



The Baltic Sea Region: A Global Digital Test Hub

Test and Demonstration facilities across borders

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Title: The Baltic Sea Region: A Global Digital Test Hub: Test and Demonstration facilities across borders

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BSR Stars S3 is an international project that seeks to enhance sustainable growth opportunities in the Baltic Sea Region, focusing on the fields of bio-, circular and digital economy. BSR Stars S3 stimulates transnational and cross-sectoral partnerships, develops integrated innovation support infrastructures and innovation management tools, and increases the capacity of innovation actors to utilize smart specialization strategies (S3). It is part of the EU Strategy for the Baltic Sea Region under the BSR Stars flagship, and has received funding from the Interreg BSR Programme.

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Foreword

The Baltic Sea Region (BSR) is a frontrunner in the digital economy. An attractive place and potential testing ground for new innovative digital solutions for business and citizens.

Over the years the region has conceived companies that have grown to become large multinationals such as Nokia, Ericsson and Skype. Alongside the large multinationals, the BSR also boasts an abundance of smaller companies that – through development of innovative digital products and services – create thousands of jobs and generate income to societies around the Baltic Sea. They develop new innovative products within diverse industries such as music service, games, apps, payment systems, and cyber security.

The region is yet to reach its full potential. There are many more digital opportunities to explore and potentials to realise. Also, given the lifecycles of most digital products and services are very short, there is a constant need for innovation and adaptation.

Test beds play a pivotal role for successful commercialisation of new digital products and services. This report gives a snapshot of digital test and demonstration infrastructures in the region. It discusses new opportunities for linking these centres of excellence to benefit from complementarities and synergies, based on a direct dialogue with the actors themselves.

There seems to be a strong correlation between competitiveness of technology-based small to medium enterprises (SMEs) and their access to test beds. Different parts of BSR show complementary test bed excellence. By networking these excellence areas, opportunities arise for offering SMEs specialised test bed services that in the best way suit their innovation needs.

Key future areas for cooperation could include: smart specialisation and test service delivery to SMEs; use of public procurement to pull digital testing and innovation; joint test bed efforts to support internationalisation of digital SMEs and boost entrepreneurship in the region.

We hope the paper can inspire a dialogue among policy makers, service providers, knowledge institutions, SME's and other stakeholders on the potential for shared technology services across borders. We hope it can stimulate ideas for new pilots, networks and partnerships across the region. We would like to thank all those that have contributed to the mapping and the discussions reflected in the paper.

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Executive Summary

- There is an increasing demand among SMEs for test and demonstration facilities to test new products, services or processes. This is accompanied by a growing acquisition of international technological services. In the Nordic countries there are well-developed national networks of technology service providers. Similar infrastructures in the Baltic countries are becoming more sophisticated. There seem to be unexploited opportunities for sharing experience across the BSR on how to successfully deliver digital test and demonstration infrastructures, and technology services to SMEs.
- In the BSR there are both overlapping and complementary areas of test bed expertise in the digital economy. This provides opportunities for SMEs to access technology services that in some cases are better tailored to their specialised needs if they could commission test and demonstration services across borders. Transnational access to R&D could add complementary benefits to domestic 'shopping' for technology services. It could benefit innovation and internationalisation of SMEs and inspire smart specialisation.
- Smaller cities in the BSR can benefit from their smaller size because it is easier to conduct controlled experiments in smaller cities than in metropolises. Also, they play an important role in development of digital solutions through public procurement. There is a potential for cooperation around modalities and good practices for effectively utilising public procurement to advance experimentation and adaptation of digital solutions in society.
- Targeted information, transparency, attention to company needs and earlier involvement are preconditions for engaging SMEs in transnational projects and looking across borders for test facilities. 'Transnational one-stop-shops' or similar concepts that include transnational funding schemes could be developed on a pilot basis to encourage commissioning of test and technologies across borders. BSR could become a pioneer region for transnational digital test beds.

1. Background and introduction

In December 2014, Baltic Development Forum (BDF) and Danish Business Authority organised the conference *Digital Growth in the Baltic Sea Region* to explore the interest of joint test bed initiatives across borders.

The discussions confirmed that access to test beds is critically important for innovation in the digital economy. This allows companies to make initial tests of innovative ideas together with end-users. Companies can then test and make final adjustments to prototypes together with relevant user groups, before investing more massively in or introducing new digital products or services on the market.¹

Having this in mind, BDF decided to further investigate the access and availability of test beds for SMEs. With a focus on digital test beds, such an activity could complement the analysis of the digitalisation potentials of BSR carried out in the think tank Top of Digital Europe.

This paper gives a snapshot of digital test and demonstration infrastructures and facilities in BSR and sheds light on funding schemes available for SMEs to support costs of testing.

The paper is commissioned by BDF within the framework of the BSR STARS S3 project,² co-financed by the EU Inter-reg BSR Programme. BSR STARS S3 aims to promote innovation in the region by identifying new opportunities for smart specialisation. Project partners include the following regions: Copenhagen Capital Region (Denmark), Sør Trøndelag (Norway), Skåne (Sweden), Tampere (Finland) and Lithuania (participating at the country level). Therefore, the paper has a particular emphasis on these regions.

BDF has initiated this activity to follow up on recommendations from the 2014 discussion, in order to explore how joint access to test beds can contribute to the smart specialisation strategies, to suggest new ways to strengthen competitiveness through innovative cross-border actions – one of the objectives of the independent, non-profit think tank Top of Digital Europe.³

The report, *State of the Digital Region 2015*, suggested that: “Policy-makers in each country should jointly set up open and linked test bed platforms to connect entrepreneurs and start-ups with public institutions such as education,

¹ http://www.bdforum.org/wp-content/uploads/2014/12/Testbeds_Background_Note.pdf
² <http://www.bdforum.org/9-dec-seminar-identified-challenges-opportunities-digital-testbeds-baltic-sea-region/>
³ <http://www.bsr-stars.eu/bsr-stars-s3/>
⁴ <http://topofdigital.eu/about/>

healthcare, city planning or public administration. This would boost entrepreneurship within the region and make it an attractive test bed region internationally, as well as provide opportunities for schools, public transit and care facilities to leverage the testing and get input to learn and improve.”⁴

The mapping part of the paper is the result of a desk study combined with interviews with representatives from a selection of test and demonstration facilities.

The mapping was presented at a seminar in Tampere, Finland, on 6 April 2017, organised by BDF and Nordic Council of Ministers. The event brought together 32 representatives for technology providers, business development agencies, policymakers and SMEs from Finland, Norway, Sweden, Denmark, Poland, Germany and Lithuania to discuss the perspectives for a broader access to test bed facilities across the region.

In particular, the seminar discussed opportunities for realising economic and technological synergies by sharing test and demonstration facilities across borders. The key findings from the seminar are reflected in the final chapter of this paper. Further information about seminar programme, its objectives and participants list is available on the BSR-Stars [website](#).

Test and demonstration facilities: Trends and policies⁵

The demand for R&D (Research and Development) facilities is steadily increasing. In Denmark, the business demand for R&D has doubled in the period from 2007 to 2014 and the demand is increasingly international in nature, as 62 per cent of acquired R&D services come from international providers. Clearly Danish companies are missing out on opportunities because they are lacking ac-

cess to facilities and expert knowledge. This is a likely scenario throughout the other BSR countries in.

It is also expected that the demand for test and demonstration of products that form part of a system of other products will increase as a consequence of digitalisation. Rising technological speed will result in reduced depreciation time, which will make own investments in test and piloting facilities even more risky, further increasing the need to access facilities and expertise externally.

From a European perspective, around 60 per cent of large industries and more than 90 per cent of SMEs feel they are lagging behind in digital innovation. Industrial stakeholders therefore point out to the urgent need for “facilities to experiment with and test digital innovations”.

This concern points toward the new EU initiative to establish a network of Digital Innovation Hubs (DIH) throughout Europe to give companies access to digital technologies and expertise by providing a one-stop-shop service to companies, particularly SMEs. Competence Centres with competences in digital technologies will be the core of the DIH’s.

These developments will further emphasise the potentials and added value of transnational test bed initiatives in BSR; for example, pioneering initiatives that could inspire the European process.

2. Digital test and demonstration infrastructures in the BSR

This chapter shortly introduces digital test and demonstration infrastructures in project partner regions and countries in the Baltic Sea Region (BSR). The majority of digital test and demonstration infrastructures are not provided at regional level. In addition, examples are given from Estonia and Latvia, even though these countries are not partners of BSR STARS S3 project.

This chapter does not present an exhaustive or comprehensive mapping of facilities, but rather a snapshot that can give an impression of trends and characteristics.

