposal round or to allow for running proposals in the same way as for the Quick Access route. This would, however, provide the industry with an advantage of increased flexibility compared to the general peer-reviewed access scheme.
- **Lack of the required technical and scientific expertise** is also a barrier to many companies. Here ESS might provide matchmaking with relevant academic research groups for potential collaborations.

Additional indicators for the success of this approach could be the number of new industry users, the number of industrial users through the Quick Access that lead to a proposal, the number of industry proposals through an industry specific peer-review, and the number of successful matches with academic or other expertise.

11.2.3. Developing new industry users

This approach involves a continuous, long-term effort by the facility within both outreach, dissemination, and education. This requires significant and consistent resources from at least one full-time dedicated staff, and the timeframe for an effect is typically long. The potential effect is also long-term and sustainable, though, reaching and educating new industry users. The effort must therefore be prioritised if the goal is that ESS should reach a wider range of industry users. It is also important to define how this staff is embedded into the ESS organisation, to ensure a successful outcome.

11.3. Industry use of peer-reviewed access – input from industry interviews

All the interviewed companies, both SME and large companies, actively participate in academic research projects for exploratory work. The project collaborations provide the companies with new insight or enables them to move into new business areas or towards new products and technologies. For RTOs, it is an important role to bring research to industrial application, and therefore participation in research and development projects is seen as a natural task.

For companies that use beamtime at neutron and synchrotron facilities through academic research projects, the peer-reviewed access program is typically the relevant route. In some cases, however, companies that regularly use proprietary access, also tend to use this commercial beamtime to collect data for academic projects. This can be the case to avoid waiting for the next proposal round if quick results are necessary, and if the measurements can easily be combined.

The companies find academic projects to join by inspiration from a current problem, by staying updated in the literature of their field, or through networking and collaborators. In many cases, the companies are part of the project consortia but are not the main project drivers. Mutual engagement and inspiration as well as a joint goal where everybody benefits, are stated as important factors for a good project. Long-term projects are useful and often necessary for high-tech development. A long

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project might be divided by shorter half-year milestones, however, to ensure progress and a relevant outcome for the company, especially when specific needs might change over time.

For less R&D-heavy SMEs, the peer-reviewed access is often less relevant and there can be some reluctance to participate in lengthy academic projects that can easily become distanced from the SME business. The fact that the wait for the beamtime can be long – sometimes more than six months – is also a disadvantage. Their exploratory work of SMEs is often of a narrower scope, aimed at solving a specific problem, resulting in more urgent 'need-to-have' requirements. Even if the less R&D-heavy SMEs join a collaboration and apply for peer-reviewed access, their level of scientific excellence is in many cases relatively low, making it difficult to compete on this parameter. Still, they may not have the ability to finance proprietary access, which means that they can easily be left excluded from facility use. Therefore, if support of SME is a priority, substantial resources must be allocated for consultancy and feasibility measurements, as well as options to participate in case studies. Since the development work of SMEs is in many cases less incremental than for larger, R&D-heavy companies, the resulting case stories will often be very impactful.

11.4. Industry use of peer-reviewed access – Evaluation and implementation

For ESS it will be a strategic decision to determine how to best accommodate industry users of the peer-reviewed access route. Evaluating the potential approaches on the three levels (Figure 5), the following recommendations are made:

- **A specific call for industry proposals** might not be necessary, especially given that industrially relevant assessment parameters are included for the peer-review, according to the draft of the ESS Access Policy. The proposals are assessed on excellence, which includes both scientific excellence, the ability to address societal challenges, and industrial relevance. According to the industry interviews, this type of assessment is seen as relevant for many industry users, including SMEs. It must therefore be ensured that the full definition of excellence is used by the evaluation panel, or that a separate panel is set up, particularly when a proposal has been indicated to have a connection to industry. The parameters must be weighted in a way that allows for industry proposals to be assessed alongside more scientific proposals and rated on a comparable and transparent scale.

- **A Quick Access mode** has already been decided. Input from the industry interviews indicates that feasibility studies through this mode can expand the industrial use of ESS, and thereby its impact. The Quick Access mode must therefore be run in a way that makes it as useful as possible to industry. This includes fast and efficient assessment of the access requests and potentially reconsidering the statement in the current policy states that it will be assessed by an external expert panel. Instead, the internal technical and scientific reviewers might assess the requests, and the access granted after approval by the Director for Science. It will be important to define the use of the Quick Access mode. If it is a way to prepare for a proposal for general peer-reviewed access, this should be stated clearly. If it can be used for any type of fast test measurement, it could also cover purely industrial tests, which might otherwise fall under the industrial proprietary access. This type of short measurement could in many cases solve the problem for a company, so that no further access is needed.

- **Match-making of any potential industrial users with the required expertise**, at universities, mediator companies, RTOs, or directly at the facility beamlines, will also be highly beneficial for industry and is required if the potential for industrial use of ESS is to be exploited. This effort might be run internally at the ESS or at an external unit. In either case, it is required that ESS is well-connected to the surrounding eco-system and is involved in networks and projects.

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- **A continuous effort towards outreach** and development of new industry users is a significant but important task. It is at the core of the ESS objectives to support and develop its user community, and to obtain socio-economic impact. It must therefore be prioritised, with at least one fully dedicated staff, and the ability to scale up as projects are initiated. Some input on industry outreach is presented in the chapter 13.

11.5. Allocation of facility staff and resources

To ensure a successful match-making and outreach, it is suggested that one full time staff is allocated for these tasks. This might not just cover outreach related to industry use of peer-reviewed access, but also to industry proprietary access as discussed in the next chapter.

11.6. Terms for industry use of peer-reviewed access

The setup for industry use of peer-reviewed access can be implemented according to the terms provided in the following sections.

11.6.1. Terms and conditions

The terms and conditions for general peer-reviewed access should be the same for industry as for other users, as given in the ESS access policy draft.

11.6.2. Terms of reference for peer review assessing industrial relevance

All proposals are assessed on excellence by an external expert review panel. According to the ESS access policy draft, excellence includes

- Excellence in the different scientific disciplines
- Excellence in addressing the grand societal challenges
- Excellence in scientific method development
- Excellence in industrial relevance and innovation

Industrial value-creation or competitive edge for the industry proposer could also be relevant to include, however, given that results must be openly available and published. It could be noted whether the results would be relevant to more than one company, or to the broader industrial eco-system.

The different types of excellence might be relevant for all proposals, regardless of any direct link to the industry. It is suggested that the proposals are rated based on the level of excellence within the categories they represent. Therefore, if a proposal is purely scientific, it should only be assessed based on scientific excellence. If it is purely industrial with no particular scientific value, it should only be assessed based on industrial relevance and innovation. Then, if a proposal combines e.g. industrial innovation with societal impact, it can be assessed on excellence in industrial relevance and innovation together with excellence in addressing the grand societal challenges.

11.6.3. Performance indicators to monitor

Each of the indicators listed in Appendix 1 are suggested as parameters to follow and might be used to follow the industry use of peer-reviewed access. The interviewed facilities generally see an advantage in tracking the number of industry users accessing through peer-review and the amount of beamtime. It might also be a good idea to note the company size, nationality, and sector, and whether they are returning users. This can provide input for facility reports and strategic discussions on outreach and impact. One facility did warn against 'over-KPI'ing', as this can easily result in a lot of work with results of limited use.

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12. Industrial Proprietary Access

Another option for industry access is the purchase of commercial, proprietary access. Through this route, the company retains all IP and the results are kept confidential with no obligation to publish. This is also an access route that is available across all the interviewed neutron- and synchrotron facilities. The aim of this report is to determine the setup for this type of access to the ESS, including the following:

- Terms and conditions
- Requirements and procedures for IP protection and transparent contract handling
- Requirements and procedures for allocation and scheduling of beamtime
- Service catalogue and price list
- Required facility staff and resources
- Performance indicators to monitor

12.1. Proprietary access – Input from facility interviews

All interviewed facilities provide access to commercial, proprietary beamtime. Some main findings from the interviews are summarised in Figure 6.

