A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

Analysis of Portugal's macroenvironment in the view of Digital Transformation of SMEs using the PESTE Framework – Exploration of Technological Factors

Sabrina Angela Scheuer (45868)

Work project carried out under the supervision of:

Professor João Nuno Lopes de Castro

17-12-2021

Abstract

The digital transformation has revolutionized entire sectors in recent years. Yet, SMEs struggle to successfully implement such profound organizational transformations, endangering their competitiveness in the long term. Scholars study internal, company-related factors almost exclusively, whereas external factors are sparsely considered. Therefore, this thesis applies the PESTE framework to investigate external factors affecting the digital transformation of Portuguese SMEs. The following section explores technological factors (knowledge transfer and digital infrastructure and connectivity) in Portugal, analyzing the external environment on SMEs' digital transformation. Based on these findings, recommendations were developed, including interdisciplinary data collection processes, innovation hubs, tailored training, and trust seals.

Keywords: Digital Transformation, SMEs, External Factors, PESTE-Analysis, Portugal, Technological Factors

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

5.4 Technological Factor

The implementation of digital technologies is an essential building block for DT. Despite the benefits and opportunities offered by digital technologies and significant growth in recent years, many Small and Medium-sized Enterprises (SMEs) still lag in the adoption of digital technologies (OECD 2021).

The extensive literature review reveals that researchers mainly focus on internal factors as a starting point to adopt digital technologies. Nevertheless, the research of external factors and the environment in which SMEs are embedded in order to implement digital technologies have not been sufficiently studied yet. Therefore, this chapter aims to ascertain whether Portugal, its external factors, and its environment represent a solid foundation for SMEs to adopt digital technologies to ramp up DT.

5.4.1 Definition and Background

Defining the technology factor within the PESTE framework is indispensable for further analysis. The theoretical background provides a general description and definition of the framework (see 3.4). The basic concept is to place the unit that is the objective of the analysis in the context of the surrounding world. Therefore, SMEs were based in the technological environment of Portugal concerning DT. As a result, two significant components were identified that are crucial to leveraging and implementing digital technologies - *Digital Infrastructure* and *Knowledge*. The OECD states that DT can only be fully realized if high-quality access to communication networks and services is made available for everyone, indicating a solid digital infrastructure (OECD 2019). Additionally, the EU states that next to the vital infrastructure, the digital workforce, consequently (tech) knowledge is essential in the path to the digital transition of the EU (European Commission 2021a). Thus, to evaluate the external technological factors in Portugal and align with the PESTE framework, the two prong-

approach with *(Technology) Knowledge Transfer* and *Digital Infrastructure and Connectivity* will be applied and discussed.

5.4.2 Digital Infrastructure and Connectivity

Digital Infrastructure and Connectivity represent an essential foundation for the operation of digital technologies. The ongoing social revolution, based on enormous data flow and unlimited and constant mobility and connectivity, requires high-quality and affordable access to communications networks, data centers, ICT, and services for all citizens and businesses, regardless of their location. The more connected people and things become, the greater the demand for connectivity. Many connected devices, including those driven by new digital technologies such as AI, require the transmission of vast amounts of data. To accommodate the increasing data demand created by the billions of devices that will migrate online in the near future, investment and continuous improvement of the digital infrastructure and connectivity by policymakers are needed. Digital connectivity even represents a social right in the EU (OECD 2019; Roland Berger 2020).

To analyze this topic, two indices were researched that evaluate digital infrastructure and connectivity. The latter represents one of five dimensions in the Digital Economy and Society Index (DESI)[1], developed by the European Commission. With this, the European Commission categorizes connectivity into four main sub-dimensions, as shown in chapter 5.4.2.1. These sub-dimensions are measured by different individual indicators (European Commission 2020b), which will be discussed in the respective chapter. Next to the DESI, the Huawei Global Connectivity Index (GCI) 2020 tracks the digital development of 79 countries by assigning a GCI score. The index measures the relationship between ICT infrastructure investment and

[1] "The Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU Member States, across five main dimensions: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology, Digital Public Services." (European Commission 2020b).

economic growth. It consists of four pillars (supply, demand, experience, and potential), with a total of 40 indicators being assessed (Huawei 2020).

In order to get a more detailed picture of the Digital Infrastructure in Portugal, this chapter will examine both indices in detail. Furthermore, both indices are applied to Portugal compared with a frontier country as a benchmark. Denmark was selected as the benchmark due to its frontier country DESI status (European Commission 2020a) and second place in the GCI among all EU-27 countries (Huawei Technologies 2020). Additionally, Denmark is comparable in terms of the geographical area, amounting to 42,924 square kilometers, whereby Portugal's geographical area totals 92,226 square kilometers (eurostat 2015). The geographical location represents a crucial indicator to compare digital infrastructure. Finally, Denmark and Portugal are members of the EU and therefore exposed to the same subsidies, regulations, and object towards actions and programs the EU sets for a Digital Economy and Society (European Commission 2021f).

5.4.2.1 DESI Portugal – Denmark Comparison

Portugal's Connectivity dimension is ranked 12th of all EU states and above the EU-27 average. Appendix 12 compares Portugal with Denmark and the EU-27 average in each indicator. The indicators are measured between 0 and 100 (European Commission 2020b). It can be determined that Portugal is above the EU-27 average in fixed broadband coverage, exceeding frontier country Denmark in fast broadband Next Generation Access (NGA) coverage, a supply indicator defined as the percentage of Households living in areas served by NGA. Compared to Denmark and the EU-27 average in the sub-dimension Mobile Broadband, Portugal falls short, notably significant in the 5G readiness subdimension. This manifests that Portugal is one of the two countries in the EU, as of August 2021, without 5G services (Carole Manero 2021). The Portuguese government established an auction, which allocates lots for frequency user right

bands in different bidding phases. The 5G auction ended in October 2021, which indicates this gap could be filled in a timely manner (Anacom 2021).

5.4.2.2 GCI Portugal – Denmark Comparison

According to the Huawei global connectivity index (GCI), Portugal ranks 25th, whereas Denmark positions 5th among 79 observed countries. The countries are compared in four areas that Huawei identifies as technology enablers. These four pillars cover 40 indicators, providing a detailed analysis of each country and pinpointing the need for further investment to advance connectivity and economic benefits (Huawei 2020). For a detailed description of each indicator, please refer to Appendix 13, Appendix 14, Appendix 15, and Appendix 16.

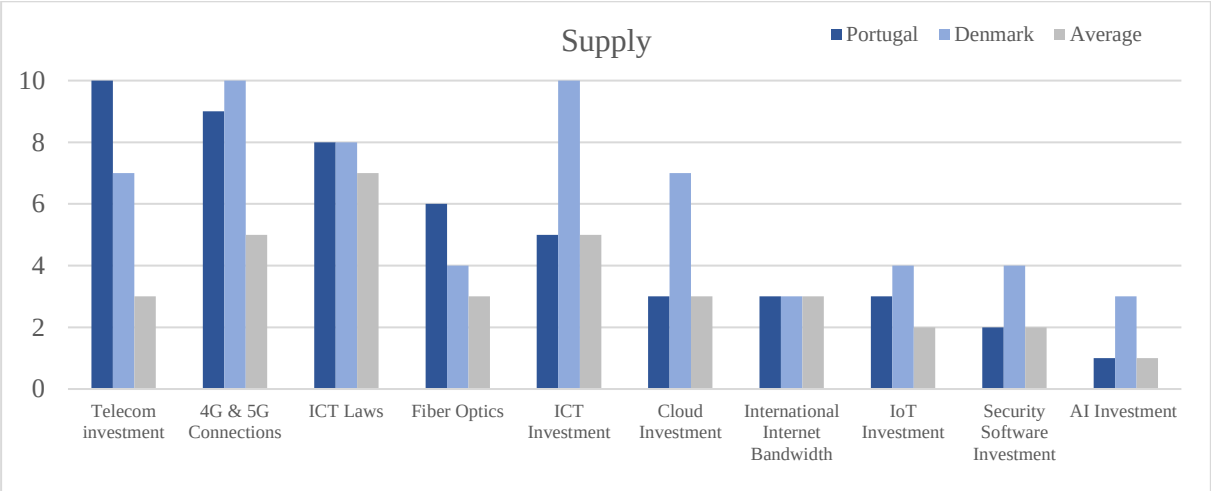


Figure 17: GCI - Supply (Huawei 2020).

The first pillar, *Supply* displayed in Figure 17, measures the current supply for products and services in the respective country. Portugal marks in all Supply Indicators average or even exceeds the average. It even outstrips Denmark in Telecom investment and Fiber Optics. This trend continues in 2021 as the ICT broadband infrastructure has expanded due to public investment and private competition, whereby one local fiber operator Altice Portugal has declared an enlargement of high-speed fiber networks. Portugal's Fiber to the Premises (FTTP), which refers to the equipment used in fiber access deployment and a delivery medium that

provides internet access directly to a user (Gartner n.d.), is twice as high as the EU-27 average (European Commission 2021d).

Moreover, in June 2021, Portugal's prime minister announced the launch of the first high-speed submarine fiber optic cable, called EllaLink, that links Europe and South America. Next to EllaLink, Sines connects 62 countries and 91 locations and serves as the main entry point to southwest Europe. Sines 4.0 is unique as it is the largest renewable data center campus in Europe, aimed to seamlessly handle the constantly-growing demand for streaming services, video conferencing, cloud computing, AI, and data storage. This data center will link the demand of the new information age and DT with the unique geographical location of Sines and make an essential contribution to the energy transition in Portugal (start campus 2021; International Trade Administration 2021; Huawei Technologies 2020; Huawei 2020).

The pillar *Demand* represents the demand for connectivity of users and activity. As Figure 18 displays, the demand of Portuguese inhabitants is mainly on par with the observed countries.

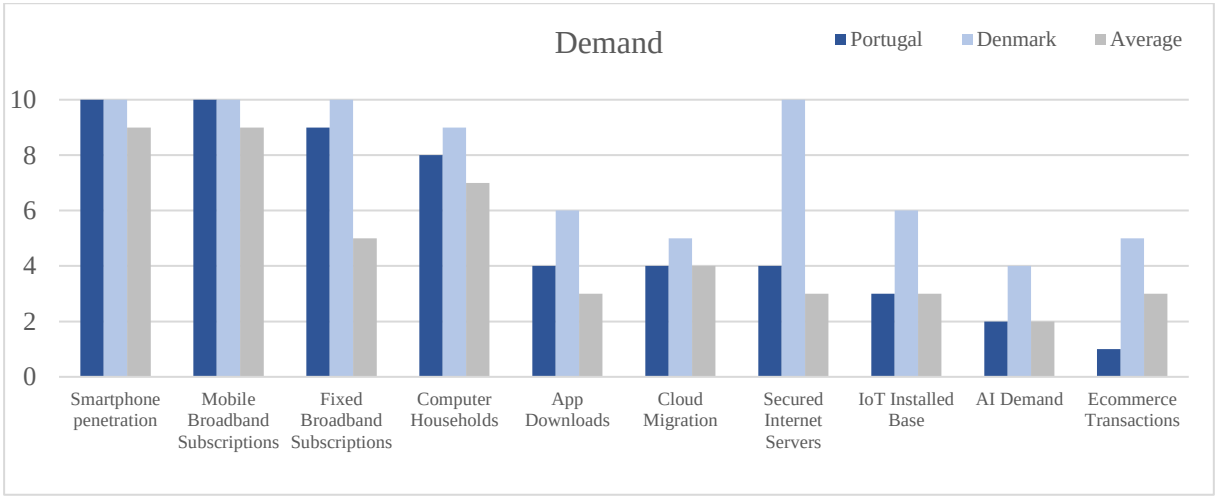


Figure 18: GCI – Demand (Huawei 2020).

