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Definition of I4.0 Public Policy Initiatives

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List of symbols, acronyms and abbreviations

ACI: Advanced Cyberinfrastructure

AI : Artificial Intelligent,

CCF: Computing and Communication Foundations

CNS: Computer and Network Systems

CoLABs: Collaborative Laboratories

DESI: the European Commission's Digital Economy and Society Index

DTx: Digital transformation

ESR: Early Stage Researcher

EU: European Union

EUR: Euro

FCT: Science and Technology (Fundação para a Ciência e Tecnologia)

GDP: Gross Domestic Product

GP: Good Practice

HMI: Human Machine Interface

I4.0 : The fourth Industrial Revolution

ICT: Information and Communication Technologies

IIoT: Industrial Internet of Things

IIS: Information and Intelligent Systems

IoT: Internet of Things

IT: Information Technology

ITN: Innovative Training Network

NAIS: National Artificial Intelligence Strategy

P2020: Portugal 2020 program

PI4.0: Plattform Industrie 4.0

R&D: Research and Development

Research, Innovation and Enterprise (RIE)

SIAC: Supporting System for Collective Actions

SME: Small and Medium-size Enterprises

UTEN: the University Technology Enterprise Network

1 Executive Summary

Industry 4.0 (I4.0) is experiencing a transition powered by data and automation technology that could transform every step of the manufacturing process from the supply chain to the product delivery to the end users. The goal is to drive productivity and innovation and empower businesses in an integrated data-driven manufacturing environment. This is an incredible opportunity and governments must act and pave the way for the industry leaders, educators and SMEs, so this new revolution can fulfil its promise. New policies should facilitate the growth of stakeholders and help manage the impact of I4.0 on the workforce, on the public sphere and on the environment. There have been various European wide, national and regional policies and programs to ensure that industries are leveraging these emerging technologies.

This report analyses and explores existing pubic policies and programs related to Industry 4.0 in Portugal, which include current initiatives, higher educational programs, and good practices. Public Policies in Portugal addressing Industry 4.0 are characterized by having a wide range of direct and indirect initiatives, supported by different incentive mechanisms, targeting diverse agents and were designed considering that there should be no unique way to leverage the potential of SMEs and Large corporations in evolving towards Industry 4.0. We have identified four Good Practices in Portugal of Public Policies for Industry 4.0 for SMEs: *i*) a Bottom-up Orchestration process for the Industry 4.0 Strategy, where the governmental role was of organizing the engagement of a wide range of stakeholders; *ii*) delegation of the Management and Monitoring Role of the I.40 Strategy to COTEC, an Independent Third-party Stakeholder, that has energized the execution and monitoring of the strategy through a set of actions that benefited from the closeness of COTEC with private corporations, public organizations and sectorial associations; *iii*) the Matching of Industry 4.0 Program Initiatives with SMEs needs, measured by the sheer magnitude of incentives committed to SMEs and corporations, but also the very large number of industrial companies that have applied and have benefited from the funds, which demonstrate that the design of the initiatives was objective since it had an extreme adherence from the target segments; and *iv*) the Strong Engagement of Private and Public Stakeholders, including well known major multinational corporations and public intermediary bodies that have the responsibility to deliver structural funds and incentives.

The report also presents an overview of national and regional public policies to boost Industry 4.0 in Finland, Czech Republic, Greece, Italy, Hungary, and Poland while exploring the case of Germany as a pioneer of Industry 4.0. When we analyse Industry 4.0 in the context of the Digital Scoreboard (DESI), the integration of Digital Technologies is one of the most vital

parameters, and from 2014 to 2019 the EU has been steadily improving on this score. Finland has not only been the leader amongst the countries studied but has actually been faster than the rest of the Europe and is therefore one of the ideal showcases. Portugal has performed reasonably well in this regard. Czechia in contrast was performing way better than the EU average in 2014 but did not maintain its lead, and by 2019 was at a similar level to Portugal and the rest of the EU. The rest of the countries studied, namely Greece, Italy, Hungary and Poland are all below the EU average with regards to the integration of Digital Technologies. A set of Good Practices of public policy for Industry 4.0 for each country are presented and demonstrate a wide variation in terms of types of initiatives, showing that there is no unique format or typology of good practices for public policy towards Industry 4.0, and country and regions can considerably learn with the examples of each other. A brief study is also presented on related public policies and situation of Industry 4.0 in more successful countries outside Europe such as USA, Japan, Korea, Canada, Singapore, and China.

The report concludes that there a wide range of public and private initiatives and good practices in Europe regarding Industry 4.0, and though in other countries like USA, Canada, China, Singapore, South Korea, similar initiatives are taking place, the focus varies from country to country. Also, it is concluded that there are good opportunities to European SMEs and large corporations for taking advantage of the global movement of shifting to Industry 4.0 since they are well advanced in adoption and are able to produce the technology that will be core to Industry 4.0 deployment

2 Defining Industry 4.0 within the Context of Public Policies

The fourth Industrial Revolution came as an approach to power the competitiveness of the manufacturing industry. Today, Industry 4.0 (I4.0) is about new technology and connectivity. It is an opportunity to radically change the way industry responds to the needs of society. The opportunities for disruption are very significant and those left behind will feel it (Arbulu *et al.*, 2018). The fourth Industrial Revolution is already happenning. Ubiquitous computing, artificial intelligent, Internet of Things (IoT), blockchain technology, neuro-technological brain enhancements, and other technological advancement are the evidence of dramatic change at exponential speed. The variety of I4.0 technologies promises to develop a hyper-automation industry with high productivity.

Apple, Amazon, Facebook, and Microsoft are between the first ten largest companies by market capitalization and the next one in a table is a Chinese company (Alibaba). There isn't a European company in that playing field. As we see, there are already some operating systems exist for building Industry 4.0. It seems the strength of Europe and the opportunity for Europe is about the specific knowledge of the technologies and the processes and digital services. As such, european companies can improve in deep knowledge of processes, unique competencies and applying technologies.

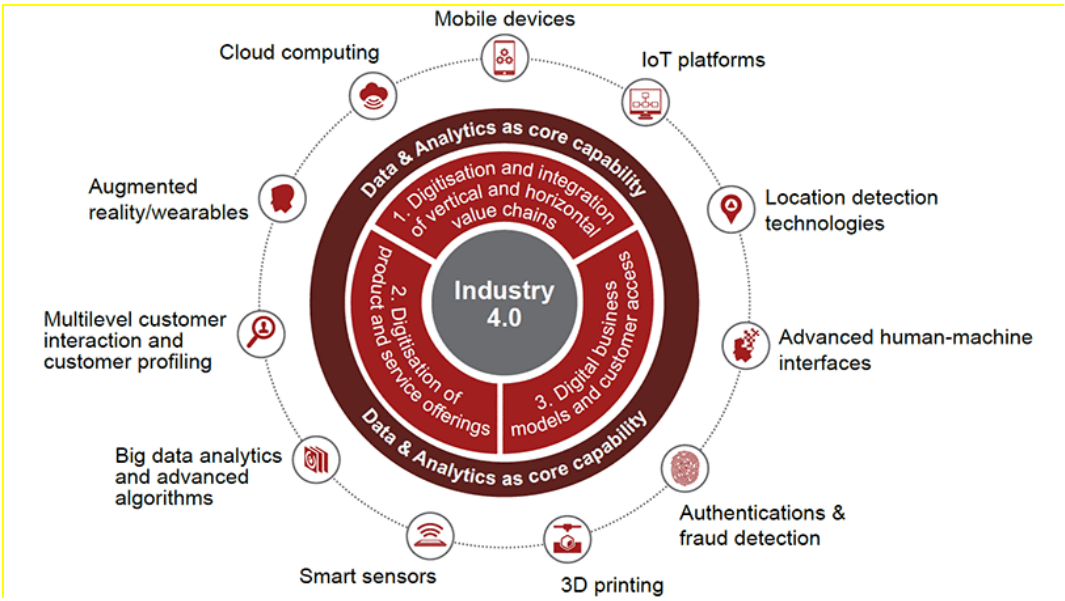

Figure 1. Industry 4.0[1].

[1] https://www.pwc.com/ca/en/industries/industry-4-0.html

Previous industrial revolutions provided the possibility of mass production and enabled very large number of people with digital capabilities. This Fourth Industrial Revolution is characterized by a range of new technologies which impacts all disciplines, economies and industries.

Exploiting new technologies, will destroy some jobs (Deloitte, 2018b). Hence, new jobs will be created and more people should get educated towards necessary skills for I4.0. In several countries governments are getting involved in supporting various initiative promoting I4.0. In Singapore, China, Japan, and Korea, the governments are behind major incentive engines to drive the investment into new technologies (Liao *et al.*, 2018). It is essential to make sure that European companies manage the transition to I4.0 successfully, as some SMEs have unique world class advantages, based on knowledge and the skills.

This is an incredible opportunity and governments must act and pave the path for the leaders, educators and SMEs for this new revolution to emerge. New policies should facilitate growth of the stakeholders and help managing the impact of I4.0 on the workforce, the public sphere and the environment.

3 Methodology

This report is elaborated based on state-of-the-art reports and information sources supplied by partners of the consortium. Moreover, the team has conducted an in-depth desk research, studying collected secondary resources, mainly focused on Portugal's reality, to identify activities, such as calls, incentives, programs. Also, it has been had very useful meetings with stakeholders that provided relevant inputs to the report.

A brief overview of other partner countries including Finland, Czech Republic, Greece, Italy, Hungary, and Poland is presented, along with their suggested Good Practices.

The research considers the following lines of analysis:

- In-depth Analysis of Portugal's Industry 4.0 Public Policies, including Good Practices;
- Analysis of Partners' Regional / National Industry 4.0 Public Policies, and selected Good Practices suggested by partners;
- Overview and comparison with Germany Industry 4.0 Public Policies;
- Overview and comparison with other countries national Industry 4.0 Public Policies, like USA, Japan, China, Canada, Singapore and South Korea;

4 In-depth Analysis of Portugal's I4.0 Public Policies

4.1 Overview of I4.0 Related Initiatives

The Portuguese economy has continued to grow in last few years[2] and there have been quite a few initiatives for bringing I4.0 to the Portuguese industries (computerworld, 2017) (VVA and WIK-Consult, 2019h). For example **Industry 4.0 program**[3] (that included 2 phases) is a program initiated by government in 2017 (KPMG Portugal, 2019). Most Industry 4.0 initiatives publicly funded are within the Portugal 2020 (P2020) program, an agreement undertaken between Portugal and the European Commission, which brings together the European Structural and Investment Funds setting the programming principles which enshrine the economic, social and territorial development policy to be advanced in Portugal, between 2014 and 2020 (Figure 2). Within this framework, **COMPETE 2020** is program run by a mission structure in the Central Administration of the Portuguese government that allocates incentives to competitiveness and internationalization, promoting the consolidation of competitive advantages, with a strategic theme focused on initiatives related with Industry 4.0. One of the landmark initiatives of this program is the **Voucher Industry 4.0** that has the objective of promoting digital transformation through the adoption of technologies that allow disruptive changes in SME industrial business models. Next sub-sections describe most of the important initiatives in Portugal.

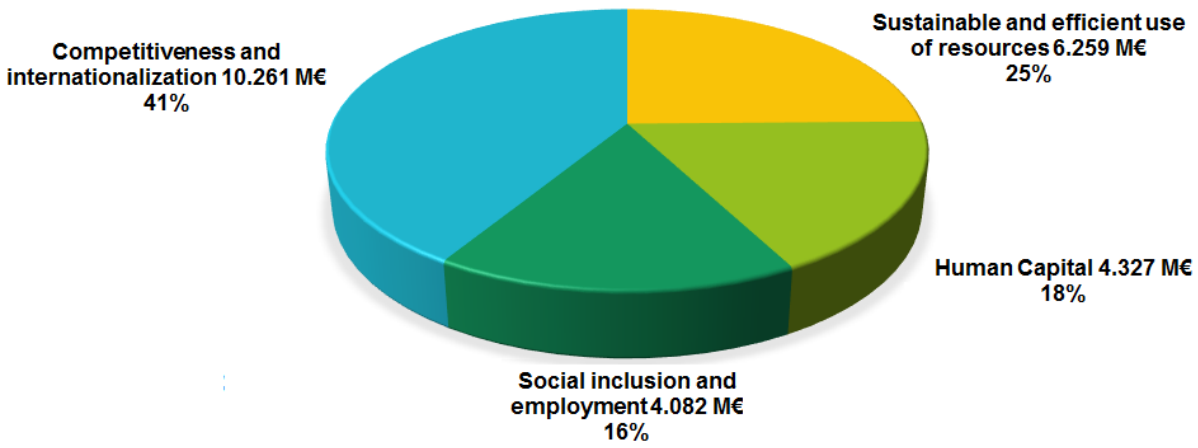

Figure 2. PT 2020 Fund allocation

[2] Portugal - GDP Per Capita Growth : https://tradingeconomics.com/portugal/gdp-per-capita-ppp
[3] https://www.iapmei.pt/Paginas/Industria-4-0-Fase-II.aspx

Table 1 presents most important initiatives for I4.0 in Portugal. After the title of initiative, starting year, type of initiative, digital technology targeted, size of company, and budget (if any available) are listed. Bellow each initiative there is a short description which can give a brief overview on the initiative.

