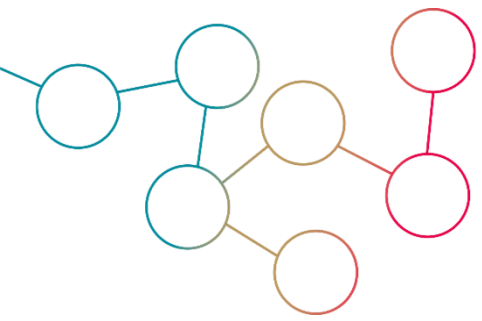


SMEs' digital capabilities and the barriers to adoption of digital innovations. An analysis across Seven North Sea EU regions.



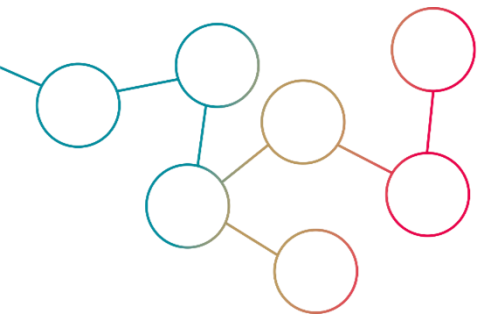


Data Projects as Adoption of Digital Innovations

Every company that started with the FBD process completed the Data Jumpstart, as one of the first steps to identify needs their digital needs and barriers.

After the Data Jumpstart had been completed, the team identified, together with each SME, a tailored data project aimed at the adoption/introduction of a digital innovation to address the SME's identified priority and needs.

Here, we focus on the key drivers, captured from the Data Jumpstart surveys, in determining an SME's likelihood to succeed, or fail, to complete the data project, i.e., to adopt a digital innovation



Overview & data

Futures By Design is an EU-Interreg North Sea project focussing on Digital Barriers to innovation for SMEs in otherwise prosperous and high-tech regions in the North Sea Area.

- Every SMEs that joins our project compiles a “Jump start data survey”
- This consists of a set of 40 questions on various aspects of an SME’s data maturity.
- For example, we look at the data infrastructure, awareness, tools and data culture within the organization.
- This, as well as other developed SMEs digital tools, are available at the [Futures By design Project Page](#)

sqans

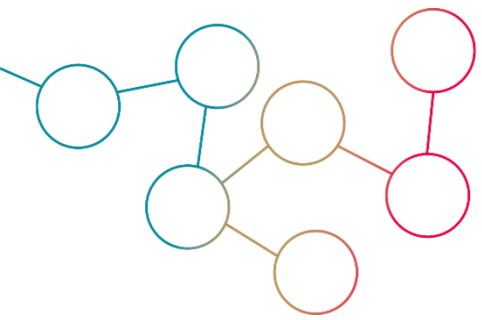
- Dashboard
- Surveys
- Respondents**
- Survey Results
- Tools
- PDF Templates
- Log Out

Respondents overview

SEARCH TABLE...

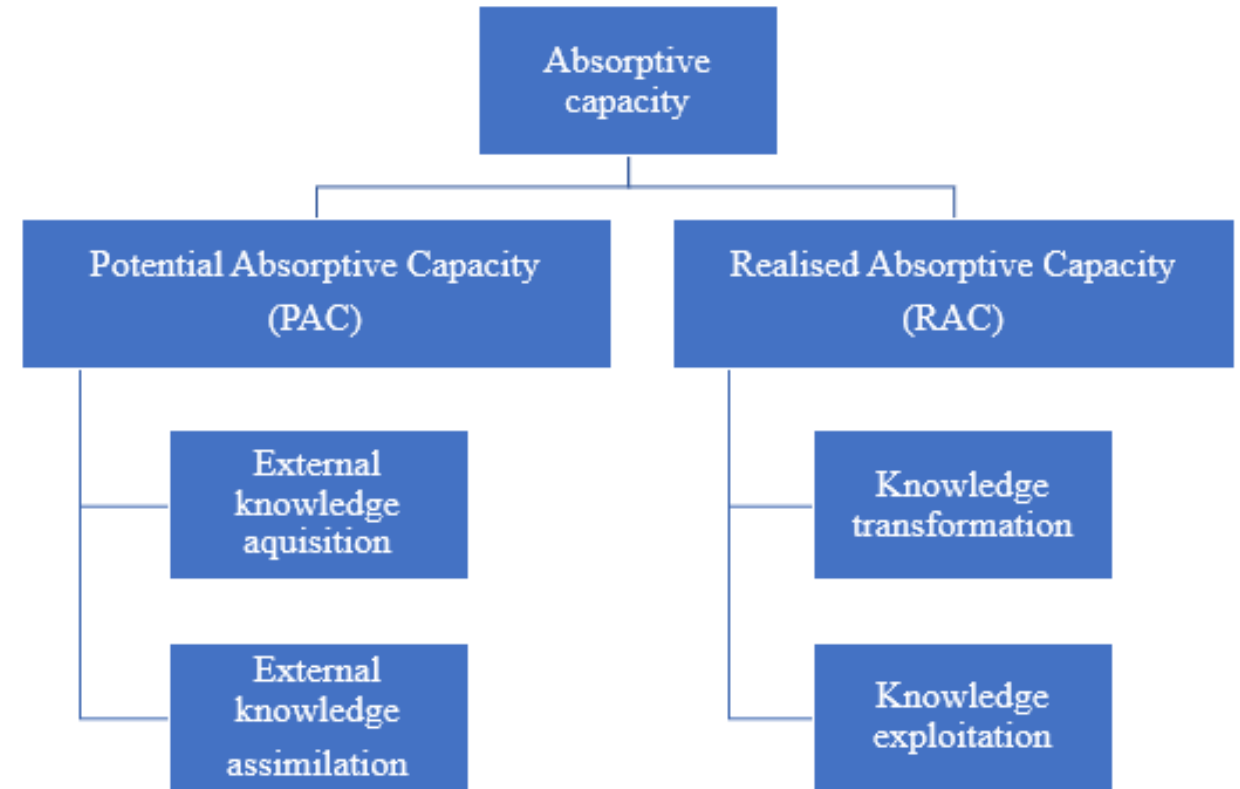
DOWNLOAD PROGRESS NEW +

| User | Company | Created | Modified | ACTIONS |
|--|-------------------------------|---------------------------|---------------------------|---------|
| jdehav@sky.com | The Barbers Den (Cambs) Ltd | Nov. 25, 2021, 12:36 p.m. | Nov. 25, 2021, 12:36 p.m. | ACTIONS |
| ihr@axiom-e.co.uk | inclusive Health Research CIC | Nov. 15, 2021, 5:07 p.m. | Nov. 15, 2021, 5:07 p.m. | ACTIONS |
| cambilingroups@gmail.com | Cambridge Bilingual Groups | Nov. 15, 2021, 2:07 p.m. | Nov. 15, 2021, 2:07 p.m. | ACTIONS |
| kiran@marketingcollege.com | Cambridge Marketing College | Nov. 8, 2021, 3:18 p.m. | Nov. 8, 2021, 3:18 p.m. | ACTIONS |