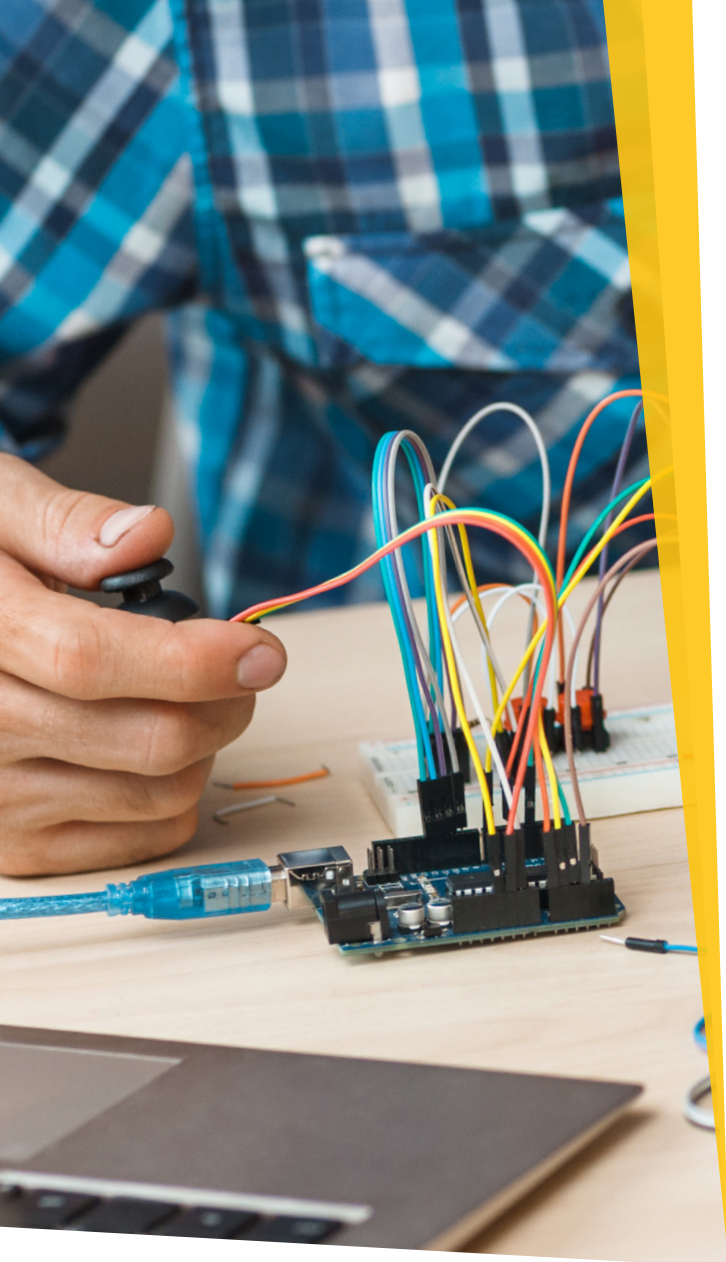
Digital test and demonstration infrastructures – Test beds

There is no clear definition of ‘digital test and demonstration infrastructure’[”] or test bed. This paper will reapply a framework commonly used, namely that: *test beds may be defined as facilities (physical or virtual) that enable companies or researchers to develop and systematically test new and innovative solutions*

such as interfaces, apps and products and their associated business models.

Test bed can be managed by private companies, associations as well as by public organisations. Test and demonstration services offered by fully owned and fully commercial private companies and laboratories are not included in the report. Investigating opportunities for integration of such private test and demonstration companies or laboratories goes beyond the scope and target group of the BSR STARS S3 project.

Furthermore, a number of pilot, test and demonstration projects are ongoing in BSR, aiming to document the more generic potentials of digital technologies, for example the research efforts on the Internet of things (IoT) and Big Data. This paper includes only test and demonstration infrastructures that are open to companies beyond those engaged in a particular project or test pilot partnership, i.e. infrastructures that provide testing and demonstration services as part of their basic activities.



2.1 DENMARK / GREATER COPENHAGEN

In Denmark, testing and demonstration services to SMEs in the digital economy are anchored within the GTS institutes – Advanced Technology Group – a network of seven independent Danish research and technology organisations with 29 offices located throughout Denmark.⁶

The GTS institutes offer a range of services to companies throughout the country, including: knowledge, technology and consultancy, cooperation on technological and market-related innovation, and testing and demonstration. However, they do not have funding available to co-finance companies' costs of hiring lab facilities, which means that the companies must pay for these services on the commission basis or apply for the public support.

The key financial incentive scheme in Denmark for companies seeking support to benefit from test and demonstration infrastructures is the InnoBooster (innovation voucher) programme.

Under this scheme entrepreneurs and SMEs can apply for project support to develop a new product or service that is not currently on the market, or to significantly improve production processes that will increase company competitiveness. Companies can be granted between DKK 50,000–5 mill to engage expertise, including advisory services and use of test and demonstration infrastructures.⁷

DELTA – a part of FORCE Technology

In 2016 FORCE Technology and DELTA merged, hence the name *DELTA – a part of FORCE Technology*. The merger provides a

Additionally, many universities, through joint research activities with the private sector, provide access to laboratory facilities for testing and demonstration of product ideas or concepts within the digital economy. However, where such infrastructures are exclusively available for companies engaging as research partners with a university – and not as partly or fully commissioned test and demonstration services – such university infrastructures are by large not included in the mapping. Commissioned based test and demonstration services provided by universities are included.

⁶ The seven GTS institutes consist of Alexandra Institute; Bioneer; DBI Danish Institute of Fire and Security Technology; DELTA Danish Electronics, Light & Acoustics; DFM Danish Institute of Fundamental Metrology; DHI Water and Environment; and DTI Danish Technological Institute and FORCE Technology. <https://en.gts-net.dk/>

⁷ <http://innovationsfonden.dk/da/investeringstype/innobooster>

number of testing, accreditation and certification services for companies in the IT/digital economy, including: Electro Magnetic Compatibility (EMC) and safety; approval and quality advice; reliability and robustness; RF/wireless; and self-testing (where companies may make use of DELTA's test facilities with support from DELTA technician).⁸

DELTA's core competence areas are: electronics, microelectronics, software technology, light, optics, acoustics, vibration, and sensor systems. Four test and demonstration platforms at DELTA are particularly targeting SMEs in the digital economy.

At their TestLab, DELTA supports companies that wish to improve reliability and adherence to regulations for various IT and digital products. During 2013–15 Delta implemented 3,000 preliminary product tests aimed at supporting companies in the early development stages to identify needed specifications and to develop test strategies. The preliminary product test helps to accelerate innovation processes and improve cost-effectiveness.

Delta is also accredited to provide EMC tests or – more simply – tests of electronic or electrical products to ensure that they work as intended in their environment. These tests help to improve durability, reduce product complaints and assist companies in producing required product documentation.

Areas of EMC test excellence include: consumer electronics, industrial electronics, acoustics, IT and telecom, automotive and transport, and wind and energy. At the TestLab, companies can also perform electric safety tests that similarly help to improve durability, reduce product complaints and assist in producing required product documentation.

IdemoLab aims to bridge the gap between technology and design. The focus is on the early stages of the design process (prototyping) and to create meaningful experiences for users and customers.

IdemoLab has four key areas of expertise:

- **IoT IoT:** IdemoLab can support companies with development of concepts and feasibility; sketching and prototyping; wireless standards; antenna designs; wireless power charging, energy harvesting and more.
- **Design Smart Things:** IdemoLab can support companies with design (design thinking via user centred design, context validation, technology validation, and solving real problems with useable, meaningful solutions), smart (sensors which allow us to interpret the world around us in a new way, sensing both what humans can and cannot, and analysing it), and things (to-market, buyable products which people truly want to invest in to better their lives).
- **Battery-less and self-powered electronics:** IdemoLab can support companies with assessing the feasibility of energy harvesting and build battery-less prototypes with energy optimised power management design. Furthermore, support is available for power management in low power devices, especially in IoT and wearable wireless sensor applications. Within this area IdemoLab offers a broad range of test facilities and climate chambers to characterise new energy harvesting technologies, within solar, thermal, kinetic and radio frequency energy harvesting technologies.

⁸ <http://testlab.madebydelta.com>

- Retail technology: IdemoLab supports companies with development of new stronger business models based on customer and company data, and innovative services that can contribute to making the physical part of retail services more competitive. The effort includes development of new technologies and their testing in a number of shops and municipalities in Denmark.
- Design and development: where support is available for hardware, firmware and software engineering, by specialists in wireless communication, Big Data analysis, visualisation, and IoT back-end platforms.
- Test and validation: where the Nordic IoT Center help perform regulatory surveys across markets and multiple sectors such as medical, automotive, marine and infrastructure, and then testing the product for either temperature, humidity, mechanical stress, salt spray, electromagnetic compatibility, electrical safety, and on this basis, document the performance of a product, including its performance with competing products.

