Combined report on O4.3 Industrial User Experience, O5.2 Pilot Activity Impact and O5.3 Open data pilot impact

Chaniotou, Ninetta, Kanka, Paula, Piwowarczyk, Piotr & Stenvall-Virtanen, Sari

Introduction

The Baltic TRAM (Transnational Research Access in Macro-Region) project offers companies free access to analytical research infrastructures (ARI) across the Baltic Sea Region, providing technical and scientific expertise to help address materials issues associated with developing new or improving products. The overall objective is to boost innovation, secure the implementation of smart specialisation strategies, and encourage entrepreneurship by supporting small and medium size enterprises, thus contributing to the regional effort of making the Baltic Sea Region innovative, sustainable and competitive.

To achieve this, Baltic TRAM also feeds into the transnational research and innovation agenda. It performs benchmarking analysis on national roadmaps for research infrastructures and smart specialisation strategies and provides recommendations to policy makers. Moreover, the project establishes structures to serve as interface between analytical research institutes infrastructures (ARI) and companies, the Industrial Research Centres (IRECs). During the project, ARI offers are marketed, and companies are offered consultations and access to research facilities to improve their products.

Baltic TRAM builds on the findings of the Science Link project, a flagship Interreg IV B Baltic Sea Region project that received EU project funding 2012-2014. Science Link is currently operated as a network. The purpose of the Science Link network is to encourage innovation and entrepreneurship in the Baltic Sea Region, to strengthen the region's competitiveness in a global context. It supports industrial research with synchrotron radiation and neutrons at research facilities in northern Europe. The aim is to create awareness of the possibilities offered at research facilities in the region and to show how research and development at these sites can contribute to innovation within European industry.

Baltic TRAM Project budget: 4,157,013.60 EUR
Interreg Vb Baltic Sea Region Programme contribution: 3,207,699.40 EUR
The project runs from March 2016 until February 2019
Baltic TRAM website: www.baltic-tram.eu
Keywords: SME development, smart specialisation, Baltic Sea Region, transnational cooperation, research infrastructures, innovation, regional development, science business collaboration

GLOSSARY

ARF: Analytical Research Facility

BT: Baltic TRAM

BSR: Baltic Sea Region

EC: Evaluation Committee

ILO: Industrial Liaison Officer

IReC: Industrial Research Centre

IReCNet: The Industrial Research Centres Network

MoU: Memorandum of Understanding

R&D: Research and development

RI: Research Infrastructure

Content

List of Figures

List of Tables

1. Background and structure of the report

This document is to be considered as the final report of the Baltic TRAM project Work Packages 4 and 5. It was jointly drafted by the responsible work package leaders (University of Turku, Foundation of Innovative Initiatives and Kainuun Etu Ltd). It represents the results achieved and challenges tackled during the BT project. This joint effort has been motivated by the close interconnection of WP:s 4 and 5. This report has not been a subject of Baltic TRAM consortium wide review.

The report is structured as follows:

1. Background and structure of the report

2. Pilot activity impact (WP5, O5.2)

3. Open data pilot activity impact (WP5, O5.3)

4. Industrial user experience: customer feedback in terms of reported impact on businesses

5. Recommendations for short- and longer-term development of IReCs and IReCNet based on the customer feedback, IReC self-evaluation and the network business model development activities

The interaction between WP: s 4 and 5 is schematically shown in Figure 1 below:

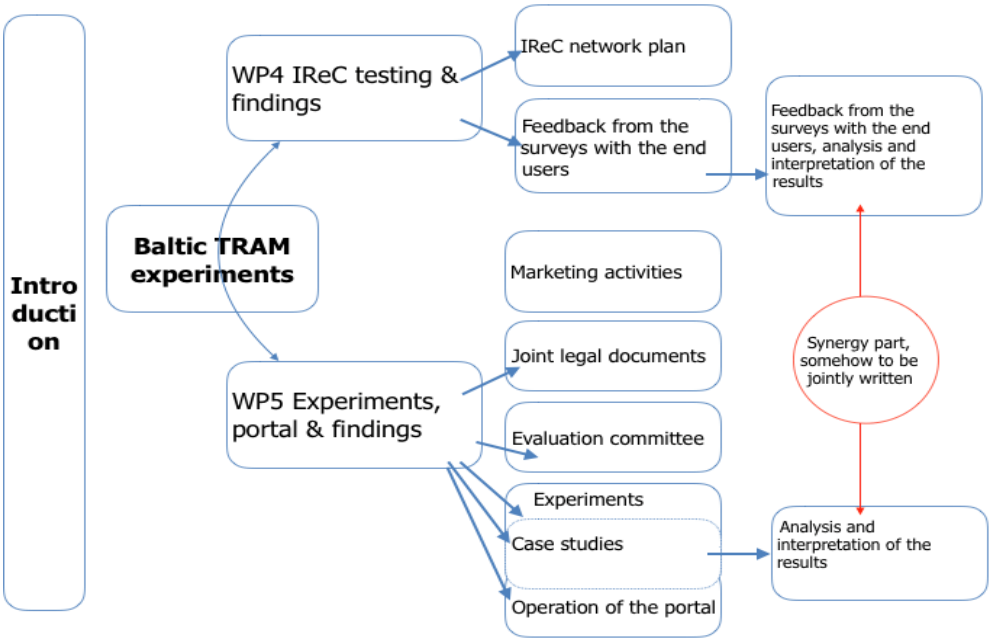


Figure 1 *The structure of the report*

In the Baltic TRAM (BT) work package 4 activities have targeted to discover and validate the industrial user demand by listening to customers, understanding their needs and developing services that meet those and to find solution to the main challenges by examining the pilot projects of the Work Package 5, where the aim has been to verify the performance of the business pilot activities with respect to extent to which the support of institutional network (IReCNet) is effective in adding value to the ARFs (Analytical Research Facilities), universities, and other parties involved in the network. The results of the WP5 have during the project been used to improve the structures and functionality of the IReCNet.

Baltic TRAM project (3/2016-2/2019) has successfully established a network of public facilities that provides and executes short-term business development and innovation services (consulting and measurement) for industrial users. This network is different from other networks, such as for example Enterprise Europe or ADAPTER in Estonia. The other networks serve as a one-stop-shop for a variety of research services from various organizations (public universities, research organizations and private providers) and on the other hand, the Industrial Research Centres is the concept of serving the industrial users in the BT project, focus exclusively in short-term consulting and measurement services, have multi-sectoral, interdisciplinary, and transnational approach.

The Industrial Research Centres Network has proven its functionality through successful pilot activities. The project partners have welcomed the results in a Memorandum of Understanding (MoU) and declared their general willingness for further cooperation. A first concept for a sustainable long-term operation model for the network has been developed. General rules and requirements have been drafted in the "Terms of co-operation" document.

Due to several interdependencies and correlations between the work package 4 and work package 5 it was reasonable to combine the final results of the activities, analysis and conclusions into one joint report. Below are presented the objectives of this report:

1. Offers basic understanding of the market need and type of users of IReC services at regional and transnational level in the Baltic Sea Region.
2. Describes in detail the cooperation models, processes and types between the IReCs, ARFs and industrial users at regional and trans regional level.

3. Reveals to what extent the pilot activities confirm the adequacy and capacity of the IReCs in particular and IReCNet in general to help identifying still existing gaps in the service processes.
4. Summarizes the findings in the Service Design experiences in the pilot projects.
5. Presents the results of the open data access pilot and provides information about the impact and results of the pilot by presenting examples of addressed research problems, used methods, received results and further usage of related open research data.
6. Evaluates and brings together the final results in the context of user feedback (WP4), practical business development pilot activities and open data pilot (WP5).
7. Makes recommendations to the short-term and longer-term development of IReCs related to customer relations and customer chain management in the IReCNet.

2. Pilot activity impact (WP5, O5.2) in Baltic TRAM

Baltic TRAM (Transnational Research Access in the Macro-region - BT) is an international project for boosting interactions between analytical research institutions and business, and link expertise to specify industrial needs. The main objective is to secure the implementation of smart specialization strategies, as well as encouraging entrepreneurship to make the Baltic Sea Region innovative, sustainable and competitive.

The eligibility area for accessing measurement services through project funds was originally restricted to the project regions and member states, and later it was decided to open up and access a larger test-base for the experiments. Thus, finally, 9 countries benefitted: Germany, Poland, Lithuania, Latvia, Estonia, Finland, Sweden, Denmark and France which is outside of the consortium, but one application was submitted by the company from this country. The Baltic Tram calls criteria enable on the one hand performing the measurement service by the ARFs from the countries outside project partnership on the other hand, companies from the European Union can apply for measurement services. The project lasted for three years; it started in March 2016 and was ran until the end of February 2019.

In general, during whole Baltic TRAM project the most applications were sent from Finland (n=17). From Poland 14 applications were sent. On the third position with number of sent application (n=8) was Estonia. One application less (n= 7) was sent from 3 countries: Germany, Lithuania and Sweden. Four applications were received from Latvia, two from Denmark and one form France. In total, the Baltic TRAM

partners received 68 applications from many different sectors. All the data you can see on the graph below. [1]

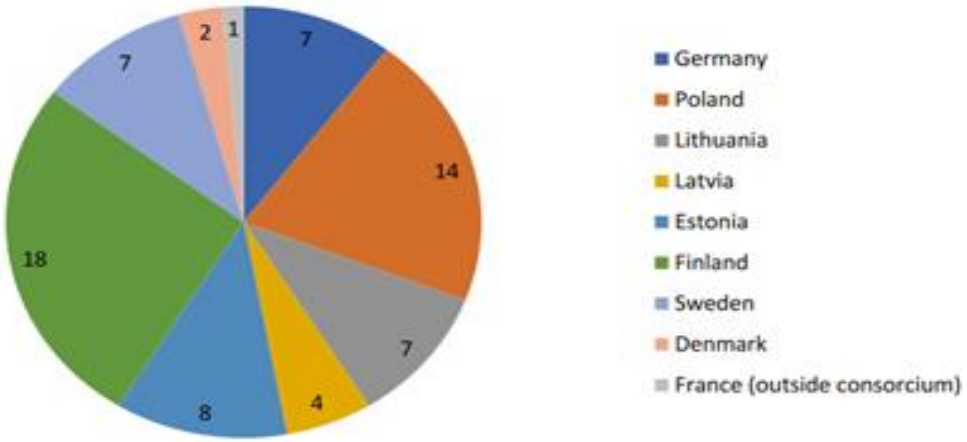


Figure 2 *Division of the countries where the applications were sent from*

One of the most important pillars of the Baltic TRAM project is an R&D (research and development) offer for industry spanning the entire region, made available by a network of Industry Research Centers, which via calls for proposals are striving to strengthen the role of research in driving product excellence.

During Baltic TRAM project three calls took place. First call took place in 2017, since 1st of May until 31st of October. In that time, 24 applications were delivered. Second call started in 2017, 1st November and it ended in 2018, 30th April. Again, 24 applications were received. Last call lasted from 1st of May 2018 up to 30th of September 2018.

During the first call, altogether 24 applications for short-term research services were prepared and submitted by six countries. The largest number, almost half – 46% (n= 11) of the applications were sent in by Finnish companies. The remaining 13 applications came from Estonia, Latvia, Poland, Germany and Sweden. Companies from three countries during the first call did not prepare any applications: Denmark, Lithuania and France.

The first call for free of charge measurements was open to all industrial sectors and this was well illustrated by the diversity of sectors represented amongst the applicants, as shown in the chart below (Fig. 3). Application were sent from 11 different sectors. From sectors as cosmetic, food and composites and plastic

industries, four applications were sent from each of this sector. Three applications were sent only form one sector – raw materials and recycling. Two applications were received from two different sectors: nanotechnologies as well as building industry. From the remaining five sectors, one application from each was delivered: agriculture, drug development, 3D printing, environmental protection and automotive and aviation industries.

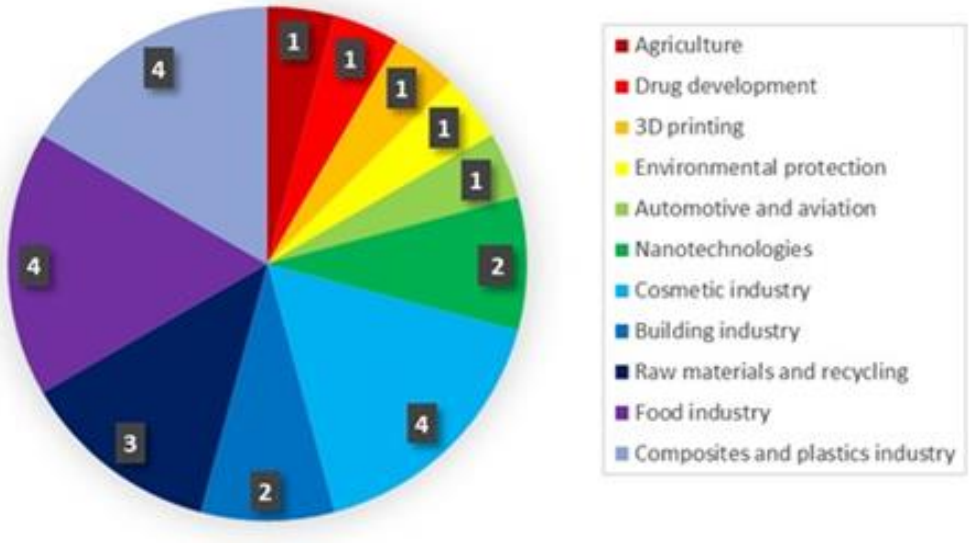


Figure 3 *Industry sector*

After the first call, assumptions stayed the same except the subject of the measurement, which was adjusted. During the second call, the measurements that would lead to a product development rather than a standardized research were primarily promoted.

During the second call, totally 24 applications for short-term research services were sent in. The applications were submitted by Finnish, Swedish, German and Polish companies (17), which accounts for 70% of all those submitted. The remaining seven applications came from Denmark, Latvia, Lithuania, Estonia and Denmark. The second call for free of charge measurements was open to all industrial sectors as shown in the chart below. In the second call again from three sectors: metal, beauty and personal care, agriculture and food industry sent four applications (Fig. 4).

In addition to the first call, applications from six different sectors were submitted: security, metal, beauty and personal care, diagnostics and measurements tools, electrical and electronic and biotechnology.

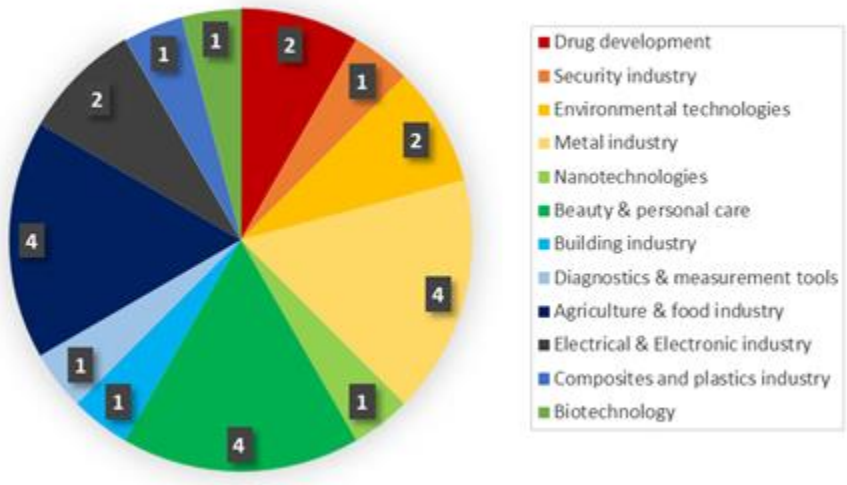


Figure 4 *Summary of the second Call*

During the third call, 20 applications were submitted by the companies located in the Baltic Sea Region and beyond. The geographical distribution of the received applications is the following: Finnish (3), Swedish (2), German (1), Lithuanian (5), Latvian (1), French (1) Estonian (2) and Polish (5) companies, which accounts for 29,41% of all submitted applications through the Industrial Research Centre network. The companies from different industrial sectors made use of the Baltic TRAM short-term, free of charge measurements offer (Fig. 5).