The focus is on SME's Absorptive Capacity

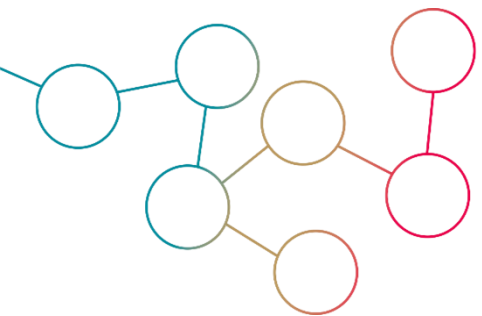
- **Absorptive Capacity** reflects an SME's ability to *recognize, internalize and apply the value of newly acquired external information* to its work processes (Cohen and Levinthal, 1990).
- **Absorptive capacity** is seen as a **precondition** for adoption of *digital innovations*.
- To better identify the key drivers and barriers of absorptive capacity in SMEs, we focus on **two very different aspects** of AC:
- **PAC and RAC** (Zahra and George, 2002)



Constructing RAC & PAC (Details of the Questions used)

- Left, concepts from literature
- **Rights**, matching questions from our *Jumpstart Questionnaire*.
- The scores obtained from a 5-point disagree-agree scale.

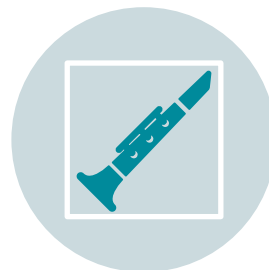
| No. | Items | Matched Jumpstart Questionnaire Answers |
|--|---|--|
| Potential absorptive capacity (PAC) | | |
| 1 | New opportunities to serve our clients are understood rapidly | Q19.1 My colleagues often bring new ideas and developments with regard to data to the table |
| 2 | We analyze and interpret changing market demands promptly | Q19.3 My organization strives for fast adoption of innovations in the field of data |
| 3 | Employees record and store newly acquired knowledge for future reference | Q20.1 My Organization is aware of the possibilities of working with data |
| 4 | We quickly recognize the usefulness of new external knowledge to existing knowledge | Q20.4 My organization often takes part in events with data as one of the main topics |
| Realized absorptive capacity (RAC) | | |
| 1 | We incorporate external technological knowledge into our firm | Q20.2 My organization likes to work with external parties when it comes to data gathering and analyses |
| 2 | We thoroughly grasp the opportunities new external knowledge offers our company | Q20.6 When new data becomes available, I use this to review my opinion |
| 3 | We periodically meet to discuss the consequences of market trends and new product development | Q19.2 My colleagues in general know their way around with new data-related technologies |
| 4 | Employees are clearly aware of how the firm's innovation activities should be performed | Q19.6 I am confident that the data within my organization is up to date |
| 5 | We are constantly reviewing how to better exploit external knowledge | Q19.4 When it comes to data, my organization has the means and opportunities to implement new developments quickly |



Project Completion and innovation



Ideally, one would like to measure our impact **with detailed financial data** on the impact of the data projects on an organization turnover.



However, the data available on the proportion of turnover due innovation collected through the Data Jumpstart, only refer to **periods preceding** the FBD's project intervention.



For this reason, our focus is on **the only observable outcome of our intervention/ interaction with an SME: its projects' completion.**

