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"Digital Transformation of the Greek Industry"

Deliverable 3: Operational Plan for implementing the Industry 4.0 strategy

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List of Abbreviations

The following Abbreviations list contains all the key terms contained in the document in order to provide a clear view of the terminology used throughout.

i4.0	Fourth Industrial Revolution
Industry 4.0	Fourth Industrial Revolution
SEPE	Federation for ICT Organizations
ESPA	European Development Support Programme
ICT	Information & Communication Technologies
STEM	Science, Technology, Engineering, Mathematics
VET	Vocational Education Training
PhD	Doctor of Philosophy
i.e.	id est
NSRF	National Strategic Reference Framework
ESF	European Social Fund
OP	Operational Programme
AI	Artificial Intelligence
5G	5th Generation Network
M2M	Machine-to-Machine
MES	Manufacturing Execution Systems
SCADA	Supervisory Control and Data Acquisition Systems
SME	Small-Medium Enterprises
EOPPEP	National Certifications Center
EPAL	Vocational upper secondary schools
IEK	Post-secondary VET schools
EPAS	Apprenticeship schools
OAED	Bureau of Workforce Affairs
CEDEFOP	European Centre for the Development of Vocational Training
e.g.	Example Given
incl.	Including
etc.	et cetera
PVD	Physical Vapor Deposition
CVD	Chemical Vapor Deposition
N/A	Not Available
R&D	Research and Development
TRL	Technology Readiness Level
IASP	International Association of Science Parks
UNESCO	United Nations Educational, Scientific and Cultural Organisation
3D	Three Dimensional
VR	Virtual Reality

AR	Augmented Reality
LCD	Liquid Crystal Display
IKE	Privately Capitalized Company
S.A.	Anonymous Company
SW	Software
SEV	Hellenic Federation of Enterprises
GRNET	National Center of Infrastructures for Research and Technology
EDYTE	National Center of Infrastructures for Research and Technology
RIS3	Research & Innovation Strategies for Smart Specialization
COVID-19	Severe acute respiratory syndrome coronavirus 2
IT	Information Technologies
UK	United Kingdom
EMEA	Europe, Middle East & Africa
CEO	Chief Executive Officer
VP	Vice President
EU	European Union
HOBI	Hellenic Industrial Property Organisation
VC	Venture Capital
ELOT	Hellenic Organisation for Standardisation
DPMA	German Patent and Trademark Office
Q4	Fourth Annual Quarter
IIoT	Industrial Internet of Things
GVA	Gross Value Added
GDP	Gross Domestic Product
CPS	Cyber-Physical Systems
ECS	Electronic Components System
GCI	Global Cybersecurity Index
ITU	International Telecommunications Union
HPC	High-Performance Computing
AM	Additive Manufacturing
CLIP	Continuous Liquid Interface Production
UV	Ultra-Violet
HMI	Human-Machine Interface
Elstat	Hellenic Statistical Authority
Eurostat	European Statistics Authority
IP	Intellectual Property
NACE	Nomenclature statistique des activités économiques
SEP	Standard Essential Patents
EPO	European Patent Office

1 Introduction to Deliverable 3: Operational Plan

1.1 Purpose of the document

This report was prepared in the context of the project "Digital Transformation of the Greek Industry" funded by the EU via the Structural Reform Support Programme. This present document constitutes the second draft of the third Deliverable of the project, titled "Deliverable 3: Operational Plan for implementing the i4.0 strategy". This version was shaped based on the technical meetings (through web conferences) with the Ministry's team and DG Reform on the 15th of May, 26th of May, June 4th (on Industry 4.0 technology groups), June 19th, June 25th, June 30th. It was also based on Workshop 3 (which laid the foundations of the Operational plan, after finalising the proposed Industry 4.0 strategy and vision with the General Secretary for Industry, which was conducted on the 14th of April 2020). Moreover, it was based on two workshops and the feedback received from the stakeholders of the public sector as well as the Greek industrial ecosystem, as per below:

- **Workshop 4** (conducted on 16/10/2020), which outlined the methodological approach for the selection of the High priority cases as well as the discrete measures developed in each of them respectively.
- **Workshop 5** (conducted on 15/10/2020), which focused on the final Strategy (Vision, strategic goals and execution pillars) and its Operational plan as well as the discrete measures developed for all six of the execution pillars.
  Technical meeting with the General Secretary and the General Secretariat's Project team as well as DG Reform (conducted on 17/11/2020), discussing finalisation actions needed throughout the Deliverable.