SenseLab provides listening and viewing tests to companies for whom the end-user perception of the product and its quality are important. The aim is to make perceptual evaluation a natural part of the product development process and benchmarking. By customising to end-users' senses, SenseLab helps companies to develop products that are more pleasant to use.

In more detail, SenseLab provides: custom and standard compliant listening tests; benchmarking; quantification of the key perceptual product characteristics; linking perceptual characteristics to consumer preferences; and access to user groups and identification of their perceptual needs.

The Nordic IoT Center is a joint effort between DELTA and several companies and business organisations. The partnership collaborates around six phases to guide the development process from IoT ideas to IoT products.⁹ These are:

- Ideation: where the Nordic IoT Centre guides companies through a process in which the concept for an IoT application is matured, tested, and validated so it can be implemented.
- Feasability: where specific applications and prototypes are scrutinised to remove any technical barriers for the solution.

Integration and manufacturing: where the Nordic IoT Center helps find the right partner to integrate the product – be it into existing systems of a company's product range or to create new systems. This includes Big Data analysis, security management, analytics, IT platforms, and business models. Also, the centre can assist with market yield analysis, production, and supply chain optimisation – all to improve the return on companies' IoT investments.

Danish Technological Institute (DTI)

DTI works to develop, utilise and communicate research and technology-based knowledge for the benefit of Danish companies. This is often carried out in cooperation with education and research institutions in Denmark and internationally. The key objective is to ensure that new knowledge is quickly transformed into value for its customers in the form of improved products, materials, processes, methods and/or ways of organising.

DTI offers consultancy and services to more than 15,000 company clients annually, within a large range of business areas, including agri-business, chemical and biotechnology, climate and energy, food and packaging and material technologies. More specifically, DTI¹⁰ test and demonstration facilities focusing on the digital economy include the following services:

The Testing Laboratory for Ecodesign and Energy Labeling provides opportunities for companies to test electronics for household and professional use, such as computers, power supplies, printers, scanners, televisions and more. Tests can be performed on a commission basis to ensure compliance to EU regulations on energy and power consumption. Companies are also offered consultancy on ecodesign and energy labelling requirements, as well as CE marking for European sale.

In 2016 Agrotech became a part of DTI. Within the agri-digital line of services, DTI is supporting companies to exploit digital competitive advantages. DTI's core competencies in the agri-digital space include the application of data acquisition, data integration, statistics and modelling in unique IT solutions. The platform for system development can be composed and developed from proof of concept demo versions, to operational market proven software systems. Services include: software development from demo systems to market proven IT systems; data collection; data management; Big Data; implementation of models of calculation; visualisation of data; statistics and modelling services including implementation of advanced calculations and models.

The Danish Meat Research Institute (DMRI) supports SMEs with equipment and IT solutions for measuring quality of slaughter animals for classification or sorting purposes. This includes solutions for foreign object detection, automation, bone fragment removal, predictive model for meat and food safety, and more.

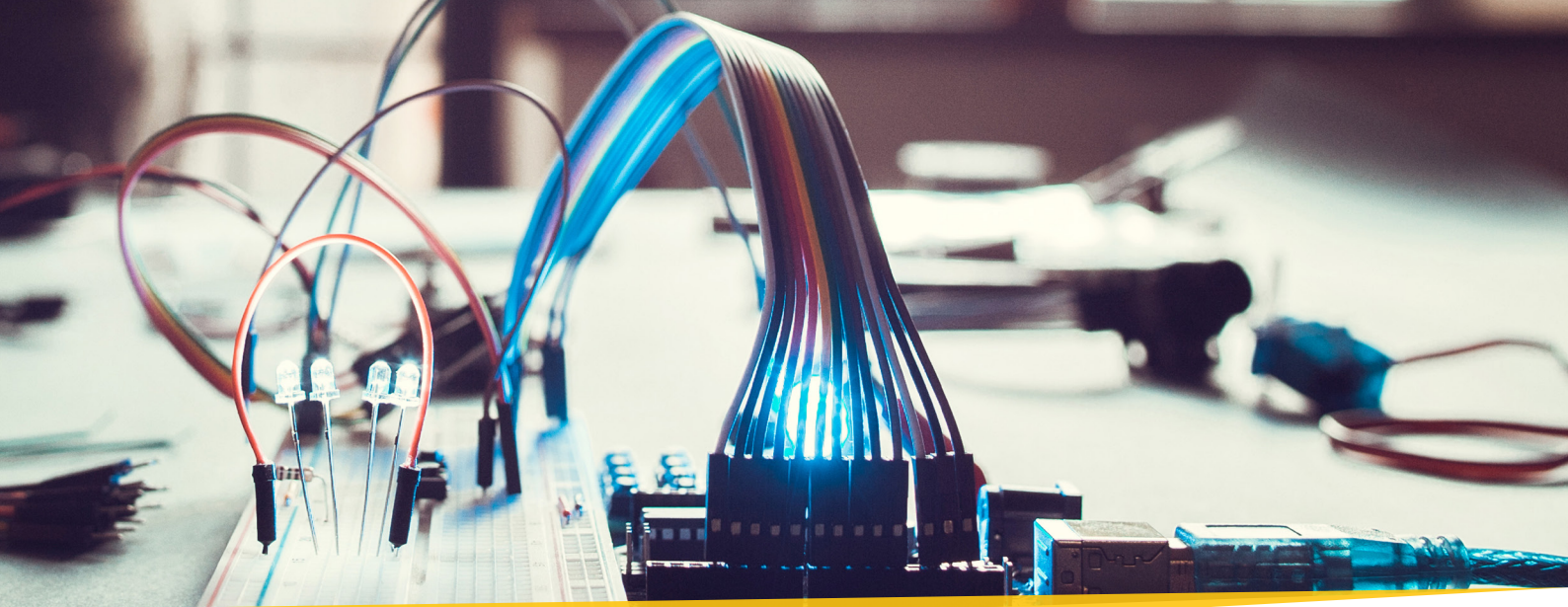
DTI also supports SMEs in developing, applying and transferring robotic technologies. For example, the Center for Robotics performs research in cooperation with Danish and foreign research institutions and enterprises. DTI can also help SMEs to identify the types of data generated by production processes, and describe how this data can be used as a basis for analysis and decision making. Another example is in the area of virtual production where DTI supports SMEs with computer-calculated simulation of small and large adjustments in production. This allows companies to assess information on the consequences of a (simulated) change in production before making actual making the changes in the process line.

Energy-related test and demonstration infrastructures

In Denmark, a number of digital economy test and demonstration infrastructures relate to renewable energy production and energy conservation such as PowerLabDK and Bornholm Test Island.

PowerLabDK is established by the Danish Energy Authority in partnership with the Technical University of Denmark (DTU) and Bornholm Utility Company (Bornholm Energi & Forsyning). PowerLabDK offers testing, technology development, educational training and demonstration of energy technolo-

¹⁰ <http://www.dti.dk/services/software-development/38014>



gies. Key industries targeted by the initiative include: wind energy, solar energy, plants and installations, offshore, utility and infrastructures, eMobility, energy analytics and business models, and smart homes.

Services to SMEs are based on self-service or full-service testing in PowerLabDK's facilities. SMEs can do – or have done – experiments within electric equipment, renewable energy sources, smart grid technologies, smart home and electric appliances, control and ICT-solutions in energy systems, wind power, e-mobility, real-time grid analysis, control centre tools and many other areas.

Moreover, the tests offered in the facility are for electric components and equipment within all application areas and all power ranges up to MW-scale. Testing can be conducted according to both national and international standards (IEC, IEEE, VDE, DS, etc.), including development tests or pre-tests before a type approval. PowerLabDK can also provide customised tests according to company specifications and identified specific needs. Examples of such tests include: performance tests, compatibility tests, environmental exposure tests (thermal, mechanical, air pollution, EMC), shock tests (short-circuit lightning), and life-time tests.¹¹

PowerLabDK has a number of specialised

labs, including Control Center Lab (a full scale real time power system control room), Electric Vehicle Lab, a High Power Lab (for short-circuit tests), and an Intelligent Energy Laboratory. Also, the full scale test and demonstration of smart grid technologies on the island of Bornholm is an integrated part of PowerLabDK.