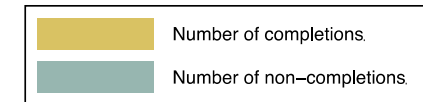
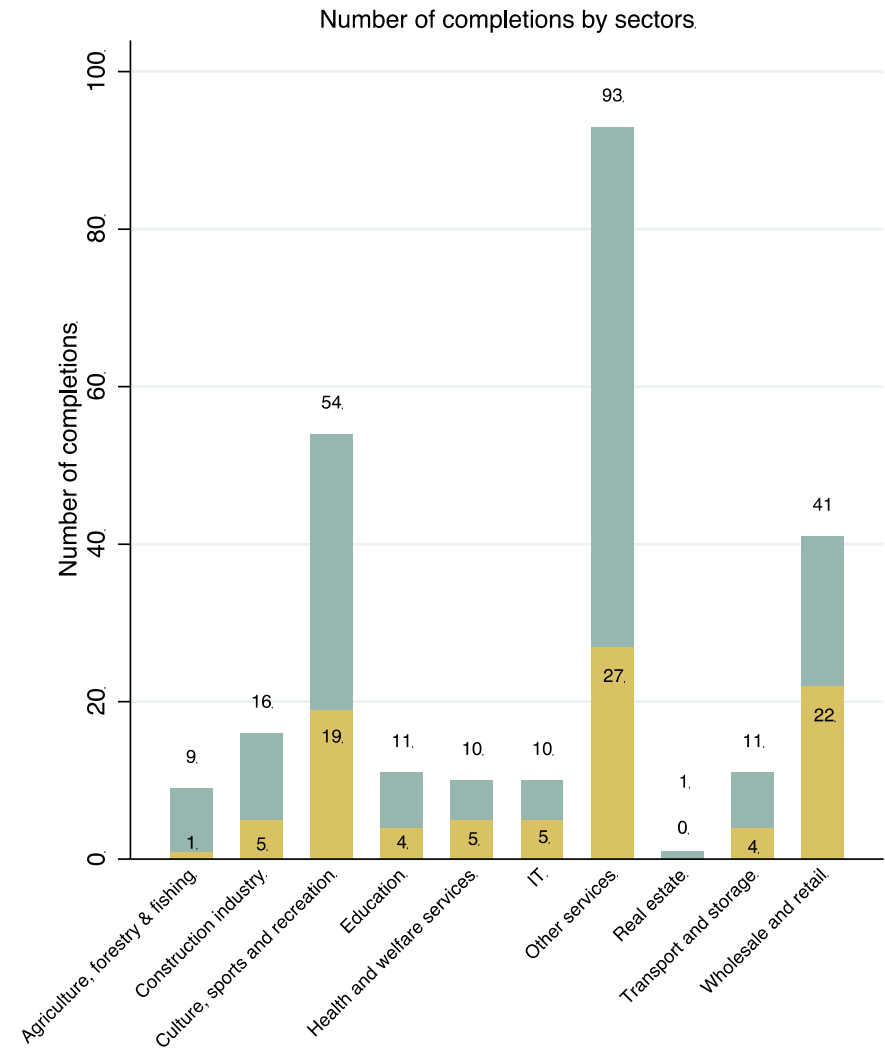
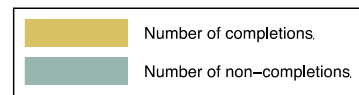
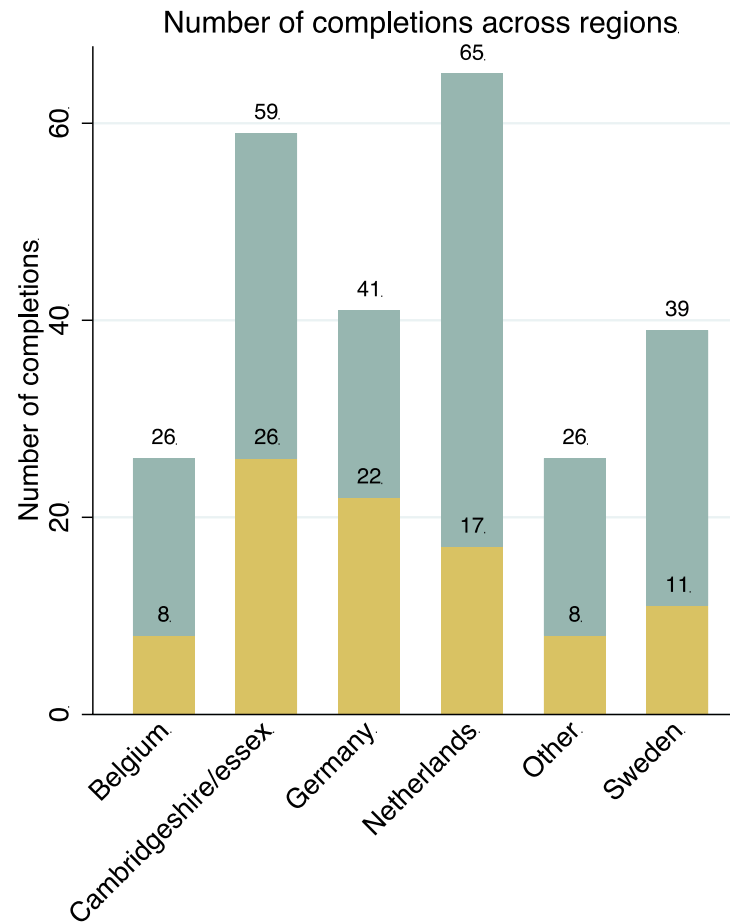


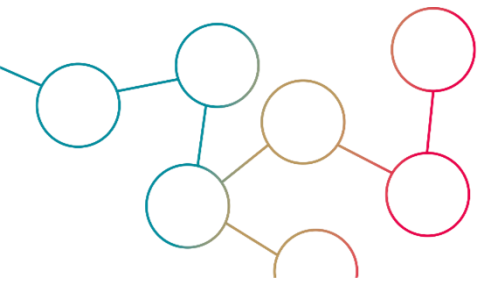
Moreover, circa 95% of companies reported that: **as the result** of their project completion, they increased their **productivity and innovation**, hence, by choosing projects' completion in the quantitative analysis, we obtain an informative proxy, on impact on growth, innovation and productivity, due to our intervention.



Number of completions across regions and sectors

- FBD has brought to successful completions 92 data project, out of 256 participating SMEs.
- These projects enable these SMEs to make a major step to being better equipped for the digital age, and for future success.
- **Project completion is a form of adoption of digital** innovation bringing in different ways of improving businesses activities through the adoption of digital solutions and technologies.
- Projects might lead to **product and service update or innovation, growth and productivity.**





Modelling Strategy

We build Two regression models, using an Instrumental Variable Probit regression (IVPR) , to assess the individual effects of both PAC, RAC on the likelihood of project completion.



We also consider the additional effects on project completion of other **key control variables** capturing different relevant dimensions of our SME's.



These focus on:

