DESK STUDY - FUTURES BY DESIGN

BACKGROUND, SCOPE AND EVALUATION STRATEGY

WP3 - CONCEPT

SIERDJAN KOSTER, FRANZISKA BAY
UNIVERSITY OF GRONINGEN, FACULTY OF SPATIAL SCIENCES
sierdjan.koster@rug.nl, f.bay@rug.nl

1. Futures by Design

SMEs, firms up to 250 employees, are the backbone of the European economy. They make up 99.8% of all companies and they account for 66.4% of all employment (European Committee, 2018). Most SMEs are smaller than 50 employees (98.9% of total) and such small firms account for almost half of all employment (49.8%) in Europe. If anything, the importance of SMEs is expected to grow over time as changing economic conditions tend to favour smaller firms. Production is becoming ever more fragmented and specialized which allows SMEs to exploit niches. Production techniques become less labour intensive in the wake of automation allowing for smaller firm sizes. Also, the still ongoing shift to a service-based economy fits the properties of SMEs.

Although the importance of SMEs fits today's economy, it does provide new challenges as well. Survival rates of SMEs are lower than those for larger firms as they are more vulnerable to changes in external circumstance, including increased – international – competition, technological change and macro-economic fluctuations. Similarly, SMEs experience considerable barriers to growth and innovation. Madrid-Guijarro et al. (2009) identify a lack of access to finance, a reluctance to take risks, having employees with skills unfit for innovation and difficulties in accessing externally available knowledge as the main barriers to innovate.

Overcoming SMEs barriers to growth and innovation is then an important goal in any economy. And, indeed innovation in SMEs is one of the thematic focal points of the EU Horizon 2020 programme. The downsides of an SME-dominated economy are felt most saliently in less prosperous, often rural areas. SMEs typically occupy an even more central position in the economic landscape of such regions as large companies tend to cluster in agglomerated, central areas. Also, given the thinner economic network, knowledge about innovation and market developments is less readily available. Finally, access to financing is further hampered as banks typically favour firms in central locations because control on their investments is typically easier.

Futures by design, then, aims at contributing to increased innovation and growth potential for SMEs in less prosperous regions in Europe.

1.1. Goal and Scope

Likely fields in which SMEs could use external support include access to finance, finding/ developing employees with skills fit for innovation and access to externally available knowledge (Madrid-Guijarro et al. 2009). The same study found a reluctance to take risks also to be a main barrier for SMEs to innovate. However, the FBD project does not seek to provide individual consultation on all of these topics for every participating SME. Rather than that, the overarching goal is to raise

awareness and provide the necessary and relevant knowledge and data for SMEs to use for their growth and innovation. Data Science has emerged as one of the most important challenges for competitive companies within the last 15 years. While most international companies have their own data science teams or departments, most smaller firms do not have the skills and capacities necessary to collect and make use of large-scale user/ customer data. Often, new technology and knowledge is available online, the main task is finding precisely relevant information and being able to interpret and translate it into business strategies. Uncertainty and complexity are some of the key obstacles in innovation management (Tidd 2001).

FBD aims at providing SMEs access to data necessary for innovation and improved firm performance.

The regions addressed with the FBD project are Cambridgeshire (UK), Antwerp (B), Groningen (NL), Osterholz (DE), Halland (SE) and Fryslân (NL). The sectors included are health, light engineering and agri-technology. These three are core industries in all participating regions and therefore crucial for the local economy. In providing SMEs in these pivotal fields with the necessary tools to grow and innovate, FBD hopes to have an impact on the whole respective region. Ideally, the participating SMEs are interested in innovating and growing their businesses and show some extend of data readiness (the internal readiness and capacity to adopt new technologies and methods, also known as absorptive capacity). The level of data readiness exhibited by the participating SMEs is only partly influenced by the strategy of contacting the SMEs. It is expected that firms willing to proactively be a part of the FBD project will also show above average levels of data readiness and more drive to innovate and stay competitive.

