Deliverable 4.1

Set-up of pilot questionnaire and datasets

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Summary

Deliverable 4.1 focuses on the development of the survey instrument of the large-scale pilot survey of intangible investments. The development of the questionnaire is based on previous theoretical and empirical evidence. Literature review reveals that in general the current treatment of intangible assets is partial and uncoordinated with a particular lack in micro level measurement of intangible assets. The questionnaire includes five different sections. Section A focuses on general information about the firm Section B concentrates on firm's intangible's investments drawing on previous surveys on intangibles, mainly the one commissioned to NESTA by the UK Office for National Statistics. More specifically, the questionnaire aims at investigating investment decisions on six intangible assets types: (i) training, (ii) software/databases, (iii) research and development (R&D) and acquisition of external knowledge, (iv) design of products and services, (v) company reputation and branding, and (vi) organization or business process improvements. Section C puts emphasis on the determinants of a firm's investment in intangible assets. Section D aims at capturing the impact of investments in intangible assets using various performance measures while a number of questions related to the impact of public policies on the intangible investments of a firm are included in Section E.

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1. Questionnaire development

The development of Globalinto Intangible Assets (IAs) Survey questionnaire is based on previous theoretical and empirical evidence. A first step to the questionnaire development was undertaking a literature review of existing empirical studies on intangible assets**.** Our review reveals that in general the current treatment of IAs is partial and uncoordinated with a particular lack in micro level measurement of intangible assets. In recent years an increasing effort has been devoted to finding more suitable measures of intangible assets. It appears that three approaches prevail:

1. The first one is based on aggregate estimates derived from **firm expenditures** on intangibles such as R&D, training and innovation (e.g. Corrado et al., 2005).

2. The second one uses measures based on the **labour input** of workers in high skilled R&D, ICT, and Organisational Capital related occupations (Piekkola et al., 2011 - Innodrive Project)

3. The third one uses direct measures based on stocks originally reported as assets on **companies' balance sheets** (e.g., Marrocu et al., 2012).

However, it seems that new methodologies and statistics with micro foundations and harmonization approaches across countries are needed for micro level analysis to better understand individual firm behavior and performance, i.e. innovation and productivity. Table 1 summarizes the results of this literature review focusing on the basic components used to capture intangible assets as well as the measurement approaches that have been followed.

Table 1: Literature review on IAs empirical studies at the micro level

Basic Components of IAs	Measurement Approach
• Tehnological and Non-technological R&D / Design • ICT intangibles (software, databases) • Marketing/Reputation/Customer Capital • Human Capital (firm-specific) • Organisational Capital (e.g.: ➢ Management / New Management Systems ➢ Organisational Structure / Restructuring ➢ Strategic Planning – New Business	• Expenditures-based [Purchased (external) and In-house/Own-account (internal)] ➢ Using firm's expenditures on intangibles (applying a depreciation rate) (e.g. Di Ubaldo and Siedschlag, 2017; Hulten and Hao, 2008) • Labor-based ➢ Using the labour input of workers in particular occupations (e.g. Piekkola et al. 2011, Riley and Robinson, 2011) • Stocks-based ➢ Using firms' balance sheets (e.g. Maroccu et al.

Strategies ➢ Business Process Improvement ➢ Marketing (<u>also as a distinctive component</u>) ➢ Human Capital – Training (<u>also as a distinctive component</u>)	2012; Arrighetti et al. 2014; Battisti et al. 2015) • Qualitative and/or other quantitative measures through surveys (e.g. EU - Innobarometer, 2013; INAPP and ISTAT, 2013; ONS Survey, 2009 & 2011) • Mixed methods ➢ Expenditures-based and stocks-based (e.g. Bontempi and Marraise, 2015; Goldar and Parida 2017) ➢ Expenditures-based, stocks-based and qualitative and/or other quantitative measures (Crass and Peters, 2014) ➢ Expenditures-based and qualitative and/or other quantitative measures (e.g. Higon et al. 2017; Hall et al. 2013; Chappell and Jaffe, 2018)

Survey-based approaches on micro level IAs remain limited. Literature review shows three recent survey works attempting to measure intangible assets in different countries:

- ONS[1], Imperial College London and NESTA[2] (2009; 2011): Investment in Intangible Assets Survey (UK).
- Eurobarometer survey (2013): "Investing in Intangibles: Economic Assets and Innovation Drivers for Growth"
- INAPP[3] and ISTAT[4] (2013): "Rilevazione statistica sugli investimenti intangibili (in English: Statistical survey of intangible investment)" (Italy)

All three approaches focus on measuring firm's spending on diverse intangible types, differentiating between in-house spending and purchase of intangible assets. They also measure the expected duration of the benefits reaped from investing into each category of intangible capital explored. Table 2 summarizes the basic characteristics of the abovementioned surveys.