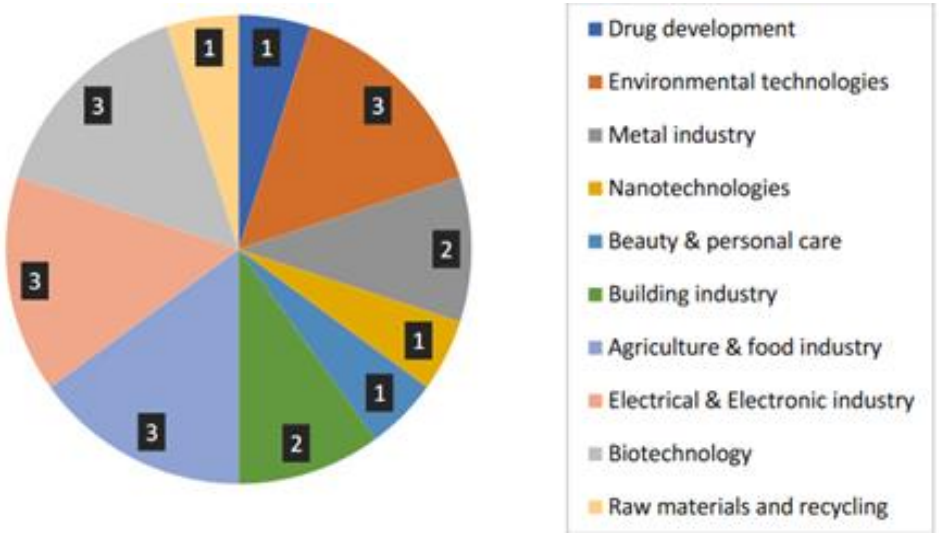


Figure 5 *The distribution of the applications by industry (Call 3)*

The third call for measurements applications was the last one arranged by the Baltic TRAM project. The project totally received 68 applications over three calls and the assessments were performed by organizing 26 evaluation sessions. Just a minor number of the applications was rejected, which means that the scope of measurements was well defined.

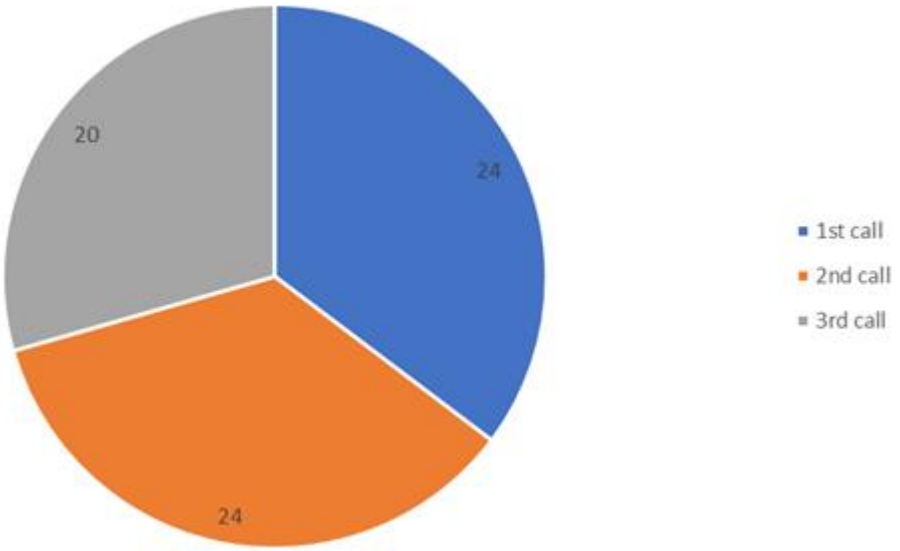


Figure 6 *Number of applications in each Call*

In addition to the calls for experiments, the open data pilot set-up was progressing along the way, including technical and content aspects. In the first quarter of 2018, it was agreed that the University of Turku would deliver the technical solution for the open data pilot. In parallel, Kainuun Etu Ltd was coordinating the content production based on case studies describing the experiments contributed by the IReCs being responsible for them. The result of the open data pilot activity is thirty-two complete case studies out of fifty-one experiments.

Clearly, there is area for the improvement. Nevertheless, the completed case studies are extremely valuable in two ways. Firstly, they have served as a good dissemination base for the results of Baltic TRAM. Secondly, based on the agreed comparative approach, the project partners have been able to gain very useful insights into the profiles of the experiments, the example of that can be their alignment (or not) to regional policies, interregional research-to-IReC-to-business cooperation, and potential for regional and interregional clustering by grouping the NACE codes. Once more case studies will be completed, the more extensive sample will function as a "capitalisation" tool for the whole project and possibly future related initiatives.

Baltic TRAM helps enterprises to benefit from expertise of scientists and equipment of research facilities. This approach double benefits from research that needs to be done. On one side, the scientist has the possibility and a practical need to do the applied research. On another side, companies can use the outcome to develop their future products and structure of business. All together 27 case studies were received by the Baltic TRAM researches.

The main purpose of the project customer survey was providing feedback about the usefulness of the experiment for the business. Over 85% (23 companies) stated that the experiment was useful or even very useful for the business. In three cases – over 10%, there was no specific answer, if the experiment was useful or not, but form the context of the response it can be assumed that it was in some way useful for the company. One company provided feedback that due to the experiment, they have successfully implemented the project and they were able to produce prototype for security and present it to potential customers. For another business the experiment was a starting point to create a new research project. Last company that did not clearly specified if the experiment was useful or not stated that measurements were on the basic level, but the feedback from their business was positive, because it allowed them to safely invest in more expensive engineering plans to build better production facilities. Only in one survey there was no answer at all to this question.

The companies also answered on achievements and follow-ups in terms of measurement results. In one case there was no answer provided and in four cases companies wrote "Not known", which is about 18%. Four companies stated that there are no plans for measurement continuation however they will keep the contact with IReC (15%). In six cases there were plans or possibilities for follow-up by extension research subject. In most of the cases the companies stated that the measurement results were very useful and had the influence on the shape of the product development process.

According to 70% of the feedback received, questions and clarification requests raised during the Baltic TRAM project, was possible to address by local IReCs. An IReC can be associated to universities, ARFs or companies. People at IReCs act as translators and matchmakers between companies with research challenges and makes „transfer happen". For the remaining 30% of the feedback received, the needed international expertise was identified and provided to companies, enabling knowledge transfer within the IReC Network. Network (IReCNet). The IReC network can be considered as a common marketing tool, knowledge exchange and service tool for the participating IReCs.

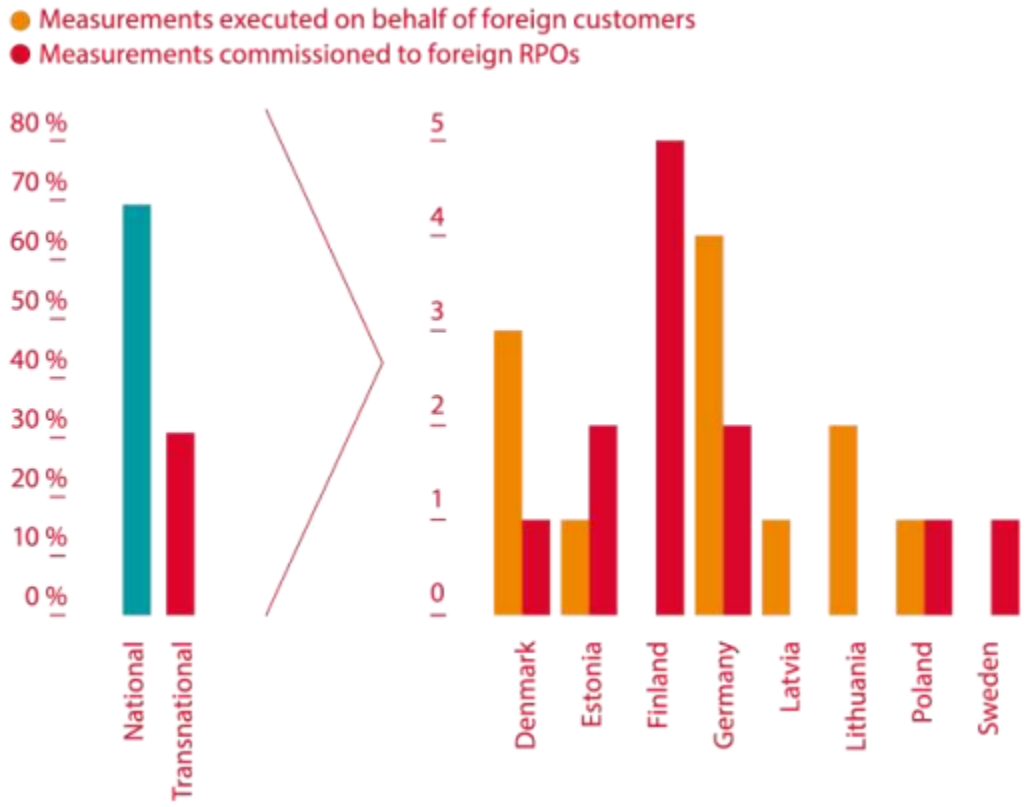


Figure 7 *Transnational exchange of cases*

The majority of benefitting companies are micro companies (Fig. 8) that are employing less than 10 people, there is a clear need for financial support in this area. Sharing the costs of "knowledge and technology transfer" between public and private parties transforms into big advantages and possibilities to develop. This policy instrument might particularly support transnational collaboration.

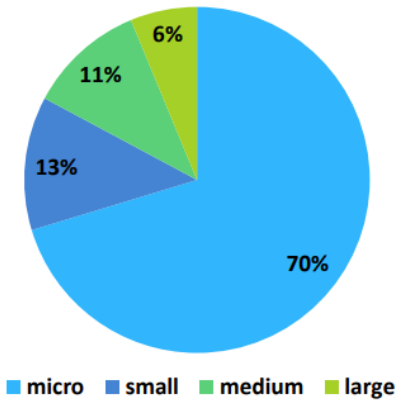


Figure 8 *Industrial research based on size of companies*

During the calls there were some general challenges named by partners, which affect, how they perceive the outcomes of this project. The partners suggested that it would be more beneficial if IREC staff were able to find time to call them. They were surprised that everything has taken longer than expected. Starting from signing contract, through getting laboratory work underway or delay in receipt of samples and other activities. The last, but not the least important challenge was reaching the right type of company, i.e. interested in doing this type of short-term research, mature in terms of appreciating role of research in product development, not taking advantage of call for one-off benefit.

Recommendations were divided into three overall topics. One area was about initial contact with companies. Main recommendation in this area was to shorter communication chain and be able to communicate directly and actually, it is possible, but it can be overwhelming and can cause to receive misleading and inconsistent information. In addition, companies are interested in knowing at the beginning how much funding they are eligible to get. This is very common approach and it thus makes sense to give an estimate to provide general overview for companies involved in researches. The second topic was connected with evaluation committee. One recommendation was related to communication, that feedbacks should be immediately shared not only with the IREC, which is linked to the applying company, but also to the IREC/ARF, which is charged with carrying out the measurements. There were few cases that it was reported that recommendations have not reached the relevant IREC in a timely manner. Most evaluation forms are not specific enough to provide tangible value to company. Second of all, there are cases where quite a few analytical techniques are recommended by the Evaluation Committee – and while we cannot discount the possibility of carrying out measurements using all techniques listed, we do not want to commit right away to carrying out all techniques, mainly for financial reasons. Third of all, if we have a case, where we need to seek out an external ARF, we cannot know the costs of the measurements up front, and so it would be unwise to commit to funding these measurements. The third main area was connected with measurements. Incorporate gathering content for the open data pilot portal by using the final report from measurements template. Populating the portal with content is essential to do right after measurements are completed and the company has had a chance to review the results and talk with the ARF & IREC. Since there are three different templates, which the IRECs will be filling out, if the ARF completes a final report using the final report template, the majority of questions in those three templates can be filled in.

There were also some general feedback provided after calls. It was suggested to create and use one, final template to systematize the information provided in the report by the ARF to the company. In addition, one recommendation suggested that it would be beneficial to make an extra effort to locate potential applicants who are interested in carrying out measurements that have intrinsic R&D value for the company.

All recommendation and feedback received was gathered and was taken under consideration either for Baltic TRAM project or/and for future projects as references.

Baltic Tram Evaluation Committee

The Baltic TRAM Evaluation Committee was an informal body of evaluators set up within the scope of the Baltic TRAM project operated in the process of open call for free of charge, short-term measurements services.

The Committee was responsible for evaluating applications submitted by companies to the Baltic TRAM Calls for Applications. If the application fulfills a set of content and feasibility criteria, including the availability of a suitable ARF capable of carrying out the required measurements, the Evaluation Committee recommended a proposal for execution. The Committee in its recommendations was guided both by a macro-regional approach (best reflected in the make-up of the Baltic TRAM project consortium, which represents ARFs from seven different countries) and a local approach (local support being preferred under 'market' circumstances because of cost factors).

The Evaluation Committee (EC) was guided by the following selection criteria both in relation to the company and to the scope of the measurement:

- A company applying for support must be eligible to receive state aid under the de minimis rule,
- A suitable ARF is available and has the capacity to execute the requested support measures in an acceptable time frame
- The applicant must as clearly as possible explain in the application how the requested service is relevant for the company's products or services,
- The proposed measurement concept should be linked to the applicant's product development challenge and it must be sufficiently mature,
- The results of the measurements presumably will enhance the level of knowledge of the applicant with regard to improvement of existing or development of new products or services,
- The concept should address how the results will be used. For example:

  a) Likely contribution of the results towards a better understanding of properties or behavior of specific materials or production processes.

b) Potentially, in case of a successful outcome of the experiments, the company very likely plans to invest in new personnel or equipment.

Membership in the EC consists of the Chair and representatives of the Baltic TRAM project partners. Following experts were involved in evaluation of the measurement applications:

1. University of Southern Denmark (SDU) , Odense, Denmark
   Prof. Jakob Kjelstrup-Hansen
   Expertise areas are:
   Organic thin-film devices: transistors, light-emitting diodes, photodetectors, solar cells. Microfabrication: lithography techniques, thin-film deposition techniques.

2. Institute of Physics, Polish Academy of Sciences
   (Chair) Prof. Krystyna Jablonska
   Expertise areas are:
   X-ray diffraction and spectroscopy, photoelectron spectroscopy, SIMS, Epitaxy, ALD technology.
   (Deputy chair) Dr. Marcin Klepka
   Expertise areas are:
   X-ray spectroscopy, TEM, FTIR, metalo-organic complexes.

3. University Oulu, Finland
   Dr. Jarkko Räty
   Expertise areas are:
   Electrochemistry, catalysis, flow cytometry

   Dr Mari Jaakkola
   Expertise areas are:
   Supercritical fluid extraction and other extraction methods, gas chromatography (GC-FID and GC-MSD), liquid chromatography (LC-MSD, LC-MS/MS, LC-UV, LC-DAD), capillary electrophoresis.

4. University of Turku Finland
   Dr. Taina Laiho
   Expertise areas are:
   surface science, chemical reactions on the surfaces, solid/liquid interface phenomena methods: hardness testing, Atomic Force Microscopy, X-ray Photoelectron spectroscopy.

Prof. Edwin Kukk
Expertise areas are:
chemical bonds in small organic molecules, radiation induced dissociation processes,
structures of metal atoms and small clusters prepared by evaporation methods:
synchrotron accelerators, electron-ion coincidence spectrometer.