Table 1. Overview of initiatives

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
1	Industry 4.0 Programme	2017	Sectoral strategy	ALL	ALL	About EUR 2.26 billion should come from Portugal 2020 / Compete 2020. Agreement (2017 and 2020, public national and EU funding)
Phase I[4] of the Industry 4.0 program, launched in 2017, was based on six areas of priority action: training of human resources, technological cooperation, creation of the I4.0 startup, financing, investment support, internationalization and legal and regulatory adaptation. **Phase II** (KPMG Portugal, 2019) of the Industry 4.0 program includes a set of accelerating measures and recommendations based on three axes: Generalize, Empower and Assimilate. **Lead by**: COTEC and IAPMEI						
2	AI Portugal 2030 (INCoDe.2030, no date)	2019	AI Strategy	Artificial Intelligence	ALL	
AI Portugal 2030 is a Portuguese national initiative on digital skills which is an innovation and growth strategy to foster Artificial Intelligence in Portugal in the European context. Portugal is showing good results in some innovation indicators (including but not limited to AI). Portuguese institutions are particularly well positioned in terms of international research collaborations, broadband penetration and product/process innovations in Small and Medium-size Enterprises (SME). By 2030, Portugal will have a knowledge intensive labour market with a strong community of forefront companies producing and exporting AI technologies supported by an academia involved in high-level, fundamental and applied research. **Lead by**: FCT.IP						

[4] Industry 4.0 Programme, Phase I – video: https://www.youtube.com/watch?v=GtkKZheqSso

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
3	Project FOOTure 4.0[5]	2018	Innovation cluster	Digitising of Industry	ALL	50 million euros by 2020
The 'FOOTure 4.0', a modernization program for the footwear industry, is presented by the Portuguese government. **Lead by**: APICCAPS						
4	Open Days i4.0 programme[6]	2017	Exchange of experience sessions	Digitising of Industry	ALL	Part of Industry 4.0 Programme
The Open Days i4.0 are promoted by IAPMEI[7] and COTEC[8] Portugal which include networking, information sharing, and visits to the most advanced industrial units in Portugal. These events are interactive and the partners present their innovative technologies and exhibit the final products.						
5	4AC-Industry 4.0[9]	2017	Accelerator, Incubator, Prototyping centre	Digitising of Industry	ALL	
It aims to support technology startups to provide the industry, both hardware and software, in transforming ideas into products, product development and in the scale-up phase. It is acting as a focal point between industry, universities, technological centres and entrepreneurs, but also investors and other stakeholders of the entrepreneurship ecosystem (Lazaro, 2017). **Lead by**: CEiiA, Startup Portugal						
6	Siemens I-experience centre 4.0[10]	2018	Competence centre	ALL	ALL	Private funding
Within the scope of the Siemens 4.0 Academy measure, Siemens inaugurates the first I-Experience Centers 4.0 in Alfragide, Portugal. This experimentation center aims at training human resources, as well as developing their digital skills, and supporting various entities, such as start-ups or universities, in the development of new solutions for the industry. **Lead by**: Siemens						

[5] Industry 4.0: Portuguese Footwear at the forefront: https://bit.ly/2QCUDYy
[6] Open Days i4.0: https://bit.ly/2JdHxwN
[7] Agência para a Competitividade e Inovação, I.P. : https://www.iapmei.pt/
[8] Associação Empresarial para a Inovação: https://cotecportugal.pt/
[9] Governo lança estratégia para a Indústria 4.0: https://bit.ly/2Wz4xye
[10] https://new.siemens.com/pt/pt/empresa/areas-foco/futuro-da-industria.html

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
7	DONE Lab Bosch Digital[11]	2016	Lab	Digitising of Industry	ALL	Public and private funding (Foreseen investment of EUR 73.7 million until 2018)
DONE Lab, advanced manufacturing of products and tools laboratory, was developed under the partnership between the University of Minho and Bosch Car multimedia through the Innovative Car HMI programme.						
8	ADIRA Industry 4.0[12]	N/A	Lab	Additive manufacturing	ALL	Public and private funding, EUR 1.4 million
The goal of this project was developing of Industry 4.0 retrofitting methodologies and management and optimization software for industrial equipment based on predictive maintenance and performance evaluation methodologies. Also, it aimed at developing of technological solutions Industry 4.0 such as systems of sensing, monitoring, acquisition and pre-processing of data and control of industrial equipment.						
9	ADD-ADDITIVE[13]	2018	Lab	Additive manufacturing	ALL	EUR 8.8 Million
ADD.ADDITIVE is a project financed by “Portugal 2020”/COMPETE 2020 in the area of additive manufacturing. The scope of project is technological development, internationalization of knowledge and technology by policy holders and use of them by potential end users. In addition to the technological aspects, this project also focuses on studying the reductions in raw materials that additive manufacturing allows and the impact of this factor on society and the environment.						
10	Act n. 46/2018[14]	2018	Cyber security regulation	ALL	ALL	No specific budget
This law establishes the legal framework for cybersecurity, transposing Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union.						

[11] http://www.donelab.uminho.pt/
[12] http://www.adira.pt/002.aspx?dqa=0:0:0:45:0:0:-1:0:0&ct=48
[13] https://weadd.com/uploads/docs/WeADD_P2020.pdf
[14] https://www.cncs.gov.pt/content/files/portugal_-_law_46_2018_en_3.pdf

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
11	National Centre for Cyber Security[15]	2012	Cyber security centre	ALL	ALL	No specific budget
The National Cybersecurity Centre is the operational coordinator and the Portuguese national authority specialised in cybersecurity working in this field with State entities, operators of Critical Infrastructures, operators of essential services and digital service providers, ensuring that the cyberspace is used as an area of freedom, security and justice, for the protection of all the sectors of society that materialize national sovereignty and the Democratic State under the rule of law.						
12	INCoDe.2030[16]	2017	National coalition	ALL	ALL	At least EUR 2 million (2017-2018, public national funding)
INCoDe.2030 is an integrated public policy initiative aimed at enhancing digital competences. It has proposed a wide range of measures involving the various governmental areas. These measures should be implemented alongside the private sector, academia and civil society initiatives with similar aims. The measures are structured around five main action lines: 1- Inclusion, 2- Education, 3- Qualification, 4- Specialisation, 5- Research						
13	Code for All[17] /Academia de Código	2015	Coding training	Programming	Unemployed individuals	Private funding
Code For All provide coding lessons for young and older people throughout Portugal. They aim to get the population of Portugal in a position to be the coders of the future.						
14	Digital Atelier[18]	2016	Training courses	ALL	ALL	Private and public funding
Providing various personalised training courses.						
15	Industry-Action Programmes	2017	Training courses	ALL	ALL	Public funding

[15] https://www.cncs.gov.pt/en/
[16] https://www.incode2030.gov.pt/
[17] https://www.codeforall.io/
[18] https://learndigital.withgoogle.com/atelierdigitalportugal

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
16	COMPETE 2020[19]	2015	Funding programme	ALL	ALL	6.2Billion Euros, 71% from EU funds (FEDER, FSE and Cohesion Fund)
The Managing Authority of the Operational Program Competitiveness and Internationalization (COMPETE 2020) is a structure in the Central Administration of the State. It is a reference institution in granting incentives to promote competitiveness and internationalization, promoting the consolidation of competitive advantages.						
17	P2020[20]	2014	Funding programme	ALL	ALL	EUR 25 billion
It is the Partnership Agreement undertaken between Portugal and the European Commission, which brings together the five European Structural and Investment Funds - ERDF, Cohesion Fund, ESF, EAFRD and EMFF – setting the programming principles which enshrine the economic, social and territorial development policy to be advanced in Portugal, between 2014 and 2020.						
	P2020 - Projects R&D[21]	2014	Funding programme	ALL	ALL	
Intensifying the effort to R&D and the creation of new knowledge Promoting the relationship between enterprises and Science Institutions						
	P2020 - Qualification and Internationalization SME's[22]	2014	Funding Programme	ALL	ALL	
To promote the competitiveness of SME's, Increasing the productivity of SME's Developing the active presence of SME's in the global market						
18	Startup Portugal(+)[23]	2016	Start-up support, including vouchers	ALL	ALL	EUR 300 million (EUR 100 from foreign investment)

[19] https://www.compete2020.gov.pt/
[20] https://www.poch.portugal2020.pt/en/Programa/Pages/portugal-2020.aspx
[21] https://bit.ly/39dLoVc
[22] https://bit.ly/33ExqKV
[23] https://startupportugal.com/sp-plus

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
In 2016 the National Strategy for Entrepreneurship Startup Portugal was launched by the Government with 3 objectives: to create and support the national ecosystem, to attract national and foreign investors and to accelerate the growth of Portuguese startups in foreign markets. The Startup Portugal+ Program, presented in July 2018, was designed by the Government to give a new impetus to the initial strategy and to address emerging challenges. In addition to the consolidation of 5 measures of the original program, 20 new measures are launched.						
19	Startup voucher[24]	2018	Startup vouchers	ALL	Startup	
The StartUp Voucher Program is part of the entrepreneurship oriented specific measures of the StartUp Portugal Program, which aims to promote the development of innovative entrepreneurial projects in the idea phase by young entrepreneurs form 18 to 35 years old[25]. It provides for a set of technical and financial tools that enable the setting up of new companies. Financed by Portugal 2020 / Compete 2020 / Lisboa 2020						
20	Voucher Industry 4.0[26]	2015	Innovation vouchers	ALL	SME	EUR 12 million
objective is to promote the definition of its own technological strategy, with a view to improving the competitiveness of the company, in line with the principles of Industry 4.0. The aim is to promote digital transformation through the adoption of technologies that allow disruptive changes in SME business models. Financed by Portugal 2020 / Compete 2020 / Regional Programs (70% grant)						
21	Masterclass on Digital Transformation in Tourism[27]	2019	Training courses	Tourism Industry	ALL	
As a first event for the International Centre associated with UNWTO Academy in Portugal, the UNWTO Academy Masterclass on “Digital Transformation in Tourism - Trends and Challenges” was conducted in Lisbon on 4th July 2019.						
22	Beyond - Portugal Digital transformation[28]	2018	Exchange of experience sessions	Tourism Industry	ALL	

[24] https://bit.ly/33BDi7S
[25] https://bit.ly/2UuBw4b
[26] https://bit.ly/2vGWEMe
[27] https://bit.ly/3dkHVHP
[28] https://beyondeyportugal.pt/

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
Beyond Portugal Digital Transformation is an initiative that aims to promote discussion around the impact of the digital revolution in Portugal and to encourage governments and entrepreneurs to accelerate the implementation of strategies capable of following the challenges of the digital age.						

Portugal currently has strong players in some areas that may serve as inspiring examples and help drive innovation and research. According to (INCoDe.2030, no date), following list identifies some of these areas where Portugal will make a specific effort to lead in Europe:

- Natural Language Processing

  Example: **Unbabel**[29] is an artificial intelligence powered human translation platform. With headquarters in Lisbon, Portugal, and San Francisco, California. Its customers include easyJet, Booking.com, Rovio Entertainment, Under Armour, Pinterest, and Facebook. Unbabel combines Neural Machine Translation with machine learning and a crowdsourced model to differentiate itself from other translation service providers.

  Example: **Priberam**[30] is the world's leading supplier of natural language processing and search technologies for the Portuguese language and the market leader in law knowledge management systems in Portugal.

- Real Time decision making with AI

  Portugal has a strong research community in data stream learning and many companies have expertise in this area (INCoDe.2030, no date).

- AI and Industry

  As shown in Table 1, a very relevant initiative is the Portugal Industry 4.0 program (KPMG Portugal, 2019), which has been officially launched by the Ministry of Economy with the aim of fostering the uptake of technology in the Portuguese industry, internationally promote Portuguese technological companies and attract investment

- AI for Software Development

  Portugal is already well equipped with a strong offer in rapid software development processes and platforms, which must continue to improve and innovate through AI.

[29] https://unbabel.com/
[30] https://www.priberam.com/

- AI for Edge-computing and IoT
- Urban transformation through sustainable Cities
  There are many leading projects in Portugal that already pursuing these challenges from car multimedia to cyber security.
- AI and sustainable energy systems
- AI, environment and biodiversity: from forests and green economy to marine species and blue economy
- Mobility and autonomous driving
- Cybersecurity
- AI and health

4.2 Higher educational programs

Based on government report on perspectives for 2030 on higher education, research and innovation (Portugal Govenrment, 2016), three main targets are considered for Portugal to fully achieve European convergence by 2030 and to boost knowledge and innovation, together with skilled job creation and wellbeing. They include:

- Achieve a level of overall R&D investment of 3% by 2030, with a relative share of 1/3 public and 2/3 business expenditure, corresponding to achieve an overall R&D investment of 1.8% of GDP by 2020 (while 1.3% in 2016);
- Achieve a level of 40% of tertiary education graduates in the 30-34 years old age group by 2020 (while only 35% in 2016), and 50% by 2030, with 60% of those aged 20 participating in higher education by 2030;
- Achieve an European leadership level of digital skills by 2030 in association with internet access and usage, as well as market demand, business development and specialized skills development.

One of the example is 2 years PhD program in Industry 4.0[31] which the Digital Manufacturing and Design (DiManD) Innovative Training Network (ITN) will provide high-quality multidisciplinary, multi-professional and cross-sectorial research and training to high-achieving early stage researchers in the area of Industry 4.0.The programme will host 14 Early Stage Researcher (ESR) positions, the candidates for 11 positions have been already selected.

[31] https://euraxess.ec.europa.eu/jobs/409078

Following subsections list few higher educational programs from the report provided by ministry of Science, Technology and Higher Education, Portugal (Portugal Govenrment, 2016):

4.2.1 CoLABs

One of the initiatives is Collaborative Laboratories or CoLABs[32] which aim to stimulate qualified employment and knowledge-based economic growth in Portugal, complementing and reinforcing the current structure and performance of R&D units and associated laboratories. They aim to stimulate the active participation of the scientific and academic system in the understanding and resolution of complex and large-scale problems which are generally not capable of being solved within a single disciplinary, scientific, technological or institutional strand (Portugal Govenrment, 2016). Unlike R&D units and Associate Laboratories, they must have a clear business plan and be designed to facilitate the attraction of new sources of funding, alternatives to the Foundation for Science and Technology (FCT). They may involve the creation of a new private institution, which can be affirmed in the Structural Funds and emerging private markets (Portugal Govenrment, 2016).