[1] Office for National Statistics
[2] National Endowment for Science Technology and the Arts
[3] National Institute for the Analysis of the Public Policies
[4] The National Statistical Institute

Table 2: Micro Surveys on intangible assets spending and life lengths

Survey	Components of IAs	Measurement Approach	Other issues under Investigation	Sample
UK, launched by ONS in 2009 & 2011 (Awano et al. 2010; Goodridge et al, 2014)	• Training (employer funded) • Software • Reputation & Branding • R&D • Design • Organisation / Business Process Improvement	• Expenditures ➢ In-house ➢ Purchased • Assets life-lengths / depreciation rates		• 838 UK firms with 10+ employees (Sample Source: firms participated in CIS) • Sample stratified by industry & employment ➢ Over-sample to knowledge-intensive industries: Engineering; ICT; Financial Services ➢ Under-sample: Construction; Utilities; Distribution; Accomodation
Italy 2013 (INAPP, Public Policy Innovation)	• Training • Software/Databases • Reputation & Branding • R&D • Design • Organisation and Management & Production Processes Improvement • Other (sector specific) IAs	• Expenditures ➢ In-house ➢ Purchased • Assets life-lengths / depreciation rates • Ratio of internal/external use for specific IAs (R&D, Software/Databases, Design)	• Effect of the economic crisis on Intangible Assets Investments	• 10.631 Italian firms with 10+ employees • Sectors: ➢ Manufacturing ➢ Services
EU - Innobarometer 2013 (Montresor and Vezzani, 2016)	• Training • Software • Reputation & Branding • R&D • Design • Organisation / Business Process Improvement	• Expenditures <u>but via qualitative scales</u> ➢ In-house ➢ Purchased	• Investments in IAs ➢ Expected Benefits ➢ Motivation / Obstacles ➢ Impact ➢ Relation to innovation projects • Innovation	• 11,317 firms with 1+ employees in EU28 and other 8 non-EU countries • Sectors: ➢ Manufacturing ➢ Services ➢ Utilities

The development of the Globalinto IAs questionnaire is grounded on the questionnaires of the three surveys mentioned above, the NTUA's experience from large-scale firm surveys on innovation and knowledge-intensive entrepreneurship either in the context of EU FP-funded projects (e.g. AEGIS, cre8tv.eu) or national projects (i.e. surveys on the top 2000^{+} Greek firms), and other available sources such as additional empirical studies on IAs and their impact on productivity and firm performance, the latest version of OSLO manual, Community Innovation Survey questionnaires etc.

The questionnaire includes five different sections. Please see the framework for the questionnaire's development in page 5 (Figure 1). **Section A** focuses on **general information about the firm** including firm's primary and secondary activities, whether the firm belongs to a national or multinational enterprise group and firm size. **Section B** concentrates on **firm's intangible's investments** drawing on previous surveys on intangibles, mainly the one commissioned to NESTA by the UK Office for National Statistics (see Awano et al. 2010) and the Innobarometer 2013. Following the classification developed by NESTA, the questionnaire aims at investigating investment decisions on six intangible assets (i) training, (ii) software/databases, excluding research and development and web design, (iii) research and development (R&D) and acquisition of external knowledge, (iv) design of products and services (excluding research and development), (v) company reputation and branding, and (vi) organisation or business process improvements. Measuring investments in intangibles involves two steps. First, we need to find out how much firms spend on each intangible category. Furthermore, we need to ask firms how much they spend on purchasing intangible assets and what they spend on "in house" or own account investment assets. For example, many firms write their own software, do their own R&D or organize their own training activities. Second, in some cases, not all that spending will be creating a long-lived asset. Therefore, we have to adjust that spending to measure investment- that is, specify that part of spending creating a long-lived asset.

Specifically, the questionnaire targets at capturing spending in intangible assets during the past year in terms of expenditures as a % of the firm's turnover, the firm's choice to allocate resources to "making" internally rather than "buying" externally those intangibles and estimating the perceived length of benefit resulting from a typical investment in the abovementioned categories of IAs using specific time intervals.

Section C puts emphasis on the determinants of a firm's investment in intangible assets. In line with the capability view of the firm (e.g. Dosi et al, 2001; Teece et al, 1997, 2007; Helfat et al, 2007 etc.) it is