Nevertheless, Portuguese people demand less in E-commerce transactions than the average. This indicator reflects orders placed on the Internet for paid goods or services (see Appendix 14). Further, Portuguese people demand less than Denmark in Infrastructure of emerging technologies like the Internet of Things (IoT) base, AI (AI), and Cloud Migration. Denmark is

a forerunner in demand for Secured Internet Services, which refers to the number of distinct, publicly-trusted net server certificates.

The third pillar, *Experience,* analyzes the experience for connectivity end users and organizations receive in Portugal. As illustrated in Figure 19, the experience for "Mobile Broadband Affordability," "Cybersecurity Awareness," and "Telecom Customer Service" lies below average.

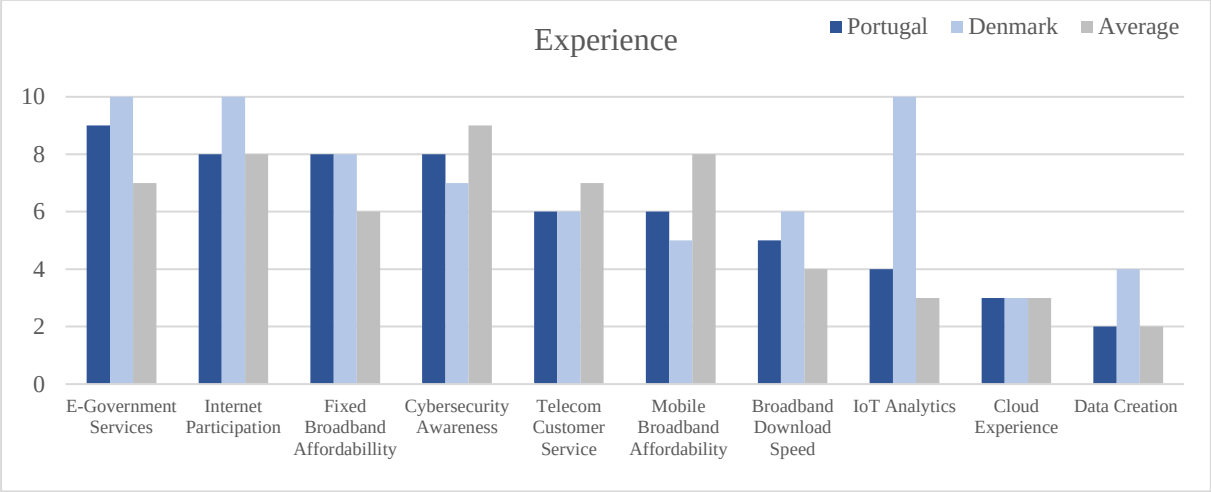


Figure 19: GCI – Experience (Huawei 2020).

Denmark is especially a frontrunner in the Experience of IoT analytics, reflecting the higher demand for an IoT installed base. Focusing on mobile broadband affordability, as the DESI has already shown, both countries are falling short compared to the EU-27 average and the 79 countries observed in the GCI. Furthermore, it is essential to highlight that Portugal is above average in E-Government services and slightly behind Denmark. The European Commission regards the Digital Service Infrastructure (DSI) and building blocks (eID, eInvoicing, eDelivery, eSignature, context broker) offered by the public sector as crucial towards DT, reducing the administrative burden for the private sector. The commission even pushes the transition to E-government through the Digital Europe Program (European Commission 2021b).

The last pillar, *Potential*, displayed in Figure 20, compromises a set of indicators that point to the future development of the digital economy (Huawei 2020).

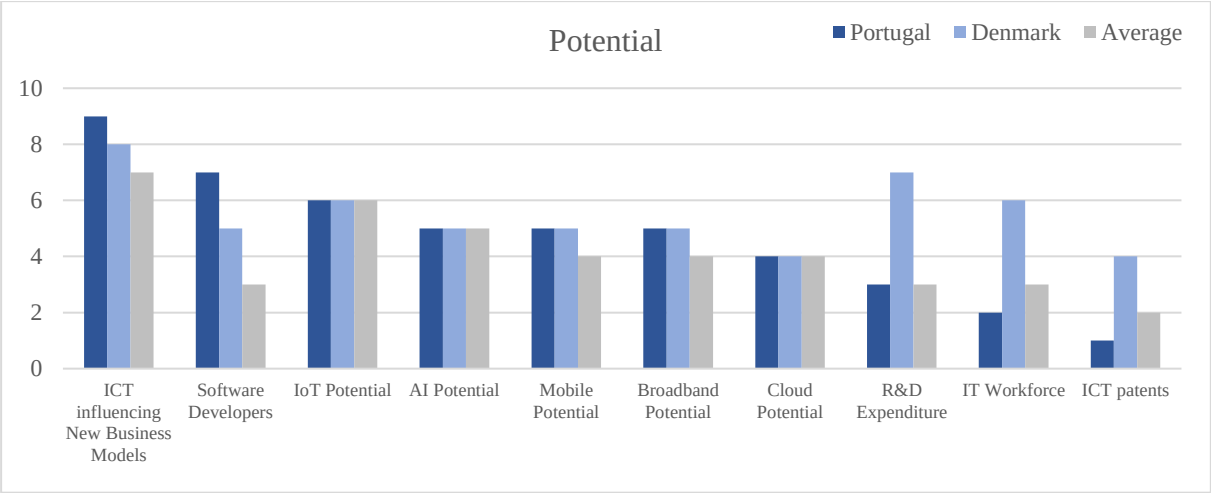


Figure 20: GCI - Potential (Huawei 2020).

Even though Portugal scores above average with the potential of Software developers, the IT workforce is notably deficient, compared to the average and Denmark. Moreover, the indicators R&D Expenditure and ICT Patents are noteworthy, with Portugal below the average and significantly behind Denmark. The ICT Patents indicator tracks the number of patents applied in the field of ICT technology in Portugal. On the contrary, Portugal has exceptionally high potential with ICT that can create new business models and scores higher than Denmark and the EU-27 average.

5.4.2.3 Conclusion

Portugal represents a solid digital infrastructure, especially on the supply side, despite lagging in 5G readiness. The latter embodies a critical stake in enhancing efficiency, productivity and creating new options alongside the value chain. It provides higher speed and capacity and lowers data latency, representing an opportunity for SMEs to disrupt traditional incumbents by offering new 5G services (European DIGITAL SME Alliance 2020). Portuguese SMEs should quickly close the gap to other countries that were able to exploit the benefits of 5G earlier. Moreover, EllaLink reinforces Portugal's strategic location and is a critical infrastructure to connect Europe with the rest of the world. This strategic position could leverage Portugal with the Sines 4.0 Data Centre to develop its status as a global tech hub. On the Demand side for

infrastructure and connectivity, Portugal is far behind average and Denmark in terms of E-commerce transactions. A critical aspect, as E-commerce and Retail is the largest sector in which Portuguese SMEs' operate. On the experience side, Portugal especially falls short in Mobile Broadband Affordability, Cybersecurity Awareness, and Telecom Customer Service. Lastly, according to the pillar potential, Portugal has a good foundation towards a digital economy in the future.

5.4.3 (Technology) Knowledge Transfer

In order to exploit digital technologies, it is essential to have the knowledge and the right skilled people. Knowledge and technology transfer are two terms that characterize the transfer of knowledge and discoveries to the public community. The knowledge resulting from science and research is typically passed on to other parties who can leverage it to develop new knowledge for the society and bring new products and services to market—ultimately leading to innovation and improved quality of life (NOVA.ID.FCT 2021). Knowledge is one of the critical resources of organizations and is crucial for their long-term performance (Anand et al. 2021). This chapter, therefore, explores the external channels and tools for knowledge transfer for Portuguese SMEs.

Research revealed that SMEs have significant skill and knowledge gaps in basic digital skills, which is also reflected in 5.4.2 in the potential missing IT workforce in the future. This overall results in a lack of integration of digital and emerging digital technologies like big data, IoT, AI, and cybersecurity into daily businesses. The gap spreads across the entire SME hierarchy and ranges from a lack of E-leadership skills to ICT proficiency. Firstly, this may be explained by the intense competition for skilled graduates with large companies on the job market and secondly by the lack of up-or re-skilling of employees through training. As the European Commission stated, less than 10% of SMEs provide training to their ICT specialists, and less than 20% offer training to their other employees (Executive Agency for Small and Medium-

sized Enterprises 2019). External factors are stated to be the main barriers to participating in training programs. These appear to be: The availability of training programs, costs of training, cost-benefit, inflexible training time schedules, the distance of training, and the inability to fully understand the content of the training based on lacking information (European DIGITAL SME Alliance 2021). Therefore, the following chapter examines different training, tools, and programs that Portugal offers to transfer knowledge to SMEs.

Researchers identified three categories for possibilities, opportunities, tools, and solutions to transfer knowledge on digitalization and DT for SMEs:

- Public funding schemes,
- Innovation or research hubs, centers, or networks, and
- Private sector solutions (Prof. Dr. Aida Kamišalić Latifić 2020).

5.4.3.1 Public Funding schemes

Public fundings schemes include different government initiatives to which SMEs have access in a specific region to promote digitalization and DT. In more precise terms, this category contains support in the form of legislation, public funding, or subsidies that support companies in implementing projects to accelerate DT (Prof. Dr. Aida Kamišalić Latifić 2020).

The Portuguese government has established a cluster program, IAMPEI — Institute to Support Small and Medium-Sized Companies. Under the Ministry of Economy, Innovation, and Development, IAPMEI's mission is to support SMEs in their innovation and international growth strategies, increase their productivity and competitiveness, enhance management skills and capability, access to financial markets, and promote entrepreneurship (European Commission 2021c).

The cluster program IAMPEI has implemented a series of programs to enhance the digital transition in different areas.

Corporate and Entrepreneurial Innovation represents the first area, which aims to encourage companies to invest in product innovation, promote qualified entrepreneurship, and support expansion (IAPMEI 2020a, 2020b; ePortugal.gov.pt 2021). It is divided into two systems which can be observed in Appendix 17. SME Qualification and internationalization represent the second area that aims to promote SMEs' competition and productivity by accelerating their presence in the global market. This area is split into two systems, described in detail in Appendix 18. Research and technological development represent the third area supported by IAMPEI. It promotes the relationship between companies and scientific institutions, aiming to boost R&D and create knowledge. A detailed description of the systems can be found in Appendix 19. (ePortugal.gov.pt 2021; IAPMEI 2020c, 2020d). Business networks and clusters are viewed as a lever to support industrial modernization and innovation, especially for SMEs (European Observatory for Clusters and Industrial Change 2019).

Besides developing the IAMPEI program, other public incentive schemes by the Portuguese government have been developed to support SMEs financially via vouchers and searching for investment. The voucher represents an incentive scheme to support the acquisition of consultancy services in innovation and R&D to support the transfer of knowledge to SMEs. The investment support is intended to reinforce national productivity and ease the search for investment for companies and entrepreneurs. Catering the specific funding needs for SMEs according to the different business stages they are placed in, the Portuguese government developed a Finance Portal, which offers a wide range of financing solutions with public support. The portal is built to provide information based on the different needs of the companies, their investment strategy (growth, expansion, export, capitalization), and the company's size or the industry in which they are embedded (ePortugal.gov.pt 2021).