Furthermore the Operational plan is the product of a series of meetings (through web conferences) conducted between the project's working team (Contractor, Ministry's team and DG Reform) with selected stakeholders of the Greek industrial environment, namely the Federation of Enterprises and the General Secretariat for Research and Technology on the 20th of July, the Ministry of Digital Governance on the 22nd of July, the General Secretariat for Public Investments and ESPA on the 23rd of July, SEPE on the 24th of July and the Hellenic Development Bank and TANEO on the 28th of July.

1.2 Setting the scene

Key focus of Deliverable 3 is the design of the Operational plan for the proposed Greek Industry 4.0 strategy as it was proposed in Deliverable 2. This essentially means that the Operational plan seeks to act as the implementation vehicle of the Industry 4.0 strategy, setting out the initiatives and priorities within the Industrial ecosystem of Greece, the will be implemented through the collaboration of key stakeholders from the Greek Public and Private sector, including Research institutions, academia and other relevant actors within it.

Based on the above, the Operational plan includes initiatives that will be rolled out for each of the six pillars of the suggested Industry 4.0 strategy for Greece, as per below. For each of the pillars, the initiatives aim to drastically upgrade the Greek industrial ecosystem and assist enterprises and the human workforce

within it with the right tools and training in order to make the leap to the Digital Age as swiftly and efficiently as possible:

- Digital skills & human capital qualifications
- Innovation & start-up supporting mechanisms in the Digital Age
- Collaboration & synergies
- Standardisation & Norms
- Regulatory Environment
- Acceleration of investment in digital technologies

Moreover, Deliverable 3 includes a further elaboration on three "High priority cases", which are identified as three focus areas with regard to Industry 4.0 that were further elaborated based on an analysis and proposal made by the Contractor's team, which is also included in Deliverable 3. Taking into account the performed analysis, the General Secretariat for Industry (on Friday 24th of July) suggested the development and focus on the following three High Priority Cases:

- **High Priority Case 1**: Smart Manufacturing Technologies
- **High Priority Case 2**: The Structural Materials Value Chain
- **High Priority Case 3**: The Circular Economy

Furthermore, Deliverable 3 consists of "The Guide", which represents a further analysis and elaboration for one of the three High Priority Cases, based on the feedback received by the Ministry's team.

1.3 Structure of the Document

The report is structured in the following way:

- **Chapter 2** provides a brief overview of this document's contents, serving as an executive summary.
- **Chapter 3** presents the key takeaways of Deliverable 2 with regards to the proposed Industry 4.0 strategy, making the link between the strategy and the operational plan.
- **Chapter 4** presents the methodological approach followed for the design of the initiatives that will be rolled out under each respective pillar of the strategy. A detailed analysis for each of them is presented, including among other details on the rationale behind their need, a description of the initiative, the involved stakeholders etc. It also presents their timeline of their implementation as well as a set of "Quick wins" for each respective pillar.
- **Chapter 5** presents the methodological approach followed and the analysis conducted by the Contractor regarding the High priority cases of the Operational plan.
- **Chapter 6** presents the Operational Plan for High priority case 1: Smart Manufacturing technologies.
- **Chapter 7** presents the Operational Plan for High priority case 2: Structural Materials.
- **Chapter 8** presents the Operational Plan for High priority case 3: Circular Economy.
- **Chapter 9** presents the Guide for High priority case 1: Smart Manufacturing Technologies.