The *first set of Laboratories* were evaluated by November 2016, including the following six projects:

- "DTx" – Digital transformation[33] (Including three universities and thirteen companies-headquarters in Guimarães)
- "Atlantic" – Space, climate and oceans[34] (headquarters in Peniche) focused on following themes:
    - Marine resources sustainability
    - Atlantic observation, monitoring and modelling
    - Climate change impact on the Atlantic
    - Future technologies for the ocean
    - Data analytics and big data
- "Forest WISE" – Forest and fire prevention[35] (headquarters in Vila Real)

[32] https://www.fct.pt/apoios/CoLAB/
[33] https://www.dtx-colab.pt/
[34] https://colabatlantic.com/
[35] http://www.forestwise.pt/

- "MORE" – Research and innovation in mountain regions[36] (Northeast; Bragança)
- "Wines and Vines" – wine and vines in the Douro region[37] (Vila Real)
- "Green CoLab" – Seaweed processing; (Algarve; Faro)

Second set of labs were evaluated by July 2018 (CoLAB, 2019):

- AlmaScience – Paper Electronics (Lisbon)
- CemLAB – Cements (Aveiro)
- Value4health – Medical Devices and Therapies (Lisbon)
- ProBiorefinery –Biorefineries (Matosinhos)
- Net4Co2 – Chemical processes (Porto)
- CoLab4Food – Food Products & Networks
- VectorB2B – Medicines and pharmaceuticals (Lisbon)
- VORTEX – Cyber-Physical and CyberSafety Systems (headquarters in Gaia)
- COLABOR – Future of work and social innovation (Headquarters in Lisbon)
- S2ul – Cities and mobility (Matosinhos)
- eCoLab – Circular Economy (Oliveira do Hospital)
- SFColab – Smart farming; West (Torres Vedras)
- InnovPlantProtect – Protection of plants; Alentejo (Elvas)
- B2E –Blue economy; North (Leixões)
- Prochild – Child protection and social innovation (various locations; headquarters in Guimarães)

The following are *the third set of labs* evaluated by June 2019 (CoLAB, 2019):

- VG CoLAB - Energy Storage
- BUILT CoLAB - Built Environment

[36] https://morecolab.pt/
[37] http://www.advid.pt/vinhaevinho&codIdioma=1

- CSESI Hub -Energy Services
- FOODLAB - Food chain
- CoLAB InovFeed - Sustainable Animal Production

4.2.2 Portugal INCoDe.2030

National Digital Competences Initiative e.2030 or Portugal INCoDe.2030 is an initiative which addresses the concept of digital competences in a broad manner including the notion of digital literacy as well as the production of new knowledge through research, which involves processing information and communicating, interacting with and producing digital content. This initiative has proposed a wide range of measures that will mobilise the various governmental bodies structured around five main action lines:

- Action line 1 - INCLUSION: Ensure that the whole population has equal access to digital technologies to obtain information, communicate, and interact with others.
- Action line 2 - EDUCATION: Ensure the education of the younger population by stimulating and reinforcing digital literacy and digital competences at all levels of schooling and as part of lifelong learning.
- Action line 3 - QUALIFICATION: Capacitate the active population by providing them with the knowledge they need to become a part of a labour market that relies heavily on digital competences, particularly to meet the demanding challenges of the progressive digitisation of business activities and industry (i.e. “Industry 4.0”).
- Action line 4 - SPECIALISATION: Promote specialisation in digital technologies and applications to improve employability and create higher added value
- Action line 5 - RESEARCH: Ensure conditions are in place for the production of new knowledge and active participation in international R&D networks and programmes. In this context, the aim is promoting scientific activity in four major key areas:
    1. Advanced Cyberinfrastructure (ACI) - including all advanced scientific computing fields.
    2. Computing and Communication Foundations (CCF) - including quantum computing, among other areas of R&D.
    3. Computer and Network Systems (CNS) - including big data, cloud computing, and IoT, among others.

4. Information and Intelligent Systems (IIS) - including artificial intelligence, as well as human- centred computing in relation to digital media.

4.2.3 Global S&T Partnerships Portugal – GoPortugal

The initiative "Global S&T Partnerships Portugal – GoPortugal" considers a new cycle of international partnerships in research and academia, involving universities and polytechnics, as well as promoting science-based entrepreneurship to foster the creation and development of new technology businesses. The main goal is to foster scientific research in Portugal at the best international level, together with improving the impact of scientific research and technological breakthroughs into economic and social gains for Portugal and for the World. This considers science and technology ventures with an international scope and nature, with emphasis on stimulus for skilled job creation and scientific employment in Portugal through science-based business ventures oriented towards global markets.

- The *MIT-Portugal Program*[38], MPP joint venture has operated since 2007 in the field of "engineering systems" and has particular emphasis on the complex processes associated with energy systems, bioengineering, transportation, and industrial production. MPP has engaged joint research teams working in both sides of the Atlantic and supports exchange of faculty and students. It has reinforced partnerships between Portuguese universities and industry.

- The *Carnegie Mellon-Portugal Program*[39] mission is to place Portugal at the forefront of innovation in key areas of Information and Communication Technologies (ICT), by promoting cutting-edge research, world-class graduate education and a close collaboration with the Portuguese industry. The CMU- Portugal Program is an educational, research, and innovation platform aimed at developing an ecosystem of high quality (dual degree) graduate academic and research program that fosters the emergence of new concepts in information and communication technologies, with an orientation towards new products and services for markets worldwide.

[38] www.mitportugal.org
[39] www.cmuportugal.org

- The *University of Texas in Austin-Portugal Program*[40] has launched the CoLab, focusing on collaborative research in advanced interactive digital media and integrating advanced computing and applied mathematics, and as from the 2nd Phase also focusing on emerging technologies, namely nanotechnology. The program carries out their activities through graduate programs and research projects that aim to create in Portugal a hub on the areas developed by the program. This collaboration also has the involvement of several industrial partners as fundamental members of the research projects financed through the CoLab.

- As part of the collaborations with the University of Texas in Austin, Carnegie Mellon, and MIT, the *University Technology Enterprise Network (UTEN)* was established in 2007 (www.utenportugal.org). It is aimed at commercialization of international technology and the professionalization of university technology managers, and comprises a network of about 40 university and research institutions in Portugal. Working together with counterparts in the US, where new business ventures have been incubated and technology transfer officers trained. A UTEN survey shows that in the period (2007-2012), the network contributed in academic environment to: 20% increased patents granted/year; 26% increasing executed licenses/year; 137% increasing license income; 132% increasing new academic spin-offs. UTEN also contributed to the following achievements in technologies companies: 127% annual growth in revenue; 37% exporting technology; 38% annual growth in hiring.

- Co-operation with the *Fraunhofer Gesellschaft*[41] facilitated the establishment in Portugal in 2008 of the first Fraunhofer Institute in Europe outside Germany, through the Fraunhofer Portugal Research Association. This is an ambitious project focusing on emerging information and communication technologies, such as “Ambient Assisted Living”, to be complemented by the establishment of R&D consortia and cooperative projects involving several Portuguese institutions and Fraunhofer institutes in Germany.

- GoPORTUGAL also aims to forge permanent working ties to a select group of technology transfer offices and incubators within the Portuguese R&D system, as well as to State

[40] www.utaustinportugal.org
[41] www.fraunhofer.pt,

agencies, in order to help leverage their existing capacities, explore synergies, and avoid unnecessary, costly overlaps.

4.3 Analysis of Portugal's Public Policies

Public Policies in Portugal addressing Industry 4.0 are characterized by having a wide range of direct and indirect initiatives, supported by disparate incentive mechanisms, targeting different agents. Indeed, Public Policies in Portugal were designed considering that there should be no unique way to leverage the potential of SMEs and Large corporations on evolving towards Industry 4.0. As a metaphor, it is possible to portray Public Policies in Portugal in Industry 4.0 as a Big Band Jazz orchestra, where the government provided orchestration for several players that played different instruments, that though following a common theme provided ample room for local players' improvisation.

Hence, from the description of section 3.2, one can conclude that the Portuguese government has set up since 2017 mechanisms and instruments for funding several publicly direct Industry 4.0 initiatives related with mainly SMEs but also with Large companies, that varied from awareness events, training programs, research and development, innovation and internationalization, higher education programs, etc. Moreover, the government, through its funding organizations and programs (e.g. COMPETE 2020, IAPMEI, ANI, etc.) have also fostered and supported initiatives from large industrial companies (e.g. Bosh, Siemens, etc.) and sectorial associations and communities that seek to raise the level of companies' maturity in the technological, organizational, people and strategy dimensions.

Considering whom is leading the initiatives and whether these are directly or indirectly targeting Industry 4.0, it is possible to organize the public policies in the following dimensions:

a) Umbrella Initiatives for directly supporting Industry 4.0:
    - Industry 4.0 Programme
b) Direct public Industry 4.0 initiatives (w/funding)

    Examples:

    - Voucher I4.0;
    - P2020 SME Qualification and Internationalization (specific industry 4.0 incentive);
    - P2020 Funding of Research and Development Projects for Individual Companies and in Collaboration (specific industry 4.0 incentive);

- Training and Higher Education programs, from shop floor operatives to PhD programs;
- Funding and investment for Startups and Scale up companies (e.g. Startup Voucher w/ specific industry 4.0 incentive).

c) Direct public initiatives (w/funding) indirectly contributing to Industry 4.0

Examples:

- Portugal INCoDe.2030;
- AI Portugal 2030;
- GoPortugal;
- Collaborative Laboratories or CoLABs.

d) Direct private initiatives contributing to Industry 4.0 (w/ no or partial public funding)

Examples:

- DONE Lab Bosch Digital,
- Siemens I-experience centre 4.0;
- ADIRA Industry 4.0.

Regarding the target agents (beneficiaries) for the direct and indirect Industry 4.0 initiatives, it is possible to organize the public policies targets in the following main dimensions:

- SMEs;
- Large corporations;
- Clusters / sectorial associations;
- Higher education and research institutes;
- Technology Transfer and Training and Centers;
- Startups.

Hence, it is possible to conclude that in Portugal, Public Policies for Industry 4.0 have been orchestrated to leverage disparate agents' needs of increasing the maturity level of Industry 4.0 in SMEs and Large corporations. There are initiatives that go from direct funding for

productivity related with Industry 4.0 capital investments, direct funding to soft issues of capacity and capability building (training for workers and advanced training for technology leaders in Industry 4.0), investment towards new products and processes through research and development in various formats of developments (individual, in collaboration, or in collaborative laboratories), to direct funding that indirectly leverages capacity building for industry, for example with AI Portugal 2030.

Also, the role of the government on the orchestration varies according to the type of initiatives. There has been a direct role, in some situations, as in all initiatives where there is direct funding to SMEs or Large corporations. In other initiatives, the role is one of an indirect orchestrator, for example by supporting cluster / sectorial associations or large corporations that then decide how to develop the playbook of initiatives to SMEs.

4.4 Good Practices in Portugal

It is possible to identify several Good Practices in Portugal of Public Policies for Industry 4.0 for SMEs. These good practices have multiple forms and manifest in different ways. In the following sections, a set of Good Practices will be described based on a reflection process of the team, recognition conveyed in meeting by Portuguese stakeholders of the ecosystem, and also recognition from international reports.

4.4.1 Bottom-up Orchestration process for the Industry 4.0 Strategy

The Industry 4.0 Strategy for Portugal was firstly launched in 2017 and Phase I of the Industry 4.0 program was based on six areas of priority action: training of human resources, technological cooperation, creation of the I4.0 startup, financing, investment support, internationalization and legal and regulatory adaptation.

The initial diagnosis and strategy document design that set the Industry 4.0 Strategy for Portugal was developed by a private consulting firm, Deloitte Consulting, funded by COMPETE 2020, but with a specific mandate by the government to develop a bottom up development process, engaging a wide range of stakeholders, from SMEs, large corporations, universities, sectorial associations, startups, etc. This process was recognised as an international Good Practice in the report Digital Transformation Scorecard 2018, where it was stated that "*Portugal's Indústria 4.0 adopted a bottom-up approach in the design and implementation of its flagship Industry 4.0 initiative. Designing the strategy relied on the*

comprehensive engagement of industry, academia and education stakeholders in order to determine the needs and potential of domestic industry (…) Furthermore, a strategic committee made up of multinational companies and relevant stakeholders guides and advises the government board on the development of the strategy's content."

Hence, the governmental role of orchestrating a bottom-up approach engaging a wide range of stakeholders, including many SMEs, startups, along with multinational corporations, should be highlighted as a Good Practice.

4.4.2 Management and Monitoring Role to an Independent Third-party Stakeholder

The Portuguese government has also delegated the management and monitoring of the execution of the Industry 4.0 Strategy for Portugal to COTEC, an independent third-party stakeholder. COTEC Portugal is the main Portuguese business association for the promotion of business innovation and technological cooperation. The universe of COTEC Portugal includes multinational companies, large national groups and SMEs, in various sectors of activity, representing, in aggregate terms, more than 16% of GDP in gross added value and 8% of private employment. COTEC's role has been particularly relevant in the Phase II of the Industry 4.0 program that includes a set of accelerating measures and recommendations based on three axes: Generalize, Empower and Assimilate.

COTEC role has been funded by COMPETE 2020's program named SIAC (Supporting System for Collective Actions) but their activity has been mainly independent from governmental guidelines, and closely develop with COTEC's associate members, hence a very grassroots approach, rather than a typical governmental top-down approach. COTEC has energized the execution and monitoring of the strategy through a set of actions that benefited from the closeness of COTEC with private corporations like multinationals, SMEs, public organizations and sectorial associations.

Thus, this has also been identified as a Good Practice of public policy regarding supporting Industry 4.0 and SMEs.

4.4.3 Matching of Industry 4.0 Program Initiatives with SMEs needs

The design of the structural funds for Industry 4.0 can also been identified as a Good Practice. The evidence emerges from the highly successful initiatives that were launched by COMPETE2020.

A set of structural funds initiatives were adapted to specifically support companies aiming at evolving in the Industry 4.0 context. The initiatives (previously described) were:

- Voucher Industry 4.0;
- Qualification;
- Innovation (Production, R&D, etc.).

Since 2017, 3948 companies have applied for these initiatives, requesting a total funding of 5 Billion Euros. From these applications, 1137 companies have been funded, with a total of 2 Billion euros of funding directly channelled towards companies addressing Industry 4.0 technologies (capacity and capability building, human resources skilling, etc.).

The sheer magnitude of the amount of incentives committed to SMEs and corporations and the very large number of industrial companies that have applied and have benefited from the funds demonstrate that the design of the initiatives was well done since they had an extreme adherence from the target segments, something that not always occurs.

4.4.4 Strong Engagement of Private and Public Stakeholders

A very important identified Good Practice is the strong engagement of several major private and public stakeholders. Some examples of this engagement and commitment are public organizations like IAPMEI (responsible for delivering many initiatives), research and development and Innovation associations like INESC TEC that mobilized many SMEs, and a set of multinational companies like Bosch, Siemens, that have been committed since the beginning of the Industry 4.0 Strategy design and execution and are seen as industry role models. Without the strong immersion of these stakeholders (and many others less visible) on the execution of strategy it would have been difficult to have achieve the results achieved so far.

5 Analysis of European National and Regional I4.0 Public Policies

According to the digital scoreboard report (DESI, 2019g) (Figure 3), Finland ranks 1st, Czech Republic ranks 18th, Portugal ranks 19th, Hungary ranks 23th, Italy ranks 24th, Poland ranks 25th, and Greece ranks 26th out of the 28 EU Member States in the European Commission's Digital Economy and Society Index (DESI) 2019.

However, as shown in Figure 4, Portugal's best performance corresponds to the Digital public services dimension which is driven by a considerable growth in the share of e-government users.

Another interesting figure is study on integration of digital technology by European Commission in 2019. As expected, Finland (Figure 5) scores much above the European average with 5th rank. Portugal is the next in the list, still above European average with the 11th rank (Figure 6). Closely, the rank of integration of digital technology in Czech Republic is 12th (Figure 7) which shows the improvement in last two years. Greece (Figure 8), Italy (Figure 9), Hungary (Figure 10) and Poland (Figure 11) are below the European average with 22th, 23th, 25th, and 26th rank out of 28 countries.