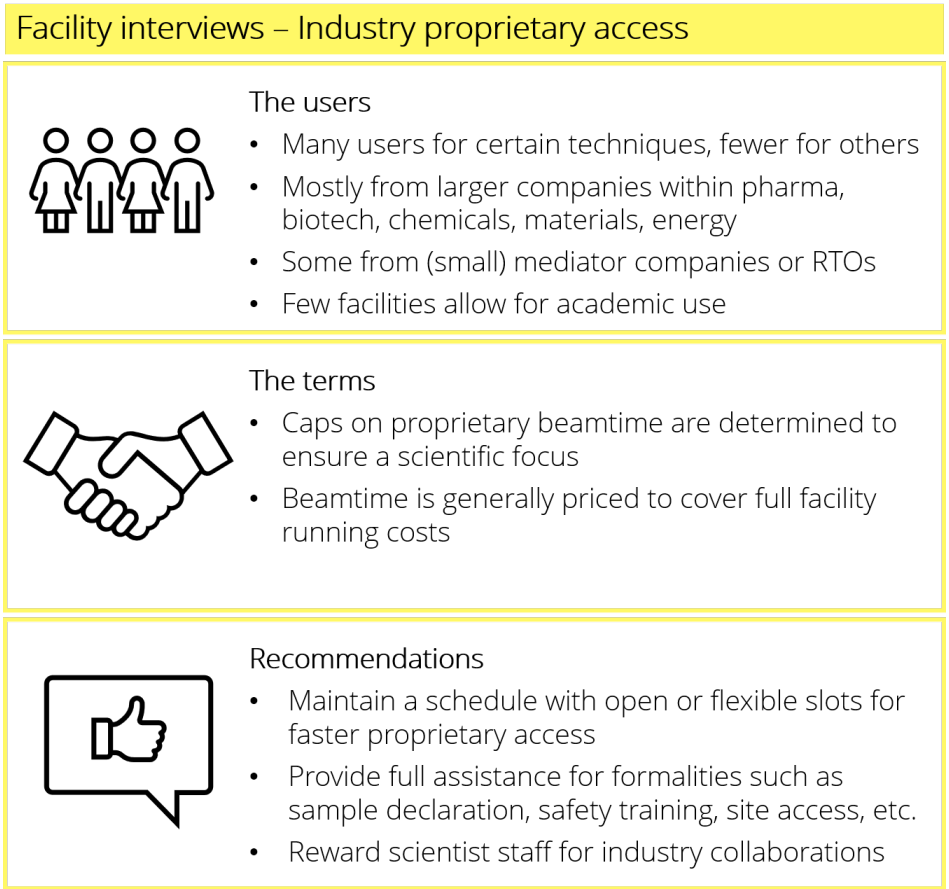

Figure 6 Facility input on industry proprietary access to beamtime

12.1.1. General characteristics of industry users of proprietary access

The level of industrial access in commercial terms varies widely between the facilities. Especially the synchrotron facilities have a high number of commercial users, up to 150 individual annual industry users per year. For neutron facilities, the numbers are typically an order of magnitude lower. The users come from diverse sectors within pharmaceuticals, biotech, chemicals, materials, and energy. They

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are mostly large companies with strong internal R&D units. Whereas local industry clients tend to top the list, the market is highly international or even global.

12.1.2. The beamtime product

The core product that the facilities offer is the beamtime. However, for this product to be useful to the industry, it must be connected with a certain level of support. This includes assistance with formal procedures for site access, sample declaration, training, etc. All the interviewed facilities find that this support is required from the facility user office, especially for non-expert users, but also in general, to ensure smooth access.

Furthermore, support is required from the beamline staff. This includes instrument set up, optimised for the specific purpose, and a beamline staff on call during the beamtime in the case of any issues. The resulting data must also be handed over to the industry client in a useful state, which often requires data reduction.
In the case of mail-in experiments, which is an increasingly used option, the beamline scientists must also handle the samples, in some cases including some sample preparation, and must run the measurement setup and data collection.

Besides the core product of access to beamtime, the facilities also offer a varying degree of extended scientific service, including data analysis and reporting of results. These services will be discussed below.

12.1.3. Terms for proprietary access

At most facilities, beamtime is purchased through the facility industry office. At PSI, a separate company, SLS-TechnoTrans maintains the task of selling the beamtime. They are not involved with the scientific tasks of providing the correct setup and data, though, but can use facility scientists under an umbrella contract.

Legal agreements are set by the facility and negotiated and signed before the beamtime. They include:

- Facility terms of delivery of the beamtime and the data and obligations for the client
- Agreement of full confidentiality of data and samples
- Protection of IP rights of both the facility and the company

Whenever it is required by the industry client, non-disclosure agreements are also signed, related to any information that is shared with the facility in discussing the problem or project.

Several of the interviewed facilities have caps in place, limiting the industrial use of the facility, typically to below 10 % of the total available beamtime. These caps are set either by the facility board, or by regulations for non-profit facilities and are aimed to ensure that the facilities are used for the general scientific progress, and not run as commercial entities.

12.1.4. Pricing of proprietary beamtime

For all the European facilities interviewed, the beamtime is priced to cover the running costs of the facility. This means that the price is given as the full annual running cost divided by the total amount of beamtime that is produced. In this way, the price includes overhead for administrative support, access to support labs, and assistance from the industry office. The setup of the beamline and reduction of the data is also included. In most cases, the income from commercial beamtime goes into the general facility budget.

Beamtime is sold at an hourly rate, or in longer slots of 4, 8, 12, or even 24 hours for neutrons. Typically, the time for setup and alignment of the instrument must be included in the purchased beamtime. The

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facilities charge the same hourly rate across all instruments. To avoid inflated prices at the early stages of a facility, where only a few beamlines are operational, the prices are based on the amount of beamtime that *will* be available when the facility is fully operational. A setup fee will be included, resulting in a higher effective price for shorter blocks of beamtime and for mail-in services.

It is observed that this way of pricing leads to comparable prices between the facilities. For most beamlines, the market is limited, and market effects of supply and demand will not influence the prices. Specifically, for synchrotron-based protein crystallography, though, the industry usage is significant, and prices might be adjusted to account for high demand or decreased slightly to be competitive. A couple of these beamlines are even funded by pharmaceutical companies, which will also drive the price down.

Many facilities have options in place to reduce the price if the industry client agrees that the results can be used in a publication of a case study. Industry case studies and success stories are of value to the facility outreach efforts, and to the general increase of awareness of synchrotron and neutron applications. Case studies are therefore also supported by European programs, such as through the CALIPSO Plus program for synchrotrons.

At ISIS, the ICRD scheme, beamtime is provided free for projects that can be published. Publication does not necessarily imply full disclosure but can also be the publication of a case study, describing the addressed problem and the impact of the results.

Prices can also be decreased for regular industry users, purchasing beamtime beyond a certain quantity, since this type of users enables long-term scheduling and efficient running of the beamline and ensures a steady income.

In some cases, even academic users also purchase commercial beamtime to obtain faster access. At ILL it has been decided that academia cannot use commercial beamtime for their own research projects (it is possible if they ask beamtime on behalf of a company or sometimes for EU funded projects). Also, industry users from non-member countries cannot access it. The application of inflated prices to companies from non-member countries might be another solution that would not exclude users.

12.1.5. **Scheduling of proprietary beamtime**

Scheduling of beamtime at the facilities is synchronised with the proposal rounds for peer-reviewed access. This means that schedules are in many cases planned six months or more into the future. For industry proprietary access, scheduling on shorter notice is most often required. Therefore, beamtime slots are pre-allocated in the schedule, open for proprietary use. Slots that are not claimed by an industry user, will be freed for other use, typically a couple of weeks in advance. This method requires a good estimate of the beamtime that will be needed for proprietary access, based on experience with the typical demand. Some wiggle room can also be offered by swapping with beamtime for internal use of instrument maintenance. In this way, access can typically be granted a month in advance for relatively simple or frequently used instrument setups. More frequent scheduling of the facility beamtime would be preferable, however, this is less compatible with the typical peer-review access that is the main user access route.

For beamlines with a high level of industry use, or with regular proprietary users, scheduling in advance is easier, and provides some predictability for the general planning at the beamline. For beamlines with less industry use, slots might not be allocated in advance but will be booked *ad hoc*, again requiring some level of flexibility in the schedule.

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A waiting time for access of up to a month does not seem to be an issue with most of the facilities' industry users. In many cases, scheduling is not the limiting factor in delaying the measurement, rather it can be delayed by the requirement of complementary sample characterization, by negotiating and signing of contracts, or by administrative tasks such as filling purchase forms and shipping of samples.

At NIST, one SANS instrument is completely allocated for industry use, ensuring the option of fast access. For this instrument, any beamtime that is not claimed by industry users will then be used for internal beamtime, or other tests or experiments. Similar arrangements can be found at industry-funded or co-owned instruments. It is still highlighted, though, that a dedicated instrument is not a requirement for a successful industry program, but dedicated people are, as it will be discussed in the section below.