2 Executive summary

The link between the proposed Industry 4.0 Strategy and the Operational plan

The national Industry 4.0 strategy aims to introduce a cohesive and comprehensive national agenda, under which all key stakeholders, i.e. the Greek Public Administration, the Greek Industry and the Greek research and

will streamline their efforts to achieve the Greek Industry's Industry 4.0 transformation and to successfully realise the Greek Industry 4.0 vision. The Greek Industry 4.0 vision is stated below:

«***An innovative, internationally competitive and extrovert Greek Industry with the leverage of digitisation and the continuous integration of new Industry 4.0 technologies & applications***»

The strategic goals that the vision and the strategy overall aim to accomplish are the following:

- Increase the Greek Industry's overall digital maturity
- Digitally upskill and reskill the human workforce in the Greek industry
- Enhance the Greek Industry's applied R&D, innovation and production capabilities
- Support the Greek Industry to transition into the zero-carbon and low environmental footprint economy
- Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
- Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
- Increase the Greek Industry's potential to meet personalized needs and imminently respond to emergencies and crises (flexible processing)
- The enhancement of internationalization of the Greek Industry and its active participation in EU ecosystems
- Increase the overall contribution of Greek industry to the Greek economy

To achieve these goals, the Strategy is expected to be implemented through six discrete pillars, for each of which discrete initiatives and actions will be pursued through the Operational plan. The six pillars are:

- **Pillar 1:** Digital skills & human capital qualifications.
- **Pillar 2:** Innovation & start-up supporting mechanisms in the Digital Age.
- **Pillar 3:** Collaboration & synergies.
- **Pillar 4:** Standardisation & Norms.
- **Pillar 5:** Regulatory Environment.
- **Pillar 6:** Acceleration of investment in digital technologies.

The Greek Industry 4.0 strategy shall holistically address the needs and support different groups of Greek stakeholders, in order to spur the rotation

to Industry 4.0 both from a "demand" and a "supply" side. In other words, the strategy shall aim to:

- Increase the Industry 4.0 adoption of Greek Industrial and Manufacturing organizations, therefore ignite the Industry 4.0 demand.
- Accelerate the commercialization of Industry 4.0 innovation, therefore spur the Industry 4.0 "supply".

Examining the Industry 4.0 "demand" side, the Industry 4.0 Strategy shall focus and provide targeted support to three stakeholder groups. Namely:

- Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0: Industry 4.0 strategy shall increase national awareness of how new Industry 4.0 technologies can transform industry, upskill and reskill their industrial workforce in the use of Industry 4.0 & Smart Manufacturing technologies and encourage the widespread and rapid adoption of Industry 4.0 and Smart Manufacturing technologies through the creation of a visible and effective industrial ecosystem that will accelerate the innovation and diffusion of the technologies across the organizations' supply chains & production lines.
- Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0: Industry 4.0 strategy shall further incentivise Industry 4.0 adoption by introducing clear Industry 4.0 standards & regulations and by providing targeted fiscal incentives for the digital transformation of their production lines & supply chains. In addition, the strategy shall incentivize and enable this group to participate in new, innovation structures and an emerging industrial ecosystem, where they will be able to participate into collaborative R&D programmes, proof of concepts, prototypes and open innovation events to actively experiment with new Industry 4.0 solutions and exchange knowledge and best practices with Industry 4.0 front-runners.
- Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0: Industry 4.0 strategy shall introduce relevant initiatives that will enable them to liaise and collaborate closely with Industry 4.0 innovators and/or academic/ research institutions, which will provide Industry 4.0 expertise and will co-design tailored, innovative solutions to address their challenges.

With regards to the Industry 4.0 "supply" side, Industry 4.0 strategy shall provide targeted initiatives and measure to:

- ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps: Industry 4.0 strategy shall enable them to collaborate with industrial/ manufacturing organizations, as well as with newly-established Industry 4.0 innovators and provide

active guidance and support for the organizations' rotation to Industry 4.0, their digital upskilling, as well as their scale up and internationalization.

- Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.): Industry 4.0 strategy shall introduce relevant programmes and new innovation structures that will encourage the closer collaboration between Industry 4.0 "suppliers" and industrial/ manufacturing organizations. These structures shall create a collaborative industrial ecosystem and a flexible production network, where stakeholders shall utilize each other's expertise in order to resolve challenges they face through innovative Industry 4.0 solutions.
- Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing: Industry 4.0 strategy shall leverage Greece's research strengths and innovation structures and assets to enhance applied innovation across the Greek Industry, as well as within specific Industry 4.0 value chains and technology groups and encourage collaboration and knowledge transfer between firms, research institutions and the Greek Government.