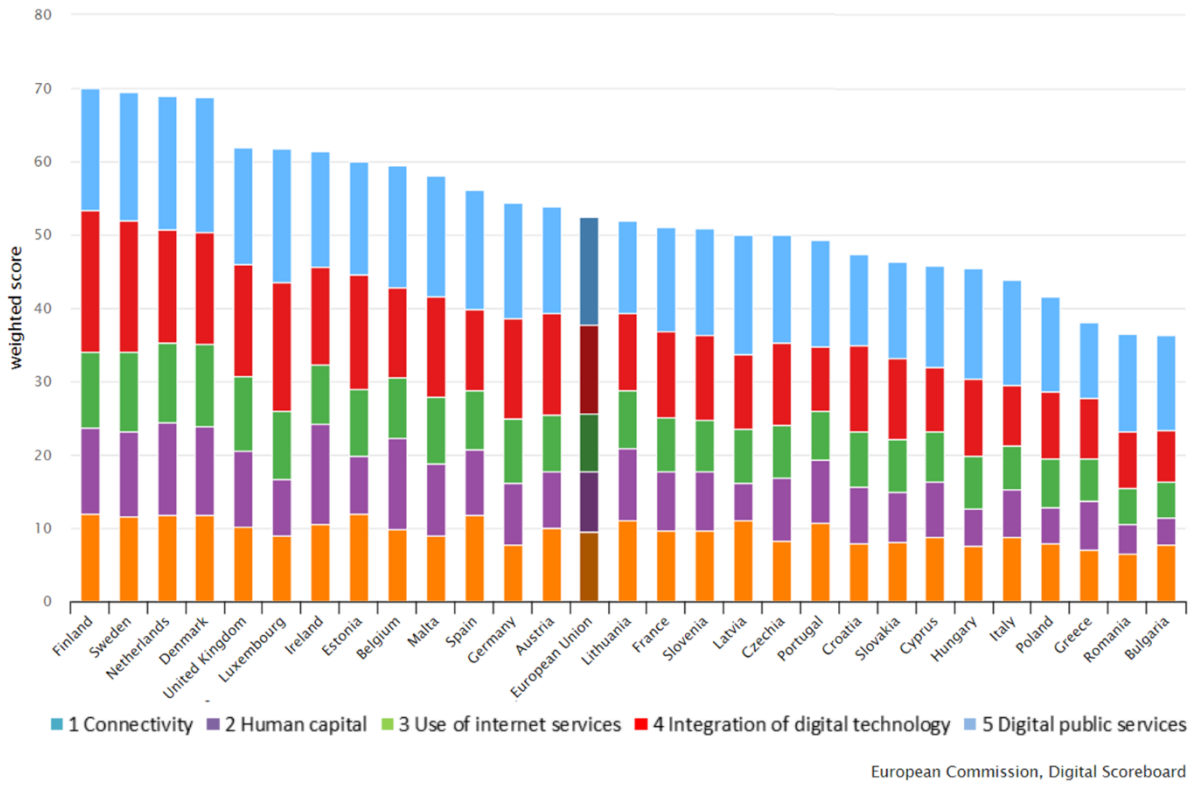

Figure 3. Digital Economy and Society Index 2019 (DESI, 2019g).

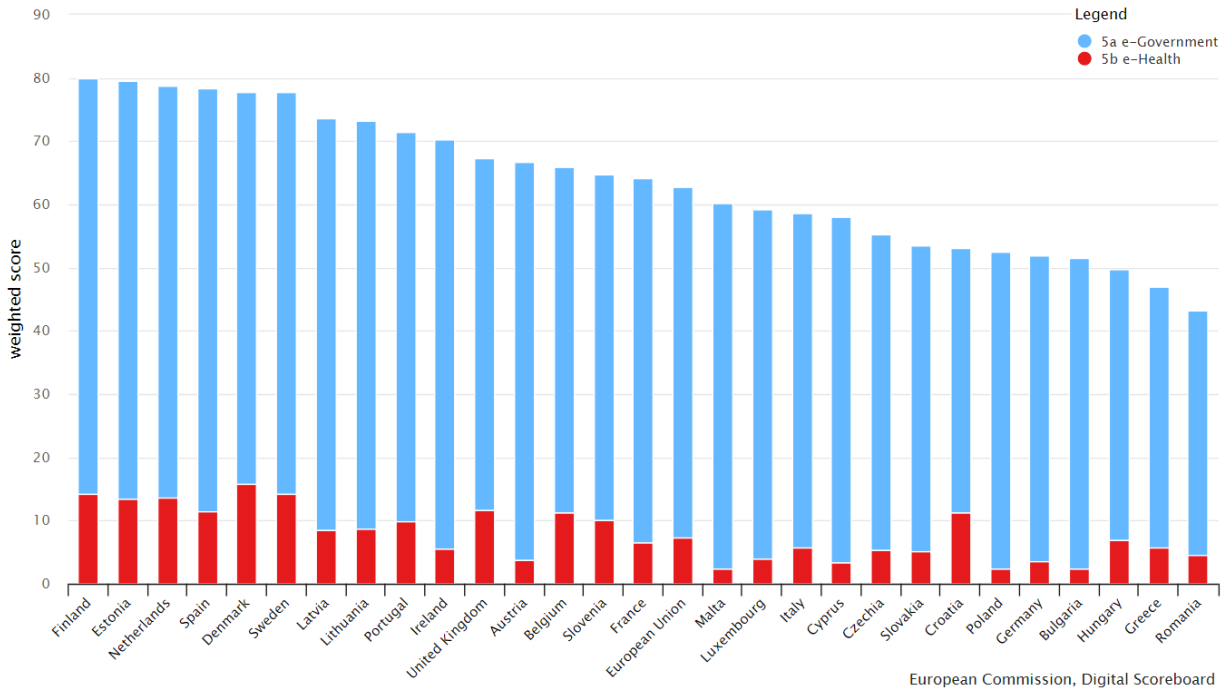

Figure 4. Digital Public Services, by Sub-dimensions of 5 Digital Public Services 2019 (DESI, 2019g).

4 Integration of digital technology	Finland		EU
	rank	score	score
DESI 2019	**5**	**58.3**	**41.1**
DESI 2018	5	55.9	39.6
DESI 2017	6	49.9	37.6

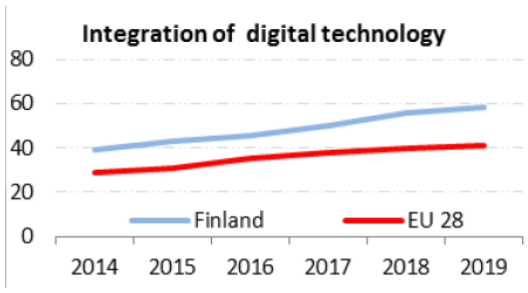

Figure 5. Integration of digital technology: Finland (DESI, 2019b).

4 Integration of digital technology	Portugal		EU
	rank	score	score
DESI 2019	**11**	**42.8**	**41.1**
DESI 2018	11	41.8	39.6
DESI 2017	11	41.8	37.6

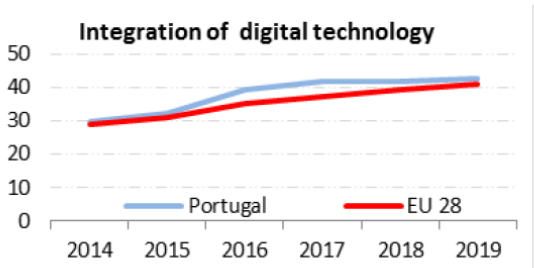

Figure 6. Integration of digital technology: Portugal (DESI, 2019g).

4 Integration of digital technology	Czechia		EU
	rank	score	score
DESI 2019	**12**	**42.5**	**41.1**
DESI 2018	12	41.3	39.6
DESI 2017	9	43.4	37.6

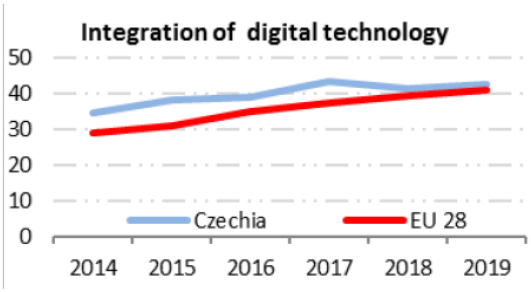

Figure 7. Integration of digital technology: Czech Republic (DESI, 2019a).

4 Integration of digital technology	Greece		EU
	rank	score	score
DESI 2019	**22**	**32.8**	**41.1**
DESI 2018	22	31.5	39.6
DESI 2017	22	30.2	37.6

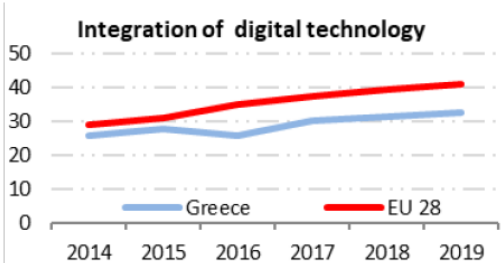

Figure 8. Integration of digital technology: Greece (DESI, 2019c).

4 Integration of digital technology	Italy		EU
	rank	score	score
DESI 2019	**23**	**32.3**	**41.1**
DESI 2018	23	31.2	39.6
DESI 2017	23	29.6	37.6

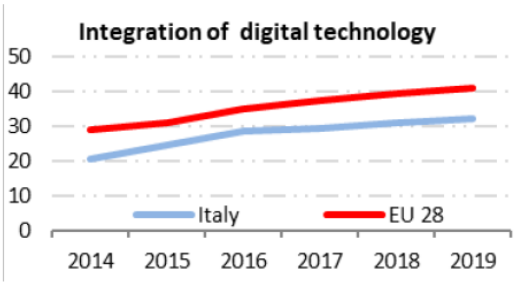

Figure 9. Integration of digital technology: Italy (DESI, 2019e).

4 Integration of digital technology	Hungary		EU
	rank	score	score
DESI 2019	**25**	**25.4**	**41.1**
DESI 2018	24	26.2	39.6
DESI 2017	24	23.7	37.6

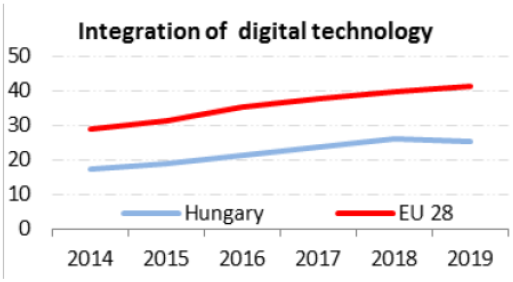

Figure 10. Integration of digital technology: Hungary (DESI, 2019d).

4 Integration of digital technology	Poland		EU
	rank	score	score
DESI 2019	**26**	**24.8**	**41.1**
DESI 2018	26	22.6	39.6
DESI 2017	25	20.9	37.6

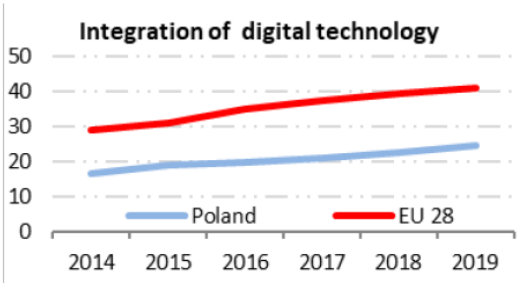

Figure 11. Integration of digital technology: Poland (DESI, 2019f).

Following sub-sections review some initiative for I4.0 in the other project partner countries. Appendix presents a complete list of initiative in each country.

5.1 Country Finland

Finland is a pioneer of the Industrial Internet thanks to its world-class machinery and ICT ecosystem. Finland is consistently ranked as a global leader for deploying the Industrial Internet of Things[42]. Many global manufacturing companies seeking to become leaders in Industry 4.0 are turning to the Finnish Industry 4.0 Ecosystem for help. The smart specialization priorities in Finnish Government Programme include[43]:

1. Manufacturing & industry;
2. Key Enabling Technologies;
3. Sustainable innovation;
4. Human health & social work activities;
5. Information & communication technologies.

The focus of smart specialisation in Finland is on the knowledge base, lead markets initiatives and regional and national ecosystems development (Roman, Nyberg and Fellnhofer, 2018).

According to Finland country report released by European Commission (VVA and WIK-Consult, 2019b), the status of digitalisation in Finland has remained stable since 2015. The share of enterprises doing electronic sales to other EU countries has remained stable, as well as their share of total turnover from e-commerce. On the other hand, the share of enterprises selling online, using two or more types of social media, and buying cloud computing services of medium-high sophistication, has increased. The evolution of ICT investment as a percentage of total investment decreased, from 9.4% in 2015 to 8.3% in 2017. Total capex spending increased from EUR 44,402.03 million to EUR 46,372.89 million over the same time

[42] https://bit.ly/2UwENQn
[43] https://bit.ly/3afauEK

period. In terms of employee digital skills and use, the level has also remained mostly stable in terms of share of enterprises providing training to their personnel to develop/upgrade their ICT skills and employing ICT specialists.

Finland has launched the "Digital Finland Framework"[44] in 2018 support effective coordination of sustainable digital transformation in the country. The "Artificial Intelligence strategy"[45] was launched in 2017 with goal of turning Finland into a leading country in the application of artificial intelligence. A total of at least EUR 344 million have been invested or is planning to be invested across the different digitising initiatives in the country between 2016 and 2022. In addition to the EUR 130 million invested from the digital transformation programme for the regional government, health and social services reform and the 100 million invested in the "Digitalisation, experimentation and deregulation"[46] strategy for public sector ICT.

The Table 2 listed the relevant initiatives in Finland.

5.1.1 Good Practices

Good Practice 1 -Awareness Raising & Training / Adoption of I4.0 Related Solutions:

- **Woodpolis 2020** (1.1.2018–31.12.2020, Total budget 756 000 €, ERDF+state funding 535 600 €):

  Wood product industry (production) is aiming at the **possibilities of digitisation and modern machines & equipment to make production more efficient.** Future possibilities, ecology of production (low carbon production), renewable raw material – material wise and production wise (heath/electricity), automation in production. Support services are important part, maintenance, and reliability – all need to be digitised in the long run to achieve competitive advantage.

