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Futures By Design: Enabling Soft Digital Network Infrastructures, by developing Digital Tools and Data Driven Innovations for SMEs in the North Sea Region

1. Introduction

Futures By Design (FBD) is an EU Interreg North Sea Region funded project created to help SMEs in rural areas of the North Sea region to use data analysis to innovate, grow and increase productivity. In accordance with the challenges identified by the World Telecommunication Development Conference 2017 and the ITU Plenipotentiary Conference 2018 Mandate on "Accelerating digital innovation ecosystems for digital transformation" that "talent is unfulfilled, SMEs are struggling, and slow digital transformation of communities is affecting social conditions and achievement of national ambitions", our project focuses on enabling small and medium-sized enterprises (SMEs) in regions of lower economic success to innovate, grow and increase productivity. SMEs are critical to regional economies and contribute considerably to regional employment, however, their capacity for success can be limited by insufficient access to data and the inability to analyse data to drive innovation and obtain improved results. The six regions where FBD is operating are: Cambridgeshire (United Kingdom), Antwerp (Belgium), Groningen (Netherlands), Osterholz and North-West Germany (Germany), Halland (Sweden) and Fryslan (Netherlands). Each has a sub-region of lower economic success. Based on our innovation tools and direct interaction with our target 300 SMEs in the North Sea Region, we will measure progress towards the objective of enabling 150 of them to grow, innovate, increase productivity to make a major step to being better equipped for the digital age, and for future success.

Drivers and barriers for data driven innovation amongst small to medium sized firms

The full report, available from the Interreg site, will be used by the project's partner teams to inform the establishment of the *Futures By Design* HSKT Hubs, a relevant example of *Soft Digital Network Infrastructure* and a key component for the success for localised digital innovation ecosystems. The contribution is structured into three sections: the first considers the emergence of data driven innovation and its relationship to digital innovation, the second highlights some of the generic barriers and drivers impacting SMEs ability to achieve data driven innovation

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regardless of country or region and, finally, the third provides national examples of barriers impacting each of the regions involved within *Futures by Design*.

2. The emergence of data driven innovations via digital innovation.

The OECD (2015) defines Data Driven Innovation (DDI) as the significant improvement of existing/ development of new products, organisational methods and markets emerging from analysis of data, including real-time analysis of big data and digital technology (OECD, 2015. Data Driven Innovation). We use the term "digital technology" not only to describe a type of technology but also to refer to the platforms, processes, and range of technologies that underpin modern information and communications technologies (ICT), including the Internet and mobile-phone platforms, as well as advanced data infrastructure and analytic approaches (USAID 2020 Digital Strategy, 2020). The principal driver of DDI is that more and more organisations are using digital technologies to leverage large volumes of (digital) data which is generated from a myriad of transactions and production of commercial processes; commonly referred to as 'Big Data' (OECD, 2015). However, DDI does not always require large amounts of data. For small businesses, DDI might, indeed, consist of the meaningful interpretation, and usage for forecasting, of small internal datasets based, for example, on customer's bookings, suppliers' transactions and tax reports. Interestingly, moving along the ladder of sophistication in DDI, new emerging techniques allow smaller datasets to be analysed in more detail, through the utilisation of deep learning and connected techniques (Medium, 2018). These techniques provide avenues to implement DDI, without, however, substituting the value of simpler and predominant forms of DDI, based on data visualisation, extrapolation, and relevant summary statistics coupled with elementary forecasting and regression methods. Furthermore, one key aspect of the evolving data revolution is the increasing availability of open data, allowing SMEs to achieve DDI through use of their own data matched with access to external datasets. Our work on FBD (research papers, pilot, initial operations) makes it clear that SMEs are very much 'small data' operators, but there is an importance even for them in knowing what is about to *hit* them through macro-advances in cloud and big data and our tools and HSKT hubs will help them navigating these environments.