The methodological approach followed to design the Strategy's Operational plan

In order to develop the initiatives of the Operational plan, many best practices have been drawn from similar initiatives that have been rolled out successfully in other European countries currently implementing Industry 4.0 strategies, always tailored to the needs and particularities of the Greek Industrial ecosystem. Besides the description of the initiatives as well as other key parameters such as stakeholders involved, beneficiaries, indicative funding sources and indicative budget and timeline of implementation, special emphasis has been given to the "Feasibility and Necessity" of all the initiatives.

"**Feasibility**" dimension (scoring scale 1 to 5) examines how feasible each initiative is to implement, taking into account the:

- Organisational culture of the involved stakeholders.
- Technological foundations.
- Regulatory framework
- Estimated time of completion.

A score of "5" would indicate that conditions to implement are ideal while a score of "1" would indicate that the conditions prevalent are hindering. Also, the "Feasibility" dimension factors in if a similar or related initiative has been pursued in the past through a previous NSRF (i.e. NSRF 2014-2020) or if through a Ministry from the Greek Public Sector, taking into account how it unfolded and if it achieved the expected results.

Respectively, "**Necessity**" indicates the "urgency of implementation", or otherwise put, the need prevalent within the Industrial ecosystem for the

respective initiative, where a score of "5" would mean that it is highly needed while a score of "1" would indicate that the initiative should not be prioritised.

The final scoring provided for each initiative in the following chapters is provided as a result of a series of consultation meetings with stakeholders from the Greek public sector as well as other key Industrial stakeholders and representatives.

Brief overview of the six execution pillars and a summary of their pursued goal through targeted initiatives

Pillar 1: Digital skills & human capital qualifications

Following the aforementioned methodological approach, Pillar 1's initiatives seek to digitally upskill and reskill all the current workforce of the Greek industry, mainly focusing on professionals with technical skills. This is pursued through developing targeted training programmes based on the technologies to be adopted and already utilised by the Greek industry.

It also includes dedicated initiatives for attracting and developing the future talent pipeline for the Greek Industry. This could be achieved by initiatives targeted at better equipping ICT and STEM students with the necessary skillsets to work in the Industry 4.0 environment, by enhancing the collaboration between the Greek academia and the Greek Industry, by enriching the education syllabus of the VET bodies to better match with industry needs and by increasing the attractiveness of the Greek Industry as a career destination for top talent.

Finally, it focuses on the repatriation of Greek human capital and the attraction of international human capital. This is pursued mainly through the design of targeted fellowship programmes for international PhD students/ researchers and Greek PhD students/ researchers working on Industry 4.0 technologies or Industry 4.0 value chains.

Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age

Pillar 2 focuses on the enhancement and promotion of innovation and respective innovation structures across the Greek Industry and the closer and more targeted collaboration of the Greek Government, Industry and Research & Academia (triple helix innovation model). This is pursued through a set of targeted initiatives for directly supporting innovation in specific Industry 4.0 value chains and technology groups, i.e. measures to encourage collaboration and knowledge transfer between firms and between firms and research institutions and initiatives for the set up innovation structures to promote the triple helix model. It also focuses on the enhancement and monitoring of the existing innovation structures, i.e. the Greek Digital Innovation Hubs.

Secondly, its initiatives are targeted in mechanisms to support the booming start-up ecosystem in Greece. Finally, this pillar also incorporates a set of initiatives for the enhancement of the applied R&D and dissemination of innovation across the Greek Industry. Relevant initiatives may include the establishment of Industry 4.0 test labs or testbeds and the introduction of

funds to support the applied research for addressing big industrial and societal challenges (i.e. the circular and green economy) that the Industry faces today.

Overall, the proposed initiatives seek to allow the Greek Government to target the specific barriers that affect innovation performance within the Greek industrial environment.

Pillar 3: Collaborations and Synergies

Pillar 3 **aims** at developing a collaborative industrial ecosystem where Industry stakeholders shall cooperate and utilise each other's expertise in order to achieve greater goals. The ultimate goal is to assist the Greek industry to advance "as one" to the Industry 4.0 era and cumulatively reap the benefits that it has to offer, instead of having a few i4.0-advanced groups of firms and many i4.0-laggards operating in two different speeds.