5.4.3.2 Innovation and research hubs, centers, networks

Innovation or research hubs, centers, or networks represent solutions, whereby non-profit or publicly funded organizations offer assistance to SMEs in their transformation process. This could be support for funding opportunities, connections or networks with institutions and experts, or providing assessments (Prof. Dr. Aida Kamišalić Latifić 2020). This chapter will focus on Digital Innovation Hubs (DIHs), a one-stop shop to support SMEs, start-ups, and midcaps with DT. More precisely, DIHs help companies to develop market competitiveness by improving their business and production processes, products, or services through digital technologies. DIHs provide access to technical expertise and experimentation so that companies can "test first, then invest". In addition, they offer innovation services, such as financing advice, training, and skills development, which are essential for a successful DT (Kalpaka, Sörvik, and Tasigiorgou 2020). According to a study by Crupi et al. 2020, DIHs fulfill the role of knowledge brokers to promote DT in SMEs. The hubs act as external factors that foster connections with other companies and institutions and mediate between unconnected actors. Thus, by supporting SMEs' DT with a collaborative approach, DIHs can make an essential contribution to creating a digital ecosystem capable of addressing SMEs' digital gaps (Crupi et al. 2020).

The European Commission's Digital Innovation Hub catalog provides a database for Innovation Hubs in Europe. It outlines in summary 698 DIHs intending to boost the networking and outline the support by regional, national, and European initiatives criteria (European Commission 2021e). The map displays DIHs that the European Commission verifies according to the requirements listed in Appendix 20.

The catalog outlines 14 DIHs in Portugal, whereby six are in full operation, six are planned, and two are part of the Horizon2020[2] program (European Commission 2021e). For a detailed

[2] Horizon2020 is the biggest EU Research and Innovation programme (European Commission 2020d).

description of each DIH, please refer to Appendix 22. The identified DIHs were clustered according to their focus sectors[3] and differentiated between urban and rural areas[4].

As displayed in Appendix 21, three out of the six fully operating DIHs are located in urban areas. Two of them focus on Manufacturing and one on Agriculture & Food. Seven DIHs concentrate on different sectors, whereby Tourism, Health, and Agriculture & Food are the highest covered sectors, with three DIHs per sector. Nevertheless, only two DIHs support DT in urban areas and two in rural areas. Lastly, only one DIH centers on the development of rural regions. As displayed in Table 17, comparing the number of SMEs and total DIHs with technologically leading countries: Sweden, Denmark, and Austria (European Observatory for Clusters and Industrial Change 2019), Portugal provides less DIHs per number of SMEs reflected in the developed DIH-SME ratio. The ratio is four times as high as Denmark's and significantly higher than the DIH-SME ratio of Austria and Sweden.

Country	SME	DIH[5] (total)	DIH-SME ratio[6]
Portugal	908544	14	64896
Sweden	645883	18	35882
Denmark	233331	15	15555
Austria	319307	18	17739

Table 17: DIH-SME Ratio (D. Clark 2021; European Commission 2021b).

The ratio shows that Austria, Denmark, and Sweden have a more profound DIH infrastructure, indicating that SMEs based in those countries have better access to knowledge and support from DIHs.

[3] One DIH can focus on more than one sector
[4] Criteria:"a population density threshold (300 inhabitants per km²) applied to grid cells of 1 km²; a minimum size threshold (5 000 inhabitants) applied to grouped grid cells above the density threshold." (eurostat 2018).
[5] Planned and fully operating
[6] Calulated as =SME/DIH

Further, it is significant to elaborate on the European Digital Innovation Hubs (EDIH) as part of the Digital Europe Program[7]. In the course of the Digital Europe Program, the European Commission has developed the EDIHs, which is equivalent to the definition of a DIH yet, besides the local orientation, EDIHs are also intended to benefit stakeholders outside the regional area across the EU. As of January 2021, the EU foresees between 3-6 EDIHs for Portugal with a total budget of around EUR 22,25 Million. The submission for the proposal started in November 2021 and will end in February 2022. (European Commission 2021a, 2021b) Appendix 23 displays DIHs that were identified as potential EDIHs.

5.4.3.3 Privately financed

In contrast to the second category, the third area represents initiatives and programs that are privately financed and which are usually characterized by offering more targeted solutions. Digitalization and DT initiatives from the private sector provide more direct access to the necessary information, as this category offers more detailed insights into the overall process and specific benefits of business process efficiency and product development. Moreover, this category has a better understanding and access to the particular market, SMEs are embedded. However, these initiatives are usually difficult to establish by SMEs, as those enterprises work with limited resources (financial and otherwise) and therefore often dependent on public funding. Nevertheless, larger companies launch initiatives along their value chain to support their suppliers, manufacturers, and other stakeholders in DT, including SMEs (Prof. Dr. Aida Kamišalić Latifić 2020).

There is no existing database in Portugal that lists the individual programs of companies. Due to the restricted resources and time of the thesis, no primary data collection was feasible. Lastly,

[7] The Digital Europe program provides strategic funding in the areas of supercomputing, artificial intelligence, cybersecurity, advanced digital skills, and wide use of digital technologies (European Commission 2021a, 2021b).

it should be noted that these programs are only relevant to a small number of SMEs, as they are very specific.

5.4.3.4 Conclusion

It can be observed that many initiatives, especially from the government, focus on start-ups, R&D, and Entrepreneurship, aiming to boost and accelerate innovation. Further, many programs, including EU initiatives, concentrate on implementing emerging technology, whereby many countries, including Portugal, have not implemented basic digital technology yet. This reflects in the average percentage of SMEs' employees in Portugal with connected computers, remaining at or below 40% with a stagnating process, while large enterprises in pioneer countries (Denmark, Finland, Sweden with around 80% or more) have made rapid progress over this period (OECD 2021). Additionally, the European Commission states that only 20% of SMEs in the EU are fully digitized. Finally, Portugal provides fewer DIHs per SME than frontier countries, whereas only four DIHs state that they concentrate on DT. The rest mainly focuses on R&D and enhancing the development of new products and services. Also, the planned EDIHs by the European Commission place their attention on driving emerging technologies rather than basic digital skills. Lastly, except for privately financed programs, public financed initiatives are very generic and strongly focus on providing funding information. Contrary to the European Commission's emphasis in their "Skills for SMEs" report, education and training need to be customized to be useful for SMEs. This includes tailored courses and training to SMEs in their specific sector, including practical content that enables direct action of SMEs (European Commission 2019).

Appendix

Appendix 1: Data points dictionary

Dataset	Data points	Definition
Portugal economic data	Internet access (Households) (%)	"Internet access is defined as the percentage of households who reported that they had access to the Internet. In almost all cases, this access is via a personal computer, either using a dial-up, ADSL, or cable broadband access. This indicator is measured in percentage of all households." (OECD Data n.d.d)
	Inflation (%)	"Inflation measured by consumer price index (CPI) is defined as the change in the prices of a basket of goods and services that are typically purchased by specific groups of households. Inflation is measured in terms of the annual growth rate and index, 2015 base year with a breakdown for food, energy and total excluding food and energy." (OECD Data n.d.c)
	Unemployment Rate (%)	"The unemployed are people of working age who are without work, are available for work, and have taken specific steps to find work. The uniform application of this definition results in estimates of unemployment rates that are more internationally comparable than estimates based on national definitions of unemployment." (OECD Data n.d.g)
	Nominal GDP Growth Rate (%)	"Nominal gross domestic product (GDP) is GDP given in current prices, without adjustment for inflation. Current price estimates of GDP are obtained by expressing values of all goods and services produced in the current reporting period." (OECD Data n.d.f)
	Corporate Net Lending (% of GDP)	"Net lending is the net amount a unit or a sector has available to finance, directly or indirectly, other units or other sectors. Net lending can be derived as saving plus net receipts of capital transfers minus net purchases of non-financial assets (i.e. the balance of the capital account), or it can be measured as the difference between net acquisition of financial assets and net incurrence of liabilities (i.e. the balance of the financial account)." (OECD Data n.d.e)
	GDP per Capita (US-Dollar)	"Gross domestic product (GDP) is the standard measure of the value-added created through the production of goods and services in a country during a certain period. As such, it also measures the income earned from that production or the total amount spent on final goods and services (less imports). While GDP is the single most important indicator to capture economic activity, it falls short of providing a suitable measure of people's material well-being for which

		alternative indicators may be more appropriate. This indicator is based on nominal GDP (also called GDP at current prices or GDP in value) and is available in different measures: US dollars and US dollars per capita (current PPPs).” (OECD Data n.d.b)
	Average Wages (US-Dollar)	“Average wages are obtained by dividing the national-accounts-based total wage bill by the average number of employees in the total economy, which is then multiplied by the ratio of the average usual weekly hours per full-time employee to the average usually weekly hours for all employees. This indicator is measured in USD constant prices using 2016 base year and Purchasing Power Parities (PPPs) for private consumption of the same year.” (OECD Data n.d.a)
	FDI Portugal (US-Dollar)	“Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor.” (World Bank)
	Number of SMEs by size	Micro, small and medium are defined in Section 3.2.1 (**Error! Reference source not found.**).
	SME Investment Rate (%)	“Measures the relationship between gross fixed capital formation and gross value added.” (PORDATA 2021c)
	SME GVA (€)	“Gross production value less the cost of raw materials and other consumption in the production process. Values are gross when not deducting the consumption of fixed capital.” (PORDATA 2021a)
	SME Turnover (€)	“The net amount of sales and services rendered (covering compensatory allowances) relating to entities' normal business after reductions in sales and not including the value-added tax nor other taxes directly related to sales and services rendered.” (PORDATA 2021b)
SMEs per sector	-	“An activity can be said to take place when resources such as equipment, labor, manufacturing techniques, information networks, or products are combined, leading to the creation of specific goods or services. An activity is characterized by the input of products (goods and services), a production process, and an output of products. An industry consists of a group of local kind-of-activity units engaged in the same, or similar, kind-of-activity.” (PORDATA 2021d)
SMEs and ICT	SME Computer Usage (%)	“Enterprises that use computers as a % of the total of enterprises.” (PORDATA)
	SME Computer Usage (%-change)	
	SME Internet Connection (%)	“Enterprises with an Internet connection as a % of the total of enterprises.” (PORDATA)

	SME Internet Connection (%-change)	

Appendix 2: PORDATA – Code example for data preparation (Python)

```
# Reading the CSV file
    prt_SMEIR= pd.read_excel("PORDATA_SME_Investment_Rate.xlsx", header=None)
# Drop rows
    prt_SMEIR = prt_SMEIR.drop([0,1,2,3,4,5,6,7,8], axis=0)
# Number of rows to drop
    n = 22
# Dropping last n rows
    prt_SMEIR.drop(prt_SMEIR.tail(n).index, inplace = True)
# Number of columns to drop
    n = 251
# Drop last N columns of dataframe
    prt_SMEIR = prt_SMEIR.iloc[: , :-n]
# Adding Column and defining index where the column should be added
    idx = 0
# Content of new column
    new_col = ["PRT", "PRT", "PRT", "PRT", "PRT", "PRT", "PRT", "PRT", "PRT",
    "PRT", "PRT", "PRT", "PRT", "PRT", "PRT"]
    prt_SMEIR.insert(loc=idx, column="Country", value=new_col)
# Adding column name to the respective columns
    prt_SMEIR.columns = ["Country", "Year", "IR-Total (%)", "IR-Micro (%)", "IR-Small
    (%)", IR-Medium (%)"]
    prt_SMEIR
```