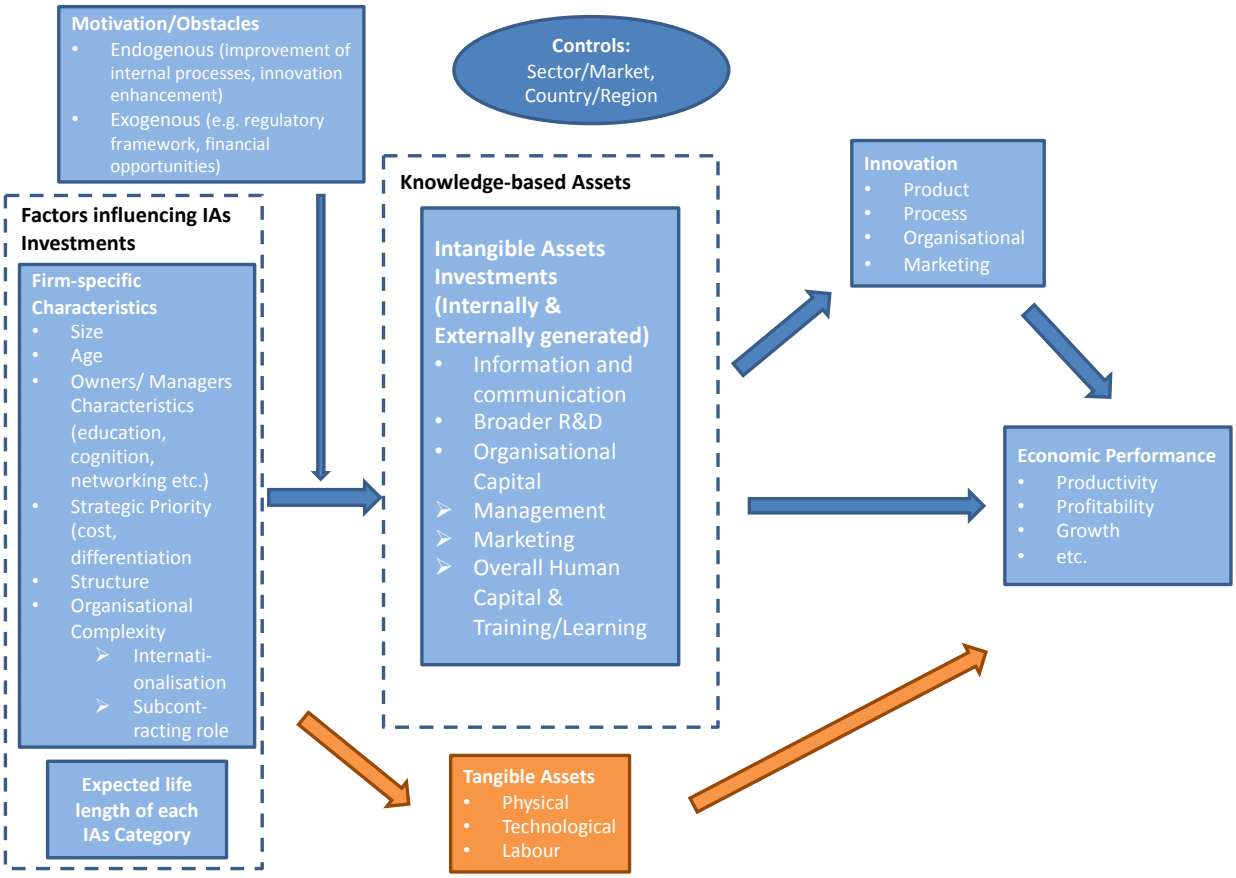
argued that a firm's propensity to invest in intangible assets can be understood mainly as a bundle of resources and capabilities that the firm has evolved over time and only marginally as a result of exogenous technological contingencies (e.g. Arrighetti, Landini and Lasagni 2014; Montresor and Vezzani, 2016). The adoption of such a perspective in the study of intangible assets investments calls for a focus on firm-specific factors that in interaction with system-specific (external factors) can explain the firm's propensity to undertake this type of investments. On this basis we choose to focus on variables such as strategic priorities, organizational complexity, human and technological resources as well as specific organizational capabilities (e.g. dynamic capabilities regarding the sensing and seizing of opportunities, innovation management capabilities, and design and digital capabilities) which we believe are important determinants of a firm's intangible investments. For example, the quality of human recourses employed by the firm, the degree of organizational complexity (e.g. degree of internationalization, FDIs) or a firm's strategic priorities (e.g. price vs differentiation strategy) may have a significant impact on its intangible assets' investment decisions.

Section D aims at capturing the impact of investments in intangible assets using various performance measures including innovative firm performance. Please note that additional performance measures related to productivity such as sales per employee, profits per employee etc. can be deducted for the sample firms from the financial data available from Orbis.

Last but not least, a number of questions related to the impact of public policies on the intangible investments of a firm are included in Section E.

A first version of the accompanying manual of the Globalinto IAs questionnaire is also being developed, providing brief definitions and interpretation of specific questions as a guidance to both the interviewer and the interviewee. An updated version of the accompanying manual will be provided along with the final questionnaire version as soon as the small-scale pilot testing phase of the questionnaire will be completed.

Figure 1. Framework for the Questionnaire Development



2. Questionnaire

A. GENERAL INFORMATION ABOUT THE FIRM

Q.1 Please indicate the firm's:

Primary activity:	
Secondary activity:	

Q.2 Is the firm part of a group?