5. Institute of Physics, University of Tartu, Estonia
   Dr. Vambola Kisand
   Expertise areas are:
   Photoelectron spectroscopy; vacuum ultraviolet spectroscopy; physics of molecules; physics of thin films; physics of nanostructures; sol-gel films and their applications.

6. Kaunas Science and Technology Park, Lithuania
   Prof. Sigitas Tamulevičius
   Expertise areas are:
   Condensed matter physics, thin films, vacuum and plasma technologies, optical measurements, surface and interface phenomena, micro and nanotechnologies, electronics, photonics, biomaterials, bio sensing.

   Prof. Renaldas Raišutis Kaunas University of Technology
   Expertise areas are:
   Development of acoustic methods for investigation of physical and mechanical properties of materials; application of ultrasonic methods for quality control of cereal products; study of the application of echolocation methods; development of ultrasonic transducers for measuring instruments.

7. Helmholtz-Zentrum Geesthacht - Center for Coastal and Materials research
   Dr. Marc Thiry
   Expertise areas are:
   Materials science, residual stresses, phase transformations, texture analysis, nanomaterials (hard and soft matter); Methods: (Synchrotron-)X-ray and neutron diffraction, (Synchrotron-) X-ray tomography, small angle x-ray scattering (SAXS), small angle neutron scattering (SANS).

   Dr. Caroline Curfs
   Expertise areas are:
   Materials science, residual stresses, phase determination, phase transformations, texture analysis, nanomaterials; Methods: (Synchrotron-)X-ray and neutron diffraction, (Synchrotron-) X-ray tomography.

8. SOLARIS National Synchrotron Radiation Centre
   Dr. Mateusz Wojtaszek
   Expertise areas are:
   Material science, semiconductors, surface science, electronic properties of solids, nanotechnology, SPM microscopy (STM, AFM, NC-AFM, FFM, 4-point probe), scanning electron microscopy

9. DESY
   Dr. Oliver Seeck
   Expertise areas are:
   The group leader of the PETRA III experiments and responsible for the operation of the beamlines P01, P02.1, P02.2, P03, P04, P06, P07-DESY, P08, P09, P10 and P11. Structure determination with X-ray scattering and diffraction techniques, especially in solid or liquid thin films and surfaces but also in bulk, X-ray diffraction methods, imaging, materials science and spectroscopy in combination with X-rays.

During Baltic TRAM project, 26 Evaluation Committee sessions were performed on which 68 applications were evaluated. Below bar charts (Fig. 9, Fig. 10, Fig. 11) show the detailed information about time frame and number of the applications evaluated during 3 calls in Baltic TRAM.

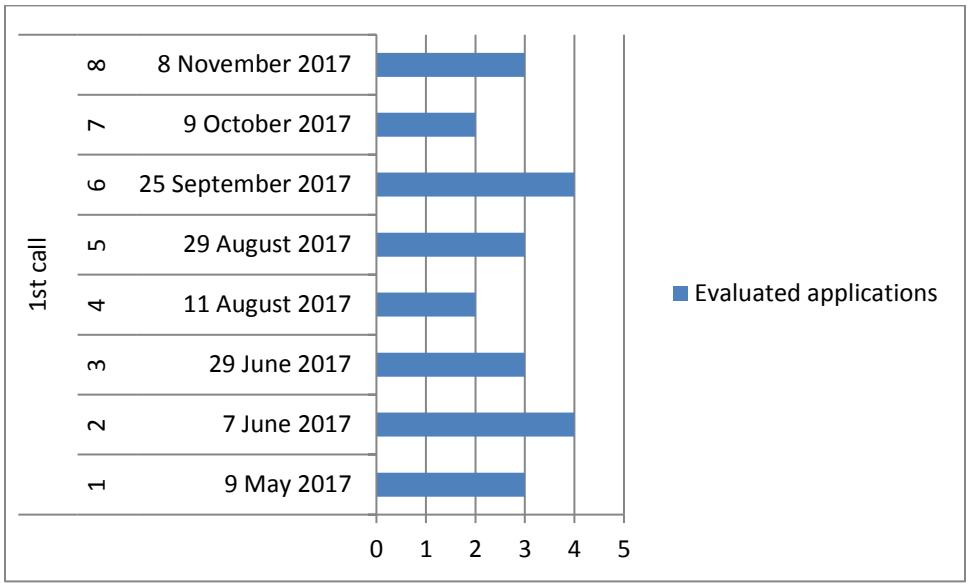


Figure 9 *Evaluated application 1st Call*

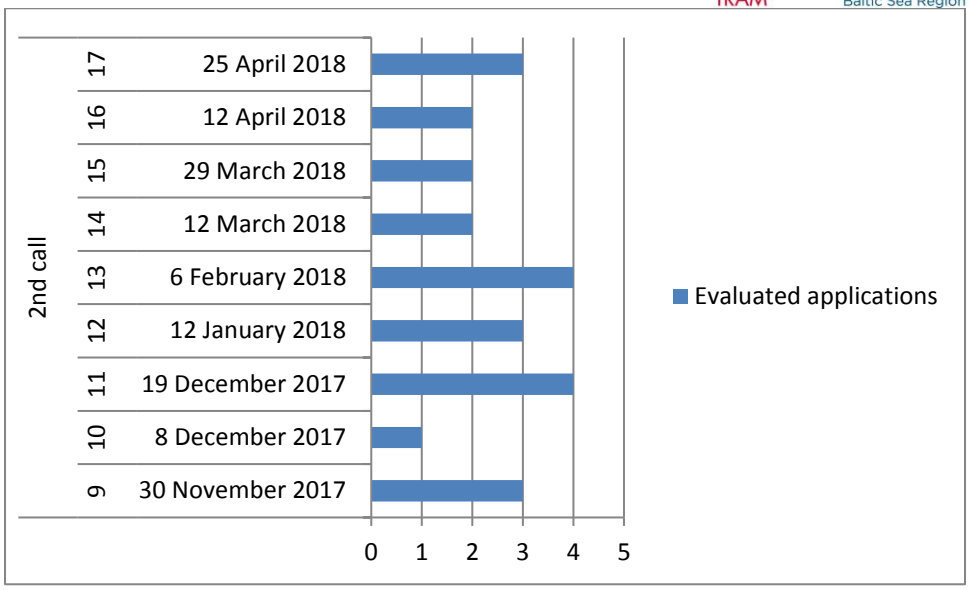


Figure 10 *Evaluated application 2nd Call*

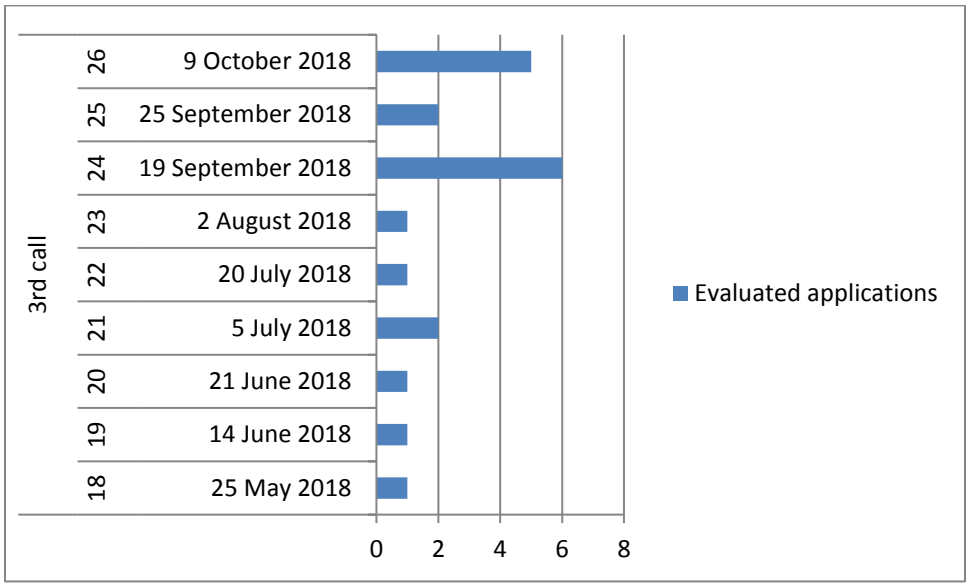


Figure 11 *Evaluated application 3rd Call*

3. Open Data Pilot activity impact (WP5, O5.3) in Baltic TRAM

3.1 Evolution of the data monitoring and evaluation fields

The open data portal (Activity 5.3 of the WP 5 of the Baltic TRAM project), is not an independent task. It is relying on WP 5.2 inputs, and itself forms part of inputs to WP3 and WP4. Thus, WP 5.3, within the Baltic TRAM project plan, is interrelated to various other WPs and activities. Figure 12 maps these interrelations without going into depth for all of them.

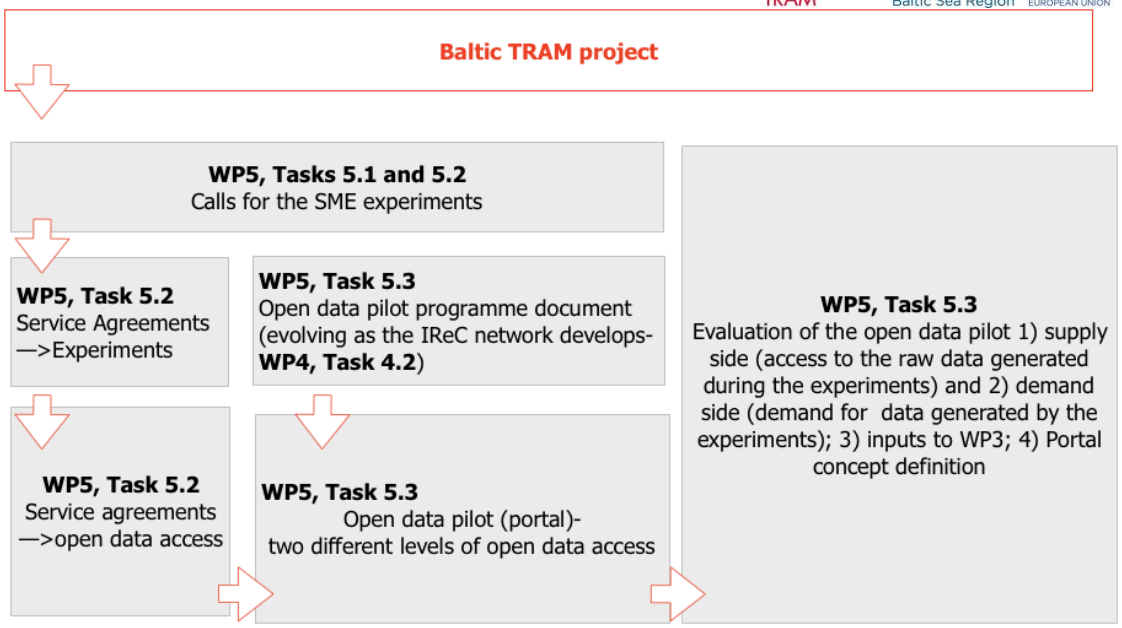


Figure 12 *The open data portal in the context of the Baltic TRAM project plan*

The evaluation takes into account the agreed parameters (section 2.6), however, it also takes into account differentiations that have occurred during the implementation.

Overall, the open data portal has "suffered" from the relatively slow rhythm of delivery of measurements, which influenced also the operation of the portal and the possibility to gain feedback to all of the evaluation parameters. Nevertheless, in spite of any delays, the portal achieved a level of maturity and generated useful insights, maybe to be explored further by the Baltic TRAM follow up project and probably other initiatives.

As a result of the relatively slow turn out of the results of the experiments, case studies have been contributed only during the last period of the project, from July 2018 until January 2019. It implies that there has not been time to test the portal as a data re-use option towards the demand generated by scientists, researchers, teachers, businesses and business intermediaries, or as an IReC network marketing tool, as has been the intention in any case.

There are more experiments completed than case studies contributed to the open data portal: 51 experiments have been completed and 32 case studies have been contributed. The present report takes into account the 32 case studies since data are missing in relation the 19 case studies that have not been submitted. The types of information discussed in the case studies and the overall analysis of the experiments have been successful in encouraging a deeper understanding of the demand for measurement services and the role of the different institutions (IReCs, ILOs, ARIs).

The experiments and the case studies have been analysed across a number of parameters. A data base has been organised accordingly. The analysis needs (and therefore also the data base range of parameters) grew during the various face-to-face and online project exchanges. Gradually, the experiments and the case studies constituted a database important not only for WP5, but also for certain WP3[1] and WP4[2] outputs. For this purpose, additional classification categories were added. This has been, overall, a positive experience as it encouraged deeper insights and increased the cohesiveness of the project. All data were mapped, and the database maintained within the context of WP 5 implementation[3]. This reinforces the usefulness of the project.

Finally, twenty-eight (28) types of data were collected and discussed. To give a more concise idea of the range and objectives of the 28 data-types, they have been grouped into seven (7) categories, as follows:

A. General information about each experiment
   1) Experiment ID
   2) Company name,
   3) Business location
   4) Type of company (micro / small / medium / large)
   5) Status of application for measurements
   6) Nº call during which the measurement application was made
   7) Status of measurements (completed / ongoing /pending)
   8) Time between submission of application & evaluation review

B. General information related to the case studies (i.e. the experiments that were also submitted as case studies for the open data portal)
   9) Open data portal case study status (for short: case studies) (Y/N)
   10) Open data portal Case study index
   11) Open data portal case study
      a. Review of case study
      b. Case study download
      c. Request for data access
   12) Access to raw measurements data (permission by SMEs)
   13) Actual availability of raw data

C. Profile of the experiment

[1] Co-ordinator of WP3 is PP14 COUNCIL OF THE BALTIC SEA STATES (The Secretariat of the Council of the Baltic Sea States).

[2] Co-ordinator of WP4 is PP4 UTU (University of Turku).

[3] The data bases were made and maintained by the Baltic TRAM partners PP11 IIF (Foundation of Innovative Initiatives) and PP4 KE (Kainuun Etu).

14) Cost of each experiment (only the beam time was reported, VAT exclusive)
15) NACE business activity classification
16) Technology level classification (of the applying business)
17) Classification of requested measurements
18) Contribution of the experiment to industrial development
19) Contribution of the experiment to materials science

D. Policy relevance
20) RIS3 relevance
21) KET relevance

E. Locational aspects
22) Lead IREC in the experiment and location
23) Any other IReCs involved
24) ARFs recommended (or in the case of external ARFs - identified / selected), and location

F. Policy relevance of the experiments
25) RIS3 relevance
26) KET relevance

G. Follow up & impact of the experiments
27) Transnational / International collaboration (Y/N)
28) Surveys (linked to WP4, after 3 and 6 months of the provision of measurements)[4]

3.2 Evaluation activities

The programme document of the open data pilot was reviewed initially by all the Baltic TRAM partners and was presented to the 2nd High Level Group meeting that took place in Stockholm on 25th of October in 2017. The portal's implementation progress was reviewed and evaluated at two instances: the first review was, at the beginning of November 2018, in view of the 3rd High Level Group meeting on 14th November 2018, and the second review took place during February 2019, i.e. just before the end of the project. The reviews are structured below into two parts: technical progress and case studies analysis and findings.

[4] On line surveys were carried out by PP3 UTU (University of Turku) coordinator of WP 4 of the project.

3.2.1 Technical progress

1st Review of the open data portal pilot (version 10.11.2018)

The technical part of the open data portal was implemented by PP3 University of Turku. The task was officially assigned in April 2018, with the approval of the Baltic TRAM internal budget re-distribution. The content coordination remained as was initially planned with PP4 Kainuun Etu. PP3 and PP4 co-operated during the period April 2018 – February 2019 to set up, populate and test the portal.