- **BIOMIT** (1.1.2017 - 21.12.2018, Total budget 924 500€, ERDF+state funding 647 200 €):

  The BIOMIT project focus is developing measurement and pre-treatment solutions for bio-economy, mining, forest and paper industry to improve their efficiency and decrease toxic emissions to the environment. The project is divided into five work packages: **1) Development and increasing the knowledge of modelling complex processing systems; 2) Development of pre-treatment and measurement**

[44] https://www.businessfinland.fi/496a6f/globalassets/julkaisut/digital-finland-framework.pdf
[45] http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160391/TEMrap_47_2017_verkkojulkaisu.pdf
[46] https://bit.ly/2xiTvmo

solutions for process industry; 3) Pilot tests for measurement solutions in the industry; 4) Development of mathematical models and reliability for data management, 5) Administration, communication and business development (connection to KANTELI project): company and project co-operation.

The main results of the project were: development and piloting 4-5 technologies which improve industrial process control and decrease toxic emissions to the environment and furthermore enable new entrepreneurship in the field of bio-economy in the Kainuu region. 1-2 international pre-reviewed scientific articles / conference papers and national and international project funding.

- **Data analytics accelerator** (1.5.2018-30.4.2020, Total budget 346 000 €, ERDF+state funding 240 000 €):

  Data analytics, big data and artificial intelligence are the major tools for modern companies to achieve large-scale competitive advantages. The target of this project is to speed-up the up-take of data analytics methods in regional companies and in the Kainuu region as whole. The project creates a straightforward process for companies and institutions to quickly try out the possibilities of data analytics and to launch new data driven solutions.

  The project consists of data analytics pilot projects with approximately 3 companies, workshops with 10-15 companies and outreach activities for even a larger number of companies. **This improves the know-how and practical experience of data analytics in the regional businesses significantly**. The data-analytics accelerator provides the necessary first push for adapting new methods, which otherwise would require major investments and competence from the participant companies. The project results in improved usage of data analytics through three channels. The deepest effect comes from pilot projects, where the data analytics capability of the participating companies can be developed on a longer term. Wider reach comes from workshops, where the work focuses on real-world questions posed by the companies and translating the concepts of data analytics into the everyday life of the participants. In addition to these results the project also runs outreach activity to educate local companies and institutions about the possibilities of data analytics and success stories from the project. The project produces quick improvements to companies' processes, but also improved understanding that benefits business development in the long run.

Good Practice 2 - Robotics for Kainuu (1.2.2016-31.3.2019, Total budget 306 300 €, ERDF+state funding 214 400 €):

The aim of this project is to **build up facilities for teaching and learning robotics in companies and in learning institutions KUAS and KVC in Kainuu region and to improve and raise the knowledge and skills concerning robotics and automation linked with it.** In addition, this will guarantee the sufficiency of professionals in the future.

Two of the learning facilities will be built in companies, robot welding station and movable service robot cell for NC machining. Two facilities will be placed in the learning institutions. They are piece handling and packaging robot cell and stationary service robot cell for NC machining. Moreover, several cooperative robots will be purchased to be used both in companies and learning institutions for many kinds of tasks, as well as health and care robotics competence will be acquired.

Good Practie 3 - OredVR (1.1.2018-31.12.2019), Total budget 349 900 €, ERDF+state funding 244 900 €):

The OredVR project adds to the knowledge on how mining companies can use virtual reality and augmented reality in visualising ore deposits for different user groups in the value chain of a mine. The OredVR project creates a virtual reality/augmented reality platform for visualising ore deposits. This platform utilises the different data mining companies collect from the site, as well as other relevant data (such as market prices) from outside sources. The platform integrates and processes the data to produce that 3D visualisations that can be utilised for different operations with, depending on the need, virtual reality (VR) or augmented reality (AR). It will have separate interfaces for several different users (e.g. executive level, mineral processing personnel, loading personnel, exploration planning). In addition, efficient ways for handling big data in mining environment are developed in the project.

Good Practice 4 - Industrial Internet

The funding measures of Business Finland (formerly Tekes) are considered very important to Finnish innovation by the stakeholders (VVA and WIK-Consult, 2019b). Industrial Internet (Teollinen internet) is particularly relevant to digitalisation. The programme offers Finnish companies innovation funding, networks and export services for developing and selling global smart digital solutions. Its main aim is to build up new ecosystems and new ways of cooperation. According to the Business Finland database41, over a hundred projects and

project partners have received funding through the programme, ranging from EUR 30,000 to EUR 982,989.

5.2 Country Czech Republic

The manufacturing industry has traditionally high contribution in the Czech economy. The country has relatively low unemployment rate (2.2% in 2019)[47]. The digitalisation in Czech Republic is medium compare to other EU Member countries (DESI, 2019a). The government of the Czech Republic showed its backing for Industry 4.0 by issuing an order in support of the initiative on August 24, 2016 followed by the establishment of the Society 4.0 Alliance on February 15, 2017[48].

Since 2018, new government put digitalisation as one of the top priorities. In October 2018, the government approved a new programme “Digital Czech Republic”[49] which deals with all the effects of digitization on the economy and society. It is a set of concepts that create the conditions for the long-term prosperity of the Czech Republic. It covers three strategies which includes areas ranging from the interaction of the Czech Republic in the European Union in the digital agenda, through digital public administration to the preparation and interaction of the Czech Republic’s society and economy for digitization.

In 2019, The "Country for the Future"[50] programme was launched as the innovation strategy of the Czech Republic 2019-2030 which presents a long-term vision with purpose of opening the country for innovative ideas and businesses considering the potential of robotisation, automation and other trends based on the idea of Industry 4.0.

National Artificial Intelligence Strategy (NAIS)[51] is another recent national strategy in order to use emerging technologies to help the Czech Republic to become an innovative economy and to support domestic companies and brands and further economic growth.

CzechInvest[52] is an Investment and Business Development Agency which is initiated by Ministry of Industry and Trade, arranges both national and international investments in the areas of manufacturing, business support services and technology centres. This organization supports SMEs as well as start-up companies and the country’s business infrastructure, and innovation.

[47] https://en.wikipedia.org/wiki/Czech_Republic
[48] https://www.ncp40.cz/en
[49] https://www.mpo.cz/en/business/digital-society/digital-czech-republic--243601/
[50] https://www.countryforfuture.com/
[51] https://www.mpo.cz/assets/en/guidepost/for-the-media/press-releases/2019/5/NAIS_eng_web.pdf
[52] https://www.czechinvest.org/

In the appendix section, Table 3 presents an overview of the main initiatives in Czech Republic.

5.2.1 Good Practices

Good Practice 1 - PRIM

The Support for development of computational thinking – PRIM (VVA and WIK-Consult, 2019a) aims to promote the conditions for open education, particularly about IT, and to contribute to the creation of an education system that ensures that every individual is equipped with the necessary competences to participate in the information society and to use open learning opportunities. The project, funded under the ESF (OP VVV), started in October 2017 and will run until 2020.

Throughout the course of the project, a number of educational and popularisation activities are being held throughout the regions to promote the topic. A number of these are organised by universities while some of them are also organised spontaneously by teachers of informatics. The project also supports the realisation of events such as Code Week or Hour of Code.

5.3 Country Greece

As shown in Figure 8, Greece performance in terms of digitisation is below the EU average. During 2009 Greece entered an unusual economic crisis with sovereign debt crisis, deficits, high unemployment rate and GDP decline. To reverse this negative trend, a new Ministry for Digital Policy, Telecommunications, and Media was established in 2016 with the responsibility for planning and implementing national policy for the ICT investments in the country[53].

Greece's GDP approximately declined 25% during the ten years recession period. Finally, Greece is progressively recovering from recession and its GDP grew by 1.9% during 2018 and 2019. The Government's reconsidered growth strategy aiming at transforming the economic structure of country supported by exports and high value-added sectors. Digital technologies and the support mechanisms for I4.0 have significant role for this transformation.

Several initiatives have been launched during 2018 (still in the phase of implementation) mainly focusing on SMEs and startups, such as the measures a) Digital Step, b) Digital Jump, c) Digital transformation of the agricultural sector and d) Research-Create-Innovate. Additional initiatives have been launched focusing on upgrading the digital skills of the work force.

[53] https://bit.ly/39cSslg

According the European Commission report (VVA and WIK-Consult, 2019d), there are major barriers regarding to regulation preventing the digital transformation, such as conflicting legislation and overlapping responsibilities between various national bodies.

Table 4 in Appendix section presents an overview of the main initiatives towards I4.0 in Greece.

5.3.1 Good Practices

SEV Programme Industry 4.0SEV Digital Transformation Observatory being the monitoring mechanism for promoting the digital transformation of Greece, developed the SEV Programme Industry 4.0 to be integrated in National Policy of I4.0 of the next programming period.

5.4 Country Italy

Italy belongs to the group of countries that are catching up in terms of digital development (Figure 9). The main challenge in Italy is the low level of digital skills among the population, demonstrated by the fact that Italy dropped one place on the Human Capital dimension (VVA and WIK-Consult, 2019f). GDP is growing since 2014[54] and unemployment rates have started falling off since 2015[55] (Still high, 9.7% in 2019).

Italy legislator put in place an organic strategy on digitisation of industry as of 2016. The national industrial plan called “Piano Nazionale Industria 4.0”[56] provides for several measures and support mechanisms (Presented in Figure 12) which introduces available opportunities and incentives to the companies for integrating I4.0. In the years 2016-2018 it has received a total amount of public funding of EUR 40 billion.

[54] https://countryeconomy.com/gdp/italy?year=2018
[55] https://tradingeconomics.com/italy/unemployment-rate
[56] https://www.mise.gov.it/images/stories/documenti/2017_01_16-Industria_40_English.pdf

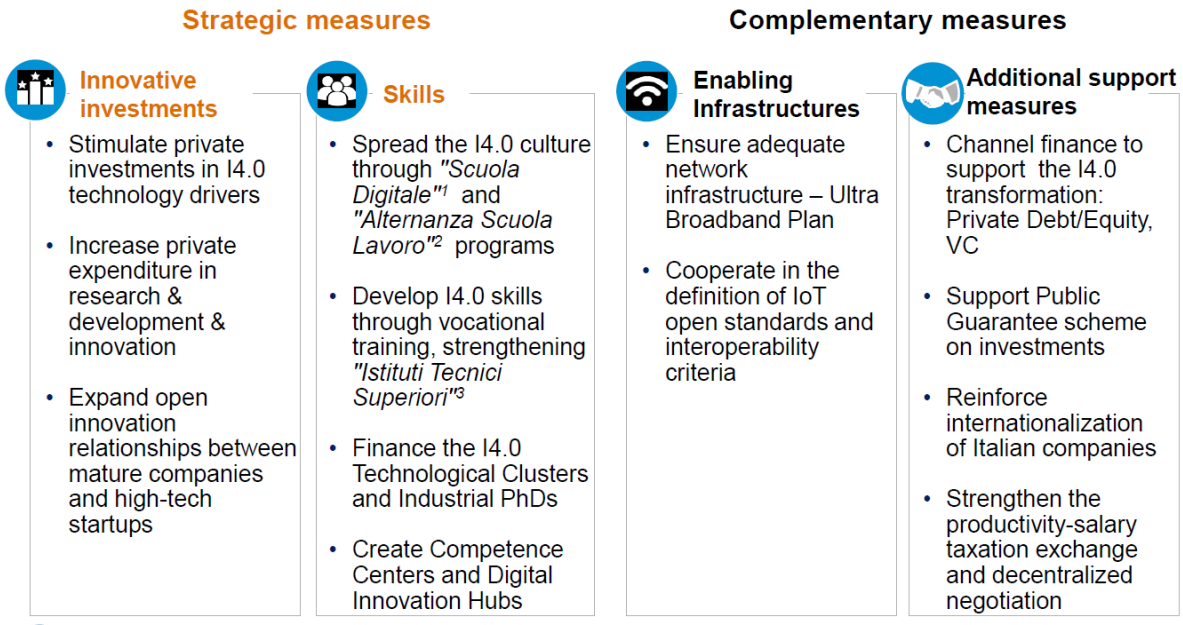

Figure 12. I4.0 national plan 2017-2020 Measures in Italy.

Although still lacking behind in terms of digital skills, Italy has become one of the most financially attractive countries in Europe for those companies investing in innovation (VVA and WIK-Consult, 2019f). However, due to the will of the current Government to direct a larger share of the public expenditure to other issues (such as income security), the total amount of investment is supposed to decline in the coming years.

Table 5 in Appendix presents an overview of the main initiatives identified in Italy.

5.4.1 Good Practices

Super and Hyper-depreciation

The two amortisation schemes consist in a 40% and 150% increase of the ordinary depreciation deduction for investments in new industrial machinery, meaning that acquisition costs are raised by an equivalent share for accounting purposes. In spite of the good use of the measures made by firms, the 2019 Budget Law foresees the annulment of the super-depreciation scheme and a cut of the hyper-depreciation. If until 2018 the tax cut was fixed at 140%, from 2019 it will variate as follow: 170% for investments up to EUR 2.5 million; 100% for investments between EUR 2.5 million and EUR 10 million; 50% for investments above EUR 10 million and below EUR 20 million.

In spite of recent changes, Super and Hyper-depreciation are considered two examples of good practices because, together with other fiscal tools presented in section 2.1, they improved Italy's fiscal profile to a great extent. According to the 2017 Digital Tax Index, as a

result of these measures, Italy's fiscal framework for innovative companies is now one of the most attractive in the world.

This is also confirmed by a more recent ISTAT publication (Report on the competitiveness of productive sectors 2018) which claims that in 2017 62% of manufacturing enterprises decided to take advantage of super-depreciation, whereas 48% used the financial incentives offered by hyper-depreciation.

5.5 Country Hungary

As shown in Figure 10, Hungary performance in terms of digitisation is much lower than the EU average. Despite Hungary has a wide network availability and a high take-up of fast and ultrafast broadband, half of the population does not have the basic digital skills. The economy in Hungary had accelerated with a 4% GDP growth in 2017 and 5% GDP growth in 2018[57]. The main sectors in Hungary are vehicle industry, electronics, life sciences, medical technology, ICT, and food industry[58].

According European Commission report in 2019 (VVA and WIK-Consult, 2019e) the Hungarian government and industry associations, together with stakeholders from the academy, have launched a number of initiatives in the last few years. Hungary has also developed several strategies and action plans as well as an overall umbrella program for digitalisation, which indicates that digitalisation in Hungary is an important priority. Table 6 in the Appendix section presents an overview of the main initiatives towards I4.0 in Hungary.

The lack of ICT and engineering professionals together with the weak foreign language and management skills are expected to slow future innovation.

Table 6 in Appendix presents an overview of the main initiatives identified in Hungary.