No, it is a stand-alone firm	1 (Go to Question 4)
Yes, it is part of a national group	2 (Go to Question 4)
Yes, it is part of a multinational group	3 (Go to Question 3)
DK/NA	4

Q.3 If the firm is part of a multinational group in which country is the group's headquarters located?

Country: ……
DK/NA

Q.4 What is the total number of employees in the firm?

Number: ……..
Refuse/DK/NA

Q.5 What was the firm's total turnover for the past year?

Number: ……..
Refuse/DK/NA

B. INVESTMENTS IN INTANGIBLE ASSETS

TRAINING: *Employer funded training of the firm's staff, whether provided by an external organisation or using internal resources*

Q.6 During the past year, did the firm fund any training of its employees?

Yes	1 (Go to Question 7)
No	2 (Go to Question 10)
DK/NA	3

Q.7 Which types of training were funded? (MULTIPLE ANSWERS POSSIBLE)

Training on IT systems / new technologies	1

Training on new production equipment	2
ISO accreditation	3
Training on maintaining current operations	4
Employees' skills development	5
DK/NA	6

Q.8 During the past year, which percentage of the firm's turnover has been spent on staff training…:

	%
…organised by **external** providers[5]?	
…using **internal** resources?	

Q.9 On average, how long does the firm expect to benefit from a typical investment in training?

Less than 2 years	1
2-5 years	2
6-10 years	3
More than 10 years	4
DK/NA	5

SOFTWARE/DATABASES: *Purchase of external software/databases and/or development of software/databases in-house excluding software development carried out as part of R&D and web design*

Q.10 During the past year, did the firm purchase or develop any software/databases?

Yes	1 (Go to Question 11)
No	2 (Go to Question 14)
DK/NA	3

Q.11 Which types of software/databases were developed/purchased? (MULTIPLE ANSWERS POSSIBLE)

Operating Systems	1
General purpose office applications	2
Special purpose applications	3
Special purpose databases	4
Big Data	5
DK/NA	6

Q.12 During the past year, which percentage of the firm's turnover has been spent on software/databases…:

[5] Include: a) training provided by external entities, whether provided on-site or elsewhere, b) levy payments for training organisations (e.g. Sector Skills Council)

	%
…purchased by **external** providers?	
…developed **in-house**?	

Q.13 On average, how long does the firm expect to benefit from a typical investment in software/databases?

Less than 2 years	1
2-5 years	2
6-10 years	3
More than 10 years	4
DK/NA	5

REPUTATION AND BRANDING: *Funding of any external or internal activities to improve reputation or brand values*

Q.14 During the past year, did the firm fund any external or internal activities intended to improve reputation or brand values, either of the firm as a whole or individual products or service lines?

Yes	1 (Go to Question 15)
No	2 (Go to Question 18)
DK/NA	3

Q.15 Which reputation and branding activities were funded? (MULTIPLE ANSWERS POSSIBLE)

Product launches	1
Promotional campaigns	2
"Branding" and "rebranding" of firm	3
Development of promotional materials	4
Market research	5
Trademarks	6
DK/NA	7

Q.16 During the past year, which percentage of the firm's turnover has been spent on activities to improve reputation or brand values…:

	%
…undertaken by **external** providers?	
…using **internal** resources?	

Q.17 On average, how long does the firm expect to benefit from a typical investment in reputation and branding?

Less than 2 years	1
2-5 years	2
6-10 years	3

More than 10 years	4
DK/NA	5

RESEARCH AND DEVELOPMENT PLUS ACQUISITION OF EXTERNAL KNOWLEDGE: *Creative work (undertaken within the firm and/or conducted by other organisations) that increases knowledge for developing new and improved products, services and processes, as well as direct acquisition of external knowledge (e.g. purchase or licensing of patents and non-patented inventions, know-how, process blueprints and other types of knowledge)*

Q.18 During the past year, did the firm fund any (external or internal) Research and Development (R&D) work or acquire external knowledge?

Yes	1 (Go to Question 19)
No	2 (Go to Question 22)
DK/NA	3

Q.19 During the past year, which percentage of the firm's turnover has been spent on…:

	%
…**in-house** R&D?	
…R&D carried out by **external providers**?	
…the acquisition of **external knowledge**?	

Q.20 If the firm funds in-house R&D, is the R&D function undertaken:

Within a dedicated R&D department (the firm has permanent R&D staff in-house)	1
By R&D teams constituted on a need basis/project basis (as needed only)	2
DK/NA	3

Q.21 On average, how long does the firm expect to benefit from a typical investment in R&D and the acquisition of external knowledge?

Less than 2 years	1
2-5 years	2
6-10 years	3
More than 10 years	4
DK/NA	5

DESIGN: *Spending on external and/or internal activities dedicated to the technical or aesthetic design of new or improved products, processes and services. Design in the technical R&D phase of product development or design of software should be excluded.*

Q.22 During the past year, did the firm fund any external or internal design activities?