The portal was designed according to the approach and functionalities proposed and agreed in the programme document and reminded in Figure 13 below. The portal is linked to the main Baltic TRAM website and utilises similar colours and design to emphasise the connection between the two locations.

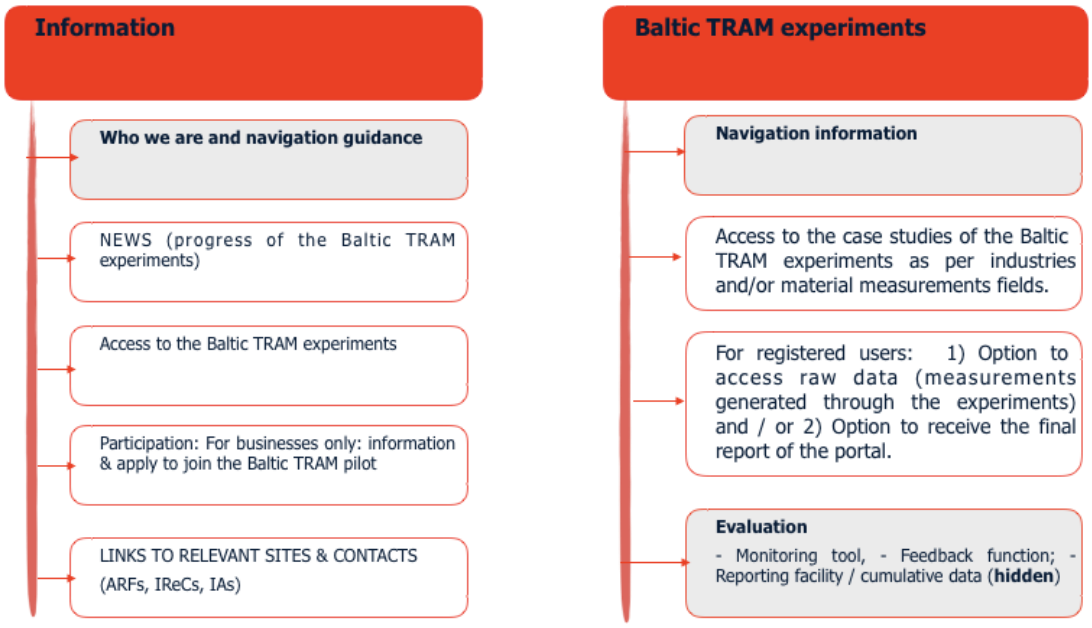


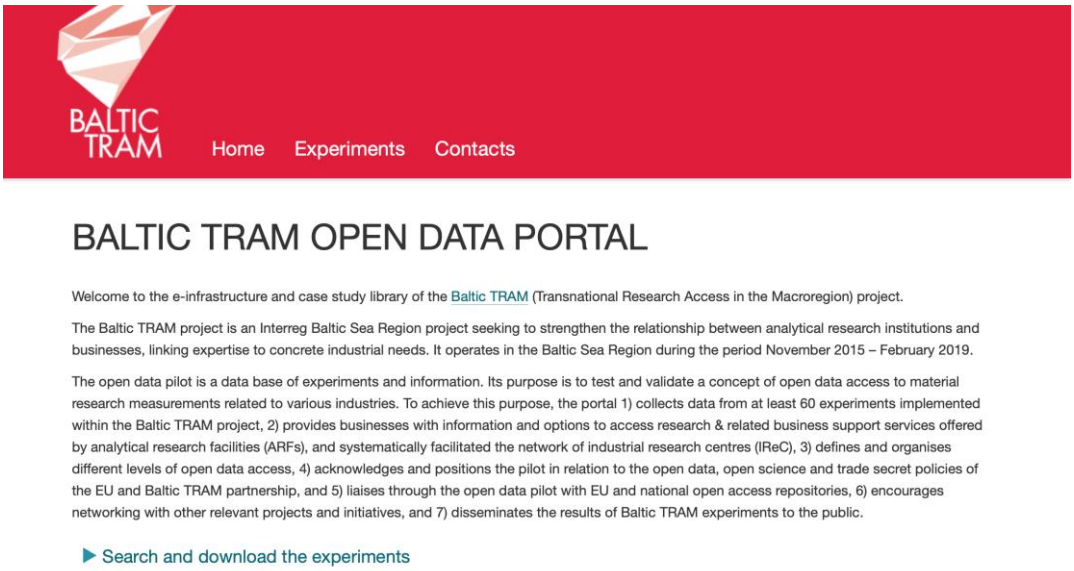
Figure 13 *The initially proposed and accepted open data portal concept*

The Open Data Portal was opened to the public on 12th September at the Baltic TRAM partners' meeting in Riga (11-12.09.2018).

During September and October 2018, the Case study format went through some further iterations. Inputs for 'NACE-codes' and 'Material research area' – metadata fields for each case study were updated to make them more uniform and more useful. A new metadata field 'Problem addressed' was also added to the scheme to enable the site users to use problem-based filtering in the search function.

To make these kinds of ongoing changes and improvements to the metadata scheme and the content of the case studies possible, the case studies were at this point uploaded directly to the portal and not to the B2SHARE. This has been a provisional solution, as it allows flexibility to correct mistakes since, once the case studies

are uploaded to the B2SHARE and from there harvested to the portal this kind of iteration is no longer feasible. This approach proved. Very useful as many iterations were inevitably required. In any case, this differentiation from the original plan is more of a technical and workflow issue since from the point of the user of the portal it makes no visible difference.



Access to the open data portal at https://opendataportal.utu.fi/experiments

2nd Review of the open data portal pilot (version 28.2.2019)

The functionality of the Experiments section in the open data portal was finalised during the period December 2018 – January 2019.

In December the user registration process was overhauled to make it more automated and streamlined from both user's and administrator's perspective. Search form for the case studies was also re-organized and made cleaner.

Several user experience enhancements were carried out based on the valuable insights we got from the user testing. Some test users reported that they did not find any raw data although they were registered and logged in. Data were uploaded, modified, tested (PP3 UTU and PP4 KE)[5] and corrected. A number of bilateral review sessions were organised online involving PP3 UTU and PP4 KE.

During December 2018 – January 2019, the portal was tested for technical and re-use interest. This has been a preliminary testing, organised between the two BT partners, PP3 UTU and PP4 KE. A basic questionnaire was delivered to 10 members (5+5) of the two organisations' regional networks, with the request for anonymous feedback. Table 4 below summarises the internal testing.

[5] Reference to the testing and the results are discussed in the section *Case studies analysis and findings*.

Table 1 *Summary of the internal testing of the open data portal*

Questions	Feedback	
Do you find the portal easy to "read" and access the different types of functions?	Yes	All 10 cases
Have you been able to easily access the case studies?	Yes	All 10 cases
Number of cases reviewed	1- 10	Most testing was done with 5 cases
Did you try to access raw data? did you register?	Yes	There appeared certain technical issues for early testers.
Has the information describing the experiment been sufficient, clear, useful?	Yes	In all cases, except one, where the tester did not read in depth, as the focus was on technical issues for this person.
Comments / recommendations **Search function**: NACE works well (all users); problem definition should be improved (5 users); materials science fields does not wok (since the case study contributors did not follow strictly the indicated classification) (4 users) **Usefulness of information**: The most useful information was the problem or target of the experiment, which methods were used and what was achieved; internal information (BT processes) was not so useful. **Privacy policy**: It was missing and needed to be added (comments to this effect were made in two cases). **Registration issues for raw data access**: for the very early users, there were some technical issues.		

Thanks to this internal testing, remaining technical issues were addressed[6]. However, in regard to other issues, such as the problem definition, there was time to acknowledge but not to address them. This is unfortunate as improvement of the problem definition, clearly, will increase the attractiveness of the portal to users.

The case studies were also linked to the relevant WP3 outputs, in terms of 1) the utilisation of classification database[7] and 2) the open data portal. As a result, a 'Raw data available' -indicator was added to the search results view to those cases which already have raw data available. This improvement made even more apparent for user to see whether they are logged in and what that means in each content (e.g. when viewing single case study page, inform visitors that to access beneficiary info and/or raw data they need to register/login).

[6] Kainuun Etu, BT PP4, thanks each and every one of the persons who tested the portal and provided their very valuable feedback.

[7] See Baltic TRAM Briefing Note 1/2019 "Baltic TRAM Smart Specialisation Trends", which is available on the Baltic TRAM web site, https://www.baltic-tram.eu/newsroom/press_releases/baltic_tram_science_for_business_in_the_baltic_sea_region/index_eng.html).

The external demand for access to material research services was also tested, validated, and the related functionality was updated.

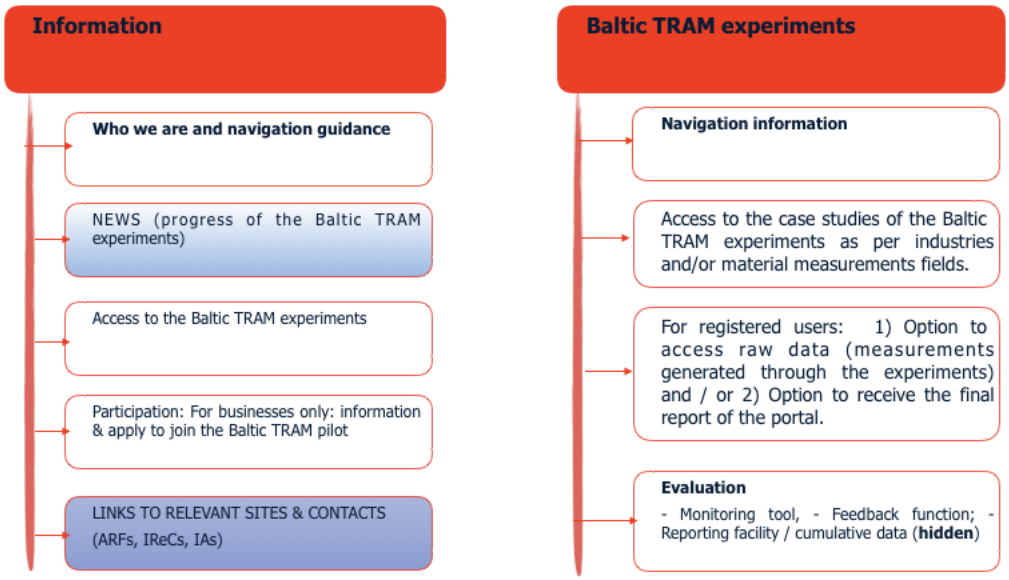
During this period, new cases and raw data documents were added to the portal as they were completed or updated.

API for the B2SHARE-harvester has been built into the portal and content type for the experiments is created according to B2SHARE data scheme so that the connection is ready to be utilized when feasible.

An important functionality of the portal was establishing more visible links to the IReC Net as a marketing and operational tool of the latter. This option was anticipated already during the planning of the portal through the "links to the relevant sites and contacts" functionality. Needs for partner inputs to the portal (news and contacts) were also discussed and missing information was requested in various occasions by PP3 UTU, PP4 KE and PP11 IIF.

Figure 14 below reiterates Figure 13 and summarises the progress towards complete implementation of the portal. White boxes indicate that the related function is completed, light grey boxes (NEWS) indicate completed functionality but operational level requiring reinforcement, and deep grey boxes (CONTACTS) indicate completed functionality but missing inputs, i.e. operational level requiring considerable reinforcement.

Figure 14 *Progress of the open data pilot, state of play 28.2.2019*



Further processing among the partners that contributed case studies and/or were involved in the evaluation committee of the experiments; indicate that the portal

could also be a full support to the operation of the IReCNet and a host a permanent competent evaluation team. This finding is discussed more in part *4.6 Summary of findings in the Open Data Pilot / Implications for the open data portal and an evolved concept.*

Access to the open data portal is at: https://opendataportal.utu.fi and to all the case studies at: https://opendataportal.utu.fi/experiments.

3.2.2 Analysis of and insights from the case studies

The case studies are described according to a jointly agreed template by the Baltic TRAM partners. This template evolved with additional information requests by the partners even as late as October – November 2018. It implies that all the case studies were continuously reviewed and updated to reflect the most recent evolutions of the description template.

At the time of the first review, as the open data portal had not been in use yet, *the demand and impact sections* included in Table 2 below, (iterating Table 3 of the programme document, page 34) could not be discussed, while the supply side inputs have been reviewed on the base of the 17 case studies contributed.

Table 2 *Monitoring and evaluation parameters of the open data pilot*

Monitoring parameters	
Supply of data	1) Total number of experiments carried out (60 experiments were initially planned)
	2) Distribution of experiments by NACE and industry fields
	3) Distribution of experiments by material research area
	4) Distribution of experiments by Member State
	5) Distribution of experiments by IReC
	6) Distribution of experiments by ARF
Demand for data	7) Number of total hits on the portal
	8) Number of case studies downloaded
	9) Frequency of NACE -related case study downloads
	10) Frequency of material science fields-related case study downloads
	11) Number of registered users to access measurement services
	12) Range and frequency of registered users requesting access to measurement services for product development
	13) Location of registered users requesting access to measurement services
	14) Number of registered users to access raw data
	15) Institutional profile, range and frequency of motivations of registered users requiring access to raw data
	16) Frequency and range of open data requested
	17) Number of downloads of the final report
	18) Frequency and range of registered end user profiles requesting access to raw data and / or the final report

Monitoring parameters	
Impact	19) Impact on the business community: *This information is generated also through the IReC and SMEs surveys, and three more questions are added: 1) Did you allow access to the measurements in the open data pilot? 2) Were there follow-up actions? Were you helped further to invest in the findings of the measurements?*

Seventeen (17) case studies is a very small sample space, but some insights have been possible:

(1) Open access issues: in principle there does not appear to be a challenge, as ARFs have not effused to share data generated in each one of the experiments and as most businesses appear willing to share "their" raw data: only in 2/17 cases data access has been restricted.

(2) Technology level of case-studies businesses[8]: most demand came from medium high and medium low tach businesses; only two (2) businesses are high tech.

(3) Average cost per experiment (consultancy fees & VAT are not included), known for the 17 case studies: 1946.70 EUR. However, prices vary considerably from 400 EUR to even 4000 EUR.

(4) Impacts on science and industry: impacts on science do not appear to be significant (i.e. the measurements requested maybe do not motivate towards new research), while impacts on industry appear to be more important since new product development is indicated in most of the cases.

(5) Importance of intermediaries: demand by businesses has been more IReC- than business- driven. One interesting approach to be replicated is the involvement of national level business support services and portals (Estonia).

(6) Location:

- Co-location of SMEs, ARFs and IReCs: mostly at national level, i.e. the national innovation system approach appears to dominate.
- Transnational solution for delivering services: some 20% of the experiments include transnational exchanges.
- Potential for interregional clustering: 4 /17 cases, all of them Finland / Estonia (C23.99 x2, C23.49x2 Construction materials).

(7) Potential for data re-use: the assumption for scientific demand for data re-use, has not been confirmed mostly because the industrial problems solved have not been scientifically sufficiently significant to lead to further research. On the other hand, the demand appears to be coming more from businesses and business intermediaries for the learning potential and for access to services,

[8] Eurostat indicators on High-tech industry and Knowledge – intensive services, Annex 3 – High-tech aggregation by NACE Rev.2. https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf

towards getting in touch with ARFs. The essential linkages between the open data portal and the IReCNet were confirmed during discussions with the WP4 coordinator (PP3 UTU). Linkages between the open data portal and the IReCNet were also brought up in the discussion during the 3rd HLG.

By referring to the Tables 3, 4, and 5, below, allows to draw some useful conclusions:

(1) Table 3 Demand for measurements: demand came for the most part from the secondary sector (manufacturing), approximately 84% (27/32) while 18% (6/32) of the demand came from service businesses. Most of the demand (20/32 about 63%) came from medium and lower technology level businesses, while 10/32 cases are high tech or knowledge intensive services. Most of the demand was focused on product development (new or existing) and only few of the cases on satisfaction of compliance requirements.