Internationalization,

Awareness digital tools

Data availability

Past innovations

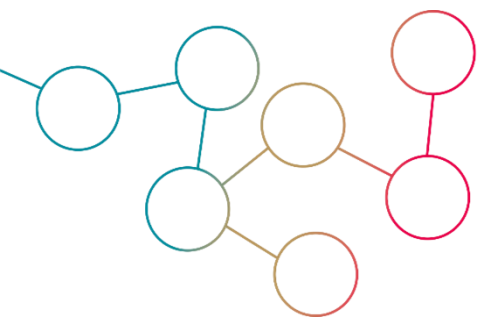
Time allocation

Awareness Security,

Data Infr.tructure

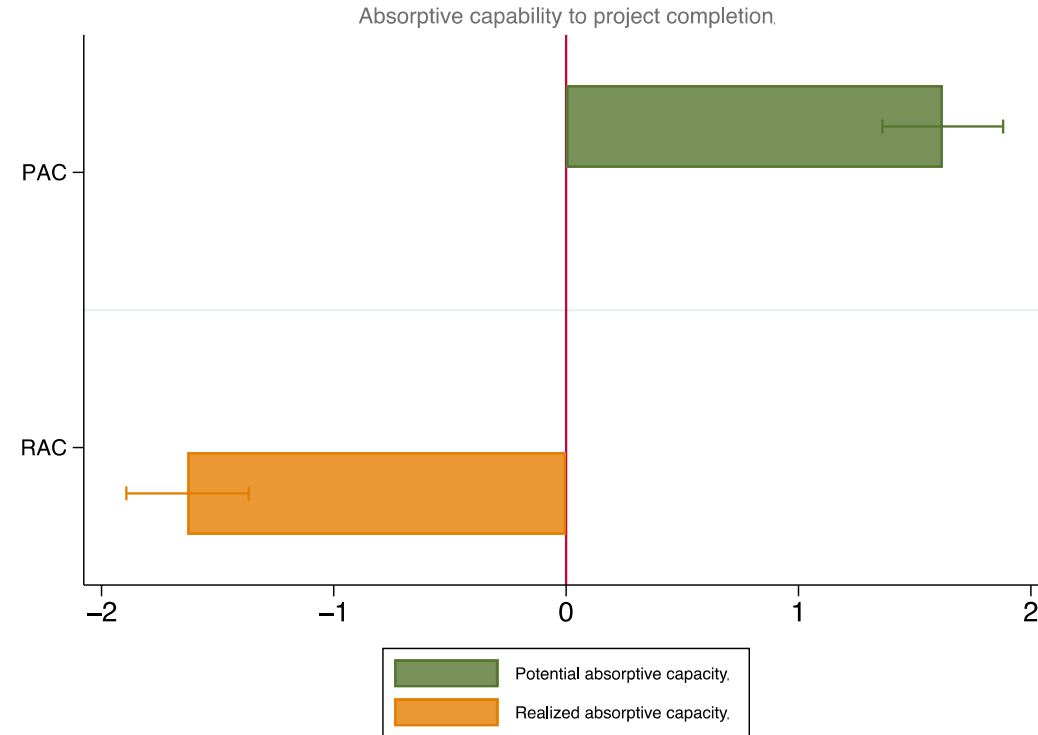
Company's Size & Age.

Main Results: the conflicting roles of PAC and RAC on Completion

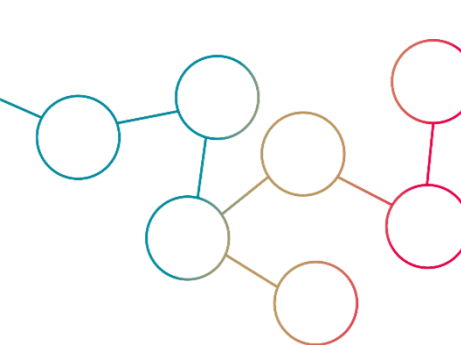


The PAC of an organization displays a significant and positive impact (1.619^{***}) on the likelihood of a project completion,

its level of RAC shows, on the contrary, a significant but negative impact (-1.63^{***}) on the likelihood of project's completion.



We use an **Instrumental Variables Probit Regression (IVPR)** model since there is a plausible reason to believe that one or more of the explanatory variables are endogenous, i.e., they are correlated not only with the dependent variable, as hypothesized, but also with other possible variables not included in the model but still affecting the dependent variables (Omitted Variables being part of the error term).

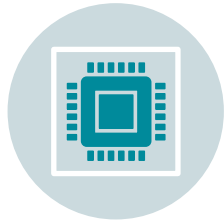


Take out: To innovate: look to the future (capabilities), do not rest on what you have learned already (competencies)



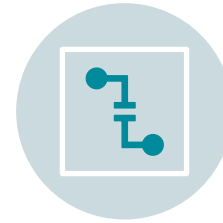
MAIN **POSITIVE** EFFECT ON DATA PROJECT COMPLETION:

A FIRM'S ABILITY TO **ACQUIRE AND ASSIMILATE** DATA-BASED KNOWLEDGE, ITS **POTENTIAL ABSORPTIVE CAPACITY**, FACILITATES THE COMPLETION AN FBD DATA PROJECT, A PROCESS OF ADOPTION OF DATA DRIVEN INNOVATIONS,



MAIN **NEGATIVE** EFFECT ON DATA PROJECT COMPLETION:

THE OPPOSITE EFFECT IS EXERTED BY A COMPANY'S ABILITY TO **TRANSFORM AND EXPLOIT** DATA-BASED KNOWLEDGE, ITS **REALIZED ABSORPTIVE CAPACITY**; HOLDING BACK THE LIKELIHOODS OF A COMPANY'S PROJECT'S COMPLETION.



...WHEN AN ORGANIZATION IS MORE **FOCUSED ON TRANSFORMING AND EXPLOITING THE SET OF ITS OWN TECHNOLOGICAL COMPETENCIES [WHAT HAS BEEN ALREADY ACHIEVED, (RAC)]** IT BECOMES LESS LIKELY TO **EMBARK ONTO, OR TO BRING TO A FRUITFUL CONCLUSION OF, A NEW DATA INNOVATION PROJECT.**



WHEN AN ORGANIZATION FOCUSES ON ITS ABILITIES **TO ACQUIRE AND ASSIMILATE EXTERNAL TECHNOLOGICAL KNOWLEDGE, (PAC)** IT BECOMES MORE LIKELY TO COMPLETE THE DATA PROJECTS BY EXPLOITING ITS **TECHNOLOGICAL CAPABILITIES.**

Conclusions and takeaways

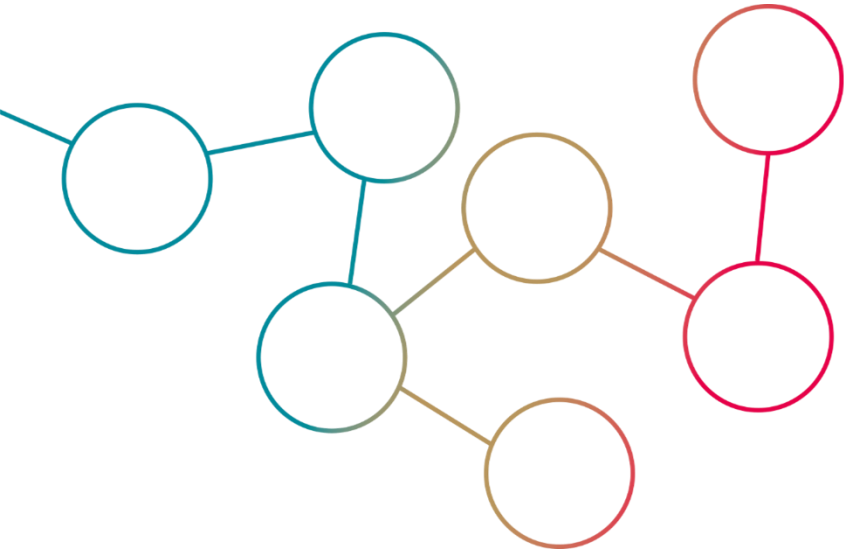
We focussed on understanding drivers and barriers for project completion, based on the data collected through the Jumpstart questionnaire. Our empirical evidence derived the following recommendations:

Recommendation 1: ” The **success** of an SME’s data-project, leading to the adoption of digital innovations, **benefits** from an increased level of SMEs’ **Potential Absorptive Capacity**. Hence programmes & policies should focus on training and supporting SMEs’ in Acquiring and Assimilating, external data-based skills.