There will be a central virtual horizon-scanning, knowledge transfer (HSKT) hub that generates a database and tool and real HSKT hubs in every region which can access all data. The regional hubs will be operated by a professional to provide support for the SMEs and continually improve the hub´s service. The hubs aim to structurally improve the innovation and growth potential in two ways which reflect the conceptual distinction between firm internal factors and external factors in adopting innovation for growth:

- HSKT hubs help improve the data readiness - as part of the absorptive capacity - of SMEs.
- HSKT hubs help SMEs in accessing information on the external environment, most specifically on the technological advances in the relevant industry.

1.2. What is an HSKT hub?

An HSKT hub offers SMEs an easy assessment of their ‘digital awareness’ and it proposes steps to optimize the use of digital tools for the benefit of the SMEs. It does so in three ways:

1) An online tool is provided in which SMEs can assess their so-called data-readiness: To what extent are SMEs aware of the options that digital tools can offer to streamline business

processes? The tool is interactive in the sense that it gives feedback to the SMEs about their current position (relative to local and international peers). Also, the tool proposes steps to take to improve their data-readiness.

2) The online HSKT hub also includes a repository that allows SMEs to scan databases that may be relevant for their businesses. It may provide information that can be used in digital tools (e.g. weather info), but it may also be used to gain access to information on the state-of-the-art of relevant technologies (patent databases). The website functions as a portal to freely available open access data, it does not store or gather the information itself.

3) In addition to the online presence, HSKT hubs provide professional support in the form of tailor-made trainings, workshops and/or tutoring to the SMEs. These are aimed primarily at steps that SMEs can take to optimize the use of digital tools and data science in their internal processes.

On the back-end of the website, Futures by Design gathers information on the SMEs involved, for example to be able to provide them with feedback on their relative position compared to their peers. Also, this information is needed to monitor outcomes and results.

Figure 1 visualizes the functions of the HSKT-hub.

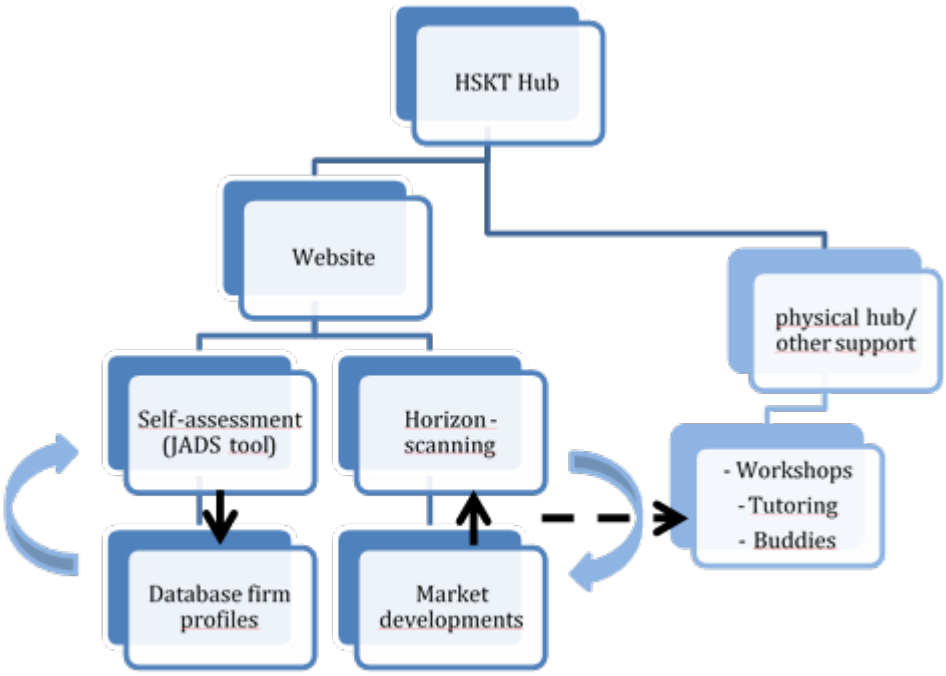


Figure 1. Concept of HSKT hubs including all processes and interactions

2. Innovation, digital skills & absorptive capacity

2.1. Innovation and new technologies

"Innovation is production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and the establishment of new management systems. It is both a process and an outcome." Crossan & Apaydin in Edison et al. 2014