Appendix 3: OECD – Code example for data preparation (Python)

```
# Reading CSV
    prt_IF = pd.read_csv("OECD_Inflation.csv")
    prt_IF = prt_IF.loc[prt_IF["LOCATION"] == "PRT"]
# Removing Columns
    prt_IF = prt_IF.drop("Flag Codes", 1)
    prt_IF = prt_IF.drop("FREQUENCY", 1)
    prt_IF = prt_IF.drop("MEASURE", 1)
    prt_IF = prt_IF.drop("SUBJECT", 1)
    prt_IF = prt_IF.drop("INDICATOR", 1)
# Renaming Columns
    prt_IF = prt_IF.rename(columns={"LOCATION": "Country", "TIME": "Year",
    "Value": "Inflation (%)"})
    prt_IF
```

Appendix 4: World Bank – Code example for data preparation (Python)

```
# Reading CSV
        prt_FDI = pd.read_excel("World_Bank_FDI.xls", header=None)
        prt_FDI = prt_FDI.loc[prt_FDI[0] == "Portugal"]
# Defining columns to drop
        n = 1
# Drop last N columns of dataframe
        prt_FDI = prt_FDI.iloc[: , :-n]
# Dropping columns in the beginning
        prt_FDI.drop(prt_FDI.iloc[:, 3:20], inplace = True, axis = 1)
# Transformung columns into rows (due to the format of the dataset)
        prt_FDI = prt_FDI.T
# Drop first rows of dataframe
N = 32
        prt_FDI.drop(index=prt_FDI.index[:N], axis=0, inplace=True)
# Inserting Country code
        prt_FDI.insert(0,"Country","PRT")
# Inserting the Year range
        prt_FDI.insert(1, "Year", range(2005, 2005 + len(prt_FDI)))
# Renaming FDI column
        prt_FDI.rename(columns={ prt_FDI.columns[2]: "FDI Portugal (US-Dollar)" },
        inplace = True)
        prt_FDI
```

Appendix 5: Merging the datasets – Code example for merging the datasets (Python)

```
# Initial Dataset merging
        left_merged = pd.merge(prt_IA, prt_IF, how="left", on=["Year", "Country"])
# Adding all other datasets to create a final dataset df
# Adding Unemployment Rate to the dataset
        IA_IF_UER = pd.merge(left_merged, prt_UER, how="left", on=["Year", "Country"])
```

Appendix 6: Visualizing the data – Code example for plotting the data (Python)

```
# Defining the style of the plot
        sn.set_style("whitegrid")
        sn.set_context("paper", font_scale=1.5, rc={"lines.linewiDT h": 1.5})
# Defining x-Axis
        x = prt_IA[["Year"]]
        plt.rcParams.update({"font.family":"Times New Roman"})
# Plotting the data
        plt.Figure(figsize = (15, 5))
        plt.xlabel("Years", fontsize=20)
        plt.xticks(fontsize=14)
        plt.ylabel("Internet Access Households (%)", fontsize=20)
        plt.yticks(fontsize=14)
        plt.plot(x, prt_IA[["Internet Access (Households) (%)"]], "bo-", color="r")
        plt.savefig("Internet_Access_Households.png")
        plt.show()
```

Appendix 7: Dataset – Portugal Economic Data

Country	Year	Internet Access (Households) (%)	Inflation (%)	Unemployment Rate (%)	Nominal GDP Growth Rate (%)	Corporate Net Lending (% of GDP)	GDP per Capita (US-Dollar)	Average Wages (US-Dollar)	FDI Portugal (US-Dollar)	#-Total	#-Micro	#-Small	#-Medium	IR-Total (%)	IR-Micro (%)	IR-Small (%)	IR-Medium (%)	GVA-Total (€)	GVA-Micro (€)	GVA-Small (€)	GVA-Medium (€)	Turnover-Total (€)	Turnover-Micro (€)	Turnover-Small (€)	Turnover-Medium (€)
PRT	2005	31,46	2,13	9,23	4,14	-3,36	$ 22.725	$ 28.148	$ 3.367.937.007	1.150.515	1.099.975	44.149	6.391	25,00	22,40	22,30	31,00	52.401 €	19.775 €	16.539 €	16.088 €	208.336 €	73.594 €	69.317 €	65.424 €
PRT	2006	35,15	3,05	9,30	4,86	-5,76	$ 24.650	$ 27.536	$13.394.502.768	1.171.093	1.119.032	45.513	6.548	26,60	26,80	25,50	27,50	54.709 €	20.093 €	17.457 €	17.160 €	216.428 €	74.133 €	72.285 €	70.011 €
PRT	2007	39,61	2,42	9,58	5,55	-5,91	$ 25.702	$ 27.720	$ 6.014.642.427	1.233.432	1.180.255	46.398	6.779	27,60	28,40	24,20	30,00	58.631 €	21.228 €	18.879 €	18.523 €	228.368 €	77.007 €	76.264 €	75.097 €
PRT	2008	46,04	2,65	9,24	2,06	-7,51	$ 26.666	$ 27.631	$ 7.819.075.463	1.260.302	1.207.098	46.383	6.821	26,60	29,10	23,60	26,80	60.471 €	21.798 €	19.613 €	19.061 €	232.696 €	77.048 €	77.145 €	78.503 €
PRT	2009	47,89	-0,90	11,23	-2,06	-3,55	$ 26.478	$ 28.913	$ 5.585.829.214	1.222.488	1.171.689	44.253	6.546	25,00	26,50	20,60	27,60	57.957 €	21.411 €	18.319 €	18.227 €	216.220 €	72.253 €	70.858 €	73.109 €
PRT	2010	53,73	1,39	12,58	2,39	-0,64	$ 27.283	$ 28.792	$ 8.966.915.539	1.167.168	1.117.787	42.968	6.413	21,50	28,00	17,50	18,40	56.854 €	20.311 €	17.959 €	18.584 €	219.744 €	71.940 €	72.364 €	75.440 €
PRT	2011	57,97	3,55	13,52	-1,96	1,16	$ 26.769	$ 28.096	$ 9.821.076.890	1.135.153	1.088.145	40.815	6.193	18,80	20,70	17,20	18,40	52.814 €	18.138 €	17.260 €	17.416 €	208.317 €	66.917 €	68.819 €	72.581 €
PRT	2012	61,02	2,78	16,58	-4,43	2,25	$ 26.438	$ 26.890	$21.396.375.527	1.085.894	1.043.003	37.118	5.773	13,70	17,50	11,80	11,70	47.346 €	16.038 €	14.920 €	16.388 €	191.973 €	61.385 €	63.057 €	67.531 €
PRT	2013	62,34	0,44	17,18	1,31	3,32	$ 27.936	$ 27.406	$15.745.220.666	1.118.427	1.077.294	35.446	5.687	15,00	19,70	11,30	13,70	48.183 €	15.869 €	15.767 €	16.547 €	190.187 €	60.738 €	62.221 €	67.228 €
PRT	2014	64,87	-0,16	14,65	1,50	6,24	$ 28.742	$ 26.935	$12.045.808.665	1.146.119	1.104.490	35.870	5.759	16,60	23,00	13,90	12,80	49.451 €	16.715 €	15.694 €	17.042 €	194.812 €	62.461 €	63.895 €	68.456 €
PRT	2015	70,23	0,51	13,03	3,85	3,32	$ 29.661	$ 26.855	$ 1.270.014.233	1.180.331	1.136.865	37.515	5.951	18,10	24,60	14,30	15,10	52.424 €	17.997 €	16.529 €	17.898 €	201.762 €	64.329 €	66.215 €	71.218 €
PRT	2016	74,05	0,64	11,47	3,77	1,18	$ 31.608	$ 26.699	$ 7.354.810.293	1.213.107	1.167.993	38.866	6.248	19,60	25,20	17,20	16,10	56.044 €	19.373 €	17.747 €	18.924 €	210030,9	66186,7	68221,80	75622,50
PRT	2017	76,94	1,56	9,23	5,07	2,89	$ 33.045	$ 26.820	$10.683.844.361	1.259.234	1.212.059	40.547	6.628	20,50	26,10	17,60	17,30	61.318 €	21.541 €	19.366 €	20.411 €	225.486 €	71.100 €	73.423 €	80.963 €
PRT	2018	79,43	1,17	7,17	4,71	-0,22	$ 34.932	$ 27.263	$ 7.846.086.578	1.294.037	1.244.495	42.581	6.961	21,90	29,30	17,00	19,00	65.742 €	23.276 €	20.749 €	21.717 €	238.522 €	74.486 €	77.487 €	86.550 €
PRT	2019	80,94	0,30	6,68	4,27	-0,61	$ 36.945	$ 27.978	$10.332.167.493	1.333.649	1.281.857	44.492	7.300	21,40	29,80	15,90	17,80	69.352 €	23.520 €	22.520 €	23.312 €	248.445 €	78.207 €	81.477 €	88.760 €

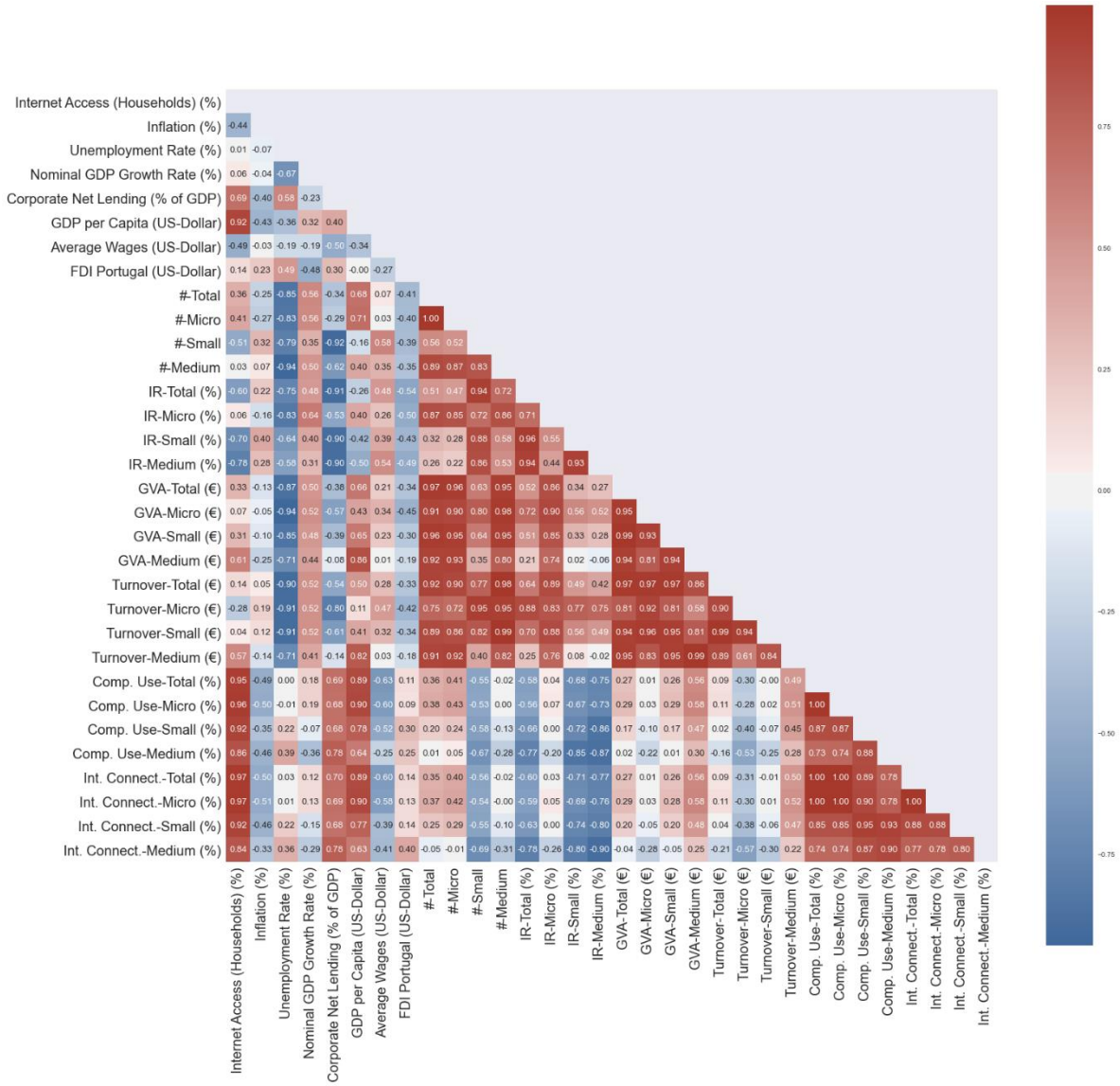
Appendix 8: Dataset – Number of SMEs per sector (Portugal)