Bornholm Test Island: Over the past five to eight years the island Bornholm – within the Greater Copenhagen Region – has made many efforts to position itself as a test island/test bed, known as Bornholm Bright Green Island. Here, many initiatives relate to the digital economy. For example, 'Villa Smart' has been running for several years as a demonstration house where companies can access – and to some extent try out their own products – for intelligent, digital-based management of buildings. 'Eco-Grid EU' is an R&D project that connects 2,000 private energy consumers to test new electricity management opportunities. It also includes testing of Smart PV Grid management. Even energy production and management systems are tested on Bornholm. PowerLabDK has made Bornholm a full-scale laboratory for this purpose, where future societal electricity systems are tested. These efforts are largely based on digital innovations.

2.2 NORWAY / SØR-TRØNDELAG

In Norway, as in Denmark, only a few test and demonstration infrastructures are provided at the regional level. Rather, a network of institutions specialised in different areas of the digital economy offer their services nationwide.

The Research Council of Norway

The Research Council promotes an integrated R&D system that supplies high-quality research, develops knowledge for dealing with key challenges to society and the business sector, fosters dynamic interaction within the R&D system nationally and internationally, and creates a framework for learning, application and innovation.¹²

The Norwegian state provides basic funding to 48 research institutes each year under the public funding scheme administered by the Research Council. The institutes fall in four areas: Technical-industrial institutes; Primary industry institutes; Social science institutes, and Environmental institutes.

SIVA

The Industrial Development Corporation of Norway (SIVA) is a government-owned entity responsible for government investment in incubators, science parks, industrial parks and real estate through partial ownership of other companies. SIVA aims to stimulate economic growth, through strengthening Norway's capacity related to innovation and creativity.¹³

SIVA is headquartered in Trondheim. Key activities of SIVA are to support business start-ups through incubation – and to provide businesses with access to expertise, networks and an academic and social com-

munity to facilitate growth, cooperation and development.

Development of industrial test arenas for future industries is a strategic priority for SIVA, as well as strengthening regional arenas for commercialisation of research and ideas from the business sector.

Katapult – innovation voucher

The Norwegian Research Council and Innovation Norway are developing a new funding programme – Katapult – which will come into effect from 2017 with a budget of NOK 50 Mio per year.

The programme will support test and demonstration activities in companies, to develop further conceptual ideas and make them market ready.¹⁴ The test and demonstration centres will be managed by SIVA. However, no decisions have yet been made on which specific industries the centres will target, in line with the government's wish for this to be a demand-driven based on company interests.

Before Katapult, no innovation voucher-type support programmes existed in Norway to co-finance test and demonstration activities of SMEs. There was – and are – a number of research and innovation programmes supporting testing and piloting at a larger societal level, which are implemented by many universities and other research institutions.

SINTEF

The Foundation for Scientific and Industrial Research (SINTEF) is headquartered in Trondheim but supports thousands of companies annually with research and development throughout Norway via a number of subsidiary organisations.¹⁵

¹² www.forskningssradet.no

¹³ <http://www.siva.no/>

¹⁴ <http://siva.no/wp-content/uploads/2015/03/norsk-katapult-forslag-til-program-1.pdf>

¹⁵ <https://www.sintef.no/en/>

The applied research, technology and innovation areas targeted by SINTEF includes:

- Renewable energy: where SINTEF partners together with industry and government agencies help to create more efficient, less polluting and more flexible energy solutions.
- Climate and environment: where SINTEF provides expertise and laboratories for development of environmentally friendly buildings, renewable energy and energy efficiency.
- Industry: where SINTEF in cooperation with industry seeks to advance fabrication methods, automation, systems and logistics, and to develop sustainable manufacturing processes.
- Materials: where efforts are targeted to the full value chain from raw materials, to environmentally-friendly production processes, to casting and moulding, assembly etc. State-of-the-art characterisation methods and laboratory facilities are available to model and determine the structure of materials and the properties of the products.
- Biotechnology: where SINTEF provides research partnerships and laboratory facilities to develop biotechnological processes used for production of a wide range of products such as pharmaceuticals, vaccines, biomaterials, enzymes, food, feed, chemicals and energy.

SINTEF Digital

Within SINTEF, SINTEF Digital offers access to skills and state-of-the-art digital

technologies within SINTEF's focus areas. SINTEF Digital carries out research and development projects and research-based consultancy, and provides laboratory and small-scale production services. Many of the SINTEF laboratories provide test and demonstration services for SMEs in the digital economy.

Acoustics Laboratories: SINTEF's labs cover a large variety of fields in acoustics, including noise, hearing, building acoustics, underwater acoustics, and auralisation.¹⁶

- The *Noise and Hearing Lab* in Trondheim enables companies to test hearing protection devices and communication equipment in a realistic environment.
- The *Building Acoustic Lab* in Oslo enables research partners and companies to carry out full scale measurements of acoustic properties of building components such as walls, ceilings, floors and floor covers, and smaller components such as doors, windows, and slit valves.
- The *Underwater Acoustic Lab* in Trondheim is equipped to carry out ultrasonic experiments, smaller-scale underwater experiments, and for testing and calibrating transducers to be used in larger-scale tests in the fjord or the ocean.
- The *3D Sound and Auralisation Lab* is a calibrated 5.1 surround system that can be used to auralise everyday sounds at the correct levels. Calibrated recordings for this are also available.

Electrotechnical laboratories: SINTEF Energy Research operates laboratories for high voltage, high power and climatic testing.

Customers are manufacturers, suppliers and users of electric power equipment. Services include research, development work, alongside routine, type and field tests for manufacturers, suppliers and users of electrical equipment.

Smart Grid Laboratory: The Norwegian University of Science and Technology (NTNU) and SINTEF are currently building a new National Smart Grid Laboratory in Trondheim, with funding from the Research Council. A system-oriented laboratory, it provides state-of-the-art infrastructure for R&D, demonstration, verification and testing over a wide range of Smart Grid use cases. This includes: smart transmission grids, HVDC grids, smart active distribution grids, micro grids, integration of smart grids, smart houses and smart industries, integration of renewables, smart grid and home automation, smart electricity use, electrification of transport, energy storage in smart grids, energy conversion in smart grids, power system stability in smart grids, monitoring, control and automation in smart grids, communication technologies for smart grids, information security and privacy in smart grids, reliability challenges in smart grids—dependencies of power grid and ICT, smart grid software Big Data management and analytics in SmartGrids.

ROBOTNOR

ROBOTNOR – Centre for Advanced Robotics – is located in Trondheim and funded by NTNU and SINTEF. ROBOTNOR specialises in the development of next generation robotics technologies and concepts, promoting education and industrial innovation.¹⁷

At ROBOTNOR a number of lab facilities are available, including:

- The industrial robotics lab: where the challenges of robot manipulation can be tackled. With multiple industrial manipulators, conveyor belts and imaging equipment, this lab can analyse and emulate a variety of scenarios.
- The robot learning laboratory: acts as a cooperation arena with the other laboratories of ROBOTNOR. Examples activities include the development of a robot controlled camera system that learns how an operator would like to view his or her environment, and a robot arm that learns to grip and lift different objects.
- The nanorobotics lab: a facility for research on nanopositioning. The laboratory is equipped with state-of-the-art instrumentation required for high resolution, high bandwidth and motion control.
- The UAV lab: the unmanned aerial vehicles laboratory is a test facility for NTNU's Research on unmanned aerial systems (UAS).

The labs are available for companies to use, for a fee. In addition, master students at NTNU can support companies with their expertise at no cost. Co-financing for companies' costs of renting lab facilities are available through various schemes, in particular those of the Norwegian Research Council.

¹⁷ <http://robotnor.no/expertise/lab-facilities/>

2.3 FINLAND / TAMPERE

In Finland, the Technical Research Centre of Finland (VTT), the Finnish Funding Agency for Innovation (Tekes), the Ministry of Transportation and Communication and a number of universities provide the majority of test and demonstration infrastructures benefitting SMEs in the digital economy.

The test and demonstration infrastructures collaborate with SMEs, either based on commissioned work or through joint research and development activities.

Tekes offers a programme – innovation vouchers – supporting innovation activities in SMEs. ‘Innovation activities’ refers in this programme to all the measures employed by the company to develop its products, services or processes, or to acquire new knowledge and competencies required in innovation activities.¹⁸

An innovation voucher can be used to purchase new knowledge and skills, for purchasing expert services related to innovation activities, such as companies providing innovation services, universities, universities of applied sciences and research organisations. An innovation voucher can amount to a maximum of EUR 5,000 plus VAT. Test and demonstration costs beyond this amount must be fully paid by the companies.

The Tampere Region Economy Development Agency (Tredea) also offers an innovation voucher scheme. This pilot programme is implemented with support from the European Union Regional Development Fund. It targets innovation in SMEs under five priorities: Renewing Industries, Smart City, Smart Mobility, IoT and Healthcare. The funds are disbursed by Tredea to pay for test and demonstration services provided by Tampere Technical University (TUT) and Tampere University of Applied Sciences (TAMK).