It follows that while measurement research and technology are high tech, demand for applications is shared across all types of industries. Therefore, there is considerable demand to be identified in the future.

(2) Table 3 policy alignment: Item (1) insights are seconded by the findings on policy alignment, indicating that out of the 32 cases, only 7 are not aligned to RIS3 strategies, i.e. about 22%, while 78% have RIS3 relevance. It follows that the intensification of the RIS3 implementation, foreseen for the next period of the Structural funds, will imply considerable demand for measurements.

(3) Table 4 location: IReCs and ARFs reveal, first of all, the predominance of the national innovation system as relevant reference, more than the regional or transnational level; about 50% of the cases make use of national level resources, 10 cases are regionally bound, and 7 cases have sought the services of transnationally located ARFs. This finding indicates considerable potential for transnational cooperation, however the types of demand and location of services

(4) Problem (-s) solved (i.e. the reason why a business needed measurement services)[9]: Most of the demand was focused on product development and product improvement, with only a few of the cases on satisfaction of compliance requirements. In one case, there was research into methodological issues ('which method would be better for improving product X'). Problems were, overall, more of industrial than research nature. It implies that the open data portal as a data re-use source for scientists does not appear to be very high.

[9] More detailed information per case-study can be found at https://opendataportal.utu.fi/experiments and, alternatively, in the *Case studies corpus EXPERIMENTS* addendum to the 5.3 document report

(5) Access to raw data[10]: The term "raw data" here refers to the original measurements done by the research institutes for each experiment. In general, research institutes have been hesitant to share the original measurements, while only four (4) out of the thirty-two (32) businesses refused access to measurement data or tracing of their identity. Therefore, we have noticed a hesitation to share data both from businesses and research institutes. As a first step towards deeper understanding, we have tried to correlate data-access business attitudes with (a) the technology level of a business and (b) the beam price (Table 5).

Results indicate, even with such a small sample, that open access probability appears to be linked to the technology level of a business and to the (higher) cost of measurements: as all of the four businesses that refused data access are classified as high tech or medium high tech, it might be reasonable to propose to research in the future the correlation between the technology classification of a business with its willingness to share measurements. In conclusion, open access is not yet a demonstrable result at least in the context of the Baltic TRAM 32 experiments' case studies.

Table 3 *Overview of the profiles of the contributed case studies*

Country	Case studies	NACE "/(...)" = number of cases	Technology level	Policy alignment =RIS3 and/or KET
DE	1	C27.20	Medium-high tech	RIS3 and KET
EE	10	C23.99 /(2) M72.19 C22.21 C32.99 C10.7.3 D35.30 C20.30 /(2) G47.91	Medium -low technology High-tech knowledge-intensive services Medium -low technology Low technology Low technology Medium high technology Less knowledge- intensive services (LKIS)	RIS3 at different levels of connection for C23.99 to C20.30 No
FI	14	C23.49 /(2) C21.20 C32.30 C10.30 /(3) F43.39 B8.1 A01.13 M71.20 C22.29 C25.61 M72.1	Medium -low technology High tech Low tech Low tech Medium-low tech Low tech High-tech knowledge-intensive services Medium-low tech Medium-low tech High-tech knowledge-intensive services	No RIS3 No No RIS3 RIS3 RIS3 RIS3 No No No
LT	4	C26.40 /(2) C21.20 M72	High tech High tech High-tech knowledge-intensive services	RIS3 all

[10] Ibid., above.

Country	Case studies	NACE "/(...)" = number of cases	Technology level	Policy alignment =RIS3 and/or KET
PL	3	M72.19 /(2) C28.93	High-tech knowledge-intensive services Medium high-tech	RIS3 all

Note: NACE codes industrial activity explanations are here[11]

Table 4 *Overview of the contributed case studies locational aspects*

Country	Number of case studies	Location of operations including transnational aspects
DE	1	All operations took place in the same region; no transnational aspects
EE	10	Out of the 10 cases, 8 were nationally based; for the remaining 2, 1 ARF was located in Germany, and 1 in Lithuania.
FI	14	Out of the 14 cases: 9 were regionally bound, for 2 cases the ARF was in Germany, for 1 case the ARF was in Estonia, 1 in Lithuania and 1 in Latvia.
LT	4	All 4 cases regionally and nationally- bound.
PL	3	All 3 cases nationally bound.

Table 5 *Overview of the contributed case studies beam prices (no VAT) & correlation to data access*

Price range	Number of cases	Raw data access	
		Yes	No
Up to 999€	13	12	1
1000-1999€	6	6	
2000-2999€	6	5	1
3000 -3999€	2	2	

[11] NACE codes and industries, EUROSTAT (2008). NACE Rev.2, Statistical classification of economic activities in the European Community, http://ec.europa.eu/eurostat .

A01.13	Growing of vegetables and melons, roots and tubers
B8.1	Quarrying of stone, sand and clay
C10.30	Processing and preserving of fruit and vegetables
C10.73	Manufacture of macaroni, noodles, couscous and similar farinaceous products
C20.30	Manufacture of paints, varnishes and similar coatings, printing ink and mastics.
C21.20	Manufacture of pharmaceutical preparations
C22.21	Manufacture of plastic plates, sheets, tubes and profiles
C22.29	Manufacture of other plastic products
C23.49	Manufacture of other ceramic products
C23.99	Thermal insulation products for construction
C25.61	Treatment and coating of metals
C26.40	Manufacture of consumer electronics
C27.20	Manufacture of batteries and accumulators
C28.93	Manufacture of machinery for food, beverage and tobacco processing
C32.30	Manufacturing of sporting goods
C32.99	Other manufacturing n.e.c.
D35.30	Steam and air conditioning supply
F43.39	Other building completion and finishing
G47.91	Retail sale via mail order houses or via internet. The company manufactures compost among other activities.
M72	Scientific research and development
M72.1	Research and experimental development on natural sciences and engineering.
M72.19	Other research and experimental development on natural sciences and engineering
M71.20	Technical testing and analysis

Price range	Number of cases	Raw data access	
		Yes	No
4000-4999€	3	2	1
5000-5999€	1		
6000 – 7999€	0		
8000€ and higher	1		1

3.3 Discussion of the findings from the Open Data Pilot and evolution of the concept

3.3.1 Generation of the open data access concept

In the Baltic TRAM approved application form, the expected outputs and achievements of Activity 5.3. are described as follows: "Output description: The output will consist of a concept for open data access addressed to companies of selected branches. The aim is to provide company information about Analytical Research Facilities offers for possible research activities in relation to the companies' basic research needs. The test infrastructure will contain data from the 60 pilot projects, describe the problem/research activity, the used methods and instruments, and the received results".

The preceding case studies analysis revealed that open access is not a given yet, neither for businesses nor for research units. However, the usefulness of the portal as a networking tool effectively supporting the IReC network and industrial applications of research, appears plausible. This option was explored further during January – February 2019; bilateral interviews were organised between the partners that contributed case studies and the WP 5.3 coordinator. The interview concept was organised into two parts, A. Questions relating to the evaluation committee function and B. Questions relating to the IReCs function. In practice however, during the discussions, there were inevitable overlaps between group A and B questions, as this helped to make cross-references between the two and gain further insights. Table 6 summarises the partners who were interviewed and dates of interviews[12].

Table 6 *Bilateral discussions on the concept of the open data portal*

Date	Baltic TRAM partner name and number	
16.1.2019	University of Tartu (as IReC)	PP 11
28.1.2019	University of Turku (the evaluation function)	PP 3
31.1.2019	Kainuun Etu (only the IReC staff)	PP 4

[12] Kainuun Etu thanks warmly all the partners listed in Table 8 who gave time to be interviewed and comment on the interviews.

Date	Baltic TRAM partner name and number	
4.2.2019	Agency for Science, Innovation and Technology (as IReC, but the discussion included also references to evaluation aspects)	PP 15
5.2.2019	Foundation of Innovative initiatives (for IReC & evaluation functions)	PP 11

A. Questions relating to the evaluation committee function

1.- Experience from the evaluation committee? Would it be a necessity in the future?

2.- What have been the most important difficulties/insights/interesting/stuff in assessing cases in the Evaluation Committee?

B. Questions relating to the IReCs function

1.- What have been the most useful and & or promising cases and why? What have been the most important difficulties?

2.- The value of the transnational connections (i.e. services from abroad) and would that be possible to maintain after the project.

3.- Is there available sufficient demand for measurement services in the first place

4.- Are there available funding channels for that purpose (of providing measurements)?

5.- Is the demand explicit and / or realised, i.e. that a more systematic application of regional policies could contribute creating a steady flow of demand? How important is the national level (national innovation system?

6.- In the case of the open data portal, the bottom line is that there would be needed more time and resources to develop the operational side (not so much the technological level). However, we also see that the open access issue is not working, i.e. we do not have the raw data in most cases and the refusal comes from the institutions that performed the measurements. During the project we saw the open access issue evolve at policy level (especially at EU level), but the real benefit for any researcher to allow access to data openly is not yet identified. Would you have something to comment on the issue?

3.3.2 Findings

The text below is a summary synthesis of all the answers provided during the bilateral interviews.

1.- The Evaluation Committee was important because of the multi sided expertise it provided. It would be necessary in the future and more types of scientists could be involved, such as geologists, chemists, biologists, and so on. Experience from

the Baltic TRAM indicates that it is important to define and describe from the beginning, the competences, processes, evaluation channels, and time-targets for the evaluation process, so as to reduce delays as much as possible. The bottom line is that the evaluation committee is an essential part in the process, but certain aspects, such as tools of interaction and objective qualifications should be revised and made clearer and more comprehensive.

2.- The most important experiments have been those that are linked to market access (new product development) as well as those where the product and/or business managers have knowledge of the importance of materials science and measurements applications. The reason is the expertise absorptiveness of the SME. For example, one of the most interesting cases involved a business in which the entrepreneurs were scientists in earlier life, so they knew what to expect and what to ask, and how to appreciate measurements.

The biggest challenges came from the type of business and the type of measurements requested:

a) businesses with 'experience in research and/or with own R&D department, these cases were more open and benefitted most;

b) businesses without R&D experience were the most difficult to benefit from measurements. *Another source of challenges* is access to multi-disciplinary expertise resources (science, industry, multi sided), on demand. Multi-disciplinary expertise is needed by IReCs during the definition phase of the problem and following the generation of measurements, to support their interpretation and the action recommendations to businesses. On the other hand, *ARFs have also a role to play*: by making sure that they make accessible (=understandable) to businesses, the constantly updated research results, so that there is a constant access to information leading to business-based demand.

Real problem in a nutshell: Linking measurements to actual product issues. Analytical expertise and industry expertise need to be present from the very beginning in order to shape the discussion with businesses. There need to be inputs from materials science as well as from sciences and interdisciplinary competences should be available as a matter of principle, to make the offers from ARFs cognitively accessible to businesses in the first place. Trust is also very important.

3.- Importance of consultation services The consulting process, consisting of various steps: 1) attracting the offer (implies specialisation for different types of industries); 2) signing the NDA and cooperation agreements with the businesses (bureaucracy a challenge); 3) supporting the businesses to fill in the application for measurements; 4) checking out the measurement process; 5) participating in the measurements repots preparations; 6) participating in the interpretations of measurements and guidance to businesses; 7) preparing case studies, case registries, survey reports and evaluation reports.

4.- *Market demand or revealed demand? National innovation networks? Funding tools? Are transnational services important?* Bottom up, business-to-research solutions

should be supported, i.e. the scaling up of businesses and the increase of their absorptive capacity are important. The explicit demand can be reinforced by reinforcing the cognitive proximities between science & industry. There is also a latent, a revealed demand, that can be identified through pro-active regional policies, for example KET applications in advanced materials, which is part of the RIS3 provisions.

For accessing demand for measurement services, national networks and connections are important. Funding tools, as well exist at national level. Transnational exchanges are possible but need to be explored better to become consolidated. At the moment there do not appear to exist sufficient funding tools at transnational level.

5.- Open data portal, focus and constraints Access to raw data seems to pose challenges for research units; re-use of data might be of interest to industrial actors and intermediaries more than to scientific actors.

3.3.3 Implications for the open data portal and an evolved concept

The main conclusion is that the portal would be more useful as an industrial networking tool. The participatory function would need to be strengthened, linkages to relevant scientific portals should be included, and the portal should evolve as a core operational tool of the IReC network. Improvements could include more functionalities, for example:

(1) The core competence and raison-d'être of the portal would be linking measurements to actual product issues. Analytical expertise and industry would be present from the very beginning, facilitating the relevance of the portal to businesses. There would be inputs from materials science as well as from sciences and interdisciplinary competences should be available as a matter of principle, to make the offers from ARFs cognitively accessible to businesses.

(2) Marketing tool of the IReCNet.

(3) Information, learning & teaching channel, linking businesses to materials science excellence and the IReC options.

(4) Standardisation of the services offered by the IReCs ((i) attracting the offer (implies specialisation for different types of industries); (ii) signing the NDA and cooperation agreements with the businesses (bureaucracy a challenge); (iii) supporting the businesses to fill in the application for measurements; (iv) checking out the measurement process; (v) participating in the measurements repots preparations; (vi) participating in the interpretations of measurements and guidance to businesses; (vii) preparing case studies, case registries, survey reports and evaluation report).

(5) Hub for accessing multi-disciplinary expertise.

(6) The updated portal should have a well-defined strategy for attracting demand under the revised considerations.

(7) The framework of the feasibility of the evolved portal would require institutionalisation by the members or the establishment of an independent entity most probably.

The evolved portal concept is shown in Figure 15 below.

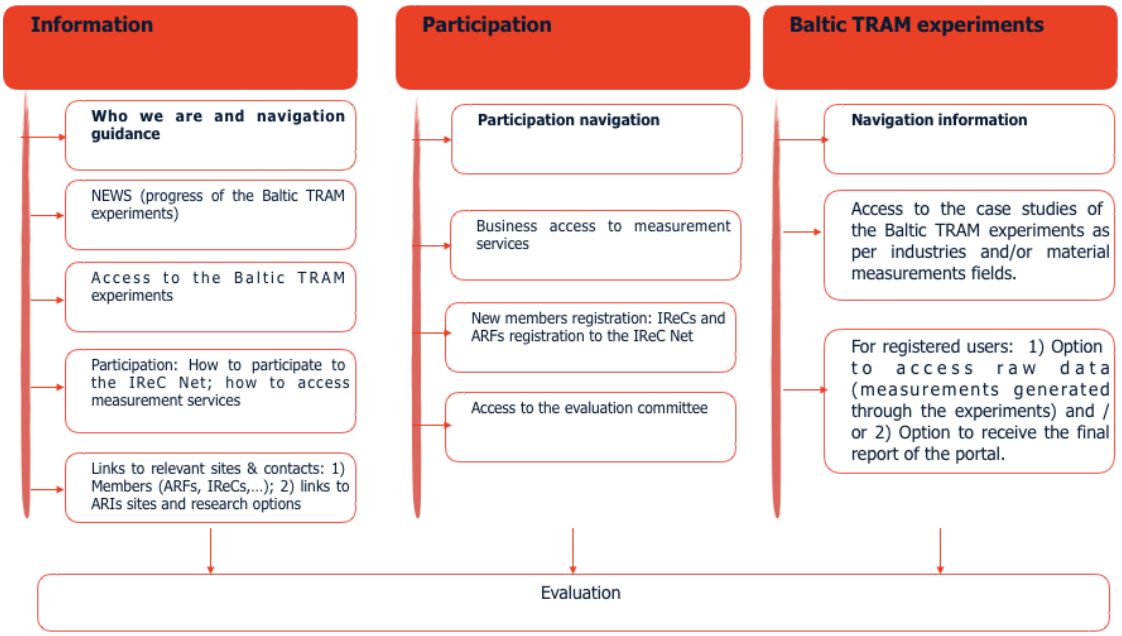


Figure 14 *Evolved concept and suggestion for the open data portal*

The portal, at the present stage, is technically complete and has a multi-sided potential to become a sustainable useful tool once time & resources are invested into the exploration of its options. To address all of the above issues, there would be needed some 6-8 additional months and it would require the involvement of all the Baltic TRAM partners and beyond. As this is hard to achieve within the time-limits of the Baltic TRAM project, maybe a follow up project could dedicate resources to this effort.