Yes	1 (Go to Question 23)
No	2 (Go to Question 25)
DK/NA	3

Q.23 During the past year, which percentage of the firm's turnover has been spent on design activities…:

	%
…carried out by **external** providers?	
…using **internal** resources?	

Q.24 On average, how long does the firm expect to benefit from a typical investment in design?

Less than 2 years	1
2-5 years	2
6-10 years	3
More than 10 years	4
DK/NA	5

ORGANISATION / BUSINESS PROCESS IMPROVEMENT: *Spending on organization or business process improvement through purchased consultancy services and/or in-house investment of managerial time.*

Q.25 During the past year, did the firm fund any external or internal work on organization or business process improvement?

Yes	1 (Go to Question 26)
No	2 (Go to Question 29)
DK/NA	3

Q.26 Which of the following organization/business process improvements were funded? (MULTIPLE ANSWERS POSSIBLE)

Quality improvement programmes	1
Business transformation projects (organizational redesign)	2
Strategy development and implementation	3
Culture change projects	4
Programmes for changes in organizational structure	5
DK/NA	6

Q.27 During the past year, which percentage of the firm's turnover has been spent on organization or business process improvement…:

	%
…carried out by **other organisations** (consultants)?	
…using **internal** resources?	

Q.28 On average, how long does the firm expect to benefit from a typical investment in organisation or business process improvement?

Less than 2 years	1
2-5 years	2
6-10 years	3
More than 10 years	4
DK/NA	5

C. FACTORS INFLUENCING INVESTMENTS IN INTANGIBLE ASSETS

Strategy

Q.29 Thinking about the firm priorities, please indicate which two of the following are the most important? (MAX 2 ANSWERS POSSIBLE)

Rapid development of new products or services	1
Tailored, customised solutions	2
Ensuring lower prices	3
Increasing labour productivity	4
Decreasing the production costs	5
Branding activities to differentiate currently its products and services	6
Other (SPONTANEOUS)	7
DK/NA	8

Q.30 During the last three years what was the % of your firm's sales in the:

Local/Regional market	%
National market	%
European market	%
International market (outside Europe)	%
TOTAL	**100%**
DK/NA	

Q.31 Right now, are there other firms offering the same products and/or services to your potential customers? (ONE ANSWER PER COLUMN)

	In your country	Abroad
Yes, many business competitors		
Only a few business competitors		
No other business competitors		
DK/NA		

Q.32 During the last three years, has the firm made investments abroad[6]?

Yes 1
No 2
DK/NA 3

Human and Technological Resources

Q.33 What is the total number of employees in the firm…
…with a University Degree? ……..
…with a postgraduate degree ……..

Q.34 How many of the firm's employees are engaged in R&D activities?

……..
DK/NA

Q.35 Which of the following areas of the Top Management Team (TMT) expertise are relevant to the performance of the firm? (MULTIPLE ANSWERS POSSIBLE)

Technical and engineering knowledge 1
General management 2
Product design 3
Marketing 4
Finance 5
None of the above 6
DK/NA 7

Q.36 Please indicate to what extent the firm has implemented investments regarding the following categories of Industry 4.0 technologies. (ANSWER ON A 5 POINT SCALE, WERE 1 IS NOT AT ALL AND 5 IS TO A GREAT EXTENT).

	1	2	3	4	5	DK/NA
Physical capital (robots, 3D technologies, smart devices, sensor						

[6] Foreign Direct Investments i.e. by buying a firm or by expanding its operations in another country.

technologies etc.)						
Digital technologies (e.g. artificial intelligence, big data, IoT, machine learning, virtual and augmented reality, blockchain etc.)						
Technologies in the field of biology (genetics/genome editing, 3D&4D print in combination with genetics and medicine, neurotechnology etc.)						

Organisational Capabilities

Q.37 Please indicate to what extent you agree or disagree with the following statements regarding the sensing and seizing of opportunities within your firm. (ANSWER ON A 5 POINT SCALE, WERE 1 IS STRONGLY DISAGREE AND 5 IS STRONGLY AGREE).

	1	2	3	4	5	DK/NA
Our firm actively observes and adopts the best practices in our sector						
Our firm responds rapidly to competitive moves						
We change our practices based on customer feedback						
Our firm regularly considers the consequences of changing market demand in terms of new products and services						
Our firm is quick to recognize shifts in our market (e.g. competition, regulation, demography)						
We quickly understand new opportunities to better serve our customers						
There is a formal engineering and technical studies department in our firm						
Design activity is important in introducing new products/services to the market						
We implement systematic internal and external personnel training						
Employees share practical experiences on a frequent basis						

Q.38 Please indicate to what extend you agree or disagree with the following statements regarding the identification and evaluation of internal and external knowledge by your firm. (ANSWER ON A 5 POINT SCALE, WERE 1 IS STRONGLY DISAGREE AND 5 IS STRONGLY AGREE).