One of the major types of innovation, leading to the generation of data and their usage for innovation purposes in the framework of DDI, is digital innovation. Digital innovation can be defined as 'a previously non-adopted digital modality to satisfy a specific need in a given context' (Giovannetti, 2017). This definition includes more traditional classifications e.g., process, product or organisational innovations, or those between radical and incremental innovations, and includes the diffusion and adoption of digital innovations in new contexts. This broad definition is essential in the framework of digital technologies due to their intrinsic relation with converging technologies that may span across all these traditional classifications. As an example, digital product innovations may satisfy the need for an intermediate product or service within a production chain in a business-to-business (B2B) framework while, contextually, the same digital platform might be used to improve service variety for the end users in a business-to-consumer (B2C) setting. For example, due to the new Covid-19 related restrictions, a farm might need to bypass retailers and directly reach consumers though digital e-commerce platforms to sell its products, while using the same platform to procure essential intermediate products. Thus, the farmers adoption of digital platforms serves both organisational, and processes innovations, both in relation to manage upstream intermediate inputs, and downstream relations with final customers. Our broad definition also encompasses digital processes and organisational innovations associated with structuring and managing resources and outputs within SMEs, as in the case of *digital connected sensors* that are used to collect data related to production,

processing, and distribution of AgriFood products[1]. This definition of digital innovation also includes the adoption and adaptation of techniques that may be well-established in other contexts, a process defined as one of *creole innovation,* Edgerton (2007)[2].

3. Generic drivers and barriers for the adoption of digital technology among SMES

Data Driven Innovations, in SMEs, critically depend on the SMEs drivers and internal characteristics encouraging SMEs to adopt and adapt digital innovations. Amongst these, the literature has identified some key factors, briefly discussed below.

3.1 Absorptive Capacity

Absorptive Capacity considers the ability of a firm to recognise the value of newly acquired external information, internalise it and apply it to its work processes (Cohen and Levinthal, 1990). This is seen as a precondition for adoption of innovations in general (Leahy et al. 2007) and digital innovation in the specific, that would require certain *digital absorptive abilities*. Among these, we have:

- **Data readiness:** Data Readiness captures the Capability to collect, store and, crucially, to make use of data as part of a firm's regular business process with the goal to increase efficiency and innovative potential (Bay and Koster, 2020).
- **Organisational capability:** This considers the capacity of an organisation to adapt to and cultivate opportunities which are occurring within the digital environment, which may require fundamental new forms of organisational structure (Quinton et al, 2018). Related to this, is a lack of business support and best practice guidance for adopting new technologies.
- **Workforce:** There is a shortage or lack of proper access to people with the right skills and in the level of systematic engagement with the skills education/training to support SMEs.

A key tool for a better understanding of the digital skills shortage in the current workforce is provided by the Programme for the International Assessment of Adult Competencies (PIAAC) organised by the OECD, that includes a Survey of Adult Skills. The ITU Digital Skills Toolkit (ITU, 2018) identifies other relevant resources[3] on developing strategies for digital skills for the workforce. The key approach of these contributions is that "digital skills develop across a continuum, and they are constantly being updated in line with changes in technology, highlighting the relevance of policy frameworks such as the Digital Competence Framework for Citizens (DigComp), developed by European Commission (EC) to improve digital competence, and providing a common language on how to identify and describe the key areas of digital competence and thus offers a common reference at European level.

3.2 Digital connectivity

Digital connectivity is clearly a precondition for digital innovation, and it is considered a social right in the EU. Following the recent COVID-19 pandemic there is an increased awareness of how

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[1] Software applications with machine learning are required to collect, analyse, and integrate data, connect devices, and guide decision making within the AgriFood supply chain. Data can help farmers to optimise inputs and adjust crops and land management regimes depending on many variable conditions between the fields, crop varieties, and climatic conditions. Data can also help suppliers of crop protection products to produce more accurate recommendations, or to gather evidence on their efficacy with more precision, reducing their use and environmental impact (FAO, 2017)

[2] David Edgerton, Creole Technologies and Global Histories: Rethinking How Things Travel in Space and Time," Journal of History of Science and Technology, no. 1 (Summer 2007)

[4] The International Telecommunications Union (ITU) discusses in depth the problem of international comparisons of the affordability of the Internet access (ITU, 2020).

essential digital connectivity is for the European economy, by allowing some forms of economic activities to continue, by relying on widespread adoption, whenever possible, of new working from home practices with both SMEs suppliers and customers along newly digitised value chains.

The EU publishes an annual report, including the "Digital Economy and Society Index" (DESI) to monitor Europe's overall digital performance. The DESI is also an essential tool used by the Commission to monitor progress on the digitisation of SMEs, ("SME strategy for a sustainable and digital Europe" COM, 2020). The DESI has five dimensions, capturing: connectivity, human capital, use of internet, integration of digital technology, and digital public services. These have been compared across our project's regions as a background for Project interventions.