Technological advancement has always been a substantial driver of innovation by making production or business processes faster, easier or more efficient. Currently, digitization and smart use of data and ICT has been argued to be one of the main determinants of growth and innovation (PwC Europe Monitor – Innovation and Digital Transformation, 2018). Digitization is a broad field that includes various opportunities for process optimization, but as with all new technologies, its implementation needs time and effort. While large enterprises increasingly make use of all options that digitization offers them, many SMEs are not yet aware of the benefits of using digital tools. The potential gains in market share and scope of e-commerce with web shops, online sales and marketing are easily explained and rather quickly experienced after implementation of the technology. When it comes to big data analysis, potential gains heavily depend on the type of data and the method of analysis, immediately tangible results are unlikely with this technology. However, with very little costs, insights into different customer, production or sales data can be used to optimize many business processes, thus increasing the enterprise's efficiency and freeing time and resources for further innovation. As with all developments of new technologies and methods, adopting these digital methods is crucial to an enterprise's competitiveness and securing its future. This is why it is a declared goal of the Horizon 2020 programme to foster digital awareness and data use among SMEs.

A lack of awareness of the benefits is only one of the hurdles to overcome. Most definitely the SMEs also need more information and advice on how to integrate the new technologies into their specific work processes, so that after a little extra effort with unlearning old routines, learning new ones and mastering skills related to them, they are forearmed for future challenges.

2.2. Absorptive capacity and data readiness

The theory of absorptive capacity as developed by Cohen and Levinthal (1990) states that in order to be capable of innovation a firm needs to recognize the value of newly acquired external information, internalize it and apply it to its work processes. As visualized below in a slightly updated version of the absorptive capacity model in figure 2, relevant influence factors on the individual level are the cognitive ability, previous experience and the social capital of the respective person. On the firm level, the organizational culture shapes how new information or knowledge can be internalized and put to use. The first step of absorbing new knowledge consists of recognizing the value of the information for the firm with the consequence to seek out information relevant to the individual firm

and its innovation. The success of acquiring the most relevant information to find solutions for challenges or ideas for future applications is influenced by the previous knowledge available within the firm. The next two steps happen simultaneously: the new information gets assimilated, meaning translated and interpreted for their firm context, and transformed by integrating it into previous knowledge clusters or experiences and combining it in new ways for novel applications. The last step is exploitation of the knowledge for commercial use or economic gains.

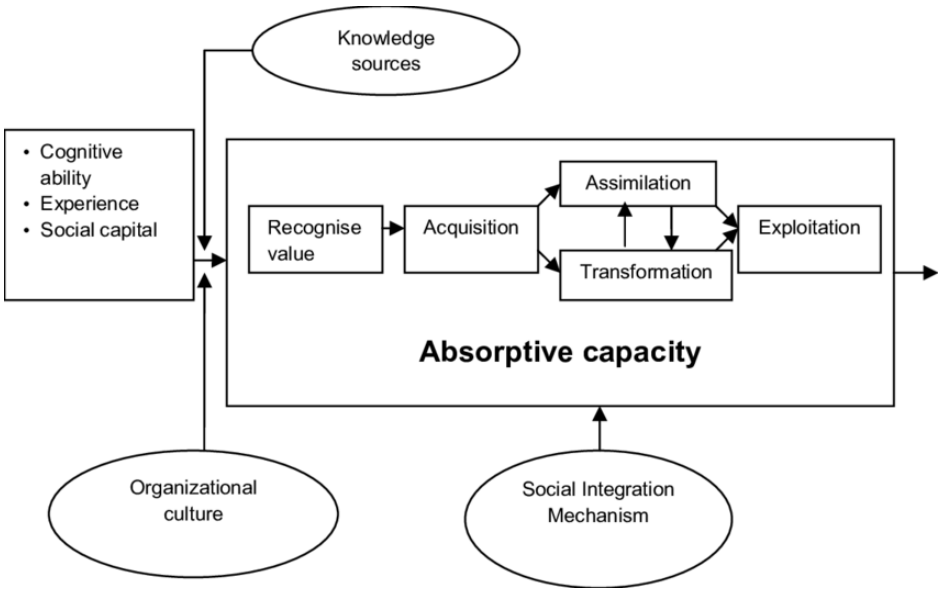


Figure 2 Theoretical framework of absorptive capacity. Source: Ziam, Landry & Amara (2009)