	1	2	3	4	5	DK/NA
Our firm supports regular, systematic communication with customers, suppliers and other organisations along the firm's value chain to identify opportunities and needs for innovation						
Our firm engages in a regular, systematic screening of our knowledge environment (e.g. through patent searches, attending trade fares, reading trade or scientific journals, or web searches)						
Our firm enters into alliances, joint ventures or strategic co-operation with other organisations						
Our firm engages in collaborative research agreements/projects with universities and research institutes						

Our firm supports the internal exchange of knowledge and experience through teamworking and informal contacts between employees						
Our firm enhances the joint development of innovation strategies across functional areas						
Our firm supports exchanging new ideas openly across the firm						

Q.39 Please indicate to what extent you agree or disagree with the following statements regarding the importance of design capabilities to your firm's business strategy (ANSWER ON A 5 POINT SCALE, WERE 1 IS STRONGLY DISAGREE AND 5 IS STRONGLY AGREE).

	1	2	3	4	5	DK/NA
Our firm has no design activity at all						
Design is used to develop the aesthetic form or style of products and services, but design activities are not conducted on a systematic basis						
Design thinking[7] methods are integrated into the product development process						
Design is a key strategic element of our firm's business model.						

Q.40 Please indicate to what extent the firm has developed the following digital capabilities? (ANSWER ON A 5 POINT SCALE, WERE 1 IS NOT AT ALL AND 5 IS TO A GREAT EXTENT).

	1	2	3	4	5	DK/NA
Digital integration within and across different business functions						
Access to and ability to use data analytics to design, develop, commercialise and improve products, including data about the users of the firm's products and their interactions with such products						
Access to networks and the use of appropriate solutions and architectures (hardware and software)						
Effective management of privacy and cybersecurity risks						
Adoption of appropriate business models for digital environments, such as e-commerce, participative platforms etc.						

[7] Design thinking refers to the systematic methodology for approaching the design of a product, service or system

D. FIRM PERFORMANCE

Innovation Performance

Q.41 Over the past three years, did the firm introduce any innovations, such as:

	Yes	No	DK/NA
	1	2	3
New or significantly improved products			
New or significantly improved services			
New or significantly improved production processes, distribution methods and/or supporting activities			
New or significantly improved marketing concepts, strategies and/or methods			
New or significantly improved organisational structures and/or management methods			

Impact of investments in intangible assets on economic performance

Q.42 Has the previous investment (mentioned in Part B) in intangible assets benefited the firm in terms of: (ANSWER ON A 5 POINT SCALE, WERE 1 IS NOT AT ALL AND 5 IS TO A GREAT EXTENT).

	1	2	3	4	5	DK/NA
Sales						
Profit margin						
Skills and qualifications of employees						
Market share						
Overall value of the firm						

E. QUESTIONS ON POLICY

Q.43 If the government provides direct subsidies to firms such as yours, how important are the following subsidies to your business? (ANSWER ON A 5 POINT SCALE, WERE 1 IS NOT AT ALL IMPORTANT AND 5 INDISPENSABLE).

	1	2	3	4	5	DK/NA
R&D subsidies						
Subsidies for internal training programmes						
Subsidies for Information and Communication Technologies (ICTs)						

Q.44 If the government provides tax incentives (e.g. tax credits, preferential tax treatment) to firms such as yours, how important are these incentives for (ANSWER ON A 5 POINT SCALE, WERE 1 IS NOT AT ALL IMPORTANT AND 5 INDISPENSABLE).

	1	2	3	4	5	DK/NA
Your business's R&D efforts?						
Your business's training programmes?						
Your business's Information and Communication Technologies (ICTs) investments?						

3. Accompanying Manual

This manual has been developed to function as a guidance to both the interviewer and the interviewee by providing brief definitions, interpretation of questions and clarifications where needed.

3.1 Introductory Part

The aim of this survey is to investigate the intensity and character of the firms' investments in intangible assets, their determinants and their impact on firm performance. The survey results, which will be communicated to each participating firm, will provide valuable recommendations for shaping EU policies in this field. The questionnaire is addressed to the CEO/firm founder (or member of the founding team) and the interview will take approximately 25 minutes.

The information each interviewee provides will not be used at an individual level nor handed over by name to the European Commission or any other third party. The information will only be used for aggregate analysis.

The manual includes useful notes (definitions, clarifications etc.) for a number of questions as well as some general notes that regard the overall questionnaire:

3.2 Notes for specific questions

3.2.1 Section A

Q1: This question seeks to identify the primary and secondary activity of the firm according to the NACE Rev. 2. Should the firm have one activity please leave the second field blank.

Q2: If the interviewee chooses item 3 she/he should answer Q3 as well. Otherwise, she/he has to proceed in answering Q4.