In the United Kingdom (UK), the Office of Communications (Ofcom) provides the latest data on connectivity through its Connected Nations Report (2019) reporting that "Over the last few years, the availability and take-up of superfast and ultrafast broadband, and the coverage and take-up of 4G mobile services have dramatically increased...access to full-fibre broadband connections has doubled from 1.5 to 3 million premises in the last year and.. the deployment of wireless home broadband from mobile networks further reduces the number of premises that cannot get a decent broadband service. However, this leaves 9% of the UK that does not have good outdoor 4G coverage from any operator, predominantly in rural areas. One in five premises, homes and businesses, remain unable to get good 4G indoor coverage or circa 53,000 premises cannot access either a decent fixed broadband service or get good 4G coverage indoors.

The key findings of the report are that "There are significant differences in performance between urban and rural areas. Overall, 58% of lines had an average 8-10pm peak-time speed of 30 Mbit/s or above in 2018. The proportion of lines receiving an average peak-time download speed greater than 30 Mbit/s was lower in rural areas of the UK (44%) than in urban areas (61%), and while 13% of urban lines had a peak-time speed of under 10 Mbit/s, the proportion was 33% in rural areas." (Ofcom 2019, page 3)

What matters for SMEs in rural areas is the geographic distribution of connectivity as there is no point of being one mile away from very good mobile coverage, if it does not reach a farm. On this topic, Rural England (2018), indicated that there are several issues relating to digital connectivity as a precursor for technology adoption, with a third of their respondents highlighting difficulty in finding external or outsourced digital connectivity support for their business.

3.3 Digital exclusion in the UK

If a community is digitally excluded, its SMEs will not be able to benefit from data driven innovations. The key components of digital exclusion, as identified by the ITU [ITU, IDI 2019] are captured by an area's level of network infrastructure and access to ICTs, (ICT readiness), the level of usage of ICTs in the relevant communities (ICT intensity) and levels of capabilities and digital skills. Low levels of ICT development, as captured by the ITU's *ICT Development Index* (IDI), can be driven by access, a poor interconnection infrastructure, and the lack of appropriate digital skills required to implement digital adoption. *Futures by Design* takes SMEs from the regions where digital skills may be weaker, on a skills-acquisition journey from self-evaluation, and starting as *data beginner* to becoming a *data player* able to benefit from a data project. Affordability, while not included directly into the IDI index, is also a crucial component in determining the costs barriers accessing infrastructure and it is calculated separately by the ITU[4].

[4] The International Telecommunications Union (ITU) discusses in depth the problem of international comparisons of the affordability of the Internet access (ITU, 2020).

4. Regional examples of barriers to data driven innovation

The *Futures by Design* report on Drivers and Barriers for Data Driven Innovation amongst Small to Medium Sized Firms ,includes a section on the barriers to data driven innovation for each of the North Sea regions involved in the project, providing examples of such barriers across the five regions addressed by the Futures by Design project in the UK, Netherlands, Germany, Sweden and Belgium. We briefly report, some summary details on the UK Cambridgeshire and Peterborough regional barriers to data driven innovation in Annex 1.