4. O4.3 Industrial User Experience Review / Customer feedback in terms of reported impact on the businesses

The Baltic TRAM project aims to support and encourage innovation and entrepreneurship in the Baltic Sea Region (BSR) especially in the context of Smart Specialization. The main objective of the project has been to improve the interaction between the companies and the analytical research facilities and to match and develop a transnational complementary service structure to support research, development and innovation activities in the region.

In order to test the developed transnational service offering and coordination model in the region, the Baltic TRAM partners conducted a customer feedback surveys

among the served companies. Survey was conducted in three stages with all customer companies: the first survey was sent to the company once they submitted their application, the second survey (first follow-up) was send after three months to all those companies who received some consultation and measurement services from the Network of IReCs and finally the third survey (second follow-up) was sent after six months after the collaboration started to all companies that received the IReC services.[2]

By the end of January 2019 altogether 42 out of 68 companies responded to the initial customer feedback survey resulting to a response rate of 62 % that can be considered to be relatively good in company survey like this. However, the success with the follow-up surveys was not so good. Only 14 companies (21 %) responded to the first follow-up survey and only 9 (13 %) to the second and final follow-up survey.

4.1 Market and need for services

During the implementation of the Baltic TRAM project open calls altogether 68 companies were selected to receive scientific consultation and measurement services to support the research-, development and innovation in the companies. More information about the companies (size, field of industry, country of operation etc. please see section x in this report). Out of all 68 served companies altogether 42, that is 61,76% of the customer companies responded to the structured customer satisfaction survey. Despite the serious efforts by the work package leaders and operational industrial liaison officers in the Industrial Research Centres across the Baltic Sea Region, the response rate remained relatively low even though the rate can by some measures be considered feasible for a company survey in general.

In terms of the most common sources of information on the IReC services during the project the companies had a tendency to be engaged first with colleagues and personal contacts and get relevant information on the services directly from them. The second most common source of information was innovation agencies or relevant development organisations, which are considered as important regional development organisations. Industrial Research Centre and other contact points focusing on and understanding the needs of SMEs and micro enterprises in facilitating regional and trans regional scientific cooperation and operating in distributed networks formed by regional development organisations, universities and stakeholders to enhance positive regional development.[3]

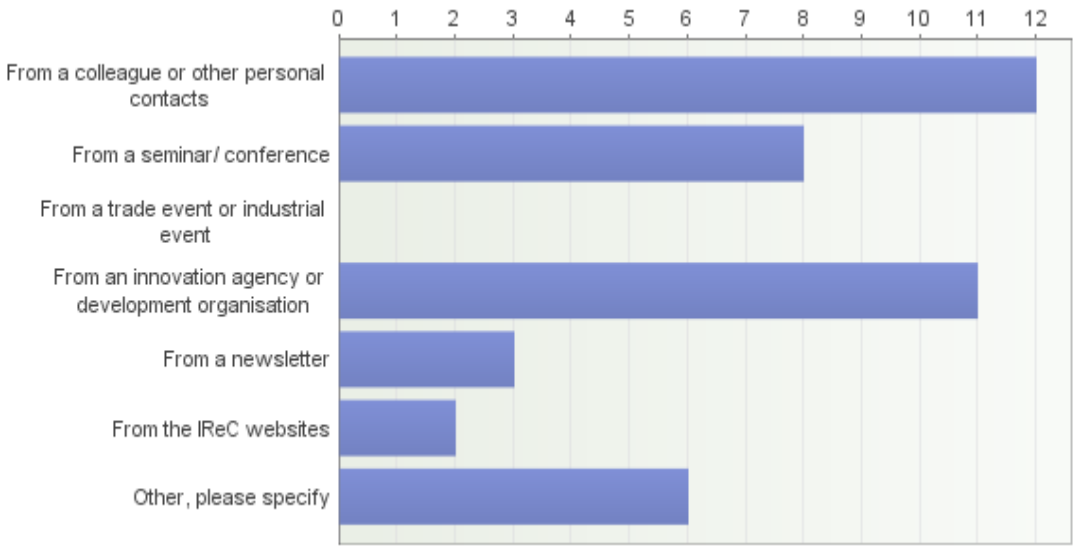


Figure 15 *Sources of information on the IReC services (n= 42)*

In their outreach activities the most effective IReCs (in terms of number of businesses consulted resulting to business case application) were Finland, Poland and Estonia (see Figure 17 below for more details). The local IReCs in these countries reported of following a very systematic and focused outreach and marketing strategy instead of very general approach towards different industrial fields and companies in general. Attending business fairs or trade events was not found beneficial by the IReCs in contacting potential customer companies and getting the first contact to start discussing potential addressed challenges with the right persons[13]. This result indicates that selecting your target markets more carefully and putting the marketing efforts into dedicated well targeted marketing activities are the most beneficial way of reaching out to right kind of research oriented group of companies who can get added value by even short term measurement and analysis services.

[13] Marketing strategy survey performed by the WPL4 (UTU) during the second call for companies covering the activities of the IReCs during the first and second call.

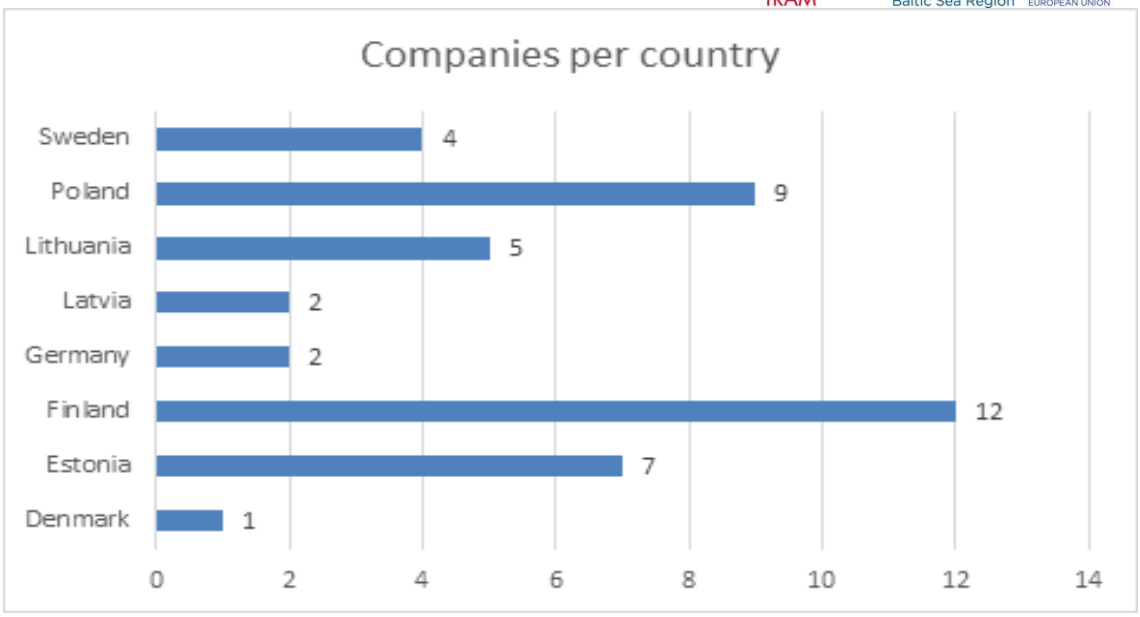


Figure 16 *Country origin of the companies responding to the first customer survey*

In terms of collecting the initial customer feedback from the industrial companies, the best performing IReCs were these same countries. The Estonian IReC demonstrated the best capacity in acquiring adequate customer feedback from its customers by reaching 85 % response rate. Polish IReC collected 64% and two Finnish IReCs together 67 % of their customer's feedback. In terms of collecting the follow-up data, the most effective IReCs were University of Tartu (EE), University of Turku (FI) and Deutsches Elektronen-Synchrotron.

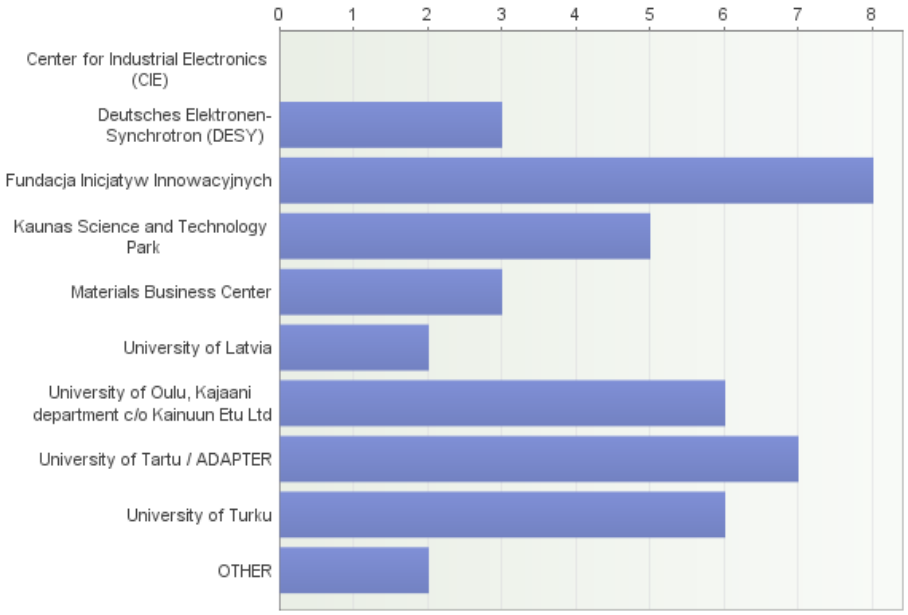


Figure 17 *The first contact IReCs (The lead IReC) for the companies responding to the survey*

In terms of research field selected to solve the analytical research challenge the variation among the cases was very wide. Two of the most common research fields to solve the selected group of company cases was analytical chemistry (n= 6), composite materials (n=5), chemical solid state and surface research (n=4) and biological chemistry and food chemistry (n= 4). For more information on the cases per industrial sector, geographical location etc. please refer to Figure 5 on page 12 in this report.

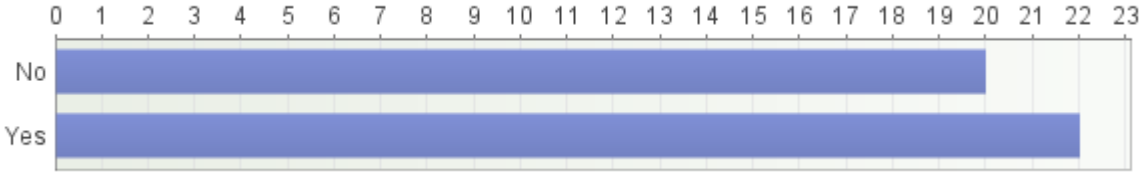


Figure 18 *Companies' prior experiences on using research services (n=42)*

Typically, companies have utilized university laboratories and research services (n= 25) or other public research organisation's services (n=14). In addition, 15 companies reported of using commercial laboratories before in their research and development work. 23,8 percent of the respondents reported not have used research services before at all. Reasons for not using research services in the RDI work varied but most commonly the companies reported that research facilities are often too orientated towards pure science (n=3), concerned about intellectual property rights and confidentiality (n= 4), research facilities often follow rules and regulations that do not fit well with us (n=3) and that their own research department usually serves us well enough (n=4). No need for such services before, either a newly established company or new branch of business activity where the TLR only recently high enough (N=8). Furthermore, accessibility of the equipment was mentioned in a couple of answers. It is interesting that a majority, 59, 5 percent (n=25), of the companies that were served by the IReCNet during the Baltic TRAM project, has their own research unit or division. Despite having in-house research services available the companies found the IReCNet service offering interesting and appealing enough so that they applied for measurement and analysis services offered by the transnational network to support their in-house RDI-work. Nearly as many of the respondents (n= 23) reported that their company had followed a research and development strategy in their operation (n= 23) which can be considered as a good sign of the companies' motivation and need to build longer standing research collaboration with research facilities instead of utilizing simple measurement services once.

A clear majority of the companies receiving IReC consultation and research services during the Baltic TRAM open calls for companies were micro or small companies both in terms of staff headcount and turnover which are the main determining factors.[4]

Categorized according to the staff headcount altogether 75 % (n=31) of the companies were categorized in the micro company category. In terms of annual turnover the figure was even bigger, 95 % (n= 40) of the companies fulfilling the criteria for being categorized as a micro company. Several of the served companies were start-up companies in their early operational years. Altogether 60 % (n= 25) were established after 2010 out of which every fifth in 2017 or after. Around 24 % (n= 10) of the served companies can be said to be mature companies being operational already before year 2000.

Table 7 *The companies per category in the Baltic TRAM Open calls*

Company category	Staff headcount	Turnover	Number of companies by personnel
Medium-sized	< 250	≤ € 50 m	4
Small	< 50	≤ € 10 m	7
Micro	< 10	≤ € 2 m	31

4.2 Cooperation between the Analytical Research Infrastructures and customers

In terms of companies' intentions on further collaboration with the research institutions, especially with the IReCs we aimed to observe differences between the two measurements, in the very beginning of the collaboration and after the companies had really received some results from the project, when we would be able to argue that there has been a change in their intention level and that this is expected to result in further "collaborations" between industry and research centres. In order to be able to evaluate possible changes in the intention levels of the companies a set of dedicated questions were drafted to the purpose. A clear majority of the customer companies saw clear advantages in collaboration with a research facility. In a scale from 1 (strongly disagree) to 5 (strongly agree), 50 percent of the respondents reported that they perceive research collaboration positively, see strong advantages in their collaboration with a research facility and furthermore consider strongly in continuing their collaboration with a research facility in the near future as well (38%). While reporting their actual plans in collaborating with analytical research facility in the near future one-fourth (26 %) very strongly and furthermore another 25 % strongly agreed on doing so.

In the first follow-up survey the overall intention on continuing collaboration with analytical research facilities was even higher than in the starting point. All of the measured indicators showed in average 6 % increase between the two first measurements. Even though the number of respondents was relatively much smaller

(n= 12) than in the first survey the result indicates that the industrial customers were satisfied with the services they received from the IReCs. In the second follow-up survey the response rate was only 13% which does not give a reliable basis for any extensive analysis. One can, however, say that the overall satisfaction with the IReCs continued to be good and intentions of continuing the research collaboration with analytical research institutions remained at good level. All of the companies in the second follow-up survey considered developing a collaboration with research facilities as an attractive option for them to enhance their research-, development and innovation activities.