12.1.6. **Services and resources offered by the facilities**

Whereas the core product of the facilities is beamtime and data, data analysis and interpretation are of course important for the industry to be able to exploit the capabilities. Companies have different levels of internal expertise, and therefore also different needs, as described in the next section. For many companies, a full service, including all analysis and a final report tailored to the specific application will be necessary.

Some facilities offer these services in full, others offer them depending on the availability of their beamline scientists. Alternatively, some facilities engage in the education of industry scientists to enable them to perform their analysis. All facilities have mediator companies or RTOs as users, who perform both data collection and analysis for their industry clients or collaborators.

At Diamond, the industry office has 14 industry-dedicated staff that can assist with experiment design, data collection, analysis, and reporting. They cover most techniques and science backgrounds, and can therefore provide quick service to the industry for a wide range of problems. The ability to run a dedicated group like this, however, depends on having a critical mass of industry users, which can be particularly difficult to reach for neutron facilities.

At most other facilities, the industry office is mainly concerned with industry outreach, projects, administration, and communication. It is then beamline scientists who will provide the data analysis. However, the general beamline scientist has the main objective to work with the users during beamtime and will often have limited time available to perform full analyses for non-expert industry users.

At PSI, the individual science groups receive the income from any industry tasks that they take. If they are in collaboration with the industry user, they can decide whether the price for the staff hours should be reduced by up to 40 %, depending on the alignment of the task with their interests. The price reduction model is defined by the Tech Trans office, and is further described in the BrightnESS2 deliverable D4.5.

At ESRF four or five industrial liaisons or postdocs, affiliated with individual beamlines, are full time or half time dedicated to working with industry, ensuring that there are resources allocated for industry support.

In general, across the facilities, many beamline scientists do not see a clear value for them in assisting the industry, since this will typically not lead to any publications. This is a bottle neck in being able to provide the industry with smooth services. In specific cases, a company will fund a scientist or postdoc

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located at or affiliated with a facility. This scientist will then be in charge of the company's beamtime proposals, proprietary access, data analysis, etc. In the few cases where this is seen, it has proven to boost the facility use by that company tremendously.

Beamline scientists must be motivated to work with industry if they are expected to take on this task. This is a point that was made by all interviewed facilities. In some cases, the scientists have a personal interest that will drive them to provide a good service to the industry. In this way, the industry service is often driven from the bottom of the facility organization, depending on the motivation of the individual scientist. If this agenda is a priority of the facility, it is therefore important to hire people with an interest and an understanding of industry problems and priorities.

The beamline staff must also be acknowledged correspondingly, for the industry support they provide, so that they are not evaluated only on their scientific output. It is also suggested that (part of) the income generated from industry proprietary access is allocated to the beamline groups. The aim and desire to provide a service to the industry is a culture and a priority that must also be set from the top of the facility organisation and communicated effectively at all levels, ensuring the resources and directorate back-up required to provide industry support. It should not be driven from the bottom up only.

12.1.7. Use of mediator companies, RTOs and Regional Hubs

Mediator companies, RTOs and Regional Hubs can access the facilities on the same terms as any other company. They offer to industry the service of designing, running, and analysing synchrotron and neutron measurements. From the facility point of view, they are therefore seen as multipliers, representing a range of industrial clients that might not otherwise have used the facility.

The Regional Hubs, such as LLB or JCNS can act as competence centers for academic users but also support their (national) industry. The Danish LINX portal has successfully channelled several regional industries and their scientific projects, to neutron and X-Ray facilities around Europe. The Regional Hubs may receive regional funding to lower the barrier to engage for their users.

The mediator companies and RTOs have industry service as their main objective and are fully dedicated to solving their clients' problems and providing reports that render the analysis results useful. They therefore represent a way to overcome the bottle neck of limited resources for dedication to the industry at the facilities. Most mediator companies work with synchrotron techniques, but further potential is also seen within neutrons. They are not tied to a specific facility but will use the place that provides the best result for their client.

In some cases, facilities refer the industry users to mediator companies, when they do not have the internal resources to solve a specific task. However, in cases where a facility also provides a similar service, there can be competition between facilities and mediator companies. This is generally not seen as an issue by the facilities, though, as there seems to be enough space for both.

At PSI, the facility was even involved in founding a mediator company, ANAXAM, located on the facility campus. If a company requires assistance beyond the access to beamtime, the Tech Transfer Office will then direct them to the right scientific contact at the facility, at a university, or at ANAXAM. This setup has helped the facility to be seen not just as a research institute, but also as a place to go for solutions to problems. ANAXAM also hires facility scientists for their services, dependent on the interest of the individual scientist.

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12.1.8. Collaboration between facilities

There is also a certain level of collaboration between facilities to ensure that the industry receives the results that they need. There are several examples (e.g. within the SINE2020 project) where clients have been sent from one facility to another if the required instrument, setup, or beamtime was not available. This has further been exercised under WP2.3 of BrightnESS², where ESS-DEMAX and ILL-ENGINEERING have demonstrated the high value of cross facility collaboration.

From the company point of view, it is not relevant which facility or technique solves their problem. The flexibility of facilities to direct industry to other facilities therefore provides the company with consultancy they can trust to lead them to the best solution. There is a level of competition between facilities, though, and as an alternative, a facility can also purchase beamtime at a different facility, and travel there to collect the required data, while not redirecting the client.

For less mature techniques with no significant market, facilities collaborate more freely. This is the case e.g. within the development of measurement setups, standards, etc. A significant amount of collaboration between facilities on industry outreach was also seen, particularly for neighbouring, complementary facilities.

12.1.9. Impact and strategy

The importance of industry use was emphasized by all the interviewed facility representatives. Not just as another group of users, but as a way to impact society and economy and to demonstrate the important societal contributions of the facilities. It is also important for the communication of how insight and better analysis methods can and have led to many significant technological and societal improvements.

It was advised that ESS should make a strategic decision on what its industry program will do, both from day one, and in the longer term. If the facility will mainly produce beamtime and data, run routine measurements and analyses, or provide a full industry service from data collection to interpretation of results. It must also be considered how other units, such as universities, mediator companies, RTOs, etc. can provide the industry with the required support.

In either case, it will be necessary to establish a dedicated industry office function. The office should provide a contact point to direct industry users to the facility scientists or external collaboration partners and service providers. It will also be a contact point for engaging in projects related to industry use.
It is also recommended to set goals for the industry use of the facility. This could be a target for one of the performance indicators, such as income or the number of industry users. Good storytelling of facility application and impact is also an important output, that can be formulated into goals.

12.2. Industrial use of proprietary access – Potential approaches for ESS

Industrial proprietary access to beamtime will be available under commercial terms and under confidentiality. It will be possible to sell beamtime at an hourly rate, in slots of a given length, or according to a specific need. Formalities for legal agreements, financial arrangements, sample declaration, sample shipment, site access, data handling, should all be set up to run smoothly. Here it is important to consider that ESS is providing a commercial service to the industry, and the task should be handled with a service-minded approach.

ESS can provide different levels of support to industry under the proprietary access scheme. The levels are presented in Figure 7 and further described in the sections below. Both the required resources as

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well as the timeframe increase with increasing levels. Input for a service catalogue and price list are provided in the separate BrightnESS² deliverable D4.5 "*Service catalogue & price list*"

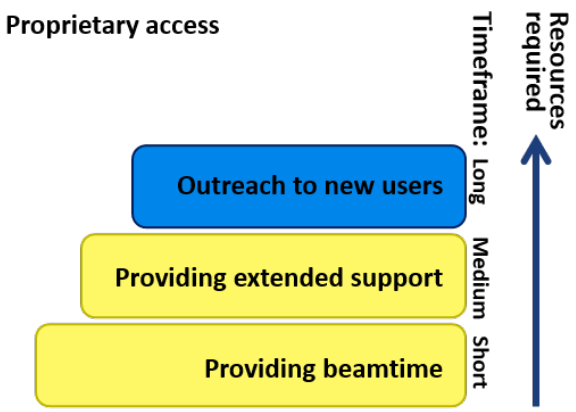

Figure 7 Potential approaches for serving industry users of proprietary access

12.2.1. Access to beamtime

The access to beamtime includes instrument setup, on-call staff for instrument issues during the beamtime, assistance in initial data storage, and potentially data reduction. All these services are provided by the beamline staff. In the case of mail-in experiments, they must also handle the samples and run the data collection.