In that regard, collaborations will be pursued through the developed initiatives across many different levels ranging from the provision of technical know-how and expertise from large, digitally advanced enterprises to Greek SMEs and mid-caps to the setup of industrial platforms on specific areas of economic activity. The aforementioned are expected to enable the creation of ecosystems of market actors in a multi-sided marketplace.

Moreover, tailored initiatives of Pillar 2 seek to promote the internationalization of the Greek enterprises and their participation in EU value chains and global emerging ecosystems.

An extremely important initiative that is expected to facilitate the implementation of the Greek industrial sector's transformation is to establish the Greek Industry 4.0 platform, for which a first positive step has been made through the sign off of the relevant memorandum of cooperation between the General Secretariat for Industry and the Ministry of Digital Governance.

Pillar 4: Standardisation & Norms

Pillar 4 focuses on setting the key ICT standardisation priorities, in accordance to the European Commission's ICT Standards plan and communication, mainly pursued through the introduction of the Greek Industrial standardisation Committee, being responsible to orchestrate the actions of all key stakeholders within the industrial standardisation landscape of Greece.

Moreover, the purpose of this pillar is to raise awareness on the importance of standardisation and the benefits it comes with for all industrial enterprises, regardless of economic activity and size. Last, Pillar 4 focuses on the accreditation with regards to industrial standards within the Greek ecosystem.

Pillar 5: Regulatory Environment

The purpose of Pillar 5 is to modernise and update the Greek regulatory environment in order to become business and industry friendly. Through targeted initiatives it aims at the removal of unnecessary obstacles that currently exist for businesses and hinder them in conducting their operations and collaborations efficiently.

More specifically, it highlights the importance of cybersecurity within the industrial landscape as well as seeks to address the subject of intellectual property and the exchange of industrial data between enterprises. Furthermore, focusing on the European agenda on achieving a "Green Industry" status in the near future, this pillar sets the tone with regard to the actions that have to implemented by the key stakeholders of the Greek industrial environment so as to achieve this critical milestone.

Pillar 6: Acceleration of investment in digital technologies

Pillar 6 includes measures that seek to boost and support financially enterprises of all different sizes within the Greek industrial ecosystem, to enable them to make their Digital leap (i.e. both adoption of new technologies and the upskilling/reskilling of employees). The Pillar will overall place a special emphasis in assisting enterprises of the industrial ecosystem financially in order to enable them to make the much needed investments and upgrade their fixed capital assets, which, for a large part of the ecosystem can be considered as outdated

For that purposes, the design of targeted financial tools and measures is pursued in order to assist in the upgrading of Greek industrial start-ups, SMEs and mid-caps, towards a "holistic" technological upgrade of the ecosystem.

Additional initiatives also aim at promoting investments in specific sectors of the Greek industrial environment, seeking to identify what sectors of economic activity within the Greek industry will be the champions of tomorrow. This will be key for the Greek industrial ecosystem, to leverage its key strengths and grow significantly in the following years, contributing the most to the Greek economy overall.

The following table outlines briefly the pursued initiatives across all 6 Pillars of the Operational plan, which are analysed in more detail in the following chapters:

Initiatives of Pillar 1
Initiative 1.1: **Develop an Industry 4.0 reskilling & certification programme for the Greek Industry Workforce** Greek enterprises perform only limited investments with regards to their personnel's digital upskilling and reskilling, and this programme is expected to

have a positive impact on industrial employees, enterprises and the economy as a whole.

Initiative 1.2: **Develop a dedicated Industry 4.0 apprenticeship programme for STEM undergraduates & graduates**

The apprenticeship programme shall enable the future workforce to gain the practical skills and knowledge they need to succeed in their chosen industry, become equipped with professional and vocational qualifications that are 'job-role' and industry specific and develop their network of social connections in their industry of choice. At the same time, it shall connect and establish long-term collaboration between enterprises of the Greek Industry and the ICT sector and the Greek academic institutions

Initiative 1.3: **Develop Postgraduate conversion programmes in Smart Manufacturing Technologies**

Key aim for this programme will be to increase the number of people from groups currently underrepresented in the Smart Manufacturing technology fields, and to encourage graduates from diverse backgrounds to consider a future in these occupations.