The innovation vouchers can amount up to EUR 5,000 per SME. It works whereby the two participating universities provide information in the form of ‘Product Cards’. In these cards the universities offer details on their test and demonstration service. SMEs can then apply for these services using a web-based platform. If a SME is granted a Tredea innovation voucher, the regional financial support flows directly to the universities once the test and demonstration service has been provided to an SME.

The programme began in November 2016 and will run until June 2018. The scheme has received much interest with 100 vouchers being disbursed in the first three months. The next call under the scheme will be in September 2017, when Tredea aims to open the programme to non-Finnish services providers; those test and demonstration infrastructures in other EU countries. For further information reference is made to the sections below on Tampere Technical University (TUT).

Finnish universities also provide services that involve components of testing and demonstration through the Demola programme. Demola is a common innovation platform for the higher education institutions in Tampere. It offers companies an opportunity to develop and test their ideas together with students. The company provides a topic for a project, idea or challenge, and a student will then work for three to four months with support from a facilitator and the partner company.

The result may be a demo or something else that validates the feasibility of the original idea. If the partner SME finds the outcome commercially useful, the company can acquire the right to use the results. There is also a small administration fee for the service.¹⁹

VTT Technical Research Centre of Finland

VTT Technical Research Centre of Finland Ltd operates (non-profit) under the mandate of the Ministry of Economic Affairs and Employment. VTT provides research and innovation services, as well as information for domestic and international customers and partners within Finland and beyond. One of the four subsidiary companies is VTT Expert Services Ltd, the others being VTT Ventures Ltd, VTT International Ltd and VTT Memsfab Ltd.

VTT Expert Services offers expertise, certification and product approval services, testing and inspection services and calibration services. Testing and inspection support of electronic products include:

- Electronic expert services, where VTT helps to ensure the reliability and safety of electrical and electronic products in accordance with the requirements of the market, users and authorities. VTT helps companies to solve technical problems relating to products or production, from the product development stage to speeding up the product's entry into markets.
- Environmental testing, where VTT help with determination of environmental condition stresses, consequent testing requirements and design of testing programmes and test set-up and fixtures. Thereafter VTT can assist with the actual climatic testing of products, vibration and shock testing and tightness testing of enclosures (e.g. against dust, water and protection against other objects).
- VTT also offers test and demonstration services on vehicles, machines and sys-

tems, including system and software testing, where companies can benefit from third party independent services for the reliability inspection and estimation of safety critical functions of software, hardware and automated systems.

5G Test Network Finland (5GTNF)

5G Test Network Finland (5GTNF) is a versatile 5G technology and service trialling infrastructure comprising of multiple interconnected sites hosted by the Finnish 5th Gear²⁰ test beds. These national 5G test networks, which are mainly funded by Tekes, are placed in several cities around Finland. They provide an integrated platform for development and testing of new applications, services, algorithms, technologies, and systems. The collaborating sites form a joint innovation platform and ecosystem which can flexibly serve the needs of industry, SMEs, start-ups and academia by providing an opportunity to try out 5G mobile technology functionalities well before 5G becomes commercially available.²¹

Generally, 5GTNF services include: support and consultancy for all 5G-related R&D; research platform for studying and exploring 5G; possibility to test partners' applications and tools over a live 5G network, including demanding IoT solutions; development of new business models; and more generally opportunity for long term cooperation in the wireless communications ecosystem.

The test beds participating in the 5GTNF ecosystems are as follows:

5G Test Network+ (5GTN+) project, hosted by University of Oulu and VTT Oulu in cooperation with over 20 industry partners, provides a scalable environment for developing future business models and services,

²⁰ <https://www.tekes.fi/en/programmes-and-services/tekes-programmes/5thgear/>

²¹ <http://5gtnf.fi/>

as well as for testing and developing key 5G technology components and related support functions. 5GTN+ provides options for open or restricted access for the test network users. In a restricted network, partners can test their innovations in a controlled environment. An open network offers an open platform where interactive value creation with users and customers can happen. Rather than pure technology, the project focuses on service and application driven research targeting, to support bringing spearhead technology and applications from different vertical application areas to real use.

Critical Operations over Regular Networks (CORNET) discovers and tests novel solutions for realizing critical communications in a highly cost-effective manner by reutilising commercial radio networks and everyday communication equipment. The main goal of the CORNET project is to develop a powerful test platform where the quality of service of critical communications in commercial radio networks as well as the operability of movable temporary radio networks can be tested in a real-life environment. The studies focus mainly on priority communication and temporary network deployment use cases.

The Wireless for Verticals (WIVE) project focuses on vertical sectors that will benefit from its vision and realisation via 5G. The vertical sectors present in the project are media and entertainment, and machine-type connectivity for industry. The project will develop future radio technology and study its application for verticals by setting up use cases, scenarios and requirements for the technology as well as via testing. Testing and trialling of the technology will happen in test facilities provided by 5GTNF as well as in the test bed from the consortium.

The final project, the 5th Evolution Take of Wireless Communication Networks (TAKE-5), provides a multidisciplinary and open research platform for the investigation and experimental evaluation of innovative ideas in networking, services and new business models for 5G. In TAKE-5, existing research networks are enhanced and integrated into a common shared test bed for the new test and validations. The project gathers the major industry players, SMEs and research institutions to work together towards 5G.

HILLA

Established by University of Oulu, Oulu University of Applied Science, Business Oulu, Tekes and VTT, HILLA is a five-year acceleration and investment program focusing on ICT smart specialisation within selected business areas: wireless ICT, automotive and traffic, health and heavy industries. The program aims to: a) accelerate research to business, b) efficiently utilise ICT and industry knowledge and resourcing in business development, and c) build market driven operation model between participants.

HILLA activities work to facilitate co-creative ideation of new business opportunities; research and technology resourcing; business sparring and partnering, project development and managed services; customer matchmaking and showcase events; and shared of R&D environments and tools.

One of the first results of HILLA was the establishment of the Nordic Test Cluster (NTC), which aims to provide a one-stop-shop for digital test and demonstration services in Finland. A Testing Special Interest Group (SIG) is also currently being planned. This will aim to bring researchers and companies together to exchange information on newest trends and requirements in digital testing.

Nordic Test Cluster

– a part of the HILLA programme

The Nordic Test Centre (NTC) is a business initiative established to promote collectively the wide range of testing, simulation and certification services available in Finland. NTC services are offered globally through a single communication channel thus allowing a rapid response for the needs of the customers.

NTC provides a wide range of R&D test services, most of which are in the digital economy space (OTA, EMC, SAR, RF, antenna, audio, structural, mechanical/environmental, etc.). Digital prototyping services are also offered. The initiative's business model combines a pool of knowledge, skills and high standard equipment and laboratories that enables NTC to make the development process cost effective and rapid for its customers.

Finnish Transport Safety Agency

– Traffic Lab

Finland aims to be the best place in the world to develop and test digital transport services. The Traffic Lab is a test bed for digital and innovative traffic and logistics services, with a focus on development of new service concepts for mobility, traffic automation, IoT, and pilots that are strategically significant to trade and industry, companies and regions.

Testing and making conclusions about people's everyday mobility are essential in the Traffic Lab. The test environments are used in attempts to find innovative solutions, to improve services, and to promote independent initiative and entrepreneurship.

The Traffic Lab provides five test environments:²²

- Growth Corridor Finland offers private companies and consortia a possibility to scale the first stage of mobility services and to more extensive modelling of the products. The network comprises of 18 cities and municipalities, all three Regional Councils of the area, as all four Chambers of Commerce.
- ITS Factory in Tampere, an innovation and experimentation environment for intelligent traffic, which aims to position Tampere region as a key player in the development of the environments for intelligent traffic.
- NordicWay aims to develop new kinds of traffic services and road traffic automation for cars, to utilise the mobile network in order to share specific and low latency traffic safety information regarding obstacles on the road, weather conditions, slippery surfaces and accidents.
- Aurora Fell Lapland Test Arena, a test area for automated driving with a goal to create an internationally unique, information-based test area and centre of excellence for intelligent traffic automation in Arctic conditions.
- Aurora Living Lab Bus, a test bed that enables development, testing and demonstration of various services and technologies in transportation. A fleet of innovative electric buses in normal operation in the Helsinki Region is used as a concrete test environment.

22 <http://traffyclab.fi/test-environments/>

The Traffic Lab provides test and demonstration services in the following areas: transport legislation; data protection, consumer protection, taxation and insurance; product commercialisation; and standardisation and certification.