Country	Year	Total	Agriculture, farming of animals, hunting, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water	Construction	Wholesale and retail trade (...)	Transportation and storage	Accommodation and food service activities	Financial and insurance activities	Real estate activities	Education	Human health and social work activities	Other sectors
PRT	2005	1.150.515	54.956	1.539	86.082	1.280	127.063	279.496	26.018	87.238	30.007	24.969	49.255	66.183	316.429
PRT	2006	1.171.093	56.100	1.495	83.585	1.334	123.013	276.313	25.449	87.777	28.491	25.905	55.460	68.987	337.184
PRT	2007	1.233.432	56.618	1.483	83.561	1.492	125.472	280.118	26.087	89.480	28.430	28.037	60.901	73.720	378.033
PRT	2008	1.260.302	56.710	1.488	81.071	1.727	124.943	276.213	25.914	91.679	25.382	30.060	63.915	79.136	402.064
PRT	2009	1.222.488	55.092	1.421	76.987	1.787	116.585	265.465	25.022	89.867	23.661	30.004	66.662	82.010	387.925
PRT	2010	1.167.168	53.792	1.321	71.982	1.797	105.369	251.273	24.079	85.919	22.806	29.559	65.315	82.877	371.079
PRT	2011	1.135.153	56.554	1.259	70.322	1.924	97.891	243.687	23.671	85.756	22.632	28.976	61.674	83.299	357.508
PRT	2012	1.085.894	56.463	1.173	67.191	2.036	87.527	232.453	22.806	83.820	21.678	28.429	56.793	81.861	343.664
PRT	2013	1.118.427	107.967	1.154	66.128	2.097	81.275	226.476	22.322	82.170	20.975	28.294	55.345	81.508	342.716
PRT	2014	1.146.119	128.757	1.098	65.900	2.142	77.792	221.673	21.800	84.078	18.834	29.557	55.314	83.682	355.492
PRT	2015	1.180.331	133.417	1.062	66.416	2.418	77.851	221.854	21.562	91.780	18.262	32.149	54.616	86.956	371.988
PRT	2016	1.213.107	132.836	1.041	66.632	5.153	78.807	220.173	21.721	97.513	18.043	35.783	54.638	90.703	390.064
PRT	2017	1.259.234	132.915	1.058	67.206	5.226	81.574	218.980	22.757	104.773	17.685	40.786	56.568	94.711	414.995
PRT	2018	1.294.037	132.871	1.018	67.850	5.589	85.256	217.610	25.501	113.135	17.072	45.507	57.884	97.972	426.772
PRT	2019	1.333.649	130.329	1.016	68.453	5.747	90.366	218.206	31.238	117.971	16.610	49.826	58.396	100.969	444.522

Appendix 9: Dataset – SMEs and ICT related data (Portugal)

Country	Year	Comp. Use-Total (%)	Comp. Use-Micro (%)	Comp. Use-Small (%)	Comp. Use-Medium (%)	Int. Connect.-Total (%)	Int. Connect.-Micro (%)	Int. Connect.-Small (%)	Int. Connect.-Medium (%)
PRT	2005	60,80	53,10	89,60	99,10	48,10	39,10	78,60	98,10
PRT	2006	61,50	54,00	93,80	99,10	50,00	42,40	80,30	99,10
PRT	2007	67,60	61,20	94,30	99,20	56,30	48,40	88,40	97,80
PRT	2008	70,10	64,50	95,40	99,50	61,20	54,60	90,60	98,90
PRT	2009	66,10	60,40	94,50	99,80	58,80	52,10	91,60	99,20
PRT	2010	67,60	61,70	96,70	100,00	59,40	52,60	93,20	99,60
PRT	2011	71,20	66,20	97,00	100,00	63,50	57,60	94,20	100,00
PRT	2012	78,40	72,20	97,80	100,00	72,70	65,50	94,70	100,00
PRT	2013	83,90	79,80	97,80	100,00	77,20	71,60	95,50	100,00
PRT	2014	88,80	85,70	98,50	100,00	82,80	78,40	95,90	100,00
PRT	2015	89,40	86,30	98,70	100,00	82,90	77,90	97,80	100,00
PRT	2016	90,10	87,20	98,80	100,00	85,00	80,70	97,70	100,00
PRT	2017	90,50	87,70	98,50	100,00	85,70	81,50	97,70	100,00
PRT	2018	91,20	88,40	99,10	100,00	86,40	82,30	98,10	100,00
PRT	2019	96,70	95,60	99,00	100,00	92,50	89,70	97,90	100,00

Appendix 10: Correlation Matrix (Portugal economic data and SME ICT-related data)



Appendix 11: Correlation Coefficients

Source: Buettgenbach 2021

Size of the correlation coefficient	Interpretation
0.90 to 1.00 (-0.90 to -1.00)	Very high positive (negative) correlation
0.70 to 0.90 (-0.70 to -0.90)	High positive (negative) correlation
0.50 to 0.70 (-0.50 to -0.70)	Moderate positive (negative) correlation
0.30 to 0.50 (-0.30 to -0.50)	Low positive (negative) correlation

0.00 to 0.30 (-0.00 to -0.30)	Negligible correlation

Appendix 12: Connectivity Dimension – Individual indicators

Source: European Commission 2020c

Sub-dimension	Description	Individual indicators	Portugal	Denmark	EU-27
Fixed broadband take-up	Take up of overall and ultrafast broadband	Overall fixed broadband take-up	24.6	34.7	27.6
		At least 100 Mbps fixed broadband take-up	27.9	17.1	12.9
Fixed broadband coverage	Availability of fast broadband and of fixed and very high-capacity networks.	Fast broadband NGA coverage	32	27.7	28.6
		Fixed Very high Capacity (VHCN) coverage	55.3	62	29.4
Mobile broadband	Includes 4G coverage, the take-up of mobile broad band, and includes the indicator on 5G readiness.	4G coverage	24	25	24.1
		Mobile Broadband take-up	7.27	16.3	10.7
		5G readiness	4.17	16.7	10.3
Broadband price index	The broadband price of retail offers	Broadband price index	51	60.6	64.22

Appendix 13: GCI - Supply

Source: Huawei 2020

Indicator	Definition
International Internet BandwiDT h	International Internet bandwidth h refers to the total used capacity of international Internet bandwidth h, in megabits per second (Mbit/s). Used international Internet bandwidth h refers to the average traffic load of international fiber-optic cables and radio links for carrying Internet traffic. The average is calculated over the 12-month period of the reference year and takes into consideration the traffic of all international Internet links. International Internet bandwidth h (bit/s) per Internet user is then calculated by converting to bits per second and dividing by the

	total number of Internet users, and this is used to calculate the index scores. Calculation: per internet user
Telecom investment	Telecom Service Provider investment in modern network infrastructure over an aggregated five-year period. This focuses on key carrier network technologies which are integral to the delivery of cloud, mobile and high-speed data services including service provider routers, service provider switches, and wireless infrastructure (including 3G, 4G and 5G). Aggregate spending over the most recent five-year period is used, in order to provide a more holistic measurement of Telco infrastructure deployments in the context of carrier investment cycles and economic wild cards. Calculation: % of GDP
ICT Laws	A survey on how developed a nation's ICT laws are (e.g. electronic commerce, digital signatures and consumer protection). Calculation: n/a
IoT Investment	Investment on IoT solutions and deployment including systems, sensors, modules, infrastructure, networks, specialized devices, security, software, connectivity services, IT and installation services, content services, OT (operational technology) and ongoing services (including consumer services). Weighed against the size of the population (IoT per capita). Calculation: per capita
ICT Investment	The overall size of the traditional ICT market in each country, as defined by the total amount of end-user spending on IT hardware (servers, storage, PCs, devices, peripherals, network equipment), software, IT services and telecom services. The total market size is measured against the overall size of the economy (GDP), which provides a measurement of market supply maturity. Calculation: % of GDP
4G & 5G Connections	A weighted score of the percentage of mobile device connections which use a 5G connection (accounting for 20% of the score) and the percentage of mobile device connections which use a 4G connection but do not use a 5G connection (accounting for 80% of the score). This measurement is not based on geographic land mass, so it is a more accurate measurement of the actual supply of 4G and 5G services to individuals and organizations. Users who have not subscribed to 4G services but who use a 4G phone are not counted; users who have not subscribed to 5G services but use a 5G phone are counted in 4G if they have a 4G connection and are otherwise not counted. Calculation: 80% of 4G connections, 20% of 5G connections
Fiber Optics	The number of Fiber to the Home (FTTH) subscriptions, measured against the total number of households in each nation. "Fiber to the Home" is defined as a communications architecture in which the final connection to the subscriber's property is Optical Fiber. The fiber optic communications path is terminated on or in the premise for the purpose of carrying communications to the subscriber. Calculation: % of total households
Security Software Investment	Investment in software related to the security of ICT resources and data. These security products may be deployed in data centers, on networks, and on devices. Spending by all end-user segments is

	included (private and public sector). The data is weighted by the total size of the population. Calculation: per capita
AI Investment	The sum of investments for the deployment of AI solutions by private and public institutions. This includes AI-related investments in hardware systems, software platforms and professional services. Calculation: % of GDP
Cloud Investment	Overall investment in public cloud infrastructure services (Infrastructure as a Service), leveraged for the supply of server (compute) and storage infrastructure resources in a public cloud environment. This provides a direct measurement of the supply of services from public cloud infrastructure deployments to end-users. It is weighted against GDP. Calculation: % of GDP