In the context of FBD the idea of absorptive capacity is interpreted in the field of data science and digital tools. The 'data readiness' of a firm then indicates the capability to collect, store and make use of data as part of a firm's regular business processes with the goal to increase efficiency and innovative potential. The absorption of knowledge on data science and tools of digitization with a consecutive integration and commercial exploitation should lead the SME to a higher level of data readiness.

In line with the model by Ziam et al. (2009), the starting point of the concept of data readiness is raising awareness for the potential gains SMEs could have from acquiring and utilizing new information or technologies. This will also the focus in the beginning of the interaction with the SMEs. Getting them to see the value in data science is the first step on their way to reaching a high level of data readiness. The acquisition of data science knowledge and skills will be supported by the project partners and specially developed tools that can hint at the type of information needed for the respective firm. One of these tools is the online assessment of the current state of data readiness of the enterprise. This will conclude with individual feedback on what the most relevant information for their level of data readiness would be. After defining their challenges and finding potential for improvement, the SMEs will acquire the relevant knowledge in cooperation and interaction with the

project partners. The effort that the firms have to make is internalize the information and translate it to their specific needs, integrate it into their existing knowledge base and transform it to fit their individual challenge or business situation. There will be concrete examples of how SMEs on different levels of data readiness absorbed new information about data science and made practical use of it in their business. This is one of the knowledge sources that can enter into the process of absorption. The outcome of this practical approach to the model of absorptive capacity is on one hand the use of the newly internalized knowledge and the economic gains resulting from that and on the other hand an improved data readiness, that makes it easier for SMEs to further advance their data science skills and thus increase their benefits from implementing digital tools into their work processes.

3. Knowledge hubs and SMEs

3.1. Adopting Innovations in SMEs

The adoption of data science in firms' operational processes is in essence the adoption of a new technology in the organization. The likelihood of a firm to adopt a new innovation depends on the interplay between internal readiness and capacity to adopt new technologies (also known as absorptive capacity, as explained before) and external conditions. These include the availability of knowledge and new technologies, but also the competition environment with more competitive environments pushing firms to seek out innovations more readily.

Factors that influence the absorptive capacity of SMEs internally are:

- Capacity / size
- Human Capital / skills
- Access to finances

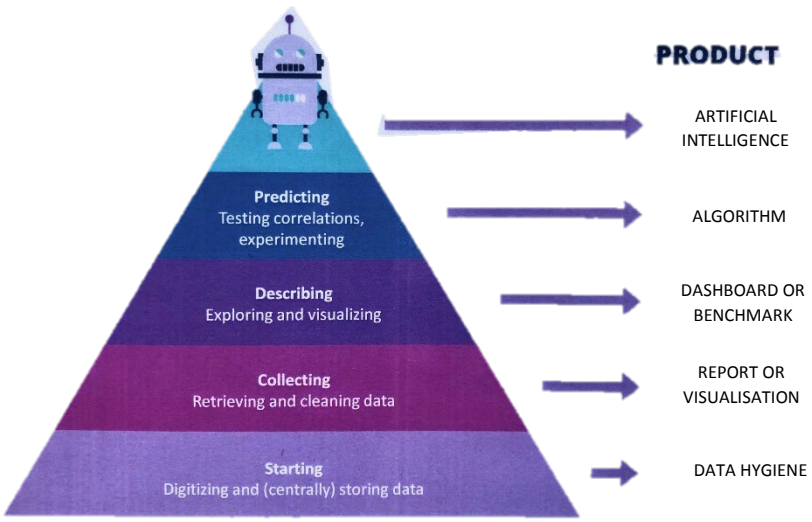
The size of the SME in terms of number of staff has an impact on the absorptive capacity for practical reasons. The more employees a firm has, the easier it is to find the time to work on data analytics and innovation management while other staff members are still running the operational part of the business. The smaller the firm, the more structure and prioritizing it takes to keep up-to-date with current developments and new technology. In this sense, the value that is given to adaptability and innovation creation goes hand in hand especially with the absorptive capacity of SMEs who, by definition, have smaller personnel capacities. Additionally, the cognitive capacity and individual skills the staff members of the SME have can also influence the absorptive capacity. For example, an employee with previous knowledge in data science or good analytical skills would positively affect the absorptive capacity in this scenario, whereas SMEs lacking these human capital factors will show a lower absorptive capacity. Gaining access to relevant information and technology can be a costly thing since not every information on the newest developments gets published in open access formats. In order to be able to make use of certain databases, tools and software, the SME needs to