Table 8 *Level of agreement with the statements concerning the company's intention to continue the collaboration with research facilities. Number of respondents (first survey/ first follow-up/ second follow-up)*

(n= first survey 42/ first follow-up 14/ second follow-up 9), 1= strongly disagree, 5= strongly agree						
	1	2	3	4	5	AVG
Developing collaboration with research facilities in an active option for me	0/0/0	3/0/0	3/1/0	17/5/ 3	19/8/ 6	4,24/ 4,5/ 4,67
I see advantages in engaging in collaboration with a research facility	0/0/0	1/0/1	3/0/0	17/5/ 3	21/9/ 5	4,38/ 4,64/ 4,33
In my organisation there is a positive perception towards collaborating with analytical research facilities	0/0/0	1/0/1	7/1/0	14/4/ 3	20/9/ 5	4,26/ 4,57/ 4,56
I am determined to start a new collaboration with an analytical research facility in the near future	0/0/0	4/1/2	11/3/2	11/3/ 1	16/7/ 4	3,93/ 4,14/ 3,78
I know the necessary details to start collaboration with a research facility	0/0/0	2/0/2	14/2/1	17/6/ 2	9/ 6/ 4	3,79/ 4,29/ 3,89

(n= first survey 42/ first follow-up 14/ second follow-up 9), 1= strongly disagree, 5= strongly agree						
	1	2	3	4	5	AVG
If I start collaboration with a research facility, I expect to have a high probability of success	0/0/0	1/0/0	11/2/3	18/7/ 3	12/5/ 3	3,98/ 4,21/ 4,00
In the short term I plan to collaborate with analytical research facilities	1/0/1	6/2/2	12/5/2	12/6/ 2	11/2/ 2	4,03/ 4,29/ 4,06

All of the companies responding to the two follow-up surveys would recommend the IReC research services to colleagues and other companies. Main reasons for recommending the services to others were an easy and fast access to high-level scientific expertise and knowledgeable personnel in the IReCs, effectiveness of activities and usefulness of the conducted measurements and final research results in the company's research-, development and innovation work. Finally, the industrial customers saw a real value of the transnational pool of analytical facilities that were accessible via the IReCNet. In the first follow-up 50 % of the respondents evaluated that they are likely or extremely likely to use services again in a short term. During the second follow-up, approximately six months after the initial contract with the IReCNet, the industrial companies were as much likely to utilise the services again already in the short term.

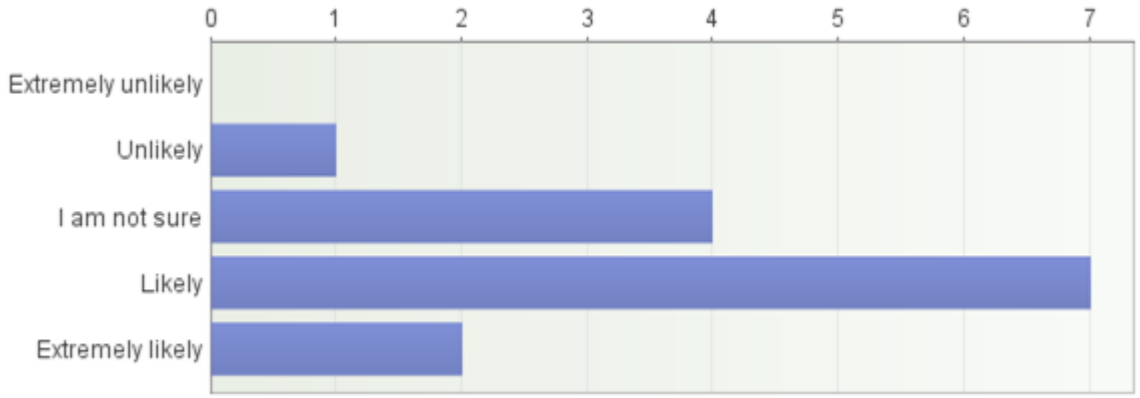


Figure 19 *Customer companies' probability of using IReC services again within 1-2 years (n=14)*

As presented earlier in this report in Figure 2 (see section pilot activity impact) almost three out of four business cases (70%) been sent during Baltic TRAM open calls was served by the local Industrial Research Centers (IReC) and affiliated local analytical facilities. The remaining 30% of the business cases were handled by shared services where the business case was solved in transnational cooperation. These transnational cases provided companies access to a broader transnational pool of complementary laboratory and research infrastructures and enabled the knowledge transfer within the IReCNet.

4.3 Customer feedback on different service aspects / "Service Design Experiences"

In the course of the Baltic TRAM project the service process was defined in a detailed way including all of the needed steps and stages. The service path description includes also all the needed agreements and formal documents to support successful collaboration between the IReCs, ARFs and the beneficiary companies and to protect the intellectual property rights of the parties. The IReC research service process is described in detail in Figure 21 below.

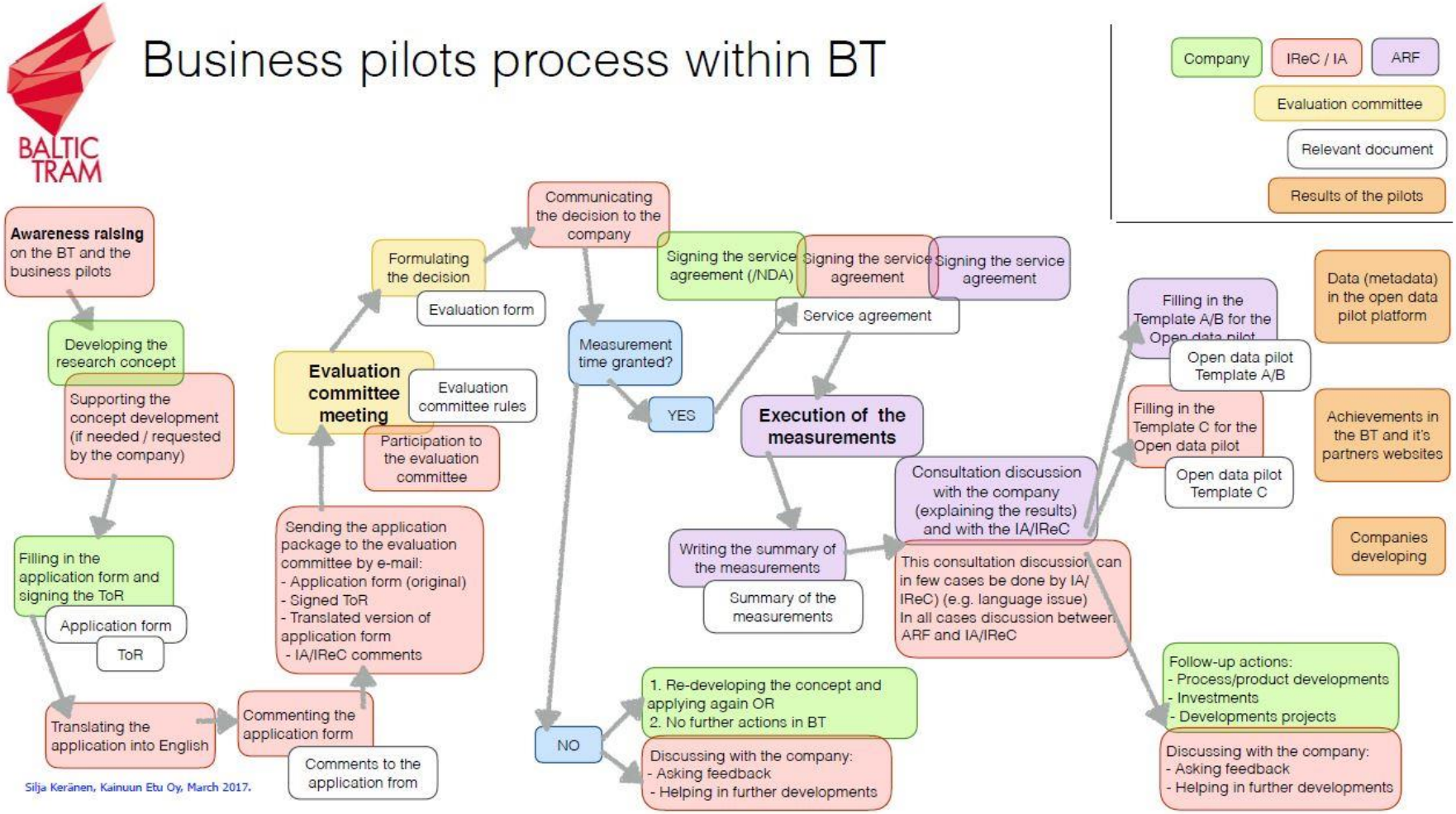


Figure 20 *The general research service process of the IReCs and the needed agreements and documents (Keränen, Silja, Kainuun Etu Ltd 2017.)*

When the customer companies were asked to rate the whole IReC service process according to their experiences, the average rate was 8,5 (on a scale from 1= very poor to 10= excellent), which can be considered to be a very good starting point for developing a whole new service offering for the companies. Approximately 50 % of the respondents rated the services being very good (n= 8) or excellent (n= 12), furthermore 38 % evaluated the services to be good (n= 16).

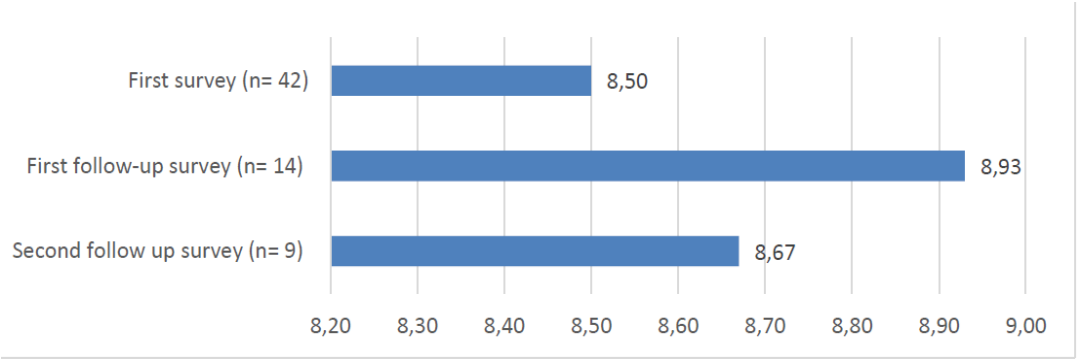


Figure 21 *The IReC Service process rating in all three company surveys on average*

In terms of evaluating different service aspects the most beneficial issues were according to the given customer feedback contacting the IReCs and finding up-to-date contact information and in more general terms the communication with the dedicated IReC personnel during the whole application and contracting time. In addition to the customer surveys the Baltic TRAM project also asked the IReC personnel (typically the Industrial Liaison Officers) to make a self-evaluation on their performance in the end of every open business call round. The IReCs were grading their own work relatively strictly only giving themselves grade 6,75 after the first call. The performance level measured by the IReC self-evaluation forms did not get higher either in the second or even in the third open call, the average rating for the IReC service process from the IReCs themselves was in later stages 6,78. The evaluation of the IReC service process did not have any clear correlation with the amount of successful business cases served but was merely dependent on highly subjective personal evaluation made by the ILOs. The most critical aspects for giving such a low grade for the service in general were reported to be too slow and bureaucratic process and the IReCs capability for not being able to do effective outreach towards the industries and hence not able to attract enough industrial customers.

In their self-evaluation, the IReCs were further asked to specify more reasons for their evaluation. The most common reasons why some of the IReCs were grading the IReC operations relatively poorly was that they considered the structured cooperation between the IReCs at transnational level was not mature enough in terms of productized complementary service offering and capabilities, expertise and

specialisation of the other IReCs in the network. Furthermore, cooperation and communication between the IReCs and between the IReC and the ARF, in cases where the measurements and analysis were done outside the first contact IReC, was often considered poorly organised leading to miscommunication and loosing track on the proceeding of the case within the IReCNet.

Table 9 *Level of agreement with the statements concerning different research service aspects in the IReC service process. Number of respondents (first survey/ first follow-up/ second follow-up)*

(n= first survey 42/ first follow-up 14/ second follow-up 9)	1= strongly disagree	2= disagree	3= neither agree or disagree	4= agree	5= strongly agree	
	1	2	3	4	5	Average
Printed and on-line material related to the services served my purposes well	1/0/0	2/1/0	11/2/2	16/2/5	12/9/2	3,86/4,36/4,00
It was easy to get information about the services before contacting the IReC	0/0/0	4/2/2	16/4/3	10/3/3	12/5/1	3,71/3,97/3,33
It was easy to find the contact information and to contact the IReC for the 1st time	0/0/0	3/1/2	7/3/1	14/5/5	18/5/1	4,12/4,00/3,56
Communication with the IReC during the preparation and application phase was timely and adequate	0/0/0	0/0/0	5/1/0	15/4/2	22/9/7	4,40/4,57/4,78
It was easy to complete the application	0/0/0	0/0/0	8/1/2	22/6/3	12/7/4	4,10/4,00/4,22
I did receive sufficient information about the fact that the organisers of the call would like to use some of the measurement data for educational and	0/0/0	2/0/1	10/1/1	16/3/2	14/10/5	4,00/4,64/4,22

(n= first survey 42/ first follow-up 14/ second follow-up 9)	1= strongly disagree	2= disagree	3= neither agree or disagree	4= agree	5= strongly agree	
	1	2	3	4	5	Average
publicity purposes						

The customers were further asked to explain their rating and grading with their own words. All except one customer would also recommend the IReC research services to a colleague or to another company as a beneficial collaboration model to enhance the Research Development and Innovation development work in a company to help you with a product development or process development related challenge. Also, the transnational complementary pool of analytical research measurements available was recognized as a clear benefit of the offered analytical services.

"The service provides fast and high-quality cooperation possibility." (Small Estonian Nanotechnology company)

"Expertise on related research fields were seen as a definitive bonus." (Small Finnish Construction company)

"Fast track, minimum paperwork, professional contact with expertise knowledge." (Medium-sized Polish Manufacturing company)

"Working with very helpful and dedicated people, who take an interest in one's problems and goals." (Swedish micro company in the field of Pharmaceuticals)

"Service was professional, and things were made easy for a small company." (Finnish micro sized company in the field of natural products)

The most appreciated aspect of the whole IReC service process was the timely and adequate communication between the company and the IReC during the whole collaboration. In the first survey 52 % (n= 22) of the respondents were highly satisfied and further 36 % satisfied with the communication. In the follow-up surveys, the percentages were even higher with 64 % of the respondents in the first follow-up and 78 % in the second follow-up being highly satisfied with their communication with the IReC.

Table 10 *Level of agreement with the statements concerning different research service aspects in the IReC service process. Number of respondents (first survey/ first follow-up/ second follow-up)*

(n= first survey 42/ first follow-up 14/ second follow-up 9)	1= strongly disagree	2= disagree	3= neither agree or disagree	4= agree	5= strongly agree	
	1	2	3	4	5	Average
Developing collaboration with research facilities is an attractive option for me	0/0/0	3/0/0	3/1/0	17/5/3	19/8/6	4,24/4,50/4,67
I see advantages in engaging in collaboration with a research facility	0/0/0	1/0/1	3/0/0	17/5/3	21/9/5	4,38/4,64/4,33
In my organisation there is a positive perception towards collaborating with analytical research facilities	0/0/0	1/0/1	7/1/0	14/4/3	20/9/5	4,26/4,57/4,56
I am determined to start a new collaboration with an analytical research facility in the near future	0/0/0	4/1/2	11/3/2	11/3/1	16/7/4	3,93/4,14/3,78
I know the necessary details to start collaboration with a research facility	0/0/0	2/0/2	14/2/1	17/6/2	9/6/4	3,79/4,29/3,89
If I start collaboration with a research facility, I expect to have a high probability of success	0/0/0	1/0/0	11/2/3	18/7/3	12/5/3	3,98/4,21/4,00
In the short term, I plan to collaborate with analytical research facilities	1/0/1	6/2/2	12/5/2	12/6/2	11/2/2	4,03/4,29/4,06

4.4 Impact of the Baltic TRAM pilot activities on the businesses

Industrial users and companies can benefit from their interaction with research infrastructures and facilities in a variety of ways. For example, using measurements and analysis as part of their Research, development and innovation work and development of new products or processes; experimenting with exploratory research based on a new idea or solving a problem that has emerged in connection with production of an already existing product.