Appendix 14: GCI - Demand

Source: Huawei 2020

Indicator	Description
Fixed Broadband Subscriptions	Total number of subscriptions that access the Internet through a wireline (including satellite) broadband internet connections. Calculation: per capita
Mobile Broadband Subscription	Total number of mobile broadband services subscribers measured in relation to the overall size of the population. Calculation: per capita
Smartphone Penetration	Smartphone penetration expressed as a percentage of total connections (excluding M2M). A smartphone is defined as a mobile handset with advanced access to internet-based services and computing functions. Calculation: % of total connections
App Downloads	The total number of new mobile application downloads in the calendar year on all major mobile platforms (including all Android and iOS). This is measured against the overall size of the population, and refers to new app downloads, not the existing installed base. Calculation: per capita
E-commerce Transactions	E-commerce involves orders placed on the Internet (i.e., the buyer clicks an order button on the Internet) in a commitment for paid goods or services. Total E-commerce measures the volume of all E-commerce transactions, both B2B and B2C (including volume purchases). Calculation: per capita
Cloud Migration	An index based on the percentage of traditional software budgets which have migrated from traditional on-premise

	licensing to ‘as a service’ cloud deployments, in order to measure demand for advanced Public Cloud Services in relation to overall ICT investment. Calculation: % of total annual software investment
AI Demand	The percent of third-party software spending and investment that is on AI software in a country. Calculation: % of total annual software investment
IoT Installed Base	Total installed base of IoT devices and systems (including Intelligent Systems). Calculation: per capit
Secure Internet Servers	Secure Internet Servers (per 1 million people) refers to the number of distinct, publicly-trusted TLS/SSL certificates according to the Netcraft Secure Server Survey. Calculation: per capita
Computer Households	The number of households with access to a computer – a fixed desktop computer, laptop, or tablet (or similar handheld computer). Excludes smartphones. Calculation: % of total households

Appendix 15: GCI-Experience

Source: Huawei 2020

Indicator	Description
Fixed Broadband Affordability	The price of a monthly subscription to an entry-level fixed broadband plan of a minimum of 5 GB. For plans that limit the monthly amount of data transferred by including data volume caps below 5 GB, the cost for the additional bytes is added to the basket. The minimum speed of a broadband connection is 256 kbit/s. The calculation is a percentage of a nation’s average monthly GNI per capita. Calculation: per GN
Mobile Broadband Affordability	The price of a monthly subscription to prepaid and postpaid data services across a variety of service plans and device types. Up to 2017, prices are for 1 GB of data for a USB/ dongle, computer-based subscription. 2018 onwards it is mapped to the 1.5 GB subscription, irrespective of the device used. This is calculated as a percentage of a nation’s average monthly GNI per capita. Calculation: per GNI

Broadband Download Speed	Average download speed for each country. These metrics leverage billions of Internet and mobile network tests to provide a current view and analysis of global Internet access speeds. Calculation: n/a
Cybersecurity Awareness	The Global Cybersecurity Index is a trusted reference that measures the commitment of countries to cybersecurity at a global level. As cybersecurity has a broad field of application, cutting across many industries and various sectors, each country's level of development or engagement is assessed along five categories: Legal Measures, Technical Measures, Organizational Measures, Capacity Building and Cooperation; and then aggregated into an overall score. Scores are derived from an online survey, which also allowed for the collection of supporting evidence. Through consultation with experts, these survey responses were then weighted in order to arrive at the final index scores. Calculation: n/a
Telecom Customer Service	Current service levels provided by telecom operators based on previous research and surveys conducted within each nation. Calculation: n/a
Internet Participation	The total number of individuals accessing the Internet at least once during the 12-month period, via wireline and/or mobile internet access. Calculation: per capita
E-Government Service	These scores are sourced directly from the United Nations E-Government Survey, which benchmarks countries according to ratings derived from a survey to assess the E-government development status of all UN member states. Calculation: n/a
IoT Analytics	Total investment on analytics software relating to IoT data analysis. These software tools that extract value from the mass of data being created via IoT to improve the experience of a nation or organization with an IoT platform that transforms IoT data into actionable information. Calculation: per capita
Data Creation	Based on the estimated availability of target-rich, actionable data (TB) which can be leveraged by AI platform and analytics tools in order to enhance the experience and ROI of organizations investing in the deployment

	of AI solutions. To improve the experience of this technology, the scalability of created data needs to be considered. Calculation: TB per capita
Cloud Experience	The percent of total IT investment within a country that is by cloud service providers. Calculation: % of IT investment

Appendix 16: GCI-Potential

Source: Huawei 2020

Indicator	Description
ICT Patents	The total number of patents filed under the PCT within the ICT technology domain in the inventor's country of residence, as measured and tracked by the OECD (stats. oecd.org). Calculation: per capita
IT Workforce	Total employment in the supply and management of IT for each nation. This includes workers employed directly in the IT industry (hardware manufacturers, software vendors, service providers and channel organizations), and IT staff employed by end-users in IT departments for the management, deployment, support, and strategic implementation of technology solutions. Calculation: per capita
R&D Expenditure	Expenditure on R&D means current public and private capital expenditure on creative work to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development. Calculation: % of GDP
Software Developers	The total number of software developers in each nation. Professional software developers are engaged in employment where the primary activity is constructing software or supervising its construction. Calculation: per capita
ICT Market Potential	An index derived from local nation survey data on the potential for market development and the economic benefits to be derived from adoption of adopting Cloud, AI, IoT and Broadband solutions. In order to assess future potential for development, the five-year forecasted CAGR (compound

	annual growth rate) is used for the time period through 2025. This CAGR accounts for current market assumptions relating to technological development, penetration rates, macroeconomic growth and the ability of customers in each country to invest in these ICT markets. Calculation: n/a
ICT Influencing New Business Model	Based on a survey conducted by the World Economic Forum, in which respondents were asked to evaluate the extent to which ICTs enable new business models. Calculation: n/a

Appendix 17: Corporate and Entrepreneurial innovation

Source: IAPMEI 2020a, 2020b; ePortugal.gov.pt 2021

System	Target	Description
SI Qualified and Creative Entrepreneurship	SME in operations for less than 2 years	Support system that includes a non-repayable incentive component
SI Productive Innovation	Companies of any kind or legal form	Aims to promote business innovation in: Production of new goods and services Adoption of new or significantly improved Manufacturing -, logistic-, distribution- or organizational processes and methods.

Appendix 18: SME Qualification and Internationalization

Source: ePortugal.gov.pt 2021; IAPMEI 2020c, 2020d

System	Target	Description
SI Qualification – individual project	SME of any kind of legal form	Individual project to strengthen the business capability of SMEs through organizational innovation, applying new methods and organizational processes.
SI Qualification – joint project-	Not-for-profit entities with specific expertise targeted at SMEs	Joint project to strengthen the business capability of SMEs through organizational innovation, applying new methods and organizational processes.

Appendix 19: Research and technological development

Source: ePortugal.gov.pt 2021

System	Target	Description

SI R&D Companies	Companies with any kind of legal form	Supporting R&D in companies and its economic development to increase cooperative projects and activities of companies to develop new products and services, focusing on higher technology and knowledge.
SI R&D Centers	Companies with any kind of legal form	Supports developing new products and services, especially in activities with greater technological and knowledge intensity. Aiming to prompt R&D with companies and other entities.
IS Industrial Property	Companies with any kind of legal form	R&D projects, aimed at promoting registration of industrial property rights in the form of registration of patents, utility models, designs, national and internationally

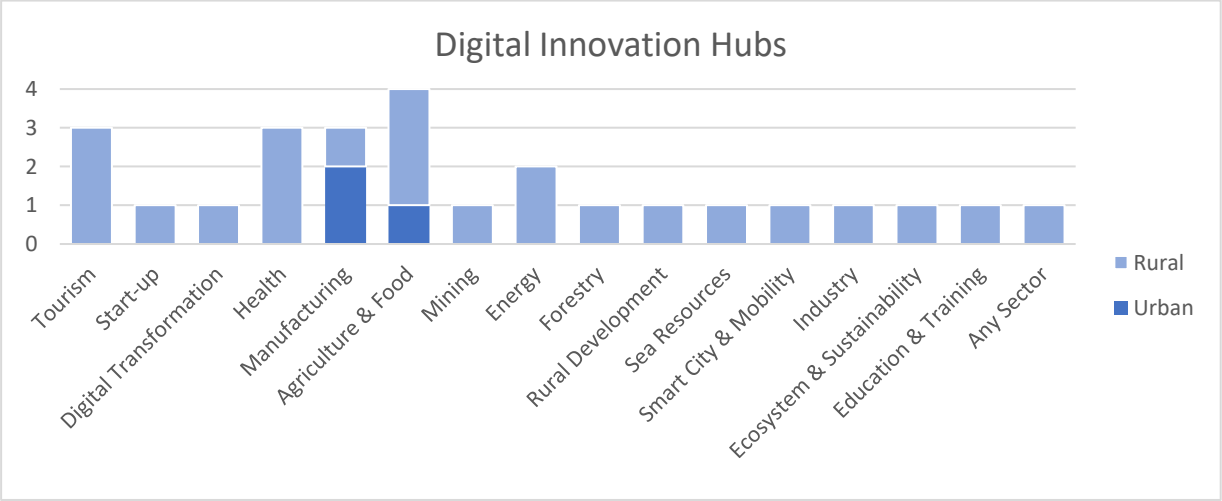
Appendix 20: Digital Innovation Hubs Criteria

Source: European Commission 2021e

Criteria
Part of a regional, national, or EU policy initiative that focuses on digitizing the industry
Being a non-for-profit organization
Physical presence in the region the DIH states, an updated website which communicates the DIHs' activities and services related to the digital transformation of SMEs or of industrial sectors that currently underutilize digital technologies
Representing at least 3 examples of how the DIH supported the DT of a company.