have the necessary financial resources. All of this can help increase the absorptive capacity if available to the company.

In FBD, this translates to data readiness of the SME. This will be measured using an online tool created by JADS and a complimentary questionnaire during the first interaction between the project partner and the respective SME. The online tool, Jump Start, covers the areas of data availability, data quality, organization of data and data skills. Based on the answers selected by the entrepreneur, a level of data readiness as well as matching needs can be determined and advice and further steps can be planned.

There are five outcome levels of the Jump Start, each visualized by a different persona. The first and lowest is the beginner level or “the egg”. Entrepreneurs on this level have no experience with Data Science at all and need help with staring to collect data. The second level is the gatherer level or “the squirrel”. At this stage, entrepreneurs have some experience with data collection but need help cleaning, preparing and storing the data adequately. The next in line is the describer level or “the pirate”. This means being able to collect, store and analyze data but still needing help with predictive analyses. The fourth level is the predictor level or “the fortune teller”. At this level, entrepreneurs can also make predictive analyses, they just need to stay up to date on the newest developments in the field of Data Science. Lastly, the expert level is personified as “the king”, meaning that the entrepreneur is aware of all new developments in Data Science.

An additional questionnaire will be used to get a more detailed impression of the SME’s data readiness. In a conversation with the entrepreneur, (potential) data sources, uses and capacities will be discussed. This should contribute to a better awareness of the need for a high level of data readiness among the owners of SMEs.



The external environment, including external orientation of SMEs, influences the absorptive capacity via the interplay of new technology and knowledge and the competitiveness of the field of business. How well direct competitors access and adapt to new evolving technologies and findings has a firsthand impact on the SME striving to innovate. In order to stay competitive in their field, SMEs must be able to keep up with current developments and implement new technologies frequently. The faster changing their field is, the more important it is for the company to have a good absorptive capacity to adapt to technological changes and implement them to generate innovations.

In FBD, this translates to horizon scanning activities to obtain access to relevant technological information as well as market information. This will be implemented in the central hub in form of a database compiled of open access data that is available to all participants of FBD and can be organized and searched through various filtering options. A customizable newsfeed with information on the newest developments in the relevant fields of technology or data science could also be a part of the horizon scanning side to the hubs.

In short then, the adoption of data-led production processes in SMEs is dependent on their absorptive capacity, which can be translated as the data-readiness of the SME. In addition, access to externally available information on technological progress and market information – the external environment – is an important prerequisite for innovation in SMEs. Data science may be of great help in facilitating the access to such information.

3.2. Hubs around the world

Knowledge hubs can be found all over the world, mostly they are regional clusters of universities, research institutions and companies driving growth and innovation in the respective region. Reviewing pertinent literature leads to the impression that the most common form of knowledge transfer hubs contain a virtual component (such as electronic databases and collaboration tools) as well as a physical component (such as a shared space, networking and face-to-face meeting opportunities). The virtual part is mainly informative and does not bear high transaction costs. The physical part is more interactive, learning from others' experiences and sharing best practices in a more direct and informal way. Most studies agree on the finding that tacit knowledge transfer best happens in direct interactions (e.g. Ardichvili 2008). Below, some exemplary regional hubs and their main tasks are listed.