5.5.1 Good Practices

Good Practice 1 - **Night of Industry 4.0 model factories**

The GP is an eligible activity of the dedicated Industry 4.0 project of EDIOP

- The activity aims at the awareness raising of SMEs towards Industry 4.0

[57] https://www.oecd-ilibrary.org/economics/country-statistical-profile-hungary-2020-1_g2g9e93c-en
[58] https://mtu.gov.hu/documents/prod/Hungarys-industry-overview.pdf

- As part of the activity pre-selected companies open up their workshops and introduce the Industry 4.0 solutions they use"

Good Practice 2 - Industry 4.0 in Vocational training (Vocational training 4.0)

The Vocational training 4.0 is a project financed from EDIOP reflecting on the skill development aspect of Industry 4.0. The GP will present objectives, main activities, timeframe and expected results of the project."

Good Practice 3 - Model Factory Program

The Model Factory Program (VVA and WIK-Consult, 2019e) is a unique initiative which is addressing the most important weaknesses of Hungary. Within the program, small industrial producers in the convergence regions are provided with knowledge, enabling these SMEs to start digitising themselves. It is therefore raising awareness, changing the mindset and approach of SMEs and educating them about their opportunities.

The three main phases of the program are building up on each other, ensuring that SMEs are acquiring all the basic knowledge before taking the next step forward. The specific elements of each SME are taken into account along the way and mentors are there to help them address their business questions.

So far 100 SMEs have participated in visiting five Model factories, which is the first phase of the program. In the second part, which is completing a two-day long lean training, 10-15 SMEs have participated until the end of 2018. After mid-February 2019, the first SMEs that completed the trainings are planned to consult their mentors to design their A3 strategies

5.6 Country Poland

Poland ranks 26 out of 28 in integration of digital technologies in 2019 (Figure 11). Poland's economic growth in the last 25 years has been strong, with continues positive GDP growth. Poland's smart specialisation strategy focuses on the following priorities(VVA and WIK-Consult, 2019g): healthy society, bio-economy comprising agri-food, forestry and environment, innovative technologies and industrial processes, sustainable energy and natural resources and waste management.

The Strategy for Responsible Development[59] determines 10 strategic sectors where Poland could become a competitive leader globally including aviation, transport means production, professional electronics, chemical industry, military systems, shipbuilding industry, IT, furniture, food processing. However, in the area of industrial automation, Poland lags most developed nations. One of the challenges that Polish manufacturing companies currently face is the development of the labour market[60].

Poland is pursuing a responsible development strategy, which is based on reindustrialization, development of innovative companies, creation of development capital, digitization, support for SMEs and cultivation of foreign markets as well as social and regional development. The foundation 'Polish Industry 4.0 Platform' is set to be launched in 2018; its goal is to facilitate the exchange of Industry 4.0 knowledge and experience in Poland[61].

Table 7 in Appendix presents an overview of the main initiatives identified in Poland.

5.6.1 Good Practices

Good Practice 1 - **Start-up Spark:**

This project managed by Lodz Special Economic Zone. The goal of the project is accelerating the development of start-ups. As part of the acceleration, the startup is merged with a Technology Recipient (a company that is an investor in the Economic Zone) and an operational mentor (a startup supervisor). Startups participating in the programme must provide solutions from the area of the Industrial Internet of Things (IoT), including virtual and augmented reality (VR/AR), artificial intelligence (AI), cyber-security.

Good Practice 2 - Research 5G network (Digital Innovation Hub 5G):

The network is designed to help building solutions for smart cities and the Internet of things based on the new communication standard. The project was implemented as part of the DIH5G Digital Innovation Hub which includes Institute of Communications - National Research Institute (leader), Lodz University of Technology, and Ericsson and Fundingbox companies

Good Practice 3 - European regional development fund (ERDF)

[59] https://www.gov.pl/documents/33377/436740/SOR_2017_streszczenie_en.pdf
[60] https://www.s-ge.com/en/article/news/20181-mem-poland-automation-making-progress
[61] https://www.s-ge.com/es/node/7181

- **Regional Operational Programme of the Łódzkie Region** (2014-2020):

  Priority Axis II "Innovative and competitive economy",

  measure II.3 "Improving the competitiveness of SMEs",

  sub-measure II.3.1 "Innovations in SMEs"

  https://rpo.lodzkie.pl/

  Under the program, companies have implemented the following investments or designed new products related to Industry 4.0:

  - Sales Force Automation (SFA) systems integrated with Enterprise Resource Planning systems (ERP)
  - Robotisation of production lines
  - Implementation of MES (Manufacturing Execution System) systems
  - Automation of production in the medical sector
  - Analytical engine for advanced data processing
  - IT system for hotel facility management in an interactive model

- Currently, the **Regional Operational Programme of the Lodzkie Region for 2021-2027** provides for support for the area of "Industry Solutions 4.0" within the framework of **Policy Objective 1 More intelligent Europe through supporting innovative and intelligent economic transformation**, Specific Objective III Increasing growth and competitiveness of SMEs, including through productive investments.

The assumption is that the above-mentioned area of support will be an element of a larger project based on the implementation of R&D work results, implementation of innovative products, processes or services. The final scope of intervention, however, will depend on many factors, e.g. the allocation granted, demarcation of support or arrangements with the European Commission.

Good Practice 5 - PFR Ventures

The PFR Ventures (VVA and WIK-Consult, 2019g) being the largest Venture Capital investment platform in Central and Eastern Europe constitutes best practice due to is flexibility in terms of financing projects at various stages of development and different sizes (from about 50,000 EUR to 15 million EUR). On 15 May 2017, the first competition for capital funds was launched (‘Starter’ component) within the ‘Start in Poland’ programme, which was discussed

above. In 2017, 20 grant agreements were concluded with the total sum of around EUR 23.435 million. In 2018 there was a noticeably increase, with 186 grant agreements concluded for the total sum of around EUR 91.1 million). The growing interest in the participation in the programme and the positive tendency in terms of the number of grant agreements demonstrates the successful set up and launch of the VC platform according to the government feedback.

5.7 Other European Countries Public Policy

5.7.1 Germany

Germany is one of the leading countries in industry and I4.0 revolution was developed in country in 2013 (Zhou, Liu and Zhou, 2015). The strategy of government for I4.0 adoption was with the propose of promoting digitalisation, emphasises workers, SMEs, businesses and globality. German companies are incentivised to bring Industry 4.0 aspects into their products like AI, automation, blockchain and Industrial Internet of Things (IIoT)[62].

The Plattform Industrie 4.0[63] has made a major contribution to developing a common understanding of "Industry 4.0" and moderate the technological and societal exchange (Kagermann *et al.*, 2016). The Platform started as an industry initiative, and was set up by the industry associations BITKOM, VDMA and ZVEI in 2013. Partners included ABB, Bosch, Telekom, FESTO, Hewlett- Packard, IBM, Infineon, Phoenix Contact, SAP, Siemens, ThyssenKrupp, Trumpf, Volkswagen and Wittenstein. The Platform contributes to facilitating the digital transformation by (VVA and WIK-Consult, 2019c):

- Providing a platform to promote networking and learning by interested private sector stakeholders. For example, it grants partners access to literature and knowledge about Industry 4.0. The task is supported through a showcase of best practices around Industry 4.0 applications. The Platform also coordinates the work of Labs Network Industry 4.0
- Mediating and coordinating the standardisation process. The RAMI4.0 project[64] is embedded within the Platform. The platform also facilitates coordination between RAMI4.0 and the Standardization Council through, for example, the publication of updates on progress in the standardization process and the results.

[62] https://blockheadtechnologies.com/these-are-the-six-countries-leading-the-fourth-industrial-revolution/
[63] https://www.plattform-i40.de/
[64] https://bit.ly/3ho4OLM

- Supporting the internationalisation strategy; it is the body responsible for signing cooperation agreements and facilitating access for German organisations to participate in Industry 4.0 efforts. The Platform further promotes the concept of Industry 4.0 with roadshows abroad.

The national strategies and the wide range of initiatives are all aligned with the priorities defined in the smart specialisation strategy, covering all aspects of the digital transformation. The priorities put forward in the smart specialisation strategy are the following (VVA and WIK-Consult, 2019c):

- Digital economy and society
- Intelligent mobility
- Healthy life
- Innovative work environment
- Sustainable economy and energy Civilian security

5.7.2 The lessons from Germany's I4.0 development strategy

According to the report (Horst, 2018) by United Nations, the German government 'captured' the private sector's efforts, while encouraging research and civil society to participate and contribute to the achievement of I4.0-related objectives (shown in Figure 13).

The Figure 14 provides an illustration of Plattform Industrie 4.0 (PI 4.0) and its contribution to Germany's I4.0 strategy and summarises the succession of strategies. Germany's I4.0 strategy is not a coherent strategy designed as a holistic intervention from start to finish. It is a complex innovation policy mix characterized by a continuous policy experimentation process; cumulative learning has been sustained for a period of over a decade or so. German policymakers have been able to tap into and benefit from a development dynamic initiated and largely driven by private sector organizations. At the same time, I4.0 has been coordinated with the actions of other academic and government organizations.

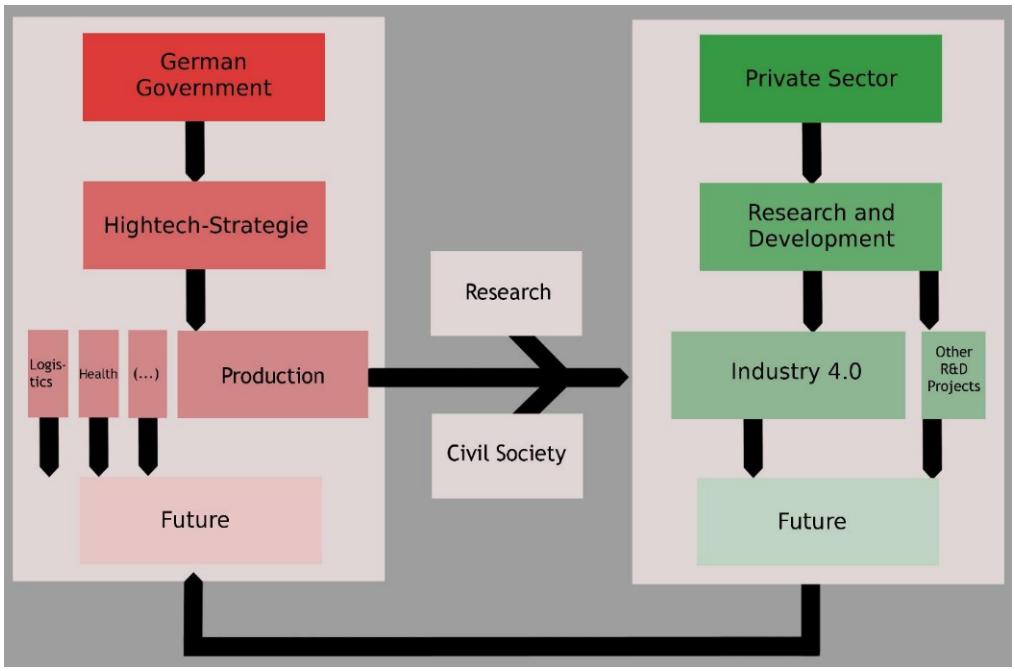

Figure 13. Public-private collaboration within Germany's I4.0 strategy (Horst, 2018).

Figure 14. The policy process of Germany's industry 4.0 strategy (Horst, 2018).

Horst (2018) also identified following insights from Germany's experience:

- The development of the country's I4.0 strategy is open to accommodating policy experimentation and the fostering of intense public-private interactions. The mediating role of government consulting bodies facilitates dialogue, priority setting and knowledge exchanges.

- Standardization efforts are necessary to nurture suitable framework conditions for I4.0. The strategic use of standards can help develop and push through an ambitious agenda for economic transformation.
- Policymaking should build on strengths, systematically drawing from existing interventions with potential to contribute to I4.0. A high number of funding initiatives, some of which proved to be very successful, helped attract the interest of different stakeholders.
- Efforts to draw from international cooperation through PI4.0 has contributed to the development and setting of standards, to the setting up of testbeds, harmonizing skills and qualification programmes and cooperation in IT security.

5.8 Cross-country Analysis

As per the Digital Economy and Society Index 2019, there can be seen a wide variation in the Digital Scoreboard Report across Europe, with Bulgaria in the bottom of the Rankings scoring almost half of Finland which is at the top of the Innovation Index. Interestingly, the score for Digital connectivity is similar across the different member states, with two factors showing the maximum variation: Human Capital and Integration of Digital Technologies. Amongst the countries explored, Portugal and Czech Republic have very similar overall scores with 12th and 11th Rank respectively. Despite this, Portugal scores way higher than the rest of the countries studied in this report in the aspect of Digital Public Services, perform better than Germany and scoring almost similar to Finland in this aspect. This indicates a tremendous effort by the government in Portugal towards e-Governance with digitization of several Public services. However, Portugal lags behind Czech Republic in terms of development of Human Capital. Similarly, despite Hungary and Italy ranking next to each other, with rank of 23 and 24 respectively, Hungary performs significantly better than Italy in terms of Human Capital while lagging behind in terms of Digital Public Services and Integration of Digital Technologies. Germany, despite being an ideal case study for implementation of Industry 4.0, scores relatively poorly in terms of Digital Public Services. This shows a big disparity in Germany where the industry is a leader in terms of integration of technology, but the Public Sector being slower in integration of technology.

When we analyse Industry 4.0, the integration of Digital Technologies is one of the most vital parameters. Figures 5 to 11 show the evolution of integration of Digital Technologies from 2014 to 2019. We can observe that the EU has been steadily improving on this score over these six years. Finland has not only been leader amongst the countries studied, but has actually been faster than the rest of the Europe and is therefore one of the ideal showcases. Portugal, despite having performed reasonably well in this regard, has shown a very

interesting trend. In 2014, it was at the level of EU average, and then underwent a significant growth in terms of Technology adoption during 2016, performing way better than the EU average. However, then the growth slowed with the rest of EU catching up and the performance in 2019 again being comparable to the EU average. Czechia in contrast was performing way better than the EU average in 2014 but did not maintain its lead, and by 2019 was at a similar level to Portugal and the rest of the EU.

The rest of the countries studied, namely Greece, Italy, Hungary and Poland are all below the EU average with regards to the integration of Digital Technologies. What is a bit alarming is that Greece while scoring higher than Italy, Hungary and Poland in 2014, actually grew slower than the EU average with a slight decline in its score in 2016, the same year when Portugal experienced a significant increase. Thus in 2019 it was significantly lagging behind the EU average. In the case of Hungary and Poland, the Technology Adoption score grew marginally slower than the average of EU.

Finally, the set of Good Practices of public policy for Industry 4.0 presented here for each country demonstrate a wide variation in terms of types of initiatives. The goal is demonstrate that there is no unique format or typology of good practices for public policy towards Industry 4.0 and that partners from each country members can learn considerably with the examples of each country or region.