Conclusions and takeaways

Recommendation 2: " The success of an SME's data-project, leading to adoption of data innovation, **suffers** from an increased level of SMEs' **Realised Absorptive Capacity**. Hence programmes & policies should focus on supporting SMEs' who do not yet have high competencies and abilities to Transform and Exploit data-based knowledge."

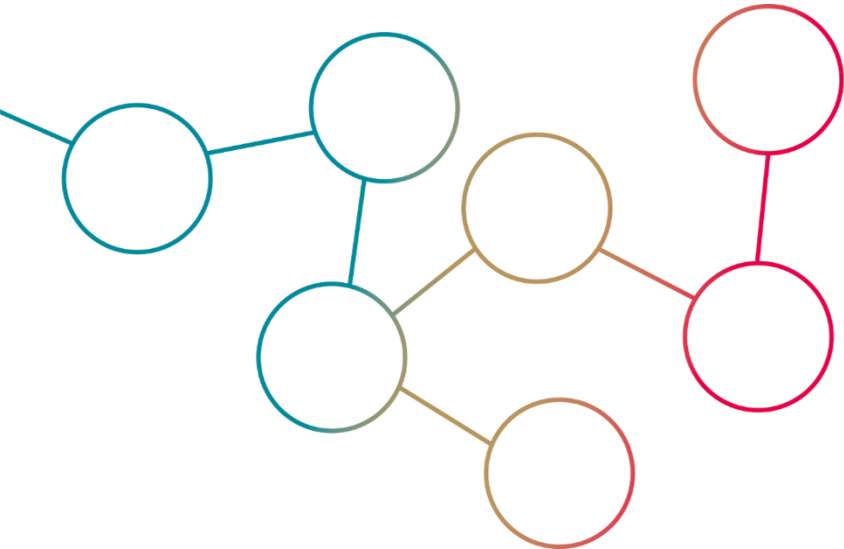
Such policies, will increase the impact of these interventions, by avoiding wasteful intervention where value for money (in terms of successful data project realisation) is low due to the smaller probability of successful projects completion when SMEs have a higher abilities to Transform and Exploit data-based knowledge.



Thank you for your
attention

EXTRA SLIDES?
No Time really...





...One more with
the estimates
numbers

| | Model 1 | Model 2 |
|--|----------|----------|
| Dependent Variable completion | | |
| Covariates | | |
| <i>Potential absorptive capability</i> | 1.619*** | |
| <i>Realized absorptive capability</i> | | -1.63*** |
| <i>Q7 - Geographic - Local</i> | .302* | -.126 |
| <i>Q7 - Geographic - Regional</i> | -.174 | -.071 |
| <i>Q7 - Geographic - National</i> | -.379** | .102 |
| <i>Q7 - Geographic - EU-wide</i> | .215 | .05 |
| <i>Q7 - Geographic - Worldwide</i> | -.141 | .056 |
| <i>Q15.1 - Tools - Spreadsheets</i> | -.067 | .127 |
| <i>Q15.2 - Tools - SQL</i> | -.006 | -.001 |
| <i>Q15.3 - Tools - Visualization</i> | -.066 | -.092 |
| <i>Q15.4 - Tools - API</i> | -.068 | .065 |
| <i>Q15.5 - Tools - Reinforcement Learning</i> | .007 | .224** |
| <i>Q16.1 - Analyzes - Productdata</i> | -.068 | .065 |
| <i>Q16.2 - Analyzes - Financial data</i> | .118 | .129 |
| <i>Q16.3 - Customerdata</i> | -.009 | -.119 |
| <i>Q16.4 - Employee data</i> | -.293*** | .226*** |
| <i>Q18.1 - Time - Gathering data</i> | -.269*** | .177* |
| <i>Q18.2 - Time - Managing data</i> | -.009 | .097 |
| <i>Q18.3 - Time - Analyzing data</i> | .028 | .053 |
| <i>Q18.4 - Time - Visualizing data</i> | -.063 | .108 |
| <i>Q21.1 - Security - Importance</i> | -.146 | .24** |
| <i>Q21.2 - Security - Software</i> | -.239*** | .144 |
| <i>Q21.3 - Security - Law</i> | .263** | -.235* |
| <i>Q21.4 - Security - Obey</i> | -.1 | .158 |
| <i>Q14.1 - Improved - Producing goods</i> | .198 | -.021 |
| <i>Q14.2 - Improved - Logistics</i> | -.103 | -.076 |
| <i>Q14.3 - Improved - Supporting</i> | -.241 | .089 |
| <i>Q14.4 - Improved - Organizing</i> | .472*** | .061 |
| <i>Q17.1 - Infrastructure - Data warehouse</i> | -.087 | -.002 |
| <i>Q17.2 - Infrastructure - Spreadsheets</i> | .032 | -.04 |
| <i>Q17.3 - Infrastructure - Cloud</i> | -.004 | .022 |
| <i>Q17.4 - Infrastructure - External</i> | -.043 | .091 |
| <i>Q17.5 - Infrastructure - Databases</i> | -.066 | -.005 |
| <i>Q17.6 - Infrastructure - Statistical</i> | -.011 | .061 |
| <i>Q17.7 - Infrastructure - Visualization</i> | -.011 | -.02 |
| <i>Q17.8 - Infrastructure - Programming</i> | -.222** | .155 |
| <i>Q9FTE</i> | .005*** | -.003** |
| <i>Q8Companyage</i> | .001 | -.004 |
| Sectors | | |
| <i>Agriculture, forestry and fishing</i> | (base) | (base) |
| <i>Construction industry</i> | .026 | .955* |
| <i>Culture, sports and recreation</i> | .346 | .758 |
| <i>Education</i> | -.218 | .806 |
| <i>Health and welfare services</i> | .128 | 1.193** |
| <i>IT</i> | .449 | 1.503** |
| <i>Other services</i> | .256 | .63 |