It should be noted that molecules and materials prepared at the ESS lab for Deuteration and macromolecular Crystallisation, DEMAX, might also be included as a service in combination with access to beamtime. It is therefore also included in the service catalogue provided in the separate BrightnESS² deliverable D4.5. "*Service catalogue & price list*"

12.2.2. Extended industry support

Further industry services might be required for measurement design, data analysis, reporting and discussion of results for a specific application. Three main stakeholders that could provide these services are identified. As shown in Figure 8, these are the relevant facility scientists at the beamlines, a central facility industry unit, or external mediator companies and RTOs. The options are not mutually exclusive.

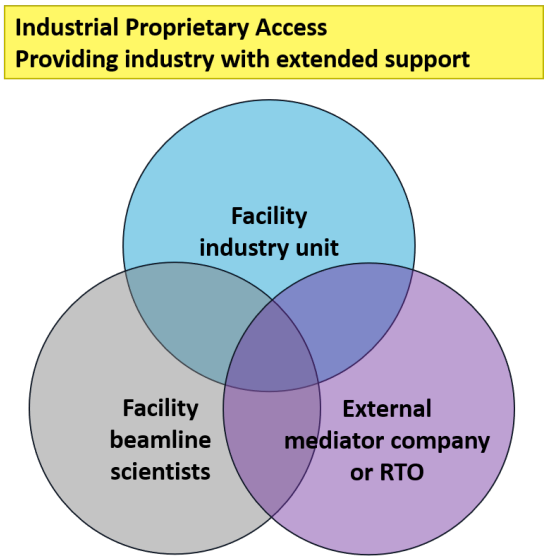

Figure 8 Potential setups for providing industry users with further services connected to beamtime

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Industry services provided by facility beamline scientists
In this approach, the highly skilled scientists that will be connected to the ESS beamlines will be given the task to provide the industry with consultancy, data analysis, and reports. The beamlines must be staffed sufficiently to cover industry services as well as the running and development of the beamline and general support of its users. A certain number of the scientists must have a sincere interest in working with the industry and also be rewarded for this effort.

Industry services provided by facility industry unit
This approach requires an internal facility unit with a team of scientists covering a range of the most industrially relevant neutron techniques and with a certain level of insight into industrial sectors. Depending on the priorities, at least three or four staff might be required. This setup is therefore only sustainable if a certain critical mass of industry proprietary access is achieved.

Industry services provided by external mediator companies or RTOs
In this approach, the required services are provided by external mediator companies or RTOs, dedicated to industry services as the main objective of their business model. Several of these already exist in Europe and in the ESS local area. For examples, see https://mixn.org. They are not tied to neutron techniques, which means that they can address an industry problem independent of whether neutron analyses are a part of the solution.

12.2.3. Developing new industry users

This approach is similar to the development of new industry users for peer-reviewed access. It can therefore be run as a combined, long-term effort by the facility within both outreach, dissemination, and education. As discussed, this requires significant and consistent resources from at least one full-time dedicated staff.
For the proprietary access specifically, it can also include match-making between companies and each of the providers of services, either within the facility, at mediator companies, or at RTOs.

12.3. Industrial use of proprietary access – input from industry interviews

Of the interviewed companies, two have independently used neutron or synchrotron measurements in their R&D. Three have used the techniques in collaboration with either academia or mediators, and one has not used neutron or synchrotron techniques at all. In addition, the interviewed mediator company and RTO use synchrotron measurements routinely as part of projects or in the services they provide to their clients.

Proprietary beamtime is typically used for cases where answers to specific questions or problems of proprietary nature are required. It can also be used in the early product development stage, when confidentiality is required, so that the general peer-reviewed access is not relevant.

A smooth access to the facility is important to all the interviewed companies. This includes the formalities, such as signing of NDAs, handling of payment, sample declaration, and safety assessments. As for the measurement, it is important that the beamline is reliable and easy to use. A reliable setup will in most cases be more important than pushing the instrument to the absolute limit for optimal data range, quality, resolution, etc. The time used for setup should be as short as possible, and some companies might expect to have the full time purchased available for measurements. Remote access and mail-in modes are seen by industry as good options for easy data collection.

Most companies will require relative fast access, on the order of a month or less within requesting the beamtime. If the waiting time is longer, the problem will often no longer be relevant, either since a different solution was found, or because priorities within the company change. This applies to both larger and smaller companies. For larger companies that use beamtime regularly, this issue can be

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solved by purchasing regular slots of beamtime. However, so far, this has only been relevant for synchrotron beamtime, where the demand for beamtime is larger. In general, it is important to manage the expectations so that the companies are aware of the timeline.

Regarding the legal setup, confidentiality is most often a requirement of the companies. NDAs can be set up, covering the information that the company will share, both during initial discussions, sample declaration, safety assessment, sample handling, data collection, and any data analysis performed by the facility. In some cases, confidentiality might be of lower importance, if the measurement results are only useful to the company itself, so that sharing comes with a low risk.
Intellectual property related to the samples and data from the samples must always belong to the company.

Except for a few companies with internal technical expertise, most companies will require a service in addition to just the access to beamtime. The companies do not have 'neutron problems', but problems related to their products and processes. They are not interested in using neutrons, or in using ESS simply because it is a world class facility. They are interested in solving their problems and will need someone to guide them to best methods to use – whether that is a neutron method or other methods. They will also require some certainty of whether a specific method is the right for them to use – maybe including a feasibility test. Finally, once a method has been chosen, they will need a full service, from data collection to analysis and report. This applies to both smaller and larger companies, who do not have the internal expertise, or who wish to out-source certain tasks.

For a point of contact at the facility, the interviewed companies all state that a person with a high level of technical expertise is required, or a person who can identify opportunities and guide to the right method and further point of contact. Some understanding of the industry way of working and prioritising will also be valuable. The person of contact at the facility should be able to communicate with industry people from many different backgrounds. This will also be important in the cases where companies want to be involved in the whole process from experiment design to interpretation of results. It is important that the beamline scientists are motivated to help the industry users and have available time to discuss with them on questions or issues. This has been found to not always be the case at facilities and can unfortunately be a barrier for smooth access and use.

To monitor the success of making ESS available to industry, a range of performance indicators can be monitored. Through the company interviews, it was recommended to set a goal for the amount of industrially used beamtime, which could also include target groups related to company sizes, sectors, etc., and the reasoning for these. The number of industry collaborations for projects or technical development can also be followed.
In general, the width of the industry user group can be interesting to follow, to see that it is not just the same very few companies that use and benefit from the facility. The number of returning users might then be used as a measure of how well the company benefited from using the facility.

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12.4. Industrial use of proprietary access – Evaluation and implementation

The availability of proprietary access to ESS has already been prioritised as an important way to serve industry. The terms for this access route must be determined based on the ESS strategy, industry needs, and societal impact. Based on the input from facilities and companies, the following points should be considered:

- **Smooth beamtime access and data collection** is the main important aspect for companies when using industry proprietary access. Highly advanced, cutting-edge techniques are not necessarily interesting. Therefore, steady-running instruments with flexible, but reliable sample environment is a priority. The setup should be relatively fast, or it should be clearly communicated how large a portion of the beamtime is expected to be used for setup. The logistics around a measurement must also run smoothly. This includes legal work, sample declaration and safety assessment, sample shipping and handling. Furthermore, communication with both administrative and scientific/technical personnel must be swift.
- **Options for case studies and feasibility measurements** can help to reduce the uncertainty of the outcome of a neutron analysis, which is a significant barrier for industry to start using new techniques. They can therefore be important tools to reach new industry users and increase the impact of the facility. This is not least the case for SMEs that might have limited budgets, but also high impact projects and problems. Also, larger companies might be conservative with respect to paying for access to techniques that they have not previously used. It should therefore be considered to set up a program for case studies at a reduced price.