Appendix 21: Digital Innovation Hubs

Source: European Commission 2021e



Appendix 22: Digital Innovation Hubs Portugal

Source: European Commission 2021e

DIH	Location	Description	Focus Area
Algarve Smart Destination, DIH	Faro		Tourism
Azores Digital Innovation Hub	Lagoa	One-stop shop for DT	Tourism and Sustainability
CONNECT 5	Aveiro Region	Gathering main national players in Information, Communication and Electronic Technologies	Digital Transformation, Start-up acceleration
DIAMOTIC Health	Coimbra	Access to knowledge, development to boost innovative product design in personal health and wellbeing	Life science & healthcare
HUB for Agriculture	Lisbon	Initiative to create a multi-sector cooperation network that promotes the connection between the technology provider and the needs of the agricultural sector	Agriculture and food
iMan Norte Hub – Digital Innovation Hub for Customer-Driven Manufacturing @ Norte	Porto	Fostering digital transformation of manufacturing companies in the northern region	Manufacturing
inNOVA4TECH hub – innovation Hub for TECHnology Transfer	Caparica	Supporting Digital Transformation of companies (SME and mid-caps) with a wide range of advanced technologies	Agriculture and food, Mining and quarrying, energy and utilities, Construction, Life sciences & healthcare, Manufacturing
INSTITUTO NACIONAL DE INVESTIGACAO AGRARIA E VETERANIA	Oeiras	Performing research activities in the field of agronomy and veterinary medicine.	Agriculture, forestry, and rural development
Madeira Digital Innovation Hub	Funchal	Developing a variety of activities, a wide	Tourism, Sea resources, and technology, agri-

		range of business services, including	food, smart city and mobility, industry, Energy and water efficiency, Ecosystem and sustainability, Healthcare, Education and Training
NOVA ID FCT – ASSOCIACAO PARA A INVOVACAO E DESENVOLVIMENTO DA FCT	Caparica	Supporting culture of Research Excellence & Innovation, Strengthening the link between industry needs and societal challenges	Potential innovation HUB from Horizon 2020 Programme
PRODUTECH Digital Innovation Hub National Platform	Porto	Fostering digital transformation in manufacturing companies	Manufacturing industry
PTCentroDiH Digital Innovation Hub da Regiao Centro	Marinha	Modernizing industries through digital transformation	SMEs of any sector
SIH – Smart Island Hub	Funchal	Promote Innovation using the islands as a living lab for "testing and learning", Digital Transformation towards sustainable development.	Start-up, SMEs, Mid-caps
UNINOVA-INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECHNOLOGIAS-ASSOCIACAO	Caparica	Supporting culture of Research Excellence & Innovation, Strengthening the link between industry needs and societal challenges	Potential innovation HUB from Horizon 2020 Programme

Appendix 23: Potential European Digital Innovation Hubs

Source: European Commission 2021b

Potential EDIH	Location	Technology	Focus Area
AI4PA Portugal	Lisbon	AI, Data Science, and Big Data, Qualification in advanced digital skills, High-performance computing, digital solutions/	Public Administration, All sectors, Communication, and electronic information technologies, Circular economy environment and sustainability, mobility and logistics

		interoperability for public sector	
Apollo Health	Caparica	AI Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Nanotechnology Micro/Nano Electronics Photonics Simulation Cyberphysical systems Blockchain Cloud computing Mobility Connectivity Sectors	Public Administration, Communication and electronic Information Technologies, Health and Biotechnology
ATTRACT DIH	Porto	AI; High-performance computing; Data Science and Big Data; Digital solutions / interoperability for the public sector Sectors, Qualification in advanced digital skills Digital solutions	Horizontal (all sectors)
Azores Digital Innovation Hub (AzDIH)	Lagoa	AI High-performance computing Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Robotics Virtual and augmented reality Internet of Things Data Science and Big	Industry Agriculture Public Administration Circular economy, environment and sustainability Tourism Culture Mobility and logistics Communication and electronic Information Technologies Energy Natural Resources and extractive industry Ocean and fisheries

		Data Advanced Materials Micro/Nano Electronics Simulation Blockchain Cloud computing Mobility	
C-Hub: Cybersecurity DIH	Lisbon	Cybersecurity Digital solutions/interoperability for the public sector Internet of Things Simulation Cyber-Physical systems Blockchain	Horizontal (all sectors)
connectAHEAD Aerospace, eHealth, and Digital Critical Technologies	Evora	AI High-performance computing Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Simulation Cloud computing Mobility Connectivity Sectors:, Industry Agriculture Public Administration Tourism Telecommunications Mobility and logistics Communication and electronic Information Technologies Health and Biotechnology Energy Trade and Services Other Sectors (aerospace)	Aerospace, health, and critical digital technologies
CONNECT5	Îlhavo	AI High-performance computing Cybersecurity Qualification in	Public administration, Education, Community, social and personal service activities, Manufacture of electrical and

		advanced digital skills Digital solutions/interoperability for the public sector Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Micro/Nano Electronics Photonics Simulation Cyberphysical systems Blockchain Cloud computing	optical equipment, Mobility (incl. Automotive), Telecommunications, Information and Communication
Defence4Tech Hub	Lisbon	AI High-performance computing Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Nanotechnology Micro/Nano Electronics Photonics Simulation Cyberphysical systems Blockchain Cloud computing	Industry Agriculture Construction Public Administration Circular economy, environment, and sustainability Telecommunications Mobility and logistics Communication and electronic Information Technologies Health and Biotechnology Energy Trade and Services Natural Resources and extractive industry Sea and fisheries Forest
DigiHealthPT	Maia	AI High-performance computing Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality	Industry Public Administration Circular economy, environment, and sustainability Communication and electronic Information Technologies Health and Biotechnology

		Internet of Things Data Science and Big Data Advanced materials Nanotechnology Micro/Nano Electronics Photonics Simulation Cyberphysical systems Blockchain Cloud computing	
Dig_In4.0 - Polo de Inovação Digital para o Desenvolvimento e Aceleração da Indústria 4.0	Amadora	AI High-performance computing Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Nanotechnology Photonics Simulation Cyberphysical systems Blockchain Cloud computing	Industry Public Administration Energy
DIGITALbuilt	Porto	AI, High-performance computing, Cybersecurity, Qualification in advanced digital skills, Additive Manufacturing, Virtual and augmented reality, Internet of Things, Data Science and Big Data, Advanced Materials, Micro/Nano Electronics, Simulation, Cyber-Physical systems,	Industry, Construction, Public Administration, Circular economy, environment and sustainability, Telecommunications, Mobility and logistics, Communication and electronic information technologies, Natural Resources, and extractive industry.

		Blockchain, Cloud computing	
DIH 4 Global Automotive	Matosinhos	AI Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Micro/Nano Electronics Simulation Cyberphysical systems Blockchain	Manufacture of textiles and textile products, Manufacture of rubber and plastic products, Manufacture of basic metals and fabricated metal products, Manufacture of machinery and equipment, Manufacture of electrical and optical equipment, Manufacture of transport equipment, Mobility (incl. Automotive)
DIH4ClimateNeutrality	Caracavelos	Data Science and Big Data/AI/ High-performance computing /Cybersecurity/ Qualification in advanced digital skills/ Digital solutions - interoperability for the public sector/ Cloud Computing.	Industry; Public administration; Circular economy, environment, and sustainability; Telecommunications; Financial sector; Mobility and logistics; Information technologies, communication, and electronics; Energy.
DIH4Sm@rtRegions	Braganca	AI High-performance computing Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Micro/Nano Electronics Simulation Cyber-Physical systems	Industry Agriculture Public Administration Circular economy, environment and sustainability Tourism Culture Mobility and logistics Communication and electronic Information Technologies Energy Commerce and Services Forest

		Blockchain Cloud computing	
DSAI – PMC - DATA SCIENCE & AI PREDICTION MODELS CENTER	Lisbon	Digital solutions/interoperability for the public sector, Data Science and Big Data, Simulation, Cloud Computing	Horizontal (all sectors)
D2P2 - Data-Driven Public Policy Innovation Hub	Lisbon	Qualification in advanced digital skills, Data Science and Big Data, Cloud computing	Public Administration
EUROPE (RE)S+T+ARTS	Aveiro	AI High-performance computing Qualification in advanced digital skills Virtual and augmented reality Internet of Things Data Science and Big Data Micro/Nano Electronics Simulation Cyber-Physical systems Blockchain Cloud computing	Horizontal (all sectors)
Future Cities DIH	Leca da Palmeira	AI Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Simulation Cyberphysical systems Blockchain Cloud computing, Mobility, Connectivity	Industry Construction Public Administration Circular economy, environment, and sustainability Culture Mobility and logistics Communication and electronic Information Technologies Health and Biotechnology Energy Trade and Services Other Sectors (Territories and Cities)
Hubility - Sociodigital Innovation Hub for	Lisbon	AI, High-performance computing,	Industry, Public Administration, Tourism, Culture, Trade, and Services

Enhanced Capabilities in the Public Sector / Polo de Inovação Sociodigital para o Reforço de Competências no Sector Público		Cybersecurity, Qualification in advanced digital skills, Digital solutions/interoperability for the public sector, Robotics, Virtual and augmented reality, Internet of Things, Data Science and Big Data, Photonics, Simulation, Blockchain, Cloud Computing, Mobility, Connectivity	
InnovTourism	Covilha	AI, High-performance computing, Cybersecurity, Qualification in advanced digital skills, Virtual and augmented reality, Internet of Things, Data Science and Big Data, Blockchain, Cloud Computing, Mobility, Connectivity	Public Administration, Tourism, Financial sector, Communication, and electronic Information Technologies, Trade and Services.
iNOVelectron	Custóias Porto	AI Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Nanotechnology Micro/Nano Electronics Photonics Simulation Cyberphysical systems Mobility Connectivity	Industry Telecommunications Energy Trade and Services

Portugal Blue Digital Hub	Leca da Palmeira	AI, Qualification in advanced digital skills, Robotics, Virtual and augmented reality, Internet of Things, Data Science and Big Data, Simulation, Cloud Computing, Connectivity	Circular economy, environment and sustainability, Tourism, Mobility and logistics, Communication and electronic Information Technologies, Health and Biotechnology, Energy, Sea, and fisheries
PRODUTECH DIH	Porto	AI High-performance Computing Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Additive manufacturing Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Advanced materials Nanotechnology Micro/Nano Electronics Photonics Simulation Cyberphysical systems Blockchain Cloud computing Mobility Connectivity Sectors	Industry
PTcentroDiH - Digital Innovation Hub da Região Centro	Marinha Grande	Micro/nano electronics Sensory systems Photonics and imaging technologies Communication networks Cyber-physical systems Robotics Internet of things AI Mobility & Location-based technologies	Construction, Manufacture of food products, beverages, and tobacco, Manufacture of textiles and textile products, Manufacture of leather and leather products, Manufacture of wood and wood products, Manufacture of pulp, paper, and paper products; publishing and printing, Manufacture of coke, refined petroleum products, and nuclear fuel, Manufacture of chemicals, chemical products, and man-made fibers, Manufacture of rubber and

		Interaction technologies Cyber security Advanced, or high-performance computing Big data, data analytics, data handling Simulation, modeling, and digital twins Software as a service and service architectures Cloud computing Additive manufacturing Laser-based Manufacturing Logistics Internet services New media technologies Nanotechnology	plastic products, Manufacture of other non-metallic mineral products, Manufacture of basic metals and fabricated metal products, Manufacture of machinery and equipment, Manufacture of electrical and optical equipment, Manufacture of transport equipment, Other Manufacturing
PT.DigMaking.IH	Coimbra	Qualification in advanced digital skills Additive manufacturing Robotics Virtual and augmented reality Internet of Things Advanced materials Micro/Nano Electronics Connectivity	Industry Agriculture Public Administration Circular economy, environment and sustainability Tourism Culture Mobility and logistics Communication and electronic Information Technologies Energy Trade and Services Natural Resources and extractive industry Forest Horizontal (all sectors)
SFDIH	Torres Vedras	AI Cybersecurity Qualification in advanced digital skills Digital solutions/interoperability for the public sector Robotics Virtual and augmented reality Internet of Things Data Science and Big Data Blockchain Cloud computing Connectivity	Agriculture Circular economy, environment and sustainability

SIH – Smart Islands Hub	Funchal	Robotics Internet of things AI Interaction technologies Cyber security Advanced, or high-performance computing Big data, data analytics, data handling Cloud computing Additive manufacturing Logistics	Energy and utilities Transport and logistics Public administration Life sciences & healthcare Environment Professional, Scientific, and Technical Activities Telecommunications, Information, and Communication
Smart Sustainable Farms Foods and Trade European Digital Innovation Hub (SFT-EDIH)	Lisbon	AI; Internet of things; Data science and big data; Blockchain; Photonics; Robotics; Virtual and augmented reality	Agriculture; Industry; Mobility and logistics; Circular economy, environment, and sustainability

References

Anacom. 2021. “Results of Auction Bidding Phases.” News release. October 27, 2021. Accessed 20-Nov-21. https://www.anacom.pt/render.jsp?contentId=1709636.