Additional covariates effects on FBD project completion/ PAC-Model

- **INTERNATIONALIZATION:**

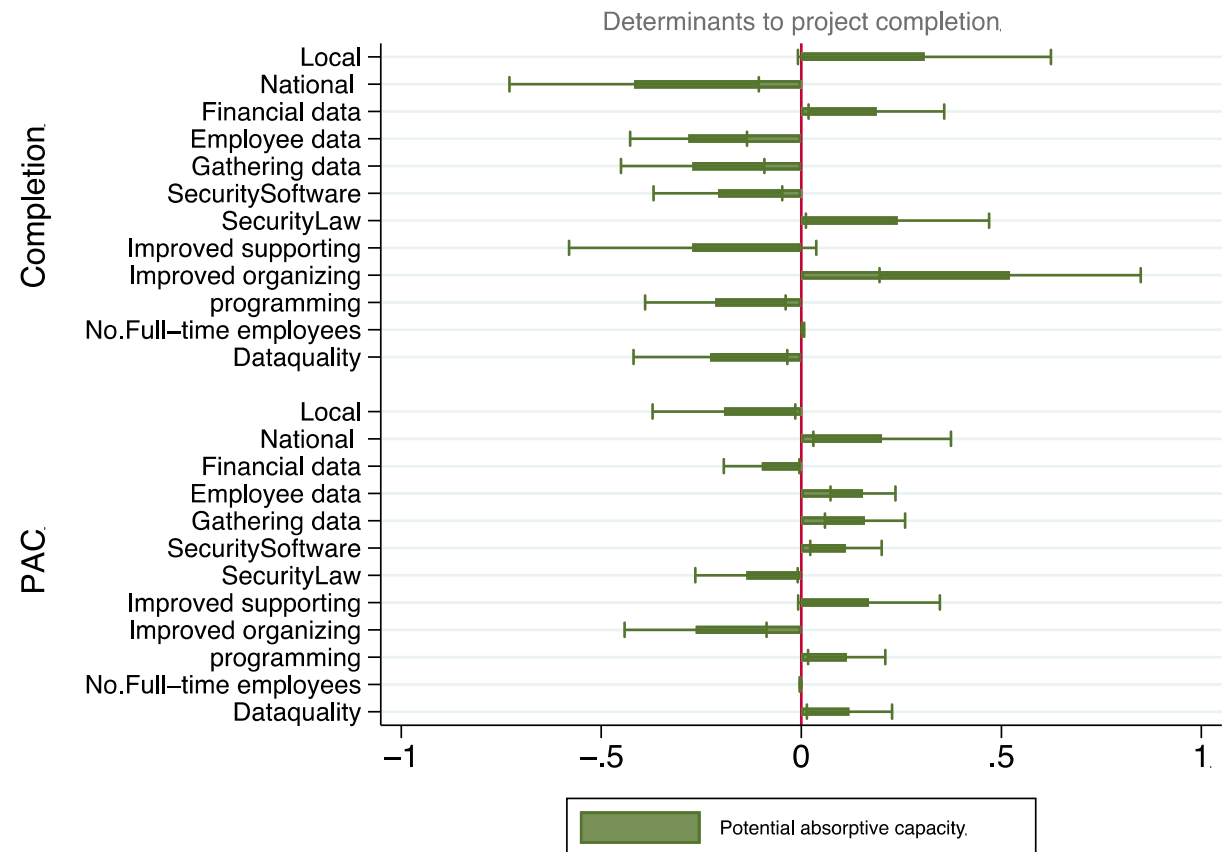
- Trading in **Local Markets** has a positive effect (.302*) while targeting **National Markets** has a significant negative effect

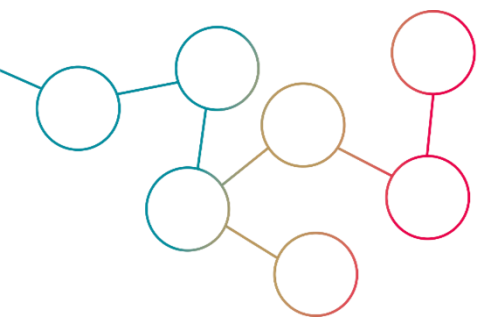
- (-.379**) on the likelihood of the completion of FBD data projects when conditioning for PAC, capturing the ability of a company for acquisition and assimilation of new external knowledge.

- This is as it would be expected since *Local market targeting might be culturally easier than even National market Targeting*, as a framework for completing FBD data projects, the nature of which was often highly local.

- **DATA AVAILABILITY**

- Focusing on Employee data, shows a negative effect (-.293***). This seems to show that a shift of the focus from seeking out external knowledge to internal operations when we control for acquisition and assimilation through the role of Potential Absorptive Capacity Model