3.2.2 Section B

This section consists of six subsections that refer to the firm's investments in the following six intangible assets respectively: a) Training, b) Software/Databases, c) Reputation and Branding, d) Research and Development plus Acquisition of External Knowledge, e) Design, f) Organization / Business Process Improvement. Each subsection starts with a definition that makes explicit how the interviewee has to consider the firm's investment in the relevant intangible asset.

Q6, Q10, Q14, Q18, Q22, Q25: These are filter questions that examine whether the firm has implemented any investment in the relevant intangible assets during the past year. If the answer is NO

the interviewee should not continue replying to the rest of the questions regarding the specific intangible asset.

Q8, Q12, Q16, Q19, Q23, Q27: These questions aim at an approximate quantitative assessment of the firm's investment in the six intangible asset types during the past year implemented by either internal or external resources. For each question, the following notes guide the interviewee to estimate the relevant spending.

Q8:

For assessing the spending on staff training organized by external providers (item 1):

- Include: a) training provided by external entities, whether provided on-site or elsewhere, b) levy payments for training organizations (e.g. Sector Skills Council)

For assessing the spending on staff training using internal resources (item 2):

- Include: a) staff costs of trainers, including development and delivery of training, b) travel and subsistence payments, c) associated costs, including providing facilities, overheads and materials but not capital items.
- Exclude: a) the cost of staff time whilst being trained and therefore absent from work, b) on-the-job training, c) capital items.
  Note: Estimates based on proportions of staff time are acceptable.

Q12:

For assessing spending on software/databases purchased by external providers (item 1):

- Include: a) off-the-shelf software, b) software licenses and license renewals, c) generic and bespoke software.
- Exclude: software embedded in other items of current or capital expenditure (e.g. software pre-installed on IT hardware)

For assessing spending on software/databases developed in-house (item 2):

- Include: a) staff costs of all staff involved, excluding contractors, b) associated costs, including office facilities, overheads and materials but not capital items.
  Note: Estimates based on proportions of staff time are acceptable.

Q16:

For assessing spending on reputation and branding undertaken by external providers (item 1):

- Include: External costs of advertising and marketing campaigns to agencies, media organizations, trade fairs, suppliers of marketing databases etc.

For assessing spending on reputation and branding using internal resources (item 2):

- Include: a) staff costs of all staff involved (e.g. product managers, sales and marketing personnel), b) associated costs, including office facilities, overheads and materials but not capital items.
  Note: Estimates based on proportions of staff time are acceptable.

Q19:

For assessing spending on in-house R&D (item 1):

- Include: a) staff costs of all staff involved, b) associated costs, including facilities, overheads and materials but not capital items.
  Note: Estimates based on proportions of staff time are acceptable.

For assessing spending on R&D carried out by external providers (item 2):

- Include: Costs of bought-in R&D services

For assessing spending on the acquisition of external knowledge (item 3):

- Include: Costs of purchase or licensing of patents and non-patented inventions, know-how, process blueprints and other types of knowledge

Q23:

For assessing the spending on design activities carried out by external providers (item 1):

- Include: Costs of bought-in design services
- Exclude: Costs of design embedded in other items of current or capital expenditure

For assessing the spending on design activities using internal resources (item 2):

- Include: a) staff costs of all staff involved (e.g. graphic designers, product designers, architects, design engineers), b) associated costs, including office facilities, overheads and materials but not capital costs.
  Note: Estimates based on proportions of staff time are acceptable.

Q27:

<u>For assessing the spending on organization or business process improvement carried out by other organizations (item 1):</u>

- Include: Costs of bought-in management consultancy services

<u>For assessing the spending on organization or business process improvement using internal resources (item 2):</u>

- Include: a) staff costs, including those who do this as part of their everyday jobs (e.g. managers working to improve general business processes) b) associated costs, including office facilities and overheads for staff involved but not capital items.
  Note: Estimates based on proportions of staff time are acceptable.

Q9, Q13, Q17, Q21, Q24, Q28: These questions aim at identifying the time length for which the firm benefits through a typical investment in the relevant intangible assets. The phrase "typical investment" implies that for answering the question the interviewee should take into account the most common case of the firm's investments in the specific intangible asset.

3.2.3 Section C

Q29: The interviewee can select two answers at most. The option "Other" should not be read by the interviewer but it constitutes a possible answer in case of a spontaneous reference by the interviewee.

Q30: The sum of the percentages must be 100%.

Q31: The interviewee can select one answer per column.

Q33: The employees with a postgraduate degree constitute a subset of the employees having a University degree.

Q35: Top Management Team: Top management is made up of senior-level executives of an organization, or those positions that hold the most responsibility. Jobs titles such as Chief Operating Officer (COO), Chief Executive Officer (CEO), Chief Financial Officer (CFO), President, or Vice President are commonly used by top managers in organizations.

Q36: The investments of the firm in Industry 4.0 technologies are examined according to the following three basic types of technologies: a) physical technologies b) information-digital technologies, and c) technologies in the field of biology.