Besides the access to beamtime, companies will often require extended support for both measurement design, data collection, data analysis, and interpretation of results. At this level of support, several providers might come into play. It will be important for ESS to define in which way the facility will be engaged with these. Three potential scenarios are identified, where the services are provided either by the ESS scientists at the beamlines, by an internal industry unit at ESS, or by external mediators such as mediator companies, RTOs or universities. A SWOT analysis for each of them is presented in Figure 9. Evaluation of the identified scenarios and on input from company interviews, leads to the following points that should be considered for the implementation:

- **A full service** from translation of their problem into the design of a measurement, to the full data analysis and a report of the results will be required by most companies. Extended support by mediator companies, academic partners, or ESS is therefore required since access to beamtime is not enough to make ESS useful to most companies. This will also include follow-up discussions on how to interpret and use the results.
- **Match-making with other facilities, universities, and service providers** covering a range of complementary techniques is an important task for ESS in providing a good and useful service to industry, since companies are interested in solutions to problems, rather than in specific techniques. Therefore, it is important to be able to point them towards other techniques or collaboration partners when relevant.
- **Extended industry support might be provided by ESS** through beamline scientists or by an internal ESS industry unit. Since the level of industry use is usually low for neutron facilities, a threat is that the critical mass required for an industry unit might not be reached. Therefore, the involvement of beamline scientists appears to be a better alternative. Here, a weakness is

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bottle necks from not having beamline scientists dedicated to industry service. To reduce the risk, scientists engaged with industry support must be motivated and interested in working with industry and understand the way companies work and prioritise. It is also important that they are rewarded for this work, and not evaluated based on scientific output only. At least 2-3 full time staff are required to cover a range of techniques and expertise – split over several beamline staff members. It should be an active management decision whether it will be prioritised to hire staff with this profile and dedication. In this way, the drive to serve industry from ESS directly can be supported both from the scientists bottom up, and from the management, top down.

- **External mediators will also provide industry support** and will be important collaborators for ESS. They can offer an alternative to providing the full extended industry support from within ESS. They are dedicated to serving industry and can therefore be valuable collaborators for ESS as a way to reach and serve more industry users. Furthermore, mediator companies and RTOs have existing networks within industry, and have the knowledge and experience to work with a range of sectors. This includes the use of other techniques, so that the focus is not on neutron or synchrotron analyses, but on solving a given problem regardless of method.
- **A continuous effort towards outreach** and development of new industry users is important for increased industrial proprietary access, as well as it is the case for the general peer-reviewed access. It is at the core of the ESS objectives to support and develop its user community, and to obtain socio-economic impact. It must therefore be prioritised, with at least one fully dedicated staff, and the ability to scale up as projects are initiated. This task covers both the general peer-reviewed access and the industrial proprietary access. Some input on industry outreach is presented in the chapter 13.

Industrial Proprietary Access
SWOT analysis for providing industry with extended support

FACILITY SCIENTISTS	INDUSTRY OFFICE/UNIT	MEDIATOR COMPANIES OR RTO	INDUSTRY
Strength Flexible access to a wide range of experts depending on need	**Strength** Direct facility knowledge and control of industry use	**Strength** Problem-oriented, flexible industry support and service	- Need solution to specific problem - Potential to contribute to the socio-economic impact of the facility
Weakness No dedicated staff – resulting in potential bottle necks	**Weakness** Resources – requiring a crew of industry-dedicated specialists	**Weakness** Limited direct interaction for ESS to industry customers	
Opportunity Synergy between academic and industrial research, development	**Opportunity** Profile and develop the facility towards industry	**Opportunity** Reaching a wider range of companies	
Threat Scientists not motivated or rewarded for their involvement	**Threat** Critical mass of industry users not met	**Threat** Not specifically dedicated to the facility or to neutron techniques	

Figure 9 SWOT analysis for different providers of extended industry support connected to beamtime staff

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12.5. Allocation of facility staff and resources

One full time staff could be engaged with providing smooth administration of access to proprietary beamtime. Support will be required from the financial, legal, logistic, safety, and other functions at ESS. Depending on the level of support that can be provided, the staff requirement might be adjusted. Another full time staff is required as a point of contact for industry match-making, collaboration, and outreach. These are similar tasks as described for industry use of peer-reviewed access, and might be combined into one position. Depending on volume of industry outreach and collaboration projects, the staff resources might be scaled up. If extended support functions are covered within ESS, another 2-3 full time staff might be required.

12.6. Terms for proprietary access

Several terms must be determined for the industry proprietary access to run smoothly as described below.

12.6.1. Terms and conditions

Terms for providing beamtime and extended industry support must be signed before any purchase of proprietary access. They should include the following specifications:

- Delivery of beamtime:
  - Date and time
  - Price
  - Conditions upon cancellation of beamtime by ESS due to facility issues or force majeure – including re-scheduling
  - Conditions upon cancellation of beamtime by the company
- Conditions for assistance during the beamtime
  - Inclusion of beamline setup – and specify whether setup is included in the allocated beamtime
  - Specification of assistance by ESS scientists during data collection, incl. for mail-in option
  - Inclusion of on-call staff for assistance in case of instrumentation issues
- Conditions for extended services
  - Price offer based on calculation according to estimated time required for task
  - Specification of assistance for data analysis and report writing – including latest date of delivery
- Handling of data:
  - Responsibility for data back-up and transfer
  - Responsibility for data reduction
  - Handling or marking of data at ESS to keep them confidential
- Conditions for samples and equipment:
  - Description of sample shipment options, including any return to company
  - Safety requirements for samples and equipment
  - Requirement for company to provide sample information
  - ESS protocols for safety assessment before and after the measurement
  - Liability for handling of samples and equipment at ESS – including for mail-in where the ESS scientists will handle the samples
  - Conditions for any loss of beamtime due to failure of samples or equipment
- Conditions for confidentiality and intellectual property
  - All information regarding the company's samples and data must be kept confidential – including information submitted for safety assessment
  - All intellectual property derived from the company's samples and data belongs to the company

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- Conditions for payment:
  - Transfer of payment, including banking information
  - Conditions upon late payment

12.6.2. Procedures for handling of contracts and agreements

In addition to the purchase agreement, there should be an option to sign an NDA, concerning any information that is shared during discussion of the beamtime, the instrument setup, or data analysis. A template should be available at ESS. It should be clarified which unit(s) within ESS that handle agreements and contracts, and how an industry office/unit within SCUO can use them.

12.6.3. Service and price list

A catalogue of services that ESS might provide based on the three levels given in Figure 7 is provided in the BrightnESS² deliverable D4.5. "*Service catalogue & price list*"

12.6.4. Performance indicators to monitor

A range of performance indicators were suggested by interviewed facilities and companies.
The number of industry users of the proprietary access route is an important indicator, also related to the impact of the facility. Here it was suggested to not only monitor the number, but also register whether they are new or returning users. The former indicates successful outreach, whereas the latter indicates a level of client satisfaction. The use of satisfaction survey is also an option that should be considered to understand how to continually improve the service of industry. Furthermore, it is suggested to track the sector and size of industry users, to be able to showcase the impact of ESS in different industrial areas.

The impact within the ESS of industry use could be followed through the number of contracts, licenses, patents, inventions, and new experimental capabilities linked to industrial proprietary access.

Not least, several facilities and companies mentioned that a main indicator of success will be good case stories of industrial use of ESS. Other than indicating success, they are also valuable in communication towards stakeholders and outreach towards new industrial users.

13. Industry outreach

Neutron techniques are not generally used or well-known tools within industry. Therefore, a significant effort will be required within outreach, dissemination, and general engagement with industry. Input was collected through the facility and industry interviews as reported in the following sections.

13.1. Industry outreach and collaboration – Input from facility interviews

It was noted by the facilities that engagement with industry needs to be a strategic goal for the ESS, and that it will require dedicated staff to work on this agenda. Whereas industry is the immediate target for the outreach effort, it is also important for the political positioning of the facility.
The facilities typically have closer collaborations with local industry, but also do work in an international setting. The tools for reaching new users and for the continuous engagement with industry is presented in the following sections.