Initiative 1.4: **"Back to I4.0 School" - Incentivize Greek enterprises to support employees to participate in I4.0/ Smart Manufacturing postgraduate convention programmes**

This programme will be aimed to enhance life-long learning, incentivizing enterprises to support their employees to participate in Industry 4.0 post-graduate programmes. This shall enable the digital and Industry 4.0 upskilling of individuals, while at the same time will infuse enterprises with advanced Industry 4.0 know-how that will enable their digital transformation.

Initiative 1.5: **Revamp of the STEM departments' & Technical/ VET (Vocational Education Training) bodies' educational curricula to reflect current needs across Industry 4.0**

This programme will aim to reflect the current Industry 4.0 requirements for their offered professions and specializations and equip the future employees of the Greek industry with the required skills to support the rise of machine-assisted work and to create new capabilities in the domain of human-machine interaction.

Initiative 1.6: **Introduce an Industry 4.0 Fellowship programme for PhD, Post-PhD Students and researchers**

Industry 4.0 Fellowships will nurture future leaders in both industry and the research base, promote greater mobility between them and ensure that a variety of Greek industrial sectors have a supply of skilled researchers.

Initiative 1.7: **Incentivise Greek mid-level and senior workforce working abroad on I4.0 areas to repatriate**

Greek enterprises need to reinforce primarily their mid-level and senior level executives by infusing in these levels expatriates with an already gained experience in Industry 4.0 levels. This will enable the enterprises to accelerate their digital transformation and rotate to Industry 4.0. As such, a set of financial and tax incentives could be provided to Greek expatriates, working in the Industry 4.0 area at mid or senior levels, to return and work in Greece.

Initiatives of Pillar 2
Initiative 2.1: Introduce an "Industry 4.0 labs/testbeds" funding scheme This programme will seek to offer to organizations of the Greek Industry & Manufacturing and more specifically the Greek Industrial SMEs and midcaps, equipment, resources (data) and competence (feasibility assessment, prototypical solutions for use cases) not usually available to them, allowing them to compete with bigger firms on innovation.
Initiative 2.2: Support the setup of a dedicated competence centre for Artificial Intelligence & Big Data Analytics for the Greek Industry Greece should intensify its efforts in the area of AI and Big Data Analytics and become a leader in technical know-how and the development and commercialization of relevant manufacturing applications, services and products. The Government shall issue a call for tender for the setup and operation of an AI Competence Center for the Greek Industry. Potential participants can be consortiums of Greek Industrial & Manufacturing companies, ICT and IT Service companies and relevant academic/research institutions.
Initiative 2.3: Introduce the "GovTech Programme for Manufacturing SMEs/start-ups" The GovTech Manufacturing SMEs/start-ups initiative is a programme, which challenges industry from the demand side to develop innovative solutions for public sector needs and it provides a first customer reference that enables Manufacturing SMEs and start-ups to create competitive advantage on the market. It shall enable public procurers to compare alternative potential Industry 4.0 solution approaches and filter out the best possible solutions that the market can deliver to address the public needs.
Initiative 2.4: Introduce a program to prepare and educate future Smart Industrial & Manufacturing entrepreneurs The initiative will prepare and educate future entrepreneurs that wish to set up a Smart Industrial & Manufacturing start-up and will set the foundations and enhance the Manufacturing start-up ecosystem in Greece, by promoting the entrepreneurial spirit and acting as an accelerator towards the development of new i4.0 products and services.
Initiative 2.5: Introduce the "Adopt an Industry 4.0 start-up" programme This programme will allow large Greek and international Industrial & manufacturing organizations (with a presence in Greece) to host in their premises and support new Industry 4.0 start-ups for a specific period of time (i.e. 6 – 12 months). Large organizations shall provide guidance, networking and valuable knowledge to help the start-ups expand their network, further develop their business model, improve their product or service and enter into new partnerships.