4. Sampling procedure

Through the large-scale pilot survey in firms we are aiming at a sample of 2000 completed questionnaires in eight countries, namely France, Germany, UK, Finland, Denmark, Norway, Greece and Slovenia. The survey population for the large pilot survey is mainly drawn from Orbis. Orbis is a commercially available database which includes information on more than 310 million companies across the globe and collects data from more than 160 separate providers as well as other own sources[8].

Through our sampling procedure, we focus on both IAs intensive manufacturing industries to capture the innovative part of manufacturing, and knowledge-intensive services. The selected subsectors in two-digit level (NACE Rev.2 statistical classification of economic activities) are provided in Table 3.

Table 3: Selected intensive IAs Manufacturing and Knowledge intensive services

NACRev 2	Sector / Subsector
	IAs intensive - Manufacturing
10	Manufacture of food products
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
24	Manufacture of basic metals
26	Manufacture of computer, electronic and optical products
28	Manufacture of machinery and equipment n.e.c.
	KI – Services
62	Computer programming, consultancy and related activities
63	Information service activities
69	Legal and accounting activities
70	Activities of head offices; management consultancy activities
71	Architectural and engineering activities; technical testing and analysis
72	Scientific research and development
73	Advertising and market research
74	Other professional, scientific and technical activities
90	Creative, arts and entertainment activities

To come up with a final sample of 2000 complete questionnaires we target at collecting approximately 215 questionnaires from firms in each small country (Finland, Denmark, Norway, Greece and Slovenia) and 310 questionnaires from firms based in each large-sized country (UK, France and Germany) in the

[8] https://www.bvdinfo.com/en-gb/our-products/data/international/orbis

abovementioned sector groups. In order to collect 2000 complete questionnaires and taking into consideration an average response rate of 25% across countries we should create an adequate population of firms. This practically means that collecting 310 responses from large countries our initial sample of firms in each large country should be at least 4 times larger, i.e. 1240 firms.

In our sample, manufacturing sector accounts for of 70% of the sampled firms and services sector accounts for 30% of the total firms. Furthermore, in each sector, we equally divide the firms into small-sized (firms with 50-249 employees in year 2017) and large-sized (firms with over 249 employees in 2017). It should be noted that depending on data availability, the firm size criterion may be extended to 30^{+} or even 20^{+} employees especially in small countries. Table 4 below summarizes the population of firms per country and sector as well as small and large firms in manufacturing and KIS respectively. Is should be noted that the creation of firm population has been implemented by the UVA team as their university has access to the Orbis database.

Table 4 suggests that the population of firms in small countries may be complemented by additional sample to reach the target of approximately 215x4= 860 firms. This will be done if required by using data from available national registries.

Table 4: Population of firms drawn from Orbis

Country	Total Firms	Manufacturing	Services	Mfg Small	Mfg Large	Svs Small	Svs Large
Finland	**685**	425	260	300	125	130	130
Denmark	**675**	415	260	300	115	130	130
Greece	**511**	361	150	300	61	130	20
Norway	**563**	370	193	300	70	130	63
Slovenia							
UK	**1260**	880	380	440	440	190	190
France	**1260**	880	380	440	440	190	190
Germany	**1260**	880	380	440	440	190	190

Lastly, we also pay attention to firms having any R&D information (during the past 10 years) and try to include as much information as possible in our sample. For smaller countries, we include all the firms that have R&D information and then select the remaining firms without R&D information by random sampling (selecting every 4^{th} or 5^{th} firm depending on the total number of firms). For large countries,

because of the availability of data, we select almost 50% of the firms with R&D information (during the past 10 years) and the remaining firms (50%) from random sampling (selecting every 15th to 20th firm depending on the total number of firms). For large countries, we also make sure that the size of the firm remains consistent over the past 10 years i.e. 50 – 249 employees for the small firms and over 249 employees for the large firms. Lastly, we only consider those firms that have contact information available in Orbis i.e. telephone number and/or website. Majority of the firms with missing telephone number were also not having the website address.

The BvD unique ID number of Orbis is used to identify the firms. Therefore, it is possible to append as much information as possible in the future. As an example, number of employees for last 10 years are given for each firm. Similarly, additional variables can be extracted from Orbis database.

Special mention should be made for the case of Slovenia since the data drawn for Slovenian firms from the Orbis database are generally poor. In addition, R&D data is not available for Slovenian companies in any of the publicly available (or proprietary) databases. The Slovenian Statistical Office does collect R&D data with yearly questionnaires for around 2500 companies (sample), but it does not reveal for which companies due to data protection issues. ULJ has implemented the sampling procedure for Slovenia based on a population of firms of AJPES data with significantly better coverage than Orbis. Taking into consideration that in Slovenia there are only 1189 firms with 20 or more employees in the survey target industries, and that only 600 of them are included in the APJES database, at this stage we will target the entire population of available firms (if companies with 30 or more employees are considered then the total available number of firms in AJPES database is around 450).

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