Tampere University of Technology (TUT)

At Tampere University of Technology, TUT-Lab provides testing and demonstration services for SMEs. TUTLab consists of two parts: ProLab and FabLab.

ProLab is a lightweight engineering workshop that supports both research and teaching by manufacturing research equipment for their use. Its services include component manufacture, assembly, mechanical and electromechanical consultation and machining services.

FabLab on the other hand is a new learning environment on TUT campus. It is an open workshop for digital manufacturing focusing on the integration of various techniques and it is the centre of manufacturing and hands-on learning for the students of TUT. The focus area is learning and joint research, rather than commissioned testing. FabLab offers different equipment for digital manufacturing, such as 3D printers, laser cutters, CNC milling machine and software for designing projects. Companies can book the machines for an hourly rate of EUR 100. Similarly, FabLab is available for companies for product development for a fee of EUR 2,000–2,500 per day. Companies can also work together with the students, for example providing challenges for the students to solve in TUTLab as course work.

SMACC

The Smart Machines and Manufacturing Competence Centre (SMACC) is a collaboration between TUT and VTT Technical Research Centre of Finland Ltd. SMACC offers high-end services in the field of smart machines and manufacturing. SMACC boosts the ecosystem development of the manufacturing industry and serves as a one-stop shop for flexible execution of research-based development projects. The competence centre provides companies with services for technological and business development and access to latest research findings.

SMACC's key areas of expertise are: advanced digital and additive manufacturing; digital design and modelling; digital services and quality management; maintenance and life cycle management; and automation and robotics. Services target companies aspiring to identify their own development targets in the digital operating environment; speed up their product and production development; test the functionality of their solutions with top experts in the field; and improve their overall productivity. Companies can join the SMACC community free of charge and gain access to specialised industry information, events, networks and the joint-use SMACC facilities at TUT.²³

2.4 SWEDEN / SKÅNE

In Sweden, the Research Institutes of Sweden, RISE (including Swedish ICT and Swerea, Swedish Research since 2016) provides most test and demonstration infrastructures benefiting SMEs in the digital economy. The test and demonstration infrastructures collaborate with SMEs – either based on commissioned work or through joint research and development activities.

Vinnova (Sweden's innovation agency) supports testing and demonstration of products, processes or services in SMEs through an innovation voucher scheme. Support can amount up to SEK 100,000.

The innovation voucher may be used to buy external expertise from research institutions, universities or private consultants and more specifically to investigate innovative and new business models, products, services or processes. The voucher may also be used to develop a strategy for mastering novel immaterial approaches. The vouchers are provided through innovation coaches at ALMI (regional business development centres), IUC (Industrial Development Centres) and Companion (regional business advisory and cooperation network).

RISE Research Institutes of Sweden

RISE Research Institutes of Sweden is a newly formed network integrating a large number of research and technology organisations (RTOs), wholly or partly owned by the Swedish state. The RTOs within RISE perform industrial research and innovation, and provide the vast majority of testing, demonstration and certification services available to companies in the digital economy in Sweden.

RISE SICS is a research institute in the field of digitalisation of products, services and businesses. SICS contribute with technology services within Big Data analytics, automation, security, and IoT. Advanced research is carried out in close collaboration with Swedish and international industry and academia – in particular within the areas of: IoT; industrial automation and maintenance; automotive and rail; telecom; digital health; digitalisation of education; decision support and business intelligence; and data centres

Key competence areas include: Big Data analytics, machine learning and optimisation; data intensive computing and cloud platforms; network technology and architectures; security, trust, privacy and integrity; Interaction and user experience; software and systems engineering and computer systems.

SICS has six laboratories:

- Computer Systems Laboratory
- Decisions, Networks and Analytics Lab
- Digital Health Lab
- People Technologies Lab
- Software and Systems Engineering Lab
- Security Lab

The main office of SICS is situated in Kista, outside Stockholm with smaller offices in Uppsala, Lund and Norrköping and regional subsidiaries SICS East (Linköping), SICS North (Luleå), and SICS Västerås.

RISE ICT provides test bedtest beds and demonstrator facilities that are both physical sites, and mobile and virtual resources. RISE ICT can support companies with pre-studies, research, industrial applications and project management as well as hands-on support. Eight test bed and demonstrator facilities are available through Rise ICT.

RISE Acreo is a research institute that provides resources and knowledge for companies throughout Sweden within electronics, optics and communication technologies. Facilities and lab resources are available for advanced R&D as well as for small scale production and prototyping. Acreo's mission is to find new ICT-solutions for existing and future demands, creating sustainable growth in the industry and the society.

Acreo National Test bed, ANT is an umbrella of test bed activities for a wide spectrum of regional, national and international institutions and companies working with research and development of today's and tomorrow's ICT products and services within the areas of smart living, eHealth, service distribution and broadband networks. The test bed is open to companies and universities that wish to test their equipment or service in a sophisticated environment with real networks using real end users.

Acreo Fiberlab is a laboratory for research, development, manufacture, and characterisation of advanced optical fibers and preforms. Testing and development can be done in advanced coating technologies, microstructured fibers and silica capillaries, doped core preforms and more.

Electrum Laboratory is a test bed for nanoelectronics. It makes available a semiconductor process laboratory, with complete process lines for device research and fabrication of components in a wide variety of materials such as silicon, glass and polymers. The 1300 m² clean-room area for electronic, optoelectronic and MEMS processing is operated jointly by Acreo and the Royal Institute of Technology (KTH).

The Printed Electronics Arena Manufacturing Lab, a greenhouse located in Norrköping Science Park (NOSP), is used for the development of prototypes and small scale production of printed electronics. As an incubator, PEA Manufacturing is open to anyone that would like to test printed electronics in their products and processes – including start-up companies, SMEs and well established companies.

RISE Interactive C-Studio is based in Norrköping. The studio works with project based applied research, development and experimental production within the field of visualisation and interaction design. With a practical and prototype driven approach C-studio works with projects within many areas such as immersive display environments, stereoscopic 3D technology, interaction design, information and geo-visualisation, ambient visualisation, and exhibition design. The centre collaborates with industrial partners and constitutes a hub for knowledge dissemination and commercial collaborations.

The test bed, usually known as 'The Catalyst' or 'The Wall' has its origins in a research project called Smart ICT for Sustainable Living, in Stockholm Royal Seaport – a project funded by Vinnova and implemented by the Swedish ICT institutes SICS and Acreo. The main aim of the test bed is to create better conditions for SMEs and enable them to create, combine, integrate, test and demonstrate their products and services on a more open and tolerant platform. Some of the test bed activities have taken place in the companies' own premises using a remote connection to The Catalyst. The Catalyst can therefore be considered as both a physical and a virtual IoT test bed. The Catalyst belongs to RISE ICT, while the researchers working with it are from SICS. The Catalyst is

a purpose-built test bed for SMEs. It is difficult for small companies to pay 100 per cent of the costs for using The Catalyst and the SICS expertise. Therefore, research activities have so far been conducted as projects with external funding with the SMEs only paying their own hours of work.

A new industry sector, the datacentre sector, is emerging in Sweden. Large companies – including Facebook, ABB and Ericsson have already installed large data centres in Sweden. To further take advantage of this opportunity SICS Swedish ICT, in partnership with Luleå University of Technology, is planning for a large-scale testing and experimentation facility under the working name SICS ICE (Infrastructure and Cloud datacentre test Environment). The test facility will enable research and support large scale testing of new datacentre technologies.

Urban ICT Arena (UICTA) is an open co-creation arena and test bed in Kista where the possibilities of digitalisation are developed, tested and showcased. The overall purpose is to futureproof Sweden by using UICTA projects to help develop tomorrow's sustainable cities, boost innovation and secure jobs for the future. UICTA has extensive an IT infrastructure comprising several different types of wired and wireless components (including 5G networks and dark fiber) – combined with a unique presence of community stakeholders from industry, academia and the public sector.

Swerea

Swerea is the Swedish Research Institute for Industrial Renewal and Sustainable Growth – and a part of the RISE network. Swerea supports industrial renewal and sustaina-

ble development. Its objectives are to create, add value and disseminate research results in material development, process and product development – and do this in close cooperation with academia, business and society. Swerea is made up from five subsidiaries, each focused on different research areas such as composites, polymers, metals, ceramics and textiles.²⁴

Swerea supports companies with testing and demonstration through smaller facilities as well as large test and demonstration infrastructures. Associated researchers support the companies with preparation, implementation and evaluation as well as in making proposals for solutions and improvements. Test and demonstration services for SMEs are provided both as commissioned work (often in the case of design, calculation and material testing) and through collaborative development efforts together with industrial partners. Around 15 per cent of Swerea's total budget is supplied from RISE and designated for strategic development. A large part of Swerea's funding is applied from national and European research programs in cooperation with industrial and research partners.