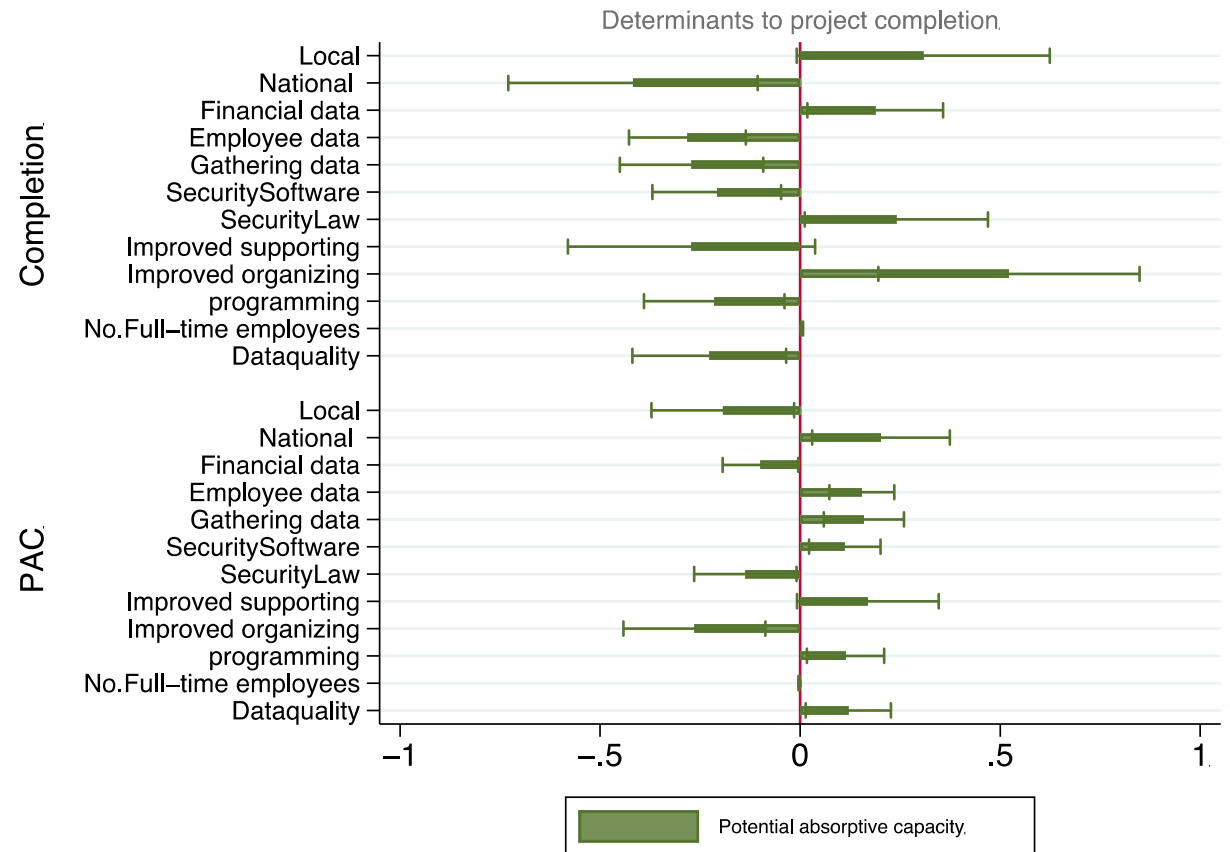
Additional covariates effects on FBD project completion/ PAC-Model

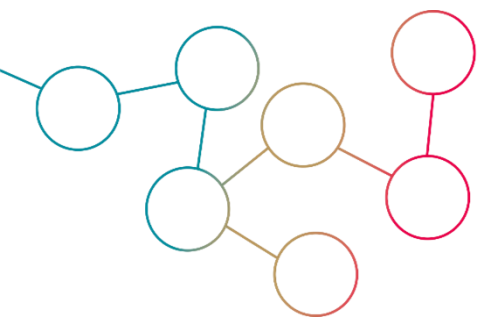
- **TIME ALLOCATED TO DATA PROCESSING:**

There is a **negative (-.269***) effect** of the time allocated **Gathering and digitizing data** on the likelihood of the completion of FBD data projects when conditioning for PAC, capturing the ability of a company for acquisition and assimilation of new external knowledge

- **PREVIOUS INNOVATIONS**

The introduction of "**New business practices** for organizing 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" **helps with the completion of FBD projects (.472***)** when conditioning for PAC, capturing the ability of a company for acquisition and assimilation of new external knowledge.