Anand, Amitabh, Birgit Muskat, Andrew Creed, Ambika Zutshi, and Anikó Csepregi. 2021. “Knowledge Sharing, Knowledge Transfer and SMEs: Evolution, Antecedents, Outcomes and Directions.” *PR* ahead-of-print (ahead-of-print). https://doi.org/10.1108/PR-05-2020-0372.

Buettgenbach, Maruice Henry. 2021. “Python Statistics for Beginners: Pearson Correlation Coefficient.” https://towardsdatascience.com/python-statistics-for-beginners-pearson-correlation-coefficient-69c9b1ef17f7.

Carole Manero. 2021. “Newsletter 25 – July – August 2021 ‹ 5G-PPP.” Accessed 02-Nov-21. https://5g-ppp.eu/newsletter-25-july-august-2021/#lien6.

Crupi, Antonio, Nicola Del Sarto, Alberto Di Minin, Gian Luca Gregori, Dominique Lepore, Luca Marinelli, and Francesca Spigarelli. 2020. “The Digital Transformation of SMEs – a New Knowledge Broker Called the Digital Innovation Hub.” *JKM*, 2020. 6.

D. Clark. 2021. “SMEs in Europe 2021, by Country | Statista.” Accessed 21-Nov-21. https://www-statista-com.eu1.proxy.openathens.net/statistics/558308/smes-in-europe-by-country/.

Digital Economy and Society Index (DESI) 2020. 2020a.

ePortugal.gov.pt. 2021. “Public Financial Assistance for Companies in Portugal - EPortugal.Gov.Pt.” Accessed 10-Nov-21. https://eportugal.gov.pt/en/cidadaos-europeus-viajar-viver-e-fazer-negocios-em-portugal/apoios-para-empresas-em-portugal/apoios-financeiros-publicos-para-empresas-em-portugal.

European Commission. 2019. “Skills for SMEs: Cybersecurity, Internet of Things and Big Data for Small and Medium-Sized Enterprises.” Accessed 21-Nov-2021.

European Commission. 2020b. *2020 International Digital Economy and Society Index.* KK-BC-20-001-EN-N SMART 2019/0087. Luxembourg: Publications Office of the European Union.

European Commission. 2020c. “Digital Economy and Society Index (DESI) 2020: Portugal.”.

European Commission. 2020d. “What Is Horizon 2020?” Accessed 21-Nov-21. https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020.

European Commission. 2021a. “Annex to the Commission Implementation Decision: On the Financing on the Digital Europe Programme and Adoption of the Multiannual Work Programme - European Digital Innovation Hubs for 2021-2023.”.

European Commission. 2021b. “European Digital Innovation Hubs in Digital Europe Programme: Draft Working Document 25-01-2021.”.

European Commission. 2021c. “Internal Market, Industry, Entrepreneurship and SMEs Entrepreneurship and SMEs - European Commission: Institute to Support Small and Medium Sized Companies (IAPMEI).” Accessed 06-Nov-21. https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/organisation/institute-support-small-and-medium-sized-companies-iapmei.

European Commission. 2021d. “Shaping Europe’s Digital Future: Broadband in Portugal.” Accessed 04-Nov-21. https://digital-strategy.ec.europa.eu/en/policies/broadband-portugal.

European Commission. 2021e. “Smart Specialisation Platform: Digital Innovation Hubs.” Accessed 12-Nov-21. https://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool.

European Commission. 2021f. “The EU - What It Is and What It Does: Digital Economy and Society.” Accessed 20-Nov-21. https://op.europa.eu/webpub/com/eu-what-it-is/en/#chapter2_6.

European DIGITAL SME Alliance. 2020. “5G Challenges and Opportunities for European SMEs.” Accessed 01-Nov-21. https://www.digitalsme.eu/blog/2020/06/17/dsme-live-5g/.

European DIGITAL SME Alliance. 2021. “Digital Skills for SMEs: Challenges and Opportunities.” Accessed 06-Nov-21. https://www.digitalsme.eu/blog/2021/08/12/digital-skills-for-smes-challenges-and-opportunities/.

European Observatory for Clusters and Industrial Change. 2019. “Cluster Programmes in Europe and Beyond.” Accessed 21-Nov-21. https://clustercollaboration.eu/sites/default/files/news_attachment/cluster_programmes_in_europe_and_beyond_0.pdf.

eurostat. 2015. “Area by NUTS 3 Region.” Accessed November 20, 2021. https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-115325_QID_589140CA_UID_-3F171EB0&layout=TIME,C,X,0;GEO,L,Y,0;UNIT,L,Z,0;LANDUSE,L,Z,1;INDICATORS,C,Z,2;&zSelection=DS-115325UNIT,KM2;DS-115325INDICATORS,OBS_FLAG;DS-115325LANDUSE,TOTAL;&rankName1=UNIT_1_2_-1_2&rankName2=INDICATORS_1_2_-1_2&rankName3=LANDUSE_1_2_-1_2&rankName4=TIME_1_0_0_0&rankName5=GEO_1_2_0_1&sortC=ASC_-1_FIRST&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23).

Executive Agency for Small and Medium-sized Enterprises. 2019. *Skills for SMEs: Cybersecurity, Internet of Things and Big Data for Small and Medium-Sized Enterprises.* Brussels.

Gartner. n.d. “Definition of FTTP (Fiber to the Premises) - Gartner Information Technology Glossary.” Accessed 10-Dec-21. https://www.gartner.com/en/information-technology/glossary/fttp-fiber-to-the-premises.

Huawei. 2020. “Shaping the New Normal with Intelligent Connectivity: Mapping Your Transformation into a Digital Economy with GCI 2020.” https://www.huawei.com/minisite/gci/assets/files/gci_2020_whitepaper_en.pdf?v=20201217v2. Accessed 04-Nov-21.

Huawei Technologies. 2020. “Country Profile.” Accessed 04-Nov-21. https://www.huawei.com/minisite/gci/en/country-profile-pt.html#dk.

IAPMEI. 2020a. “IAPMEI - SI Empreendedorismo Qualificado E Criativo.” Accessed 10-Nov-21. https://www.iapmei.pt/PRODUTOS-E-SERVICOS/Incentivos-Financiamento/Sistemas-de-Incentivos/Incentivos-Portugal-2020/SI-Empreendedorismo.aspx.

IAPMEI. 2020b. “IAPMEI - SI Inovação Produtiva.” Accessed 10-Nov-21. https://www.iapmei.pt/PRODUTOS-E-SERVICOS/Incentivos-Financiamento/Sistemas-de-Incentivos/Incentivos-Portugal-2020/SI-Inovacao.aspx.

IAPMEI. 2020c. “IAPMEI - SI Qualificação - Projeto Conjunto.” Accessed 10-Nov-21. https://www.iapmei.pt/PRODUTOS-E-SERVICOS/Incentivos-Financiamento/Sistemas-de-Incentivos/Incentivos-Portugal-2020/SI-Qualificacao-Conjuntos.aspx.

IAPMEI. 2020d. “IAPMEI - SI Qualificação - Projeto Individual.” Accessed 10-Nov-21. https://www.iapmei.pt/PRODUTOS-E-SERVICOS/Incentivos-Financiamento/Sistemas-de-Incentivos/Incentivos-Portugal-2020/SI-Qualificacao-Individuais.aspx.

International Trade Administration. 2021. “Portugal - Information and Communications Technology.” Accessed 04-Nov-21. https://www.trade.gov/country-commercial-guides/portugal-information-and-communications-technology.

Kalpaka, Annita, J. Sörvik, and A. Tasigiorgou, eds. 2020. *Digital Innovation Hubs as Policy Instruments to Boost Digitalisation of SMEs: A Practical Handbook & Good Practices for Regional/national Policy Makers and DIH Managers.* JRC science for policy report 30337. Luxembourg: Publications Office of the European Union.

NOVA.ID.FCT. 2021. “Knowledge Valorization – NOVA.ID.FCT.” Accessed 17-Nov-21. https://www.novaidfct.pt/knowledge-valorization/.

OECD. 2019. *Enhancing Access and Connectivity to Harness Digital Transformation: Going Digital Policy Note.* Paris. Accessed 30-Oct-21. https://www.oecd.org/going-digital/enhancing-access-digital-transformation.pdf.

OECD. 2021. *The Digital Transformation of SMEs.* OECD studies on SMEs and entrepreneurship. Paris: OECD Publishing. Accessed 19-Nov-21. https://www.oecd.org/industry/smes/PH-SME-Digitalisation-final.pdf.

OECD Data. n.d.a. “Average Wages.” https://data.oecd.org/earnwage/average-wages.htm.

OECD Data. n.d.b. “Gross Domestic Product (GDP).” https://data.oecd.org/gdp/gross-domestic-product-gdp.htm.

OECD Data. n.d.c. “Inflation (CPI).” https://data.oecd.org/price/inflation-cpi.htm.

OECD Data. n.d.d. “Internet Access.” https://data.oecd.org/ict/internet-access.htm.

OECD Data. n.d.e. “Net Lending/borrowing by Sector.” https://data.oecd.org/natincome/net-lending-borrowing-by-sector.htm.

OECD Data. n.d.f. “Nominal GDP Forecast.” https://data.oecd.org/gdp/nominal-gdp-forecast.htm#indicator-chart.

OECD Data. n.d.g. “Unemployment Rate.” https://data.oecd.org/unemp/unemployment-rate.htm.

PORDATA. “Database.” https://www.pordata.pt/en/DB/Search+Environment/New+Search.

PORDATA. 2021a. “Gross Value Added in Small and Medium-Sized Enterprises: Total and by Size.” https://www.pordata.pt/en/Portugal/Gross+value+added+in+small+and+medium+sized+enterprises+total+and+by+size-2968.

PORDATA. 2021b. “Turnover in Small and Medium-Sized Enterprises: Total and by Size.” https://www.pordata.pt/en/Portugal/Turnover+in+small+and+medium+sized+enterprises+total+and+by+size-2932.

PORDATA. 2021c. “Investment Rate in Non Financial Small and Medium-Sized Enterprises: Total and by Size.” https://www.pordata.pt/en/Portugal/Investment+rate+in+non+financial+small+and+medium+sized+enterprises+total+and+by+size-2934.

PORDATA. 2021d. “Small and Medium-Sized Enterprises: Total and by Sector of Economic Activity.” https://www.pordata.pt/en/Portugal/Small+and+medium+sized+enterprises+total+and+by+sector+of+economic+activity-2928.

Prof. Dr. Aida Kamišalić Latifić. 2020. “Smart SME's: WP 3 Collection of Good Practices and Existing Tools.”.

Roland Berger. 2020. “5G at the Heart of Portugal's Digital Society.” Accessed 31-Oct-21. https://www.rolandberger.com/en/Insights/Publications/5G-at-the-heart-of-Portugal's-digital-society.html.

start campus. 2021. “SINES 4.0.” Accessed 04-Nov-21. https://www.startcampus.pt/index.php/sines-4-0.

World Bank. “Foreign Direct Investment, Net Inflows (% of GDP): Metadata Glossary.” https://databank.worldbank.org/metadataglossary/jobs/series/BX.KLT.DINV.WD.GD.ZS.