5. Developing tools to overcome digital barriers for SMEs

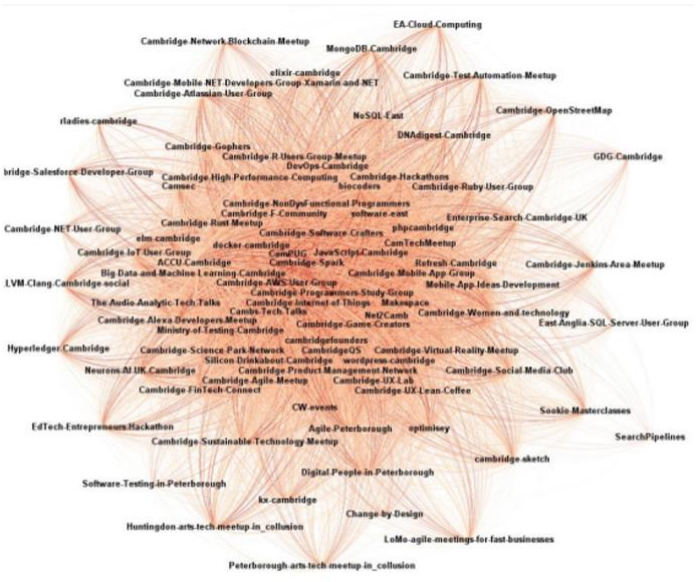
Futures by Design is developing different tools which we use to support SMEs in our regions. The purpose is to help participating SMEs with their next step to become more data driven and to provide the building blocks towards the formation of localised *Soft Digital Network Infrastructures*. The set of developed tools helps to outline the current status of digital awareness, discovering the lack of core digital skills and competencies, identifying needs, define the problem statement and explore the digital innovation possibilities. Every dedicated tool has its own added value and is helpful in a different stage of data-driven working for SMEs, starting from the assessment of an organisations level of data maturity before the start a dedicated project. In Annex 2, we report the recommended sequencing in which the tools being developed can best be used and create the most value, representing a possible path to digital awareness for SMEs.

Annex 1

UK Regional Analysis: Cambridgeshire and Peterborough

The digital sector is a significant part of the Cambridgeshire and Peterborough regional economy and has more than twice the employment in digitally intensive sectors compared to the rest of the country (CPCA 2019). In detail, Cambridgeshire and Peterborough's digital sector represents 8.84% of the region's total business turnover and 8.22% of employment, compared to a national share of 3.5%. But, more than this, digital is an enabling sector whose products and services offer increased productivity to all other industries – including two of the region's most important: agriculture (centred on the rich land of the Fenlands) and manufacturing (the largest sector in the region totalling 23% of business turnover).

On the policy side, *Anglia Ruskin University* has been working with *Cambridge Wireless* in developing our regional Authority digital strategy, the Cambridge and Peterborough Combined Authority Digital Sector Strategy, (CPCA 2019). This work is based on the analysis of both secondary and primary data collected through a survey of regional SMEs, focussed on identifying the perceived the key barriers faced within the local digital economy. One of the key identified barriers, emerged from the research underpinning the CPCA Digital Sector Strategy, was identified in the supply of a sufficiently skilled workforce across all levels of the digital sector, the retention of existing talent, and the upskilling of the adult population to enable all citizens to thrive in a digital world. The Digital Sector Strategy's vision is that the entire region becomes a *highly networked environment* where organisations help bring the communities together and support them as they make the right connections. The Cambridge and Peterborough Combined Authority Digital Sector Strategy reported that there are around 60 dedicated networking organisations in the Greater Cambridge area offering formal opportunities for high quality networking in general business areas, technology, energy efficiency, health-technology, and agrotechnology. These networking organisations work alongside organic, community-driven networking opportunities, as highlighted in Tech Nation 2018 through *Meet-Up* data. The relationships between the Meet-Up networks in Cambridgeshire and Peterborough is visualised below, demonstrating how individuals participate in multiple networking activities.



Connection map showing member-based links between meet-ups in the CPCA Area. If a member of one meet-up is also a member of another meet-up, a "bridge" is formed and mapped. Meet-ups with the most bridges are towards the centre.

Source: CPCA, digital sector strategy 2019

However, our survey found that networking was hampered by barriers that can be seen as preventing the emergence and success of the local *Soft Digital Network Infrastructure*, particularly in the more disadvantaged districts of the region: in the *Fenlands* agricultural areas two priorities were identified as critically relevant: “High quality business networking opportunities need to be more available across the entire region”, and “more inter-sector networking opportunities need to be available (e.g. agriculture meets sensors)” This last priority was also seen as critically important in the *Huntingdonshire* area. This evidence provided the rationale for further targeted intervention, as the one being implemented by the *Futures by Design* tools and HSKT hub.

Annex 2

The tools being developed and used to overcome digital barriers for SMEs

1) Data Jumpstart + Data Report

   This scan consists of a set of 40 questions that dive deeper into various aspects of data maturity. For example, we look at the infrastructure, tools and culture within the organization. Every company that starts with the FbD process completes this scan. When the Data Jumpstart has been completed, we move towards defining the outcomes. Every SME will receive a detailed report in which we break down the results and benchmark them against the reference group.