Georgia Research Alliance (Georgia Tech, USA):

I. academics in charge of research and knowledge transfer, thus

II. generating knowledge and

III. working together with partner companies and the business community translating knowledge into commercial value

Advanced Technology Development Center (Georgia Tech, USA):

I. provides entrepreneurs access to Georgia Tech facilities and researchers

II. creates space to network within local and academic entrepreneurial community

"Mittelstand 4.0" competence centre (various locations, Germany):

I. experts provide information and workshops on digitisation to all companies

II. offer regional networking opportunities for tacit knowledge sharing in physical hubs

III. help implement and optimise new processes via case studies and mentoring

Regional Innovation System Bangalore (India):

I. cooperation between higher education institutions and small group of SMEs for better use of customer/ user data

II. aimed at increasing absorptive capacity of regional SMEs through interactive learning

While all abovementioned hubs share the goal of increasing competence and innovation among local entrepreneurs, they make use of different resources and strategies to do so. A common theme for hubs in big cities or which are connected to renowned universities is that they mainly provide a space for tacit knowledge sharing and leave the rest to the entrepreneurs and scientists themselves. This seems to work well in the close proximity of Georgia Tech but is rather hard to imagine for the Futures by Design setting and participants. The regions participating in this project are not mainly cities with an existing knowledge cluster that the SMEs should get connected with. Meeting in a physical hub rather far from their firm location would not work for the SMEs targeted with Futures by Design, on the one hand because they most likely do not have much spare time to spend on networking and making connections for tacit knowledge transfer, on the other hand because they might not even be aware of the benefits of gaining new knowledge and insights in their fields. This is why the FBD project focuses more on raising awareness and providing knowledge individually, to spark innovation in the long run.

So, learning from more regionally diverse or rural projects like the one led by the German government, the knowledge will be brought to the SMEs and developed in interaction between them and experts instead of the more classical setting of a physical hub. Using case studies, trainings and mentoring seem to be the best choice to support knowledge gain in more peripheral areas. The information will be provided by a central hub. The meeting space does not play a big role in the FBD project as the knowledge transfer will happen directly and explicitly and thus cause tacit knowledge sharing to be of minor importance.

4. Evaluating Futures by Design

4.1. Goal and indicators of success

The ultimate goal of the project is to increase the regional growth potential of less prosperous regions in the North Sea area. The SMEs in Futures by Design as well as the HSKT hubs themselves are expected to contribute to this goal. Even though Futures by Design is expected to contribute to these goals there are many other elements that may also influence the regional or firm's competitiveness. It is therefore useful to distinguish between results and outcomes. The results are directly connected to the project interventions, while the outcomes describe the anticipated effects of the project intervention. While outcomes can be credibly related to the project interventions, the direct impact is difficult to establish as external factors beyond the project may also influence the overall performance of firms. For example, in case the economy in a region is hit by a downturn in the economy, firms performance is likely negatively affected even though the project may have been in fact been successful.

As the project results indicators, we use and collect the following information / indicators:

Table 1 Measures for Project results

	Questionnaire Question
1. Increased SME growth (5%)	
1a. SME Employment	How many people (in fte) are currently employed in your firm?
1b. Turnover	What was your firm´s turnover in the last calendar year?
1c. Market area served	In which geographic markets did your enterprise sell goods and/or services? (Local / regional, national, EU, beyond)
2. Increased SME productivity	
2a. Employment / Turnover	
2b. Perceived efficiency	How much time was spent working on core processes? (in per cent)
3. Increased SME Innovative Capacity	
3a. Perceived knowledge awareness	To what extent do you feel up-to-date with state of the art in your field?
3b. Perceived data-readiness	To what extent do you feel able to adopt data-informed processes into the work process?
3c. Improved data-maturity	Based on JADS classification: Jump Start – Brain Wave – Data Booster – Data Player, pre and post measure