Swerea's engineering hall in Mölnadal – close to Gothenburg – houses extensive production resources for companies creating prototypes of new products. The facility has production equipment to suit a number of different materials and technologies. In the digital space Swerea can assist with building electronics using circuit boards, soldering, contacts and so on, as well as production of enclosures for electronics, enabling them to cope with high temperatures and rugged environments.

The Virtual Lab is a service to companies that use simulation to support certification

24 <https://www.swerea.se/en/about-swerea>

and safety approval. Companies can access expertise in the use of modelling and computational tools that can be applied within different materials (ceramics, composites, textiles and metals) and manufacturing processes. Advanced modelling and simulation can be performed in many different areas of the development process, including conceptual design, materials development and manufacturing engineering as well as prediction of the performance and characteristics of components and systems.

2.5 LITHUANIA

The Lithuanian Agency for Science, Innovation and Technology provides SMEs with support to research and innovation activities through innovation vouchers. The innovation voucher supports companies buying R&D expertise or knowledge from research institutions. The aim is to speed up knowledge transfer and commercialisation of research results. Companies may receive support amounting to 70 per cent of eligible costs, up to EUR 5,682.

Testing and demonstrating is not specifically mentioned in the programme, as Lithuania currently lacks such technological service institutions. Rather, collaboration between SMEs and companies takes place in the form of joint research and entrepreneurship incubation activities at a number of universities and national research institutions. The universities and research institutes have recently established what is called 'open access R&D centres/laboratories', where business and public partners can access the R&D resources, advanced technologies and access other advanced services. The 'Open R&D Lithuania network' is a joint venture between 14 Lithuanian universities, 13 public research institutes and eight science and technology parks.

Kaunas University of Technology

Kaunas University of Technology (KTU)²⁵ has two centres of science, studies and entrepreneurship: The 'Santaka' and 'Nemunas' valleys. Santaka and Nemunas is part of the National Innovation and Entrepreneurship Centre located at KTU. Established in 2014, it serves as a hub in Lithuania for applied scientific research and innovation.

KTU hosts the IT Open Access Business Lab specialised in providing technology service-



²⁵ <http://ktu.edu/en/institute-materials-science/>

es on eye tracking equipment to companies in communication, advertising, web services and media agencies. The equipment establishes human gaze heat maps to help establish where the gaze is focused. Such research helps to find out whether the advertising layout, website or product packaging efficiently attracts consumer attention and where exactly they cast this focus. More specifically the eye tracking equipment is designed for: assessing advertising product design in focus groups of potential customers created; assessing attention of website visitors in focus groups; and assessing attention of consumers of print layout design in focus groups.

Vilnius University

Research areas at Vilnius University includes: diagnostics and treatment of diseases, genomics, biomolecules and biotechnologies, changes in ecosystems, protection, natural resources, and new functional materials and derivatives.

Companies and other organisations can collaborate with Vilnius University through joint research activities, commissioned research services, use of research infrastructure and services at Open Access Centres – including assistance with licensing inventions and patent applications.²⁶ Research areas related to the digital economy at Vilnius University includes: laser physics and light technologies; fundamental and applied mathematics and informatics, and information technologies.

Vilnius Gediminas Technical University

Vilnius Gediminas Technical University (VGTU) is active in technological science and experimental development, benefitting from its 14 institutes, two research centres and 34 research laboratories.

The main VGTU initiative targeting product development and prototyping, is the cre-

ativity and innovation Centre, 'LinkMenu Fabrikas', that aims to nurture research and innovative ideas into commercial products, services or processes. At LinkMenu Fabrikas the emphasis is on audio, electronics, metal engineering, picture, colour and paint.

LinkMenu Fabrikas includes a workshop on electronic and electromechanical work. Here, companies can rent facilities for design of electric schemes; design and manufacturing of printed circuit boards; composition of electronic systems; optimisation of electronic systems; and electromechanical works. Also at LinkMenu Fabrikas there are workshop facilities for 3D printing and layouts and 3D scanning.²⁷

Center for Physical Sciences and Technology

The Center for Physical Sciences and Technology (FTMC) is the largest scientific research institution in Lithuania, with the areas of fundamental research and technological development in laser technologies, optoelectronics, nuclear physics, organic chemistry, bio and nanotechnologies, electrochemical material science, functional materials and electronics.²⁸ FTMC primarily carries out fundamental and applied research, as well as experimental investigations in the fields of physics, chemistry and technologies to the benefit of the Lithuanian society and economy.

FTMC has both a large pool of laboratory facilities and experts, including 38 habilitated doctors of science, 246 doctors of science, more than 500 researchers and 60 PhD students. In January 2017, over 300 scientific investigations were ongoing commissioned by companies. Key areas of scientific expertise in the digital economy space include development of new optoelectronic devices as well as electronics and sensors.

²⁶ www.vu.lt, www.vu.lt/en/research/intellectual-property-and-innovations/for-business

²⁷ www.vgtu.lt/for-business/research-and-services/sustainable-building/87312

²⁸ www.ftmc.lt/en/science/directions-of-scientific-activity

2.6 LATVIA

Currently in Latvia – as in Lithuania – it is the universities that provide the majority of test and demonstration infrastructures in the digital economy. Nonetheless, there are ongoing efforts to soon announce an Innovation Voucher scheme providing up to 60 per cent government co-financing for R&D projects and product testing.²⁹

The Institute of Electronics and Computer Science

The Institute of Electronics and Computer Science was created in 1960 as a part of the Latvian Academy of Science and is a state research institute dedicated to fundamental and applied research in computer science, information, communication and electronic technologies. It has six different laboratories: signal processing, time measurement, sampling conversion, network research and development, embedded system and cyber-physical systems, all of which can be used by university students. Moreover, the Institute provides different products and services such as dimension 1200es 3D Printer and Digital Serial Analyser, used for consumer electronics gigabit transmitter and signal path characterisation.

One of the services they provide is the EDI Test bed. This is a 100+node heterogeneous sensor network and wireless sensor networks test bed for validation and research in sensor network protocols. It can be used as a test facility for large-scale experimentation with sensor network software and hardware and WIFI network software.³⁰

Riga Technical University

Riga Technical University (RTU) highly prioritises collaboration with industry, including innovation and technology transfer, and application of scientific discoveries. For business and other organisations, RTU offers: laboratory research; design and prototyping services; start-up support; as well as premise and equipment lease. RTU Lab assists with prototype design, experimental production, product upgrade, as well as contracted work; consultative services on product design and development; prototyping and testing; and design of custom-made research.³¹

Equipment can be leased through the Use Science Platform which is an online scientific service, equipment, and program register. The Use Science system was developed to catalogue, record and locate laboratory equipment, ICT and specialist tools more effectively, by utilising the assets already in existence and lessening the need for duplication of material assets. This ensures that RTU employees, students, representatives of enterprises and other institutions, as well as public users have the information regarding research equipment, software, and services, which are available at RTU and Use Science partner institutions. More than 20 different partners offer their services and equipment through this system in many different research fields including biotechnology, computer science and technology. Although most of the partners are universities, SMEs and start-ups can also enquire the access to the equipment for testing and prototype development and finding available testing and demonstration facilities in Latvia.³²

²⁹ <http://www.labsoflatvia.com>

³⁰ <http://www.edi.lv/en/about/>

³¹ <http://www.rtu.lv/en/valorization/uznemumiem-un-organizacijam-1/services-2>

³² <https://scientificservices.eu/facility>

RTU Design Factory brings together research, education and the industry to create a new hands-on learning culture and opportunities for radical innovation. RTU Design Factory provides access for researchers and students to facilities, tools and services for prototyping, enabling them to create new and complex solutions. Technologies on offer range from laser cutting and engraving, 3D printing and scanning, to high-speed CNC machining and post-processing. They also work with interdisciplinary student and researcher teams to solve real-life challenges from various industries by developing scientific equipment, demonstration models or fully functional prototypes to support scientists and staff of RTU. Nevertheless, start-ups and SMEs can rent the equipment and the space as well in order to develop their solutions and prototypes.

RTU also supports business development through Idea Lab, which helps students and alumni members to develop their business ideas into the reality. Idea Lab provides the space for the meetings and work, consultations by experts, mentoring and in some cases, also the financial support for the business idea development. Idea Lab's main focus is on the students, however in some cases it also works with start-ups and SMEs to help them to develop the solutions by providing access to the Design Factory, to test and develop prototypes and apps.