13.1.1. Reaching new industrial users

A general comment across all facilities is that reaching new industry users is hard. It should be expected to take both time, and continuous resources. Here it can be necessary to focus on specific sectors or techniques to make a targeted and efficient effort. The facilities do not have specified goals for their

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industry outreach, but do target it towards specific sectors or communication channels. Some of the tools they use are given below:

- **Case studies** demonstrating how neutron analyses are and will be useful to industry is seen as an important tool. They can be either short, flashy presentations of facility impact, or more technical descriptions of work that has been done with industry. They can help to make the value creation from a neutron analysis more apparent, and thereby break the barrier for a company to take up the use of neutron techniques. For measurements at ESS, though, it is recommended to not start raising the expectations before they can be easily accessed.
- **Funding schemes** for proprietary access to initial measurements can also be seen as a tool to reach new users, as it reduces the cost and therefore the risk for a company to test a new technique.
- **Sector-oriented or topical conferences** with industrial relevance are a seen as a good place to approach potential industrial users, rather than neutron technique conferences. This can also include bringing a booth to represent the facility, or to give a presentation. Some conferences offer business-to-business meetings, which is rather effective since it gives the option to target specific industry contacts. Participation in smaller industry network meetings can also be effective in providing knowledge on current issues, and contacts to relevant stakeholders.
- **Academic conferences** can also be relevant, particularly by engaging with scientists who are running industry collaborations. This scientist can then be informed on potential analyses, as well as the facility access routes that apply to industry aside from the general peer-reviewed access.
- **Meetings and discussions** with individual companies are a key tool. It is important to identify the right person in the company to talk to, ensuring that they can act on a strategic or operational level. Some facilities, specifically target industry research scientists who are aware of the company's specific challenges within analytical techniques. A meeting could be combined with a visit at either the facility or the company. Some facilities find that these meetings are an efficient way of reaching new users, whereas other prefer to focus on group events.
- **Social media** presence can also help to increase the awareness of a facility. Consistency with posting news stories etc. can increase the visibility.
- **Facility scientists** are often key players in reaching out to industry, and many connections are created through them. Given that they typically have a highly academic background with less knowledge on how to engage with and sell to industry, sales training of selected scientific staff can be beneficial.
- **Transfer of people** is another, quite effective, way of gaining contacts. When previous facility employees or previous academic neutron users find position in companies, they are often good advocates for the use of neutron techniques and might also work as direct collaborators of the facility.

13.1.2. **Continuous engagement with industry**

Other efforts towards industry outreach might not specifically target new users, but rather the general engagement in the industrial eco-system. The interviewed facilities highlighted a range of initiatives as listed here:

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- **Organisation of industry groups and conferences** can be a good way to engage with industry. PSI runs events such as 'Industry Day' where industry and the facility present recent results. At MAX IV, events and network activities are organised within specific industry sectors or themes. Here, the groups are organised as open forums, with participation from both industry, academia, and other stakeholders. These platforms can be used as a place where industry can bring their challenges to both the facility, and to other participating research organisations. Online events can also work well, and often attract higher attendances, since it is lower cost for the participants.
- **Industry consortia** with member companies is a related way of engaging with industry The industry consortium nSoft at NIST is centered around the general topic of soft materials and provides training, test measurements, and seminars etc. The consortium is used as a way to mature industrial users and develop capabilities at the facility.
- **Participation in projects** in collaboration with industry is important to stay connected with industry bring neutron techniques into play in current research and development.
- **Collaboration between complementary facilities** is seen as an advantage, as it allows for covering a wider range of techniques and expertise, thereby addressing more industry problems. If the facilities' constraints allow, collaboration on policies etc. can also beneficial.
- **Inclusion of industry on boards etc.** is seen as a good way to engage industry, mainly relevant once the capabilities to serve industry are coming into place.

13.2. Industry outreach and collaboration – Input from industry interviews

Representative from both smaller and larger companies (see section 10.2) were interviewed on their advice on how a facility like ESS can best reach out and collaborate with industry. Their input is presented below:

- **Industry involvement in academic projects** is particular relevant for the more R&D heavy companies, both small and large. They tend to actively participate in research collaborations and also have an ear to the ground on new techniques and up-coming projects. The value proposition and the complementarity of the project partners should be clear. For some high-tech products, a long timeframe is required, whereas other development projects should have a more limited timeframe, or at least an option for flexible goal-setting, corresponding to the changing focus points of the company.
- **Industry involvement with external analytical services**, such as access to industrial proprietary beamtime and extended support, are typically initiated through networking at conferences, or by personal interest of company employees.
- **The pitch for value creation** must be strong to reach new users. This is especially true for SME, who will need to have a clear picture of what ESS can do for them in order to invest their time and resources in a collaboration.
- **Funding schemes** for new industrial users will help to break the barrier and reduce the risk for a company to engage in a collaboration with unknown or unclear outcome.
- **Existing industry consortia and networks** will be useful for ESS as a setting to listen to industry needs and understand how ESS might provide some unique value. Presentations by ESS at seminars etc. in industry groups can also be a good option to present the possibilities. However, the focus should be on understanding and addressing the industry needs rather than presenting the technical aspects of ESS.
- **Relatable and relevant case studies** are a good tool to exemplify how neutron techniques might create value, rather than highlighting the methods themselves.

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13.3. The industry outreach effort

The effort to reach out to industry is resource demanding and has a long timeframe for the effect (see Figure 5 and Figure 7). It does, however, form the foundation of future, sustainable industry engagement and should therefore be included as an important part of the facility operation. Even before facility operation, resources should be dedicated to collect insight into industrial sectors and problems, and to enter project collaborations with other stakeholders.

14. Conclusions

Input has been collected on the required setup for industry access to ESS, based on interviews with both synchrotron- and neutron facilities and industry representatives. Conclusions were drawn for industry use of both the peer-reviewed access and the proprietary access.

Industry use of peer-review access

- **Industrially relevant assessment parameters are included for the peer-review.** Therefore, a specific call for industry proposals might not be necessary. Proposals are assessed on excellence, which includes both scientific excellence, the ability to address societal challenges, and industrial relevance, and it must be ensured that the full definition is used by the evaluation panel, or that a separate panel is set up.
- **A Quick Access mode** can expand the industrial use of ESS, through access to feasibility tests, which might be especially useful to new users. Assessment of the access requests must be fast and efficient, potentially replacing the external review with an internal. It must be defined whether Quick Access is mainly a way to prepare for a proposal for peer-reviewed access, or whether it can also cover proprietary access.
- **Match-making of industrial users with the required expertise**, at universities, mediator companies, RTOs, or directly at the facility beamlines, will also be a good way to increase industry use of beamtime at the ESS, making it important to stay well-connected to the surrounding eco-system.

Industry use of proprietary access

- **Smooth beamtime access and data collection** is of highest importance industrial users, and steady-running instruments with flexible, but reliable sample environment is a priority over highly advanced, cutting-edge techniques. The surrounding logistics such as sample declaration, safety assessment, shipping and handling must also run smoothly.
- **Options for low-cost case studies and feasibility measurements** can help to reduce the uncertainty of the outcome which is a significant barrier for industry to start using new techniques. They can therefore be important tools to reach new industry users and increase the impact of the facility.
- **A full service** will be required by most companies, covering from translation of their problem into the design of a measurement, to the full data analysis and a report of the results. This extended support might be provided by mediator companies, academic partners, or ESS.
- **Match-making by ESS of industrial users with other facilities, universities, and service providers** can help to provide industry with a good and useful service, focusing on the company's problem rather than on specific techniques.
- **Extended industry support might be provided by ESS** through an internal ESS industry unit, which would, however, require a significant industrial use, and will therefore not be relevant

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from startup of facility operations. Beamline scientists can assist in providing the required service. They must then be at least part time dedicated to industry service and be motivated and rewarded for working on industrial problems. At least 2-3 full time staff are required to cover a range of techniques and expertise – split over several beamline staff members.

- **External mediators will also provide industry support** and will be important collaborators for ESS. They are dedicated to industry support, and can be a way for ESS to reach and serve more industry users, using both neutrons as well as complementary techniques.

It is further concluded that the two described access routes in combination with a Quick Access mode as mentioned, will satisfy the draft access policy for ESS and adhere to the European Charter of Access to Research Infrastructures and to the International Recommendations for Access to Research Infrastructures.

Regarding outreach to (new) industry users, the following input is collected:

- **A continuous effort towards outreach** and development of new industry users is a significant but important task. It is at the core of the ESS objectives to support and develop its user community, and to obtain socio-economic impact. It must therefore be prioritised, with at least one fully dedicated staff, and the ability to scale up as projects are initiated.
- **Case studies** demonstrating how neutron methods can be useful to industry is seen as an important tool to make the value creation from a neutron analysis more apparent, and thereby break the barrier for a company to take up the use of neutron techniques.
- **Funding schemes** for proprietary access to initial measurements is also seen as a tool to reach new users, as it reduces the cost and therefore the risk for a company to test a new technique.
- **Sector-oriented or topical conferences and network meetings** with industrial relevance are a seen as good places to approach potential industrial users, rather than neutron technique conferences.
- **Academic conferences** can also be relevant, particularly by engaging with scientists who are running industry collaborations and informing on options for industry at the facilities.
- **Meetings** with individual companies, site visits, and discussions are a key tool. It is important to identify the right person in the company to talk to, ensuring that they can act on a strategic or operational level. Insight into the company's specific challenges within analytical techniques can also be important.
- **Social media** presence can also help to increase the awareness of a facility. Consistency with posting news stories etc. can increase the visibility.
- **Facility scientists** are often key players in reaching out to industry, and many connections are created through them. Given that they typically have a highly academic background with less knowledge on how to engage with and sell to industry, sales training of selected scientific staff can be beneficial.
- **Transfer of people** is another, quite effective, way of gaining contacts. When previous facility employees or previous academic neutron users find position in companies, they are often good advocates for the use of neutron techniques and might also work as direct collaborators of the facility.
- **Organisation of industry groups, conferences, and consortia** can be a good way to engage with industry and develop industrially relevant capabilities at the facility.
- **Participation in projects** in collaboration with industry is important to stay connected with industry bring neutron techniques into play in current research and development.