Additional covariates effects on FBD project completion/ PAC-Model

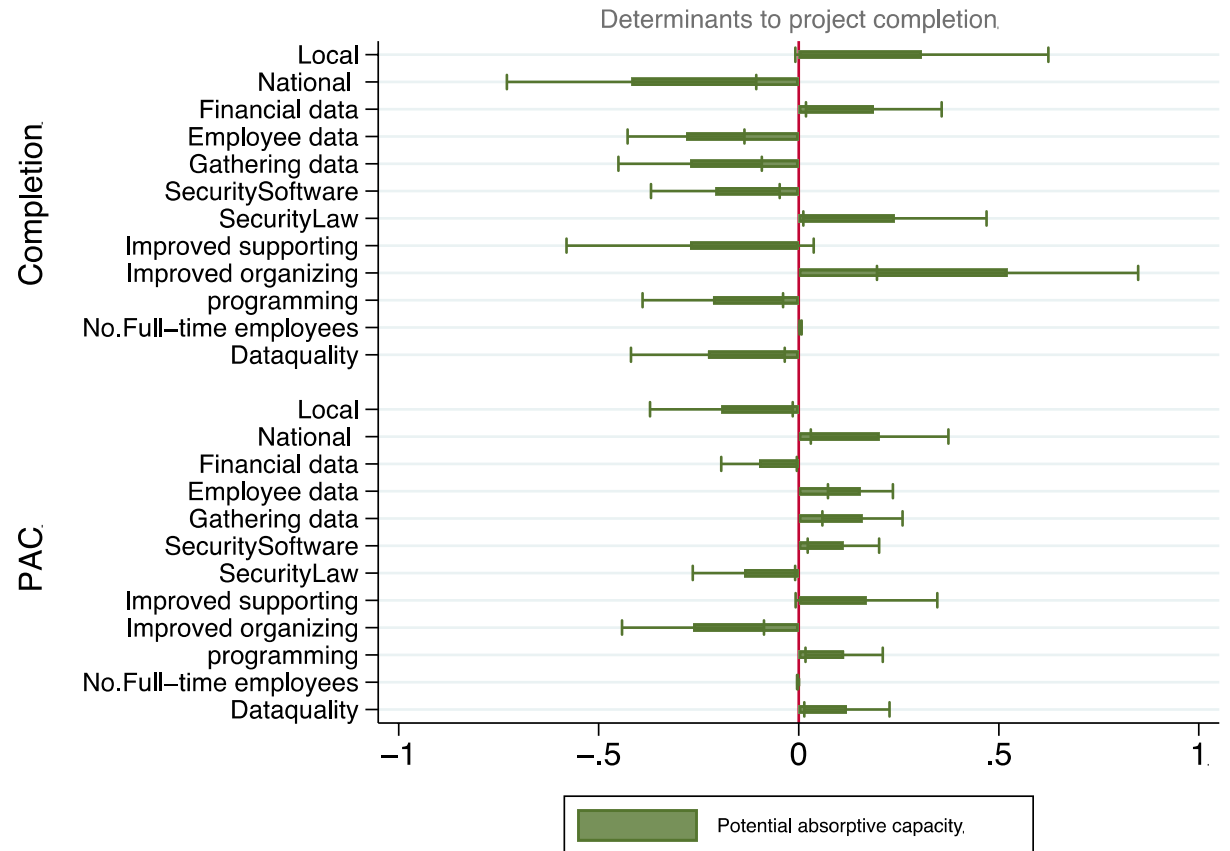
- DATA INFRASTRUCTURE

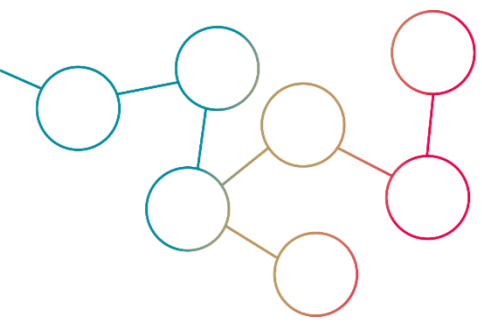
There is a **negative effect** for companies having data infrastructure for “**Programming languages such as R or Python**”. This variable has in facts a negative impact of **(-.222**)** on project completion when conditioning for PAC, supporting the hypothesis that **companies, may become less open-minded to the appreciation of new external knowledge, as they acquire and assimilate knowledge based on algorithm and experience.**

- FIRM SIZE

Firm size helps with the completion of FBD projects when conditioning for PAC (.005***), capturing the ability of a company for acquisition and assimilation of new external knowledge.

According to **resource-based view, firms with more employees are more likely to bring diverse ideas, perspectives and resources that can fuel the innovation.**





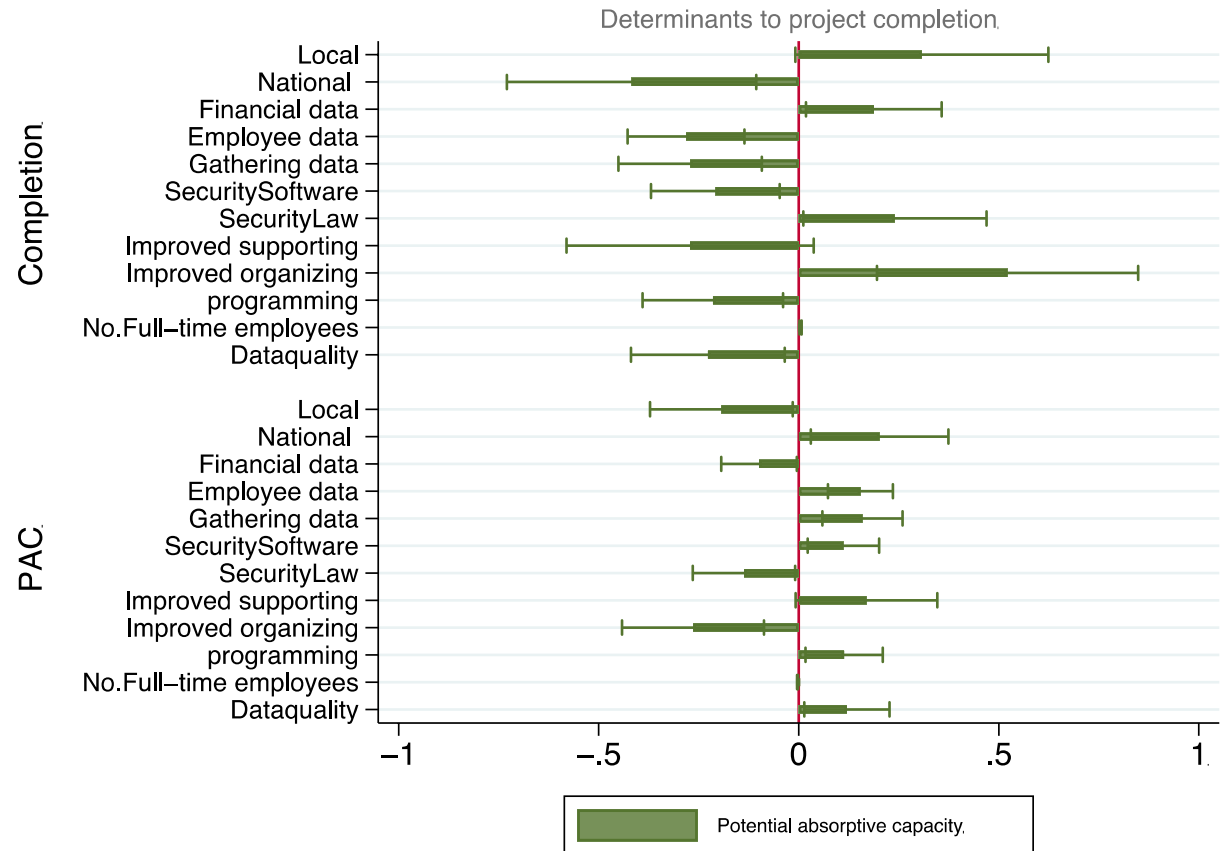
Additional covariates effects on FBD project completion/ PAC-Model

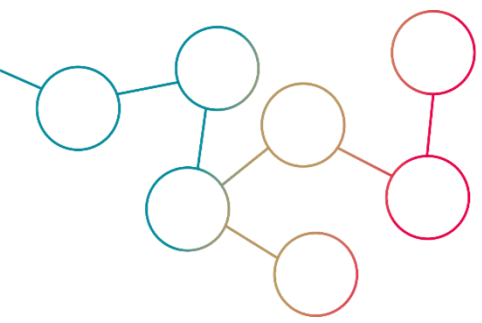
- DATA SECURITY

The effect of legal awareness is **positive (.263**)** .

Moreover, in this model, the variable “In my organization everybody uses the same software” capturing **conformity expresses a significant and negative impact (-.239***)** on completion .

This effect is likely to capture a cautious behavior, highlighting the role of **conformity in constraining innovations**.





Additional covariates effects on FBD project completion/ RAC-Model

- All covariates effects
- These can be discussed as above . The full details are in the report