2.7 ESTONIA

In Estonia innovation vouchers are available to SMEs through Enterprise Estonia. The innovation voucher enables SMEs cooperating with a higher education institute, test laboratory, or intellectual property experts, to develop innovative solutions, carry out tests with new materials, gather knowledge on technologies, conduct studies in intellectual property databases and more.

The maximum grant to SMEs is 80 per cent of costs up to EUR 4,000. Eligible activities supported under the scheme include: consulting on product or service development; consulting on production or technology; conducting product tests and industrial experiments; carrying out feasibility and cost-benefit research; legal protection consultation, tests and registration regarding patents, utility models or industrial design; consulting regarding metrology, standardisation and certification; and development and implementation of technological solutions.³³

Currently in Estonia – as in Lithuania and Latvia – it is the universities that provide the majority of test and demonstration infrastructures in the digital economy.

Tallinn University of Technology

Tallinn University of Technology (TTÜ) is the only technological university in Estonia and the flagship of Estonian engineering and technology education. One of its institutions, the Mektory Center for Innovation and Business, has a special focus on start-ups and development of new solutions for different problems.

It arranges start up competitions and workshops on how to launch a start-up as well as mentoring students in their ideas development. These concepts are promoted

33 <http://www.eas.ee/service/innovation-voucher/?lang=en>



on the Mektory website and can be pitched to industry delegations that visit the centre. Moreover, it offers different testing facilities and office space for students free of charge.

The centre has 11 different labs including Electronic lab, Telia TestLab and VR Lab 'Re:creation'. The electronic lab is a workshop created in collaboration with Erikson for quick prototyping and provides different equipment for testing. VR Lab 'Re:creation' focuses on virtual reality and aims to develop virtual reality skills, encourage students to engage in scientific research and develop ideas into practical applications. University students, scientist and visitors can improve products and services with unique virtual reality applications, train staff or clients through different simulations in virtual reality, test telepresence and establish cooperation with different research and development platforms.³⁴

Telia TestLab, also known as Smart Lab, is testing environment for mobile applications. It has a variety of mobile devices (hardware and software) on which manual and automatic tests can be run to provide the best user experience. University students can learn to develop and test apps on different devices (mobiles, pads, wearable) with different platforms (Android, Windows Phone, iOS). Testers and developers have a physical place to run automated tests with applicable software and emulators. Researchers and advanced stu-

dents can further develop automated testing, and companies outsourcing application development can benefit from an environment to test that outsourced application development function as ordered. The cost for using the lab for business customers is EUR 40 per hour plus VAT, which includes the rent of all lab devices, infrastructure and help with installations.

University of Tartu

University of Tartu (UT) is Estonia's leading centre of research and training and includes four faculties: Faculty of Arts and Humanities, Faculty of Social Sciences, Faculty of Medicine and Faculty of Science and Technology. The Institute of Computer Science within Faculty of Science and Technology is one of the fastest growing and most international institutes at the UT.

An important UT initiative is the Mobile & Cloud Lab at the Institute of Computer Science. It conducts research and teaching in the mobile computing and cloud computing domains and research topics include: cloud computing, mobile application development, mobile cloud, mobile web services, IoT and migrating scientific computing and enterprise applications to the cloud. In 2016 Institute of Computer Science opened an IoT lab in collaboration with Telia. The equipment in the lab will mainly be used by researchers in the mobile and cloud computing laboratory to create ground breaking, new smart solutions.³⁵

3. Policy observations and Recommendations

The mapping demonstrates that there are well-developed national networks of technology service providers that SMEs can benefit from to test new products, services or processes.

Moreover, it appears that test and demonstration infrastructures in Lithuania, Latvia and Estonia are becoming more sophisticated, partly due to support from new innovation voucher schemes in all three countries.

The Baltic countries have some way to go to reach the level of test bed service and expertise available to SMEs in Denmark, Finland, Norway and Sweden. Nevertheless, this situation offers an opportunity for sharing experiences on 'nuts and bolts' for successfully delivering test and demonstration services to SMEs in the digital economy.

Based on the mapping and the discussions at the Tampere workshop we put forward a number of policy observations and recommendations for macro-regional cooperation that can support and advance the Baltic Sea Region's position as the 'Top of Digital Europe' in years to come.

- 1. BSR regions and cities should make further efforts to jointly develop (smart city) digital test beds to fertilise the emergence of new business opportunities for digital SMEs. This should be done in partnership with companies and research institutions.***

Through public procurement, cities and regions play an important role in developing digital solutions in areas such as e-government, transportation, health or utilities. The public sector is the largest consumer of digital solutions in BSR. As cities and regions already provide test bed platforms for smart innovation across BSR, the region could benefit from cooperation around modalities and good practice for effectively utilising public procurement to advance experimentation and adaptation of digital solutions in society. It will also encourage SMEs to acquire test and demonstration services across the region.

The 2016 *State of the Digital Region* report argues that smaller cities in BSR can bene-

fit from their smaller size. It is for example much easier to conduct controlled experiments in cities like Tallinn or Malmö than in London. Bornholm Bright Green Test Island has proven this by conducting digital simulation of energy systems in a small (isolated) context but with implications and solutions that span much further than the island of Bornholm. Could the BSR do more to take advantage of such opportunities to do full-scale societal experiments in small scale, and thus at relatively lower costs?

Could cities and regions benefit from connecting, much more than is the case today, their smart city test bed? Several regions today make overlapping efforts to champion similar digital economy smart solutions at the same time. Combining efforts could provide new opportunities, such as for larger scale testing – a critical component for innovation in the digital economy. Combining efforts could encourage regions to ‘zoom in’ on specific digital economy areas where they hold particular excellence versus other regions. Could the BSR become a world class hub for innovation and business development in smart digital solutions for transportation systems, hospitals, power plants, water supply, waste management and more?

2. ***Pilot actions should encourage and explore the benefits from opening up and sharing digital test bed platforms across borders, thereby encouraging SMEs from one country to benefit from test bed infrastructures in other countries.***

While test, demonstration and verification infrastructures in principle are available for both domestic and foreign SMEs alike, in reality “most SMEs shop for digital technology services at home”. With test services – as

with any other services – it does not always make sense to buy everything at home. Transnational access to R&D would benefit innovation and internationalisation of SMEs and inspire smart specialisation in the digital economy in the BSR.

There are both overlapping and complementary areas of test bed expertise in the digital economy among regions and countries in BSR. Denmark has digital test bed expertise related to the energy sector; Norway’s expertise is related to the maritime sector; and Sweden and Finland occupy similar expertise related to the communication sector. This provides opportunities for SMEs to access technology services that in some cases are better tailored to their specialised needs. They should be able to commission test and demonstration services across borders, rather than mainly ‘shop for such technology services at home’.

3. ***We need better knowledge of the test bed excellence supplied. A more complete inventory, detailing also BSR’s particularities and complementarities in digital test bed excellence, including Germany and Poland, would encourage a better match of supply and demand across the region.***

It is necessary to improve the overview and inventory of existing infrastructures, excellence areas, existing equipment and machinery, and make this information available to SMEs. Furthermore, SMEs express a need for better targeted information, more transparency, more attention to company needs and earlier involvement as preconditions for engaging in transnational projects and looking across borders for test facilities.

For them to benefit from complementa-

rities in excellence and specialisation, technology providers should ensure that SMEs are informed and encouraged to commission test and technologies across borders. 'Transnational one-stop-shops' or similar concepts could be developed on a pilot basis.

A first step could be raising awareness of the various areas of particular excellence and complementarities of test and technology services across the BSR. Provision of test and demonstration infrastructures to SMEs requires significant financial and human capital. The same applies to SMEs that want to make use of these facilities. Test and technology service providers are mandated to provide a rather extensive set of 'basic' technology and test services locally and nationally.

neighbouring peers on commissioned services for SMEs it is important to identify cooperation areas that emphasise complementarities and mutual benefits, without risk of impacting negatively on current test and technology service delivery. For example, this could look like access to new knowledge and technologies, and a larger market. Hence 'sharing' test and demonstration facilities should be seen as broadening or extending opportunities.

4. For the test and technology providers, there should be clear incentives and added value of transnational collaboration as preconditions for taking further steps together.

We recommend to focus on the specific areas with complementary advantages. Related to this is a call for 'smart collaboration in the Baltic Sea Region', more specifically collaboration in areas of test and demonstration that are too large or too complex for regions and countries to address individually.

Designing policies and undertaking digital economy experiments is far from an exact science. Because of the complexity of developing and continuously keep up-to-date test bed infrastructures and technology services, there is unexploited added value in sharing experiences on how to successfully deliver digital test bed infrastructures and services to SMEs.

We propose that because test and technology service providers compete with their



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The Baltic Sea Region: A Global Digital Test Hub

Test and Demonstration facilities across borders