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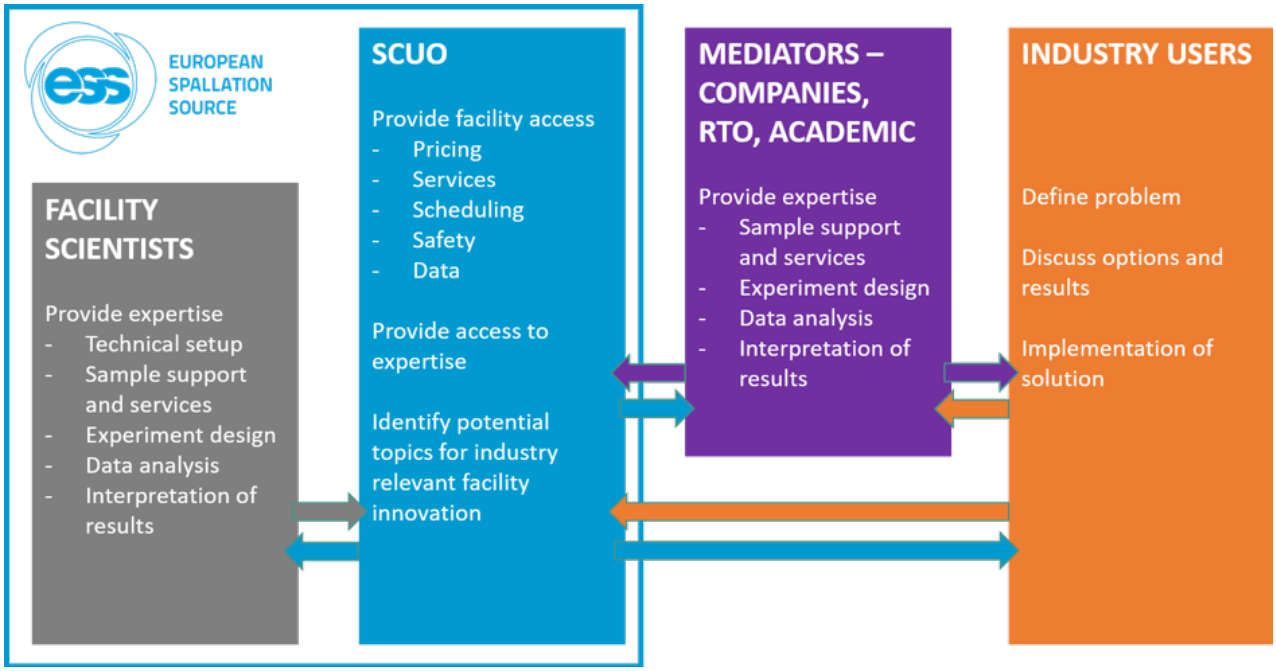
- **Collaboration between complementary facilities** allows for covering a wider range of techniques and expertise, thereby being able to address more industry problems. Collaboration on policies etc. can also beneficial.
- **Inclusion of industry on boards etc.** is seen as a good way to engage industry, but is mainly relevant once the facility is running so that capabilities to serve industry are coming into place.

The defined Infrastructure for Scientific Support for Neutron Experiments is found to be covering the analysed requirements for the targeted access routes.



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15. Appendix

15.1. Appendix 1: List of performance indicators for the socio-economic impact of ESS, related to industry access, as determined in WP5.

DTU

General comments:

- Structure: All indicators are pre-existing (in the BrightnESS² SEI report), some measures are also pre-existing (begins with "Existing:", or added (begins with "New:").
- The last column indicates which indicators/measures are applicable to all scenarios. Many measures are service oriented (providing best possible services) and so many are applicable to all scenarios. All others might only be relevant to specific scenarios.
- Some measures are more valuable than others – this is an overview of all indicators/measures that could be applied, but not all may not be necessary

Objective 1 - ESS produces research outputs that are best-in-class both in terms of scientific quality and in terms of socio-economic impact

Impact type	Indicator	Indicator detail	Measures	Application/comments
Scientific	**Number of publications**	Number of publications based on the research performed using facilities/resources of the RI. The publication is shared by the countries of the home institutions of all authors, the sum of the shares being one.	**New:** Number of publications by industry citing ESS use.	Application: All scenarios
Scientific	**Number of citations**	Quality of RI publications and number	**New:** Total number of citations to publications by external ESS users, citing ESS use	Application: All scenarios
Scientific	**Neutron source reliability**		**Existing:** Faults statistics (duration and cause) • **New:** during commercial use	Application: All scenarios

DTU

Objective 2 - ESS supports and develops its user community, fosters a scientific culture of excellence and acts as an international scientific hub

Impact type	Indicator	Indicator detail	Measures	Application/comments
Scientific	**Training of people who are not RI staff**	The total number of person hours for which people external to the RI have made use of training opportunities provided by the RI, through both real (e.g. face to face) events and on-line services	**Existing:** Non-RI staff: Total number of hours spent in training sessions (excl. Registration, breaks); for online sessions, time logged in.	Application: All scenarios
Scientific	**Number of user requests for access**	For access to facilities: number of user proposals for access For resource RIs: number of users of resources, such as collections, data, services	**Existing:** Total number of proposals to use the ESS facility received • **New:** by industry	Application: All scenarios
			Existing: Total number of proposals to use the ESS facility received by instrument • **New:** by industry	Application: All scenarios
			Existing: Total number of successful applications to use the ESS facility (proposals accepted) • **New:** by industry	Application: All scenarios
			Existing: Total number of successful applications to use the ESS facility (proposals accepted) by instrument • **New:** by industry	Application: All scenarios
			Existing: Total number of successful applications to use the ESS facility (proposals accepted) by societal challenge • **New:** by industry	Application: All scenarios
			Existing: Total number of successful applications to use the ESS facility (proposals accepted) for each discipline science area • **New:** by industry	Application: All scenarios
			Existing: Total number of successful applications to use the ESS facility (proposals accepted) for each discipline science method • **New:** by industry	Application: All scenarios
			Existing: Share of users as per ESFRI country • **New:** by industry	Application: All scenarios

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Scientific	**Collaboration Excellence (scientific)**	For access to facilities: number of granted proposals/accepted users For resource RIs: number of logins/downloads/studies or provisions of service.	**Existing:** Total number of proposals to use the ESS facility completed • **New:** by industry	Application: All scenarios
			Existing: % Oversubscribed (proposals to use the ESS facility) • **New:** by industry	Application: All scenarios
Scientific	**User satisfaction**	Based on survey results; a survey can be run to measure user satisfaction on project selection, support and other items, to evaluate how the RI answers its user needs.	**Existing:** Overall user satisfaction • **New:** by industry	Application: All scenarios
Scientific	**Extent of resources made available**	Experimental time available or size of resources database made available to users to facilitate research	**Existing:** Number of machine hours offered to users (operating schedule) • **New:** to industry	Application: All scenarios
			Existing: Number of hours of beam time offered to users (planned time with neutrons) • **New:** to industry	Application: All scenarios
			Existing: Number of machine hours offered to users by instrument (operating schedule) • **New:** to industry	Application: All scenarios
			Existing: Number of hours used by users (effective time with neutrons) • **New:** to industry	Application: All scenarios
			Existing: Number of hours used by users (effective time with neutrons) • **New:** to industry	Application: All scenarios
Innovation	**Collaborative projects with industrial partners**	New collaborative projects carried out with industry are a major mechanism through which knowledge circulates and impacts innovation	**Existing:** Number of ongoing research projects involving industry	
			Existing: Number of ongoing research projects involving industry coordinated by ESS	
			Existing: Number of ongoing research projects involving industry AND academia	
			Existing: Number of ongoing research projects involving industry AND academia coordinated by ESS	
Innovation	**Regional firms using the RI facilities**	Contributes to the development of the regional firms skills and impacts on their innovation capacity	**Existing:** Number of regional firms using the RI	Application: All scenarios
Innovation	**Share of users associated with industry and publications with industry Objective**	For access to facilities: number of granted proposals/accepted users For resource RIs: number of downloads/studies or provisions of service	**Existing:** Number of industrial users	Application: All scenarios
Social	**Engagement achieved by direct contact**	Outreach by public relations/direct contact with specific target groups: organisation of (e.g. summer schools, events for industry, government sector etc.) or participation at events organised by third parties; and visitors to the RI	**Existing:** Number of other non-scientific events organised by ESS • **New:** for industry	
			Existing: Number of other non-scientific event participants • **New:** by industry	
			Existing: Number of informational visitors (individuals) • **New:** by industry	Comment: for example, to discuss user opportunities
			Existing: Number of informational visits (groups) • **New:** by industry	Comment: for example, to discuss user opportunities
Social	**Educational and outreach activities**	The educational training activities have an indirect impact on participants knowledge and skills	**Existing:** Total number of educational training activities organised/co-organised by ESS • **New:** for industry	