Initiative 2.6: Introduce an Industrial Strategy Challenge Fund to enhance innovation & collaboration across the Greek Industry

Greek R&D appears disassociated with applied research & industry implementation. In fact, the Greek R&D is mainly dominated by the higher education sector, while Greek organisations appear reluctant to invest in applied R&D. This leads to limited commercialization of Industry 4.0 ideas and sporadic infusion in the Greek Industry. This initiative will aim to address this issue and bring closer the Greek Government, Industry and research & academic community to target and tackle a set of existing industrial challenges.

Initiatives of Pillar 3

Initiative 3.1: Introduce the "Idea Agora" Pitch Programme

This initiative shall support the Greek start-ups and SMEs with a focus on developing Industry 4.0 solutions to help mid-size/large Industrial/ Manufacturing companies accelerate to their growth and resolve existing business challenges by developing new, innovative Industry 4.0 solutions and applications.

Initiative 3.2: Introduce an Industry 4.0 Awareness Programme

This programme will be focused to Greek Industrial enterprises and particularly the Greek SMEs and midcaps, the majority of which appear to demonstrate limited knowledge on what Industry 4.0 consists of and how this is expected to radically change the Industrial paradigm. It could also benefit the Greek Industry and more specifically the manufacturing sector, raise its profile and brand recognition and attract more young people to enter the industry.

Initiative 3.3: Evaluate and set up of Industry 4.0 value chain Innovation Districts

The Industry 4.0 innovation district value chain shall transform dedicated industrial urban land into an innovative district offering modern walkable spaces for the strategic concentration of intensive knowledge-based Industry 4.0 activities, that shall connect research institutions with large firms and small start-ups and enable their cooperation and development of new Industry 4.0 solution in the value chains of focus.

Initiative 3.4: Develop a dedicated Industry 4.0 platform for Greece

The national Industry 4.0 digital platform (portal) will enclose all the necessary information regarding the Greek Industry 4.0 strategy and will act as an umbrella that will embrace all the initiatives & supporting mechanisms that will be promoted and pursued through the Industry 4.0 strategy and its six execution pillars. The portal will in fact materialize the memorandum signed between the General Secretariat for Industry and the Ministry of Digital Governance in 2019. The platform will act as the "single source of truth" for information, awareness, networking and promotion of Greek companies on topics related to "Industry 4.0".

Initiative 3.5: **Design a national portal for Industrial patents**

The portal will gather the Industrial patents already developed in the past, under a central node, and is going to operate as a tool of registry for the patents that will be developed in the future by Greek Enterprises and/ or research institutions and academia. This portal shall be linked to the existing official patent registries and will consist their “front-end”. It will enable all interested stakeholders to record and review the life cycle of each patent, from the patent application filing to its granting

and publication, and even possible subsequent developments, gaining valuable insights and protecting the intellectual rights of its owners/ inventors.

Initiative 3.6: Introduce a "scale up and internationalization" programme for Greek Industrial SMEs/ start-ups

The programme will provide funding for consulting, training and implementation services to start ups/ SMEs that wish to scale up either within Greece or abroad. In more detail the program shall be addressed to Greek start-ups/ SMEs that:

- run their operations in Greece and they have closed at least one financial year
- aim to ask for additional funding from VCs (i.e. from the "Growth Stage Window" from Equifund) (in case of start-ups)
- demonstrate a high potential of internalization of their products, service or technology
- plan to expand in foreign markets

Initiatives of Pillar 4

Initiative 4.1: Introduce a Greek Industrial Standardisation Committee

The Greek Industrial Standardisation Committee will be responsible to develop the Industrial standards for the country. On that note, seeking to support the changes proposed throughout the operational plan of the i4.0 strategy, it will develop discrete standards and norms throughout the Greek industry, in collaboration with key stakeholders from the Greek industrial ecosystem, such as the Hellenic Organisation for Standardisation (ELOT).

Initiative 4.2: Develop the Greek Industry 4.0 standardization framework

The Greek Industry 4.0 standardization framework to be developed for the Greek Industry, always consistent with EU's ICT Standardisation priorities, will be based on a three-stepped approach that will be performed within the Greek Industrial environment:

1. Map-out of the "as-is" state of play with regards to the major I4.0 building blocks (I4.0 technologies & applications) around Standardisation within the Greek Industrial ecosystem.
2. Perform a Gap Analysis between the Greek and other EU Industrial standards, examining what standardisation pioneers (such as Germany and France) and in general more "standards' advanced" EU countries are pursuing.
3. Utilising the results of Steps 1 and 2, the final step will be to develop a Standardisation Action Plan for the Greek Industrial enterprises, with regards to groups of i4.0 technologies and applications.