3c. Product Innovation adoption	What is the share of turnover from products or services introduced in the last 2 years that were new to your company?
3d. Process Innovation adoption	- Have you introduced new or significantly improved methods of manufacturing for producing goods or services within the last 2 years? - Have you introduced new or significantly improved logistics, delivery or distribution methods for your inputs, goods or services within the last 2 years? - Have you introduced new or significantly improved supporting activities for your processes, such as maintenance systems or operations for purchasing, accounting, or computing, within the last 2 years?
3e. Organizational Innovation adoption	Have you introduced new business practices for organising procedures (i.e. first time use of supply chain management, business re-engineering, knowledge management, lean production, quality management, etc.) using data-informed decision making?

Table 2 Project Outputs

Indicator	Target	This includes…	Info comes from
Improved or new innovation support measures launched	10	- The launch of HUBS - Workshops organized - Tools developed or launched	- All FBD partners
Enterprises participating in cross-border, transnational or interregional research projects	300	- Users of the HUBS	- HUBS - Website admin
Research Institutions participating in cross-border, transnational or interregional research projects	10	- Partners in FBD - External partners in FBD - Participants in meetings	
Number of organizations / enterprises adopting new solutions by project end	200	- Product Innovations - process Innovations	- Questionnaire - website admin

		- Increased data awareness	
Number of organizations / enterprises informed about new solutions by project end	1000	- Website hits (tool) - audience in meetings	- All FBD partners - Website

4.2. Evaluation Strategy

The evaluation strategy ensures that the project results and outputs are documented and that the results, where possible, can be attributed to the project's interventions.

To do this in a meaningful way, the strategy has two important steps.

1) In the first step, information is collected, documented and analysed regarding the profile of the SMEs that select into the project (a table with information collected for SME profiling can be found in the appendix). The results of the project are likely to be different if the profile of the SMEs are different. Particularly, as explained earlier, the absorptive capacity of SMEs needs to be assessed as this indicates the readiness and ability of SMEs to adopt new technologies.

- Regional level information: sector structure, activities, firm sizes, technological frontier
- firm level info (SMEs participating): Aimed at absorptive capacity, including data-readiness, performance indicators

2) As a second step, participating SMEs are scored on the result indicators as presented in Table 1. Some of these result indicators can be obtained in one session, but for other it may be necessary to have repeat measures if at all possible.

- firm level info: Result indicators, including changes in data-readiness

With this information in hand, we can approach the evaluation in 4 distinct steps:

1) A comparison will be drawn between the SMEs that have participated in the HSKT hub benchmarked by the profile of the entrepreneurs in the region. This allows HSKT hubs to assess their outreach strategy and helps us see if we target the SMEs that we want to target in the project.

2) The initial survey and online statistics allow for assessing the scope of the project in terms of SMEs reached. How many SMEs have assessed their data-readiness? How many have used the HSKT hub to improve/ increase their data-readiness?

3) By following SMEs over time (surveys), we will be able to see if the SMEs involved improved their business performance. The initial survey scores can be compared to the follow-up survey scores, measured after active participation in the project, e.g. in form of a workshop. The surveys will include

questions on the SME's business performance as well as the assessment of their data-readiness. Thus, we can assess the effect of participation in the FBD project on both, business performance and data-readiness.

4) Conditional on data availability, we may assess the impact of the HSKT hub while controlling for the characteristics of the firms that have been involved in the HSKT hub. It is likely that the most innovation-ready firms find their way to the HSKT hubs. By comparing the regional firm characteristics to the (same) characteristics of the SMEs involved in the HSKT hubs, their impact can be assessed more precisely.

5. Concluding Remarks

The Futures by Design project, in essence, seeks to boost the absorptive capacity of SMEs, their capacity to identify and adopt new technologies for the benefit of their businesses. Perusing the existing literature on innovation, the adoption of new technology comes in two phases that both have a place in the FBD-project. First, entrepreneurs need to be aware of the possibilities out there and see the relevance for their business. Secondly, entrepreneurs need to have or develop the tools to effectively use the available technology. Typically, the two reinforce one and other.