6 Non-European I4.0 Public Policy

6.1 USA

According to the "A guide to Industry 4.0 in the US" report[65], US manufacturers have been one of the most ardent adopters of Industry 4.0. There is evidence that manufacturers are seeing real return on investment from new Industry 4.0 technologies. They are seeing top line and bottom line growth through using these new disruptive approaches and tools. Hence, they are improving productivity and mitigating risk with better quality control. The US government sees manufacturing as an engine for growth and has incentivised manufacturers to adopt Industry 4.0 using Quality Jobs tax credits, R&D tax credits to boost implementation of techniques such as robotics, a Qualified Facility for Refundable Tax Credits to promote the location and expansion of manufacturing facilities including R&D and the litigation of smart contracts to boost block chain adoption.

[65] https://www.essentracomponents.com/en-us/news/guides/a-guide-to-industry-40-in-the-us

6.2 Japan

Japan has been a strong player in manufacturing and production. Japan is the world´s predominant industrial robot manufacturer, producing a record 153,000 units in 2016[66]. On the other hand, Japan faces many societal challenges, such as an increased ageing population[67]. Industry 4.0 can provide a solution to this pressuring problem. Japan is already popularising the idea of 'Society 5.0'[68] which aims to create a new social contract and economic model by fully incorporating the technological innovations of the fourth industrial revolution with embedding these innovations into every corner of its ageing society. As shown in Figure 15 connecting data and using data efficiently will encourage innovation, better productivity and dissemination of technology[69]:

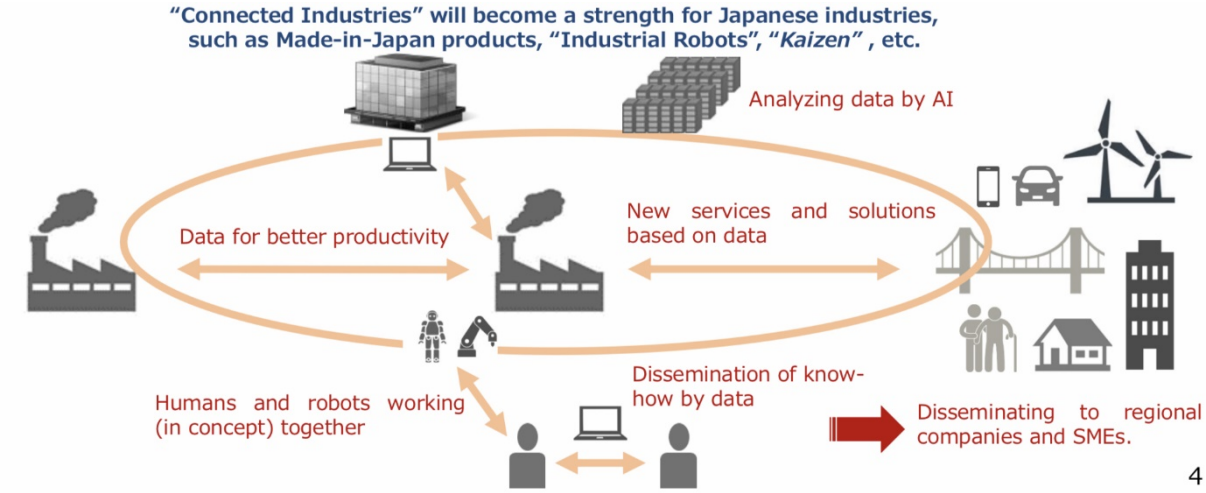

Figure 15. Connected Industries Tokyo Initiative.

6.3 Korea

Korea, have been very successful at technological catch-up, spending 4.3% of its GDP (2014) on R&D, and emerged from nowhere to become a new global player in science, technology, and innovation, establishing a world prominence in such areas as telecommunications, automobiles, ships, iron and steel, and others (KSP, 2018). South Korea has had the highest robot density in manufacturing since 2010[70]. The growth is a result of increased adoption particularly in the electronics and automotive industries. In 2016, South Korea's trade ministry announced it would spend $450 million (500 billion won) in five years to grow its robotics footprint. The country is spending a big chunk of the money on corporate R&D centres.

[66] https://www.therobotreport.com/10-automated-countries-in-the-world/
[67] https://blockheadtechnologies.com/these-are-the-six-countries-leading-the-fourth-industrial-revolution/
[68] https://tcrn.ch/2xbyJF7
[69] https://bit.ly/2wqRFj2
[70] https://www.therobotreport.com/10-automated-countries-in-the-world/

6.4 Canada

Canada is currently a hub for innovative tech which includes anything from blockchain to AI to complete digitalization[71]. The I4.0 has created new critical success factors in the manufacturing sector, and the potential implications for Canadian manufacturing are significant, particularly in terms of improving productivity to drive growth. Canadian manufacturing companies, particularly SMEs, will need to be supported on their digitisation journey in order for them to fully capitalise on the potential of Industry 4.0 tools (PWC, 2018). The aerospace hub in Quebec has been a bright spot in Canada's manufacturing outlook (PWC, 2018). Canada has a highly developed mixed economy with manufacturing as a key contributor to the country's revenue, exports and employment. However, it is crucial for Canada to develop new partnerships and expand into growing markets. Canada's leadership should also be reinforced through continuous technological development and innovation to capitalise on the emerging trends (PWC, 2018).

6.5 Singapore

Singapore is among the leading countries for I4.0 and is a leader on the Global Trade & Investment driver as one of the most open and trade-friendly countries in the world[72]. Singapore has strong Institutional Framework and future-oriented approach of the Government as key strengths. Government had a big role towards Industry 4.0 revolution which has two parts (Liao *et al.*, 2018):

1. long term policy direction and creating right structure of economy to match the number of people that will exist in the society and the types of jobs that will be available. One of the factors was incentivising the right industry to grow, also incentivising the right types of companies to setup home in Singapore which then results in creating certain types of jobs. Government invested on education towards providing necessary training for the jobs.
2. Short term policy for the transition from manufacturing to service-based economy, for example by incentivising companies to send their employees for short term training.

"Research, Innovation and Enterprise 2020 Plan"[73] is one of the Singapore's national strategies to develop a knowledge-based innovation-driven economy and society. Public investment in research and innovation has grown over the last 25 years. Under the five-year Research, Innovation and Enterprise (RIE) 2015 Plan, the Singapore government committed

[71] https://blockheadtechnologies.com/these-are-the-six-countries-leading-the-fourth-industrial-revolution/
[72] https://bit.ly/2J9boqg
[73] https://www.nrf.gov.sg/rie2020

$16 billion over 2011 to 2015 to establish Singapore as a global research and development (R&D) hub. The government also has sustained its commitment to research, innovation and enterprise, and invested around $19 billion for the RIE2020 Plan over 2016 to 2020. Within these programs it is included the digitalization of manufacturing and thus Industry 4.0.

6.6 China

Chinese manufacturing industry successfully has shown a continuous growth during recent years and is now the second-largest economy in the world and a prominent role in the Fourth Industrial Revolution (Wang, 2018). In 2015, China has put forward the "Made in China 2025" project[74] for transforming and upgrading the current manufacturing industry. This project consists of a series of innovation policies, which focus on the development of high-end manufacturing sector for China to achieve its transformation from the former manufacturer of quantity towards one of quality. Furthermore, Chinese government initiated Internet Plus strategy[75] to establish a contextual link between networking, integration, and new platform-based business models.

According to Deloitte report (Deloitte, 2018a) the growth of smart manufacturing in China is manifested in three main aspects:

1. Chinese industrial enterprises have benefited from a higher level of digital capacity and quality, laying a strong foundation for the future analysis, prediction and self-adaptation of manufacturing systems.
2. In terms of financial benefits, smart manufacturing is making a much greater contribution to corporate profitability.
3. In terms of typical applications, China has become the largest consumer of industrial robots, supported by fast-growing demand.

The same report indicates the five focus areas of smart manufacturing deployment among Chinese industrial enterprises as: digital factory (63%), in-depth extraction of equipment and user value (62%), industrial internet of things (IoT) (48%), business model restructuring (36%) and artificial intelligence (AI) (21%).

According to the World Economic Forum[76] discussion there are few important factors for this growth:

[74] Made in China 2025, Ministry of Manufacturing and Information Technology (MIIT): https://www.csis.org/analysis/made-china-2025
[75] http://english.www.gov.cn/2016special/internetplus/
[76] https://www.youtube.com/watch?v=0F7B5iRg_sI

- Emphasising and investment on education progressively (Specially in engineering and mathematics)
- Investment on automation technology, IoT, Computing Power
- Using the creativity of human on innovation and managing and creating new systems

7 Comparison between EU and Non-European

The concept of Industry 4.0 was first introduced by the German researchers back in 2010. Germany as a pioneer of I4.0 internet driven self-controlling and sensor aided production systems is shaping the future of the machines based on cyber physical production systems orders will be able to steer themselves independently through entire value chains.

There are a wide range of public policies, translated in strategies and program across Europe to address the take up of Industry 4.0 by SMEs and Large corporation, which were discussed in previous sections. It was also briefed the public policies in some non-European countries. Different countries within Europe and globally share a very close understanding of I4.0, despite differences in their focus.

While Europe is focused on standardization and is already well advanced on automation and robotization engineering and design work, Chinese manufacturing industry has shown a continuous growth during recent years. Still, most companies in China are still a long way from manufacturing standards for Industry 4.0. This opens up unique sales opportunities for European suppliers with regard to industry software, sensors, robotics, and designs with the goal of positioning European as a supplier of automation technology and high-tech products to the Chinese market. Another opportunity for European is helping Chinese manufacturing to increase the efficiency and reduce the emissions and providing environmentally sustainable solution.

The Japanese industry is already very advanced as far as process automation is concerned. The challenge is to integrate the highly customised IT solutions of the different value chain partners in order to create value networks. Japan is leading in shop floor automation but lags on digital integration of global supply chains.

South Korea’s economy brings together several value chains under one roof. South Korea’s SMEs have traditionally focused mainly on manufacturing technology and have a low level of automation. There are many highly innovative product concepts and global pioneers of data-driven business models. The major South Korean telecoms and electronics corporations are

very active in the development of smart products, smart services, and new, data-driven business models.

American companies are particularly strong in the development of innovative Internet, software, and service business models. Many large US companies are working on the development of software platforms for I4.0 or the Industrial Internet of Things. Established platforms are often controlled by a single company. In USA's pragmatic, implementation-focused approach to I4.0, ideas and talent are often regarded as more important to success than technology. As a result, start-ups enjoy extensive access to venture capital.

Singapore is among leading countries for I4.0 and is a leader on the Global Trade & Investment driver as one of the most open and trade-friendly countries in the world. Singapore has strong Institutional Framework and future-oriented approach of the Government as key strengths. Public investment in research and innovation has grown over the last 25 years.

Canada is currently a hub for innovative tech which includes anything from blockchain to AI to complete digitalization. The I4.0 has created new critical success factors in the manufacturing sector, and the potential implications for Canadian manufacturing are significant, particularly in terms of improving productivity to drive growth.

8 Conclusions

Industry 4.0 is a wide term that encompasses different perspectives, industries, corporate functions, technologies, and fields. Today industry 4.0 is about connectivity.

It is an opportunity to radically change the way industry responds to the needs of society. As previous industrial revolutions were led by innovations in manufacturing processes and systems the advancement of industry 4.0 will be driven by a smart interconnected pervasive environment.

The opportunities for disruption are huge and those left behind will feel it. Simply copying a more successful country wide I4.0 strategy like Germany's may not provide the desired results in other countries, as Policymakers should consider that I4.0 policy development process will require long-term commitment of resources and will need to be specifically designed to suit the given country's situation.

This report explored the existing pubic policies and programs related to Industry 4.0 in Portugal which included current initiatives, higher educational programs, and good practices. It also

presents an overview and good practices of national and regional public policies to boost Industry 4.0 in Finland, Czech Republic, Greece, Italy, Hungary, and Poland while exploring the case of Germany as a pioneer of Industry 4.0.

When we analyse Industry 4.0, the integration of Digital Technologies is one of the most vital parameters. We can observe that the EU has been steadily improving on this score over these six years. Finland has not only been leader amongst the analysed countries, but has actually been faster in adopting new technologies than the rest of the Europe and is therefore one of the ideal showcases. Portugal has performed reasonably well in this regard, and shown a significant growth in terms of Technology adoption in the recent years. Czechia in contrast was performing way better than the EU average in 2014 but did not maintain its lead, and by 2019 was at a similar level to Portugal and the rest of the EU.

The rest of the countries studied, namely Greece, Italy, Hungary and Poland are all below the EU average when regarding the integration of Digital Technologies.

This report also presents a brief study on related public policies and situation of Industry 4.0 in more successful countries outside Europe such as the USA, Japan, Korea, Canada, Singapore and China.

While Europe is already focused on standardization and is already advanced on automation and design work, Chinese manufacturing industry has successfully shown a continuous growth during recent years. However, most companies in China are still a long way short of the manufacturing standards. On the other hand, Japanese industry is already very advanced as far as process automation is concerned. South Korea’s economy brings together several value chains under one roof but lack supply chain integration, and major South Korean telecoms and electronics corporations are very active in the development of highly innovative products, smart services, and new, data-driven business models. US companies are particularly strong in the development of innovative Internet, software, and service business models. Singapore is a leader on the Global Trade & Investment driver as one of the most open and trade-friendly countries in the world. Canada is currently a hub for innovative tech which includes anything from blockchain to AI to complete digitalization.

There is a unique opportunity for European suppliers namely those focused in industry software, sensors, robotics, as they can position Europe as a supplier of automation technology and high-tech and design products.

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10 Appendix

Following sections are presenting country report provided by European Commission at 2019 on overview of national initiatives on digitising industry:

10.1 Finland

Table 2. Overview of initiatives – Finland (VVA and WIK-Consult, 2019b).

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
1	Digital Finland Framework	2018	National strategy	N/A	N/A	No budget
2	Finland's age of artificial intelligence	2017	National programme, research and innovation support	AI	N/A	No budget
3	Digitalisation, experimentation and deregulation (Public sector ICT)	2015	Government priority in the government programme	N/A	N/A	EUR 100 million 2015-19
4	The digital transformation programme for the regional government, health and social services reform	2016	National strategy, public and private sector cooperation	N/A	ALL	EUR 130 million for 2017-2018, 100 million for 2019. National, public.
5	CLIC Innovation Ltd	2007	Open innovation cluster	N/A	N/A	Unknown
6	DIMECC Ltd	2008	Innovation platform	N/A	N/A	EUR 30 million programme portfolio in 2017
7	KIRA-digi	2016	Digital platform	N/A	N/A	EUR 16 million, public, 50% from the government, 50% from the sector (2016-2018)
8	The Well-being and Health Sector's Artificial Intelligence and Robotics Programme (Hyteairo)	2018	Government programme	AI, robotics	N/A	Unknown
9	Industrial Internet	2018	Funding programme	N/A	ALL	EUR 31,468,765, national, public.