Objective 3 - ESS is built safely, on time and on budget, operates safely, efficiently and economically, and responds to the needs of its stakeholders, its Host Countries and Member Countries

Impact type	Indicator	Indicator detail	Measures	Application/comments
Social	**Gender balance and diversity**	Demonstrates the effort made by the RI for equity (RI exemplarity)	**Existing:** Percentage of women (users & trainees) • **New:** from industry	
			Existing: Number of nationalities (users) • **New:** from industry	
Social	**Safety Training**		**Existing:** Number of released Safety Training courses • **New:** for industry	Application: All scenarios Related to indicator: Training of people who are not RI staff
Social	**Incidents & incident reporting**		**Existing:** Number of safety incident reports received • **New:** concerning commercial use	Application: All scenarios
Economic	**Income from commercial activities and the number of entities paying for service**	Share of revenue from the RI's economic activities (sale of services and goods, access provision) reported in the in the annual accounts	**Existing:** Share of revenue from access provision	Application: All scenarios
			Existing: Share of revenue from commercial activities	Application: All scenarios

Objective 4 - ESS develops innovative ways of working, new technologies, and upgrades to capabilities needed to remain at the cutting edge

Impact type	Indicator	Indicator detail	Measures	Application/comments
Innovation	**Patents**	The number of patents developed by the RI demonstrate its impact on innovation	**Existing:** Number of patents applications by ESS with industry partners granted	
			Existing: Number of patent applications by ESS with industry	
			New: Number of patent applications by industry, related to research at ESS	Application: All scenarios Comment: Could be collected via survey
			New: Number of patent applications by industry granted, related to research at ESS	Application: All scenarios Comment: Could be collected via survey
Innovation	**Technology transfer**		**Existing:** Number of outgoing technology transfer agreements	

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15.2. Appendix 2: List of questions for interviews of synchrotron and neutron facilities

BrightnESS2, Deliverable 4.4, Appendix 2
Interview questions for industry officers at synchrotron and neutron facilities

Present status. The aim is to obtain the background/situation for the further conversation.

- *Who are your industry users? Field, size, geography, etc.*
- *How many industry users do you have every year?*
- *How are your industrial users accessing? The distribution between academic proposals, academic collaborations, commercial, etc.*
- *Do you have a certain fraction of beamtime set aside (or a cap) for industrial usage? Certain goals?*

- The commercial beamtime 'product'. The aim is to understand the various ways industrial need for commercial analyses can be met.
  - *What is the product of commercial beamtime? Hours, experiment, data, picture, report, assistance, discussion (before or after measurement), the full job?*
  - *Which steps are you involved in, fulfilling the (wide range of) industry requirements, from problem to solution? Incl. engagement of beamline scientists. What are your resources? Recommendations?*
  - *Do you provide beamtime for or collaborate with mediator companies or RTOs?*

- Access policy and pricing of commercial beamtime. The aim is to understand how beamtime is and could be priced and sold.
  - *What costs are covered? Facility cost, facility running, beamline, personnel, etc.? How is pricing set?*
  - *Is the pricing based on budget for the facility – or for the specific instrument?*
  - *What is considered in the pricing, e.g. actual cost, national membership, potential academic 'mis-use' of commercial beamtime, or others. Recommendations?*
  - *Is the income from commercial beamtime allocated for a specific purpose?*
  - *Is industrial beamtime flexible regarding whether it is commercial with NDA, or for publication?*

- Beamtime logistics. The aim is to understand how the logistics around providing industry access are and can be solved, while meeting the requirements of both facilities and industry.
  - *What is the logistical setup? Legal/Financial/Registration, travel/Samples/Safety/Data/..*
  - *How might the setup improve through collaboration with other facilities? (shutdown scheduling, NQL, etc.)*
  - *Do you have a level of flexibility of the scheduling (e.g. open slots) to meet industry needs? Recommendations?*

- Access by proposal for pre-competitive research. The aim is to learn how industry can best access academic beamtime, either on their own or with university partners.
  - *How is industrial use of academic beamtime promoted?*
  - *Do you have any specialized access modes/programs? Recommendations?*
  - *Could/should access be based on innovation merits rather than scientific excellence?*

- Recommendations regarding industry consortia/clusters. The aim is to understand how industry consortia are and can be used.
  - *Do you use industry consortia/clusters for building of knowledge within (potential) user group? Focused e.g. around certain beamline, industry problem, sample environment, etc.?*
  - *Do you support/are you experienced with industry development of sample equipment? Does the developer gain special access or other credit?*

- Monitoring/logging of industry use and impact. The aim is to understand how the use and impact of industry access can be measured and followed.
  - *What key performance indicators do you use, and how are they collected?*

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- *How can KPIs include both commercial and academic use?*

- Communication. The aim is to understand how (potential) industry neutron users are reached.
  - *How do you reach new industry users?*
  - *What are your goals for increased awareness? –*
  - *Who is the target of your outreach efforts? Companies, associations, sectors, mediators, public, political*
  - *Would a joint strategy across facilities be helpful?*
  - *How do you collaborate with broader industry communities/the innovative eco system?*
  - *How is industry involved in the facility user group and organizations?*

- ESS recommendations
  - *Do you have any recommendations to the ESS as a new facility, regarding industry access?*

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15.3. Appendix 3: List of questions for interviews of industry representatives

BrightnESS2, Deliverable 4.4, Appendix 2
Interview questions for industry representatives

- Assessing the value of an external service or collaboration
  - *Do you have an internal R&D unit/team? Size?*
  - *How do you use external collaborations for problem-solving? Commercial services or academic collaborations?*
  - *If uses both, what is the driving factor in deciding one over the other? (when to buy services over collab)*

- Use of external academic collaborations
  - *How do you see your need for (academic) R&D projects? How much do you participate in them?*
  - *How do you find/join projects?*
  - *What makes a good R&D project? What would incentivize you to join a project?*

- Use of external analytical services The aim is to understand the various ways industrial need for commercial analyses can be met.
  - *At what steps of your production/development are external analyses relevant?*
  - *Would/do you rely on third party support to perform beamtime experiment? E.g., LINX association, RTOs, mediators. If so, do you consider it a better solution if such kind of support is provided directly from a RI?*
  - *What is the product you want to access from an external provider/collaborator? Hours, experiment, data, picture, report, solution of a problem, assistance, discussion (before or after measurement), the full job?*
  - *Which type of contact would you wish to have at an external service provider? Technical scientist/engineer, engineer/scientist with sector knowledge, business person*
  - *How much do you like to be involved in design/data collection/interpretation?*
  - *What information do you need to see if the value matches the price or the time spent? What should a price list look like?*
  - *What are your typical needs regarding timeframe?*
  - *What are your typical needs regarding confidentiality?*
  - *Is flexibility of commercial vs public for a beamtime of importance?*
  - *What are other main needs for a collaboration with an external provider? (legal, financial, administrative, samples, data, safety)*
  - *How important is i) development of product/process, ii) improvement of product, iii) application of patents, iv) improvement of know-how and capabilities, v) expansion of network?*

- Finding new services or collaborations
  - *How do you find new services/solutions?*
  - *What are your recommendations to facilities for reaching new industry users?*
  - *What are your recommendations to facilities for staying in touch with the broader industry communities/the innovative eco system?*
  - *Are you a member of any networks/clusters in your domain? Have you engaged in collaborative R&D via this network?*
  - *How do you see the benefit of industry networks related to facility application? Or for (co-)development of industrially relevant sample equipment? Available for all facility users?*
  - *What are your success parameters? What KPIs would you suggest for an analytical facility with regards to industry access and use?*

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