In the IReC service process also an active business development aspect has been strongly visible and played a big role in the overall service provision in the IReCNet business model. Therefore, in the business cases also the IReCs were expected to take an active developer role and guiding the companies go further with the findings on the delivered research measurements and analysis of the results. When asking whether the companies received or not any follow-up actions suggested by the IReC roughly one third of the companies, 35,7 % (n= 5) reported of receiving suggestions on how to further invest on or utilise the findings of the research measurements done by the IReC or the affiliated Analytical Research Facility. In the second follow-up 44 % of the respondents (n= 9) reported that they had received such further business development support from the IReC. In cases where no further measures or activities were suggested the industrial customers reported the reason to be the fact that no further actions in the regard of the RDI-problem was not identified and no further collaboration was then not needed.

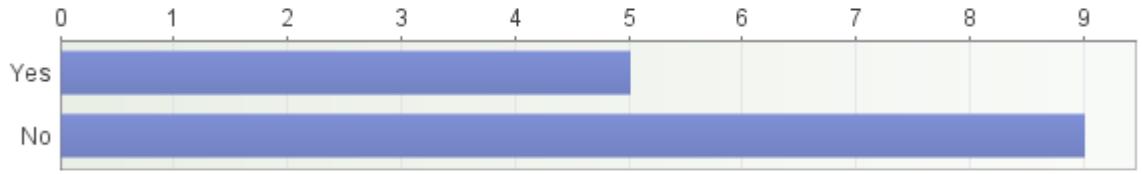


Figure 22 *The number of companies receiving follow-up or further development activities by the IReC during the contracting phase*

When asking the industrial customer to further describe the concrete follow-up or further development actions to support their business development processes in the company, the respondents explained that getting the measurement results and having a dedicated IReC person (Industrial Liaison Officers) to explain both the theoretical background and the practical applications of the measurements was the most beneficial further development boost they needed in order to get forward with the relevant RDI work in the company. The majority of the companies did not get any further suggestions on possible follow-up activities because the nature of the

presented challenges were quite simple and could be solved by one measurement round.

Below there are some informative and descriptive examples on how the industrial customers defined in their own words the benefits and added value they have so far gained from the offered IReC services:

- "Possibility to carry out specific high-level measurements and analysis, which is needed for the further development of our products."
-"Received useful information about product characteristics."
- "We got a lot of analytical data, which will help us to go further with following R&D work. Therefore, the IReC services were very helpful for us."
- "The product has now a new fire class"
- "Our company decided to vary the manufacturing process in order to obtain better surface treatments free of tin whiskers thanks to the services provided."
- "Measurements showed differences in spatial frequency and shape of the grooves as well as profile depth between the e-beam and dot-matrix patterned diffraction gratings. These differences can be easily recognized at the expert level, thus providing a very high security degree and preventing counterfeiters."
- "We understood the value of our raw material."
- "We improved the scientific level of research. We aim to understand some crucial properties of our materials."
- "We wanted to find out to what extent atomic force microscopy could be used to characterize protein coated polystyrene surfaces. We got the answer to that question."
- "Understanding how the residual stresses evolving approaching free edges which are typical geometry Features of real structures."
- "We can really use the results in our product marketing."
- "The product has now a new Lambda value."
- "We were able to verify some of our hypotheses considering our developing production."
- "The tests were carried out according to plan and the results were as expected."
- "We got a couple of analytical services to define further development of our materials. With the information we got, we know which ways are promising and which are not."
-"We got interesting insights into the rate determining processes in our batteries."

[1] Annex 1 is presenting application form
[2] Annex 2 is presenting the survey templates in detail
[3] See for example State regional development agency of Latvia, 2014: Evaluation of the BSR project “Science Link” contact points and their network, recommendations for future work. page 30
[4] EU Recommendation 2003/361: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32003H0361
[5] Hufnagel & Sassenberg: The Baltic Sea Region A science Powerhouse Final seminar, 26.11. 2018 in Brussels

5. Recommendations for short- and longer-term development of IReCs and IReCNet based on the customer feedback, IReC self-evaluation and the network business model development activities

As noted earlier, open data pilot and the development of the Industrial research centres and the associated network (Industrial Research Centre Network's model) in the Baltic TRAM project have been very much interconnected by sharing among them various interdependent activities. Based on the extensive and thorough evaluation activities the project consortium was able to collect an impressive compilation of evaluation data containing quantitative data and qualitative data on the actual business pilot activities, customer feedback data gathered in three different stages of the service path offered for industrial customers and reflective self-evaluation surveys conducted with the operational Industrial Research Centres after all three open calls for companies. In addition to these sets of evaluation information and reflective data, the development processes in the project have contained numerous rounds of consultation and discussions with all project partners to collect as rich as possible opinion on different aspects of activities in the whole life time of the Baltic TRAM project.

One of the main objectives in work package 4 was to make a review of the existing regional resources and further development of Analytical Research Facilities, to establish a tested operational network of IReCs and to collect and utilise adequate customer feedback data to be used in the development of the Industrial Research Centres and the transnational network of Industrial Research Centres.

One of the aims of WP5 was to test and assess the performance of Industrial Research Centres (IReCs) as intermediaries between Analytical Research Infrastructures (ARIs) and enterprises using pilot actions. Based on inputs from both WP3 and WP4 (customer experience review), the IReC network formed in WP4 should in WP5 identify those smart specialisations which require interregional cooperation and identify specific businesses active in those scientific areas whose scientific challenges merit greater support. The resulting pilot activities will help to evaluate the performance of the newly established structures and cooperation mechanisms (Smart Cooperation in Science; specific IReCs and the IReC network in general) and illustrate the extent to which ARI communities (providers and users alike) can profit from this more advanced collaboration framework across the Baltic Sea Region. Additionally, a pilot action in the form of a portal on special open data access pilot action will focus in on how the actual research done as part of these pilot actions can benefit researchers, businesses and intermediaries, e.g. IReC members. from open data access. This will be done by developing first steps towards an einfrastructure which will streamline data flow, data presentation and analytics and facilitate access to open data. One of the

lessons learned from Science Link is that contextualisation of a given research initiative via access to historical datasets and previous research can enhance the benefits that a business can reap from collaboration with ARIs. The open data access pilot action is a response to this need.

In terms of the tasks and expected outputs in the core work packages the Baltic TRAM project has nicely reached the expectations and has been able to deliver all the expected outputs with certain limitations. Based on the final analysis of all gathered evaluation data the project partners have also been able to identify certain aspects where the project has not been able to reach the full potential of the established operations and cooperation structures in the IReCNet. In the following we are addressing the main core conclusions stemming from the presented evaluation information. The objective in this is to offer a structured path forward in developing the transnational network cooperation further in the Baltic Sea Region context and beyond. Parallel to faced challenges and obstacles we will likewise also be stressing the achievements of the Baltic TRAM project to showcase where the success of the implemented project activities.

Before going deeper to the analysis conclusions and recommendations, it is worthwhile to state the most important indicators which have been used to grade the project activity impact in work packages 4 and 5. In the Terms of Reference for the IReCs the **Key Performance Indicators of the IReCs** were specified to include two short term KPIs: Number of business cases completed and Number of data sets fed into the public e-RI database and one long-term KPI: Impact on competitiveness of the customer companies (aspects specified in the industrial customer survey template). In addition to these, the other most important quantitative indicators are the following:

1) number of evaluation committee meetings
2) number of business fields served
3) number of locally served business cases
4) number of transnationally served business cases
5) number of all beneficiary companies in total, including those companies who received direct consultation or other help but did not submit an application (this data is presented at the BT project level in WP1 and WP2….?)
6) number of new products developed
7) Number of operational Industrial Research Centres
8) customer feedback on quantitative factors
9) IReC self-evaluation on quantitative factors

The most important qualitative indicators are the following

1) number of cases which required multidisciplinary approach to be solved

2) number of cases which required standardised measurement/ one simple measurement technique/ method to be solved
3) cooperation between the IReCs
4) cooperation between the IReCs and affiliated ARFs
5) cooperation between IReCs and external ARFs
6) customer feedback on qualitative factors
7) IReC self-evaluation on qualitative factors
8) connections to S3 fields

Medium and Long-term KPIs:
Impact on competitiveness of the customer companies (aspects specified in the industrial customer survey template)

Based on the presented set of quantitative and qualitative evaluation factors the Baltic TRAM work package 4 and 5 leaders have made a final analysis on the impact of the project activities. The main conclusions are presented in the following in no particular order.

Concerning the establishment of the tested operational network of Industrial Research Centres the Baltic TRAM project partners reached a milestone of approving and working along the lines of the IReC concept captured by the document "Terms of Reference for the Baltic TRAM Industrial Research Centres" and clearly the basic level of transnationally coordinated approach was reached. In addition to this, the agreement on the document "Terms of Reference for the Baltic TRAM Industrial Research Centres" was complemented by a concerted implementation of three open calls, which required a compliance with a jointly elaborated and agreed stages of implementation. Together the main outputs **Terms of Reference for the IReCs and draft Terms of Cooperation for the IReCNet (O 4.2), overall documentation for the management of the business pilot activities (O5.2) and** Open Data Pilot Programme Document (O5.3) form the earlier agreed and jointly tested operation model.

The drafted IReCNet ToC captures suggestions for further institutionalization of the coordination model proposed by the Baltic TRAM project even though the project did not have enough time to reach the final stage of maturity in the negotiations so that the minimum amount of partners would have been ready to sign the document by the end of the project implementation time. Likewise there was too little of time left for subsequent in-depth examination of the results of the tested operational phase which clearly leaves room for further analysis and development activities. However, the above presented results can tell a great deal already about lessons learn and

conclusions reached about the potential, value added, as well as certain shortfalls of the jointly implemented sum of activities.

Institutionalized coordination model for the Network of IReCs was discussed over the last period of the Baltic TRAM project containing several consortium wide consultation and commenting rounds. Despite of these the project partners were not able to reach a common understanding to make a joint agreement in the form of signed Terms of Cooperation for the IReCNet. More time and effort needs to be invested to fully capture the results of Baltic TRAM project in all aspects. One can still argue that Baltic TRAM has successfully established a network of public facilities that provides and executes short-term innovation services (consulting and measurement) for industrial users. This network is different from other networks, such as: Enterprise Europe or ADAPTER in Estonia, which serve as a one-stop-shop for a variety of research services from various organizations (public universities, research organizations and private providers), as BT focuses exclusively on short-term consulting and measurement services. It is - in addition to the few commercial providers of such services - a kind of scientific "fire department" for the industry. The IReCNet has during the Baltic TRAM project proven its functionality through successful pilot activities. The project partners welcomed the results in a Memorandum of Understanding (MoU) and declared their general willingness to cooperate further. A first concept for a sustainable long-term operation of the BT network has been developed.

However, the finalisation of the process of really establishing the operational Network of IReCs remains to be done after closure of the active implementation stage of the Baltic TRAM project. The (MoU) which came into force by the end of the Baltic TRAM project (more precisely on 25th of February 2019) is laying good grounds to continue this development work. The overarching goal of the MoU is to express support and commitment towards multilateral collaboration among the signatory parties within the capabilities of each signing party, which is to strengthen the macro-regional and pan-European competitiveness in a global context through improved incentives, which are tailored for science-business cooperation. The Parties do so by seeking to bolster the relationship between (analytical) research institutions and businesses by exploring opportunities and enabling structures that facilitate cooperation between companies and researchers; as well as by linking expertise to concrete industrial needs. After the closure of the Baltic TRAM project, it is clear that the signatory parties of the MoU will continue to discuss the cooperation structures in more detail and we suggest that University of Turku (which has been leading the IReCNet development in the Baltic TRAM) will take responsibility of taking this development work further in a coordinated manner. The Terms of Cooperation for the IReCNet is offering a practical tool for this development.

In addition to further development of the IReCNet and the actual establishment of the network structure there is a need to strengthen certain core elements in the network activities, including the service offering of the network, specializations and capabilities in the member IReCs so that the complementarity of the research laboratories could be better reached and utilised at regional and macro-regional levels. Better knowledge about the capabilities and accessible measurement techniques in different member IReCs would greatly speed up the service process towards the customers, which would be very beneficial for all parties. Secondly, also capacity building activities and common training activities within the network should be systematized so that the knowledge and technology transfer activities between the IReCs and within the IReCNet would be more efficient and bring more added value to the members and through them to the industrial customers as well.

The business pilot activities, received customer feedback all show that there is a need for this kind of specialised short term measurement and analysis services in the Baltic Sea Region. The customer value highly an easy, quick and beneficial access to the analytical research facilities where they can receive support and boost to their research, development and innovation activities. As indicated in this report even many SMEs that have their own internal research unit or department find these services beneficial and are interested in applying them.

The scope of evaluation done in the Baltic TRAM project do not offer very deep insight to the strategically important reasons for companies to use the analytical research facilities to complement their own research capacities and efforts so it would be worthwhile to look more deeply in to this question in the next stages of the development of the IReCNet cooperation. The used customer surveys failed to capture in detail a longer-term impact on competitiveness of the customer companies. In the used customer survey follow-ups, there were not sufficiently detailed questions on the different impact aspects to secure collection of adequate evaluation data on this. In any case, to quantify impact, a larger. Sample space (i.e. number of experiments) and project duration would be required.

The final analysis on the business impact in the BSR can only be done after some time by using dedicated follow-up measures to contact the target companies again. Nevertheless, some revealing insights were identified during the bilateral sessions that Kainuun Etu, as coordinator of the open data pilot, held with those partners (IReCs) who contributed case studies to the portal (Estonia, Finland both partners, Lithuania and Poland one partner). Common findings include: (i) the important role of the IReCs as a multi-sided facilitator with demanding competence requirements in the measurement process; (ii) the highest impact is to be found on the one hand,

among businesses that have a certain level of education (cognitive proximity between the IReC/measurement issue and the business manager); and, on the other hand, among those cases that aimed at reaching better market placement through new product development. Such findings could be explored better in follow up actions, targeting accordingly the marketing activities of IReCs; (iii) finally, the importance of the evaluation committee as a critical knowledge and multi-competence "hub" and as potential part of a permanent IReC function as well, was also identified in all interviews.

The connections of the served businesses and research challenges to the smart specialization fields of the Baltic Sea Region has been analysed in the concluding publication of the Baltic TRAM Work Package 3 – the Baltic TRAM Briefing Note 1/2019 "Baltic TRAM Smart Specialisation Trends". According to this report, none of the S3 strands were overwhelmingly represented in the pool of business cases. However, some of the S3 can be considered to have a certain potential to pave the way for closer science-business cooperation in the national as well as transnational setting[14] . The existing prioritization on a regional and national level in various parts of the Baltic Sea Region focuses on medical and life science sector, sustainable energy, bio economy and blue growth[15]. More solid findings on the S3 transnational trends should be examined in the future by reviewing a broader exploratory set of practical science-business interaction cases[16].

[14] Baltic TRAM Briefing Note 1/2019 "Baltic TRAM Smart Specialisation Trends" conclusion 4.4"Potential to serve as an impetus for closer transnational cooperation in specific specialisations" elaborated on pp. 13-14 available online: https://www.baltic-tram.eu/sites/sites_custom/site_baltic-tram/content/e24058/e24059/e84531/e84533/BalticTRAMSmartSpecializationTrends_eng.pdf

[15] Baltic TRAM Briefing Note 1/2019 "Baltic TRAM Smart Specialisation Trends" section 1 "Value of the Baltic TRAM Open Call´s Results" elaborated on p. 6 available online: https://www.baltic-tram.eu/sites/sites_custom/site_baltic-tram/content/e24058/e24059/e84531/e84533/BalticTRAMSmartSpecializationTrends_eng.pdf

[16] More details on the suggested way forward are elaborated in the Baltic TRAM Story of Europe in My Region "Baltic TRAM Goes Beyond the Buzzwords of the European Cooperation" section "It is time for more testing of smart specialisation" elaborated on p. 2 available online: https://www.baltic-tram.eu/e88312/BalticTRAM_EuropeinMyRegion2019_storytelling_eng.pdf