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
10	Kasvumoottorit ("Growth Engines")	2018	Platform development programme	Digital platforms, AI applications, data utilisation	ALL	EUR 60 million (2018-2019), national, public.
11	Business Finland AI Business Programme	2018	Funding programme	AI	ALL	EUR 200 million (2018 to 2022)
12	Information Management Act	2019	Information management act	N/A	N/A	No Budget
13	Act on Transport Services	2018	Act on digitalisation of transport services	N/A	N/A	No Budget
14	Yrittäjän digikoulu (Entrepreneur's digital school)	2017	Training events	N/A	Micro and small	National,public, amount unknown
15	Digiaikakauden taidot (Skills of the digital era)	2018	Funding / Training voucher	N/A	Individuals	National, public, EUR 7 million
16	Innovation Voucher	2016	Support voucher	N/A	SMEs	Unknown

10.2 Czech Republic

Table 3. Overview of initiatives – Czech Republic (VVA and WIK-Consult, 2019a).

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
1	Industry 4.0	2016	Sectoral strategy	ALL	ALL	No specific budget
2	Digital Czechia	2018	General strategy	ALL	ALL	No specific budget
3	National Strategy for Artificial Intelligence (NAIS)	2019	A.I. strategy	ALL	ALL	No specific budget
4	Competence Centres Programme	2002	Competence centres	ALL	ALL	EUR 333.4 million (2012-2019)
5	National Centre for Industry 4.0	2017	DIH	ALL	SME	Unknown budget
6	OP PIK Cooperation	2015	Funding programme	Clusters, accelerators	SME	EUR 73.6 million, ESF (2015 – 2020)

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
7	TRANSPORT 2020+	2019	Funding programme	Automation, digitalisation, navigation and satellite systems	SME	EUR 76 million (2020 – 2027)
8	Decree no. 82/2018 Coll.	2018	Cyber security regulation	Cyber security	ALL	No specific budget
9	National Cyber and Information Security Agency	2017	Cyber security centre	ALL	ALL	Unknown budget
10	Council for Research, Development and Innovation	2002	Consultative body	ALL	ALL	No specific budget
11	Czech National Coalition for Digital Jobs	2016	National Coalition	ALL	ALL	Private funding
12	PortálDigi	2017	Digital Platform	ALL	ALL	Unknown budget, ESF
13	PRIM	2017	Educational reform	ALL	ALL	EUR 4.25 million, ESF (2017 – 2020)
14	Digital literacy	2018	Educational reform	ALL	ALL	EUR 5.25 million, ESF (2018 – 2020)
15	OP PIK Innovation Vouchers	2015	Innovation vouchers	ALL	SME	EUR 14 million, ESF (2015 – 2020)
16	Regional vouchers	2009	Innovation vouchers	ALL	SME	EUR 5.7 million (2009 – 2018)
17	CzechInvest Start-up support	N/A	Start-up support	ALL	SME	Unknown budget
18	OP PIK Application	2015	Funding programme	ALL	SME	EUR 379 million ESF (2015 – 2020)
19	OP PIK Innovation	2015	Start-up support	ALL	SME	EUR 400 million ESF (2015 – 2020)
20	OP PIK Potential	2015	Funding programme	ALL	SME	EUR 197 million ESF (2015 – 2020)

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
21	OP PIK Proof of concept	2015	Start-up support	ALL	SME	EUR 42.6 million ESF (2015 – 2020)
22	Trio	2016	Funding programme	Micro and Nanoelectronics, Photonics, Artificial Intelligence, and Security	SME	EUR 349 million (2016 – 2022)
23	Epsilon	2015	Funding programme	ALL	SME	EUR 505.3 million (2015 – 2025)
24	DELTA	2014	Funding programme	ALL	SME	EUR 37.9 million (2014 -2021)
25	ESA BIC Prague	2016	Incubation centre	ALL	SME	Unknown budget

10.3 Greece

Table 4. Overview of initiatives – Greece (VVA and WIK-Consult, 2019d).

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
1	National Digital Policy 2016-2021 (NDS)	2016	Horizontal Strategy	ALL	ALL	N/A (EU and National Funds)
2	Digital Step	2018	Investment subsidy	Social Media, Mobile Services, Cloud, IoT, Cyber Security	SMEs	EUR 50 million. Co-financed by ERDF and by national funds.
3	Digital Jump	2018	Investment subsidy	Social Media, Mobile Services, Cloud, IoT, Cyber Security	SMEs	EUR 50 million. Co-financed by ERDF and by national funds.
4	Digital transformation of the agricultural sector	2018	Digitisation support - Digital platform	Mobile Services, Cloud, IoT, Big Data and Data Analytics, AI	N/A	EUR 33.5 million. Co-financed by ERDF and by national funds
5	Research-Create-Innovate	2017	Research & innovation support	Robotics and Automation Machinery, Big Data and Data Analytics, 3D-Printing, AI, Cloud, IoT	Micro: 338, SmALL: 197, Medium: 101, Large: 93	EUR 75.5 million (during 2018) – 729 firms funded. Co-financed by ERDF and by national funds

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
6	Directive(EU) 2016/1148	2018	Other Regulatory measure	N/A	ALL	none
7	Cloud National Policy	2018	National working group	Cloud	ALL	none
8	Directive 2014/55/EU	2018	Other Regulatory measure	N/A	ALL	none
9	Upgrading digital skills of private sector employees	2018	Financial Grants for training	N/A		EUR 24,000,000 – 15,000 beneficiaries. Co-financed by ERDF and by national funds
10	STEM	2019 (announced 2018)	Vouchers	N/A		EUR 13,392,000 – 10,000 beneficiaries. Co-financed by ERDF and by national funds
11	Creation and provision of large-scale educational programs in Digital Skills and implementation of pan-Hellenic educational and information activities in Digital (Intelligent) Agriculture	2019 (announced 2018)	Educative platforms	N/A		EUR 9,585,572 – 10,000 beneficiaries. Co-financed by ERDF and by national funds
12	Digital Skills for ALL initiative	2018	Distance learning/training programmes	N/A		150,000 beneficiaries. Co-financed by ERDF and by national funds
13	Trainingand certification of knowledgeand skills of workers in the private sector(2nd cycle)	2018	Training and Certification	N/A		EUR 70,387,748.44. Co-financed by ERDF and by national funds
14	ALLiance For Digital Employability (AFDEmp)	2017	Training and Certification	ICT		N/A
15	Article 71A Law 4172/2013	2013	Horizontal - Tax incentives for patent-based products	N/A		N/A

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
16	Article 22A of the Hellenic Income Tax Code(Law 4172/2013)	2013	Horizontal - Tax exemption for R&D	N/A	ALL	N/A
17	POL.1210/2017	2017	Horizontal – Tax exemption for R&D	N/A	ALL	N/A
18	Equifund	2018	Venture Capital	Robotics and Automation Machinery, Big Data and Data Analytics, 3D-Printing, AI, Cloud, IoT	ALL	EUR 15 million invested during 2018. It is expected to mobilize over EUR 400 million

10.4 Italy

Table 5. Overview of initiatives – Italy (VVA and WIK-Consult, 2019f).

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
1	Piano Nazionale Industria 4.0	2016	National strategy	ALL	All, with a focus on SMEs	National and public, ca. EUR 40 billion
2	Super and Hyper-depreciation	2016/ 2017	Amortisation scheme	Cloud, IoT, Robotics and Automation machinery, Big data and Data analytics, AI	ALL	National, 2016: EUR 170 million, 2017: EUR 943 million, 2018: EUR 2,532 million
3	Tax credit for Research and Development	2015	Research and Innovation support	Cloud, IoT, Robotics and Automation machinery, Big data and Data analytics, AI	ALL	National, 2015: EUR 255 million, 2016: EUR 598 million, 2017: EUR 1,462 million, 2018: EUR 2,532 million
4	Nuova Sabatini	2015	Funding	Cloud, IoT, Robotics and Automation machinery, Big data and Data analytics, Cybersecurity, RFID, 4D manufacturing	SMEs	National, 2016-2018: EUR 1,274 million, 2019: EUR 48 million, 2020-2023: EUR 96, million/ year, 2024: EUR 48 million

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
5	Innovation and Development agreements	2016	Research and Innovation support	ICT, Nanotechnologies, Advanced materials, Biotechnologies, Advanced technologies Cloud, IoT,	ALL	National and regional, 2016: EUR 206 million
6	Competence Centres	2019	Competence Centres	Robotics and Automation machinery, Big data and Data analytics, AI	ALL	National, 2019: EUR 72 million
7	Direttiva NIS	2018	IT security regulation	N/A	ALL	N/A
8	Innovative SMEs and Start-ups legislative framework	2012	Industrial policy	N/A	SMEs and start-ups	National, 2012-2017: EUR 30 million/year, 2018: EUR 50 million2
9	Patent Box	2017	Copyright regulation	N/A	ALL	National, 2017 and 2018: EUR 400 million/year
10	Tax Credit for training	2017	Subsidy for staff training	N/A	ALL	National, 2017 and 2018: EUR 250 million/year
11	Strengthening of technical schools (ITS)	2017	Digital skills certificate	N/A	ALL	National and regional, 2017-2019: EUR 33 million/year
12	Innovation Manager Voucher	2019	Voucher	N/A	SMEs	National, 2019: EUR 75 million
13	SMEs Guarantee fund	2000	Guarantee fund for loans	ALL	SMEs	N/A
14	Digitisation Vouchers	2015	Voucher	ALL	SMEs	National, 2018: EUR 50 million, European 2018: EUR 50 million

10.5 Hungary

Table 6. Overview of initiatives – Hungary (VVA and WIK-Consult, 2019e).

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
1	Industry 4.0 Development Strategy	2016	Sectoral Strategy	ALL	Mainly SMEs	EUR 4,629,344 to support SMEs + EUR 12,344,917 Allocated to increase capacity
2	Digital Success Progr	2016	Umbrella program	ALL	Mainly SMEs	EU funds (ERDF, ESF), loan and venture capital program, tax cuts
3	Irinyi Plan	2016	Action Plan	ALL	Mainly SMEs	EU funds (ERDF, ESF) + national resources
4	National Smart Specialisation Strategy	2014	General Strategy	ALL	ALL	There is no independent funding ALLocated, it is linked to specific strategies.
5	Industry 4.0 National Technology Platform	2016	Digital Platform	ALL	Mainly SMEs	Membership fees
6	“Model Factory” Program	2017	Fablab	Production visualization Supply chain visualisation/ collaboration/ optimisation, Predictive maintenance, Big data, IOT, Modern warehouse/ logistical, solutions Robotics, Augmented Reality, 3D printing	Mainly SMEs	National funding EUR 7,315,273 (June 2017 – Dec 2019)
7	DIH Network	2017	Digital Network	FinTech	Mainly SMEs	EU funding (ERDF and ESF)
8	Modern Enterprises’ Programme	2016	Comprehensive digital economy development program	N/A	Micro companies, SMEs	Split between EU and national funding (18.8 million EUR)
9	Industry 4.0 Working Groups	2016	Working Groups	ALL	Mainly SMEs	N/A

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
10	Coalition for Artificial Intelligence	2018	Working group/ Coalition	AI	Mainly SMEs	N/A
11	FinTech Innovation Hub	2017	Working group Coalition	FinTech	Mainly SMEs	N/A
12	Digital Success Coordination Centre	2017	Coordinati on Centre	N/A	Mainly inhabitants, few SMEs	Split between EU and national funding
13	Digital Success Mentor Program	2017	Training program	N/A	Mainly inhabitants, few SMEs	Split between EU and national funding
14	Digital Workforce Program	2017	Training program	N/A	Mainly SMEs	Split between EU and national funding
15	INPUT Porgram	2016	Training program	ALL	SMEs	EUR 17,373,622 EU funding (ERDF) and national budget
16	Innovation Vouchers	2016	Innovation Vouchers	ALL	Micro companies, SMEs	EUR 190.5 million
17	Hiventures Plc. –Incubator Investment Construction	N/A	Incubator Construction	ALL	Micro companies, SMEs	EUR 28,391,735

10.6 Poland

Table 7. Overview of initiatives – Poland (VVA and WIK-Consult, 2019g).

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
1	Responsible Development Strategy	2017	Horizontal strategy	ALL	ALL	Public funds: 350 billion EUR + Private funds: 167.5 billion EUR

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
2	Smart Growth (PO IR)	2014	National Work Programme	ALL	ALL	Total budget around 10.2 billion EUR (around 8.6 billion from EUR (ERDF fund)
3	Future Industry Platform	2019	Horizontal strategy	IoT, Cyber Security, Robotics and Automation Machinery, Big Data and Data Analytics, 3D-Printing, AI	ALL	Around 15 million EUR budgeted for 2019-2021 (public and private funding)
4	From Paper to Digital Poland	2016	Digital platform for e-government services	ALL	ALL	N/A
5	Start in Poland	2016	Ecosystem for start-ups	ALL	SMEs and start-ups	Around 0.7 billion EUR
6	Polish Industry 4.0 – support for DIH	2019	Support program for Digital Innovation Hubs	IoT, Cyber Security, Robotics and Automation Machinery, Big Data, Data Analytics, 3D-Printing, AI	SMEs	Planned budget around 15 million EUR (2019-2021)
7	The Constitution of Business	2018	Package of laws supporting businesses	N/A	ALL	N/A
8	Innovation Act	2017 & 2018	Tax incentives and R&D support for businesses	N/A	SMEs and start-ups	N/A
9	National Cybersecurity System	2018	IT security regulation	N/A	N/A	N/A
10	Training activities for the development of digital competences	2017	Educational Training	ALL	Schools & universities	23 million EUR

#	Initiatives	Starting year	Type of initiative	Digital technologies targeted	Size of companies targeted	Budget
11	The broad alliance on digital skills	2013	Industry Alliance	ALL	N/A	N/A
12	'Technician – programmer' programme	2018	Education Programme	ALL	Schools	N/A
13	Innovative solutions for digital activation	2018	Educational Training	ALL	Schools	35 million EUR within Programme Digital Poland 2014-2020 (EU funding ERDF)
14	PFR Ventures	2016	VC	ALL	SMEs and start-ups	Around 0.5 billion EUR since 2017 to date
15	Vouchers for innovations for SMEs	2014	Innovation Vouchers	ALL	SMEs	Around EUR 1.2 million (2014 to 2020)