2) Preparing for FbD project

   To support the SME in the best possible way on its journey to becoming a more data-driven company, it is important for us to get to know the company better. Therefore, we created an assignment with several questions about the SME. We focus on the barriers met by the company and where do data opportunities are seen. We also focus on what do employees and customers think of about the company ideas.

3) Data inspiration booklet

   In order to give the SMEs participating in the FBD process a better picture of what is already possible for them in the field of data science, we have created a booklet in which some examples of projects within SMEs are illustrated. The examples in this inspiration folder are also divided into these 5 data maturity levels, hence after the Data Jumpstart tool, that asseses the level of data maturity for the company, it is easily seen which example projects are feasible for each data maturity level.

4) How to determine focus guide

   Most entrepreneurs who want to start the transition to a more data-driven company run into the following question: “Where do I start?” This guide has been created with the aim of helping SMEs determine their starting point. You decide on which part of your company you want to focus; you gain insight into your main motivation to get started, you define your ambition and challenges and ultimately work towards the challenge that requires the least effort and represents the most added value for your company.

5) Data structure guide

   Before moving on to the prediction stage, it’s important to know if the data available for an SME is ready for this. This data structure manual explains how a company can best check whether the data is collected correctly. For further analysis it is important that the data is clean and structured.

6) Data Explorer

   Many SMEs are not yet familiar with the quality of their data. The Data Jumpstart tool shows where the organization stands in the terms of data maturity. Part of this is the data quality. For example, there may be a lot of empty values in certain columns, or a negative number for an invoiced amount. The Data Exploration tool has been developed to determine how an SME can improve data quality. The data can be uploaded in a simple manner and the company will receive a report containing the various findings in the data.

7) Zipcode Explorer

Various projects have shown that many organizations need insight into their demographic customer geographic distribution. The Zipcode Explorer tool has been developed for this purpose. It provides insight into from which city and zip code the customers come from. By using this tool, for example, the management of customer relations can take place in a targeted manner.

8) Footprint tool

Websites are an integral part of SMEs identity. With the footprint tool, SMEs immediately get an overview of their website. This tool contains information about SMEs social media accounts, contact information, most important keywords of website, a short summary of the content, comparable websites and the loading speed. This allows an SME to compare how well its website scores compared to the competition.

9) Datasources checklist

A data sources checklist has been developed to check the quality of SMEs data sources. With this, the available data sources are mapped, but also described which are relevant within the organization. For each data source, questions are asked such as “Is it an open data source?”, “Is it sensitive data from a privacy perspective?”, “How was this data collected?”. By providing the answers to these questions, you can think in advance whether an SME will run into problems with a data science project.

10) Data Brainwave

The Data Brainwave distinguishes between three main categories:

- **Knowledge infrastructure**
  The extent to which various software is currently used, the expertise in-house, or collaborations with IT parties.
- **Preconditions**
  Prior to a project, consideration must be given to the commitment from different (management)layers, the available budget and the application of regulations.
- **Expectation management**
  By considering the expected results and ongoing challenges in advance, the chances of the project succeeding are greater.

11) Data Booster

The Data Booster has been developed to convert the results of the Data Brainwave and Data Jumpstart into actions. A brainstorm session is organized with the affiliate partner. The insights from the various used tools are discussed and used to start with a first specified step. During this session, we look at what else the company needs in terms of tools or support to achieve the formulated goal. After this session, the company or another commercial party can immediately start a project. In some cases, the partner can also support in the implementation of the project.

12) Data Ethics

The Data Project Ethics Assessment (DPEA) is intended as a decision-making tool to help data (science) students, practitioners and entrepreneurs start a data science project. The DEPA consists of a series of questions covering some, but certainly not all, important ethical considerations. Filling in the form gives a global picture of the ethical impact of the project.

This could then affect the choice to start the project, make changes, or stop it altogether and abort it.

13) Data Security

Whether SMEs are working with the data within their own company or working together with another party, it is very important to also consider how they handle their data safety. We have made a small checklist for SMEs with several tips on how to handle data in the safest possible way and what they should consider when thinking about working safely with data.

References are available on request and on the original report on the *Drivers and Barriers for Data Driven Innovation Amongst Small to Medium Sized Firms*, which can be downloaded here

For further information see
Project web site: http://futuresbydesign.net/ and https://northsearegion.eu/fbd/#

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