Given their small sizes, the absorptive capacity of SMEs is relatively low. Put plainly, the typical SME entrepreneur is busy particularly running their business and less so investigating avenues to improve it. This observation then defines the scope of the FBD project to two interdependent activities:

First and foremost, FBD aims at increasing the awareness among entrepreneurs about the potential of using data to boost their own businesses. This involves pointing them into the direction of relevant data sources, but more to the point it tries to ask the question whether the structured use of data is relevant for an entrepreneur. Given the time constraints SMEs face, this first step needs to have a very low threshold and it should supply entrepreneurs with immediate feedback to questions such as: “Where do I stand? Should I explore the use of data in my day-to-day operations any further?”

The second step of the process is to train interested entrepreneurs in the use of data for their business, increase their relevant skill set. In contrast to many existing hubs, FBD is then not so much about creating a platform or network of interested entrepreneurs, it is much more about creating a proper and easily accessible learning environment. Even though entrepreneurs may mutually benefit from each other, the primary focus of the project is to provide entrepreneurs with the tools to explore and implement data science into their business.

6. References

Ardichvili, Alexandre. "Learning and knowledge sharing in virtual communities of practice: Motivators, barriers, and enablers." Advances in developing human resources 10.4 (2008): 541-554.

Chaminade, Cristina, and Jan Vang. "Globalisation of knowledge production and regional innovation policy: Supporting specialized hubs in the Bangalore software industry." *Research policy* 37.10 (2008): 1684-1696.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative science quarterly*, *35*(1), 128-152.

Depietro, Rocco, Edith Wiarda and Mitchell Fleischer, "The Context for Change: Organization, Technology and Environment," in Tornatzky, Louis G. and Mitchell Fleischer, The processes of technological innovation. Lexington, Mass.: Lexington Books, 1990, pp. 151- 175.

Edison, H., Ali, N.B., & Torkar, R. (2014). Towards innovation measurement in the software industry. *Journal of Systems and Software* 86(5), 1390–407.

Madrid-Guijarro, Antonia, Domingo Garcia, and Howard Van Auken. "Barriers to innovation among Spanish manufacturing SMEs." Journal of Small Business Management 47.4 (2009): 465-488.
- Rogers, Everett M., Diffusion of innovations, 3rd ed., New York: Free Press, 1983.

PwC. (2018). Europe Monitor – Innovation and Digital Transformation: How do European SMEs perform?

Tidd, Joe. "Innovation management in context: environment, organization and performance." International journal of management reviews 3.3 (2001): 169-183.

Youtie, Jan, and Philip Shapira. "Building an innovation hub: A case study of the transformation of university roles in regional technological and economic development." Research policy 37.8 (2008): 1188-1204.

Ziam, S., Landry, R., & Amara, N. (2009). Knowledge brokers: a winning strategy for improving knowledge transfer and use in the field of health. *International Review of Business Research Papers*, *5*(4), 491-505.

7. Appendix

Table 3 Demographic information needed from SMEs for profiling, collected in online questionnaire

Variable/ information	**Measured in/ scale**
Age of owner	In years
Age of company	In years
Number of employees	In fte
Did current owner start the business?	Forced choice: yes/no
Industry	Health, light engineering, agri-tech, other
Market	Regional, national, international
Highest education	Drop down menu
Vocational background in field?	Forced choice: yes/no
Experience in field	In years
Nationality	Drop down menu
Gender	Male/ female
location	Region, country
Family history of self-employment?	Forced choice: yes/no
Family/ living situation	Single, married (with kids)
Level of social support	1 item, likert scale ("How would you rate the social support you receive from family, friends and the likely?")
Level of experience with Data Science	1 item, likert scale ("How would you rate your level of previous experience with data science?")
Openness to new experiences	2 openness items taken from BFI-10
Knowledge self-efficacy	4 items (scale taken from Lin 2007)
Knowledge collection/ sharing (predictive of innovation capacity)	4 items (scale taken from Lin 2007)