Initiative 4.3: Awareness campaign on standardisation within the Greek industrial landscape

The campaign on standardisation at the Greek landscape, will seek to present to all stakeholders across the Greek Industry what the benefits of Standards and Norms are, highlighting their importance and the need for action at the Greek Industrial ecosystem. In order to reinforce their potential impact, the campaign should also refer to best practices and results for industrial enterprises across the EU, showcasing how they achieved greater results, enhanced synergies with other enterprises, suppliers, vendors etc.

Initiative 4.4: Enhance the accreditation of enterprises on industrial standards

The main objective, for this initiative, through the Greek Industrial Standardisation Committee and the key stakeholders that are already providing certification services within the Greek environment to industrial enterprises will be to incentivise them to both adopt standards in their business models as well as get certified for their use.

Initiatives of Pillar 5

Initiative 5.1: Strengthen the Cybersecurity framework of Greece with regards to Industry 4.0

Industry 4.0 and the benefits it has to offer revolve around ground-breaking technologies and applications, innovative productions systems and smarter ways of conducting day-to-day business so much within each firm as well as with regards to the collaboration with external partners. If the aforementioned are one side of the coin, then cybersecurity constitutes the other side, ensuring that all the aforementioned are utilised on a safe and structured way, protecting businesses and individuals in the Digital Era. It is only logical that Greece has to act and improve the cybersecurity framework especially with regards to Industry 4.0.

Initiative 5.2: Enhance the Greek industrial ecosystem with regards to intellectual property

The purpose of this initiative will be to re-design the Greek framework around intellectual property following the example of the European Commission and EU member countries that have pursued to adjust their legislation and regulatory environment in order to promote competitiveness, innovation and growth of their industrial sector.

Initiative 5.3: Reinforce the free flow of non-personal data within the Greek Industrial Sector

Modern collaborations can achieve greater efficiency and enhanced results through the exchange and use of business data with regard to production time, product characteristics and services produced etc. It is therefore crucial that the Greek industrial regulatory environment is well established and well-defined when it comes to the free flow of non-personal data of industrial enterprises.

Initiative 5.4: Green Industry 4.0 initiative

In order to make products fit for a climate-neutral, resource-efficient and circular economy, reduce waste and ensure that the performance of front-runners in sustainability progressively becomes the norm, it is necessary that the Greek Government pays close attention to what the European Commission aims at when proposing sustainable product policies or legislative initiatives.

Initiatives of Pillar 6

Initiative 6.1: Accelerated depreciation scheme

This initiative is aimed at encouraging industrial businesses to invest (based on the amounts saved from tax deductions) in new Industry 4.0 technologies to improve and modernise their products, services and business models.

Initiative 6.2: Acceleration of investments (funding scheme) for Industry 4.0 start-ups

The scheme will support the Greek start-up ecosystem and create the right conditions for ambitious entrepreneurs of the Greek Industry through targeted support. That being said, it will allow to build a strong start-up ecosystem for the Greek Industry, allowing for synergies and diffusion of best practices across its participants, leading to higher innovation.

Initiative 6.3: Acceleration of investments (funding scheme) for Industry 4.0 SMEs & Mid-Caps

Greek industrial SMEs and mid-caps should be placed in the epicentre of the Industry 4.0 strategy's effort to contribute to the utmost degree for the Greek economy, since they constitute the majority of companies within the Industrial sector. This will be the target group of beneficiaries for this initiative, seeking to assist them significantly in making their digital leap with regards to all aspects of their business operations and products or services produced.

Initiative 6.4: Acceleration of investments (funding scheme) for large scale industrial enterprises to become "game changers" for the Greek industry

It is critical to engage the large industrial firms (based on 2017 list there are 56 businesses that their annual revenue is categorized as large businesses) that can be characterised as the country's "Industrial stars", since they actively support and drive the growth of the ecosystem, always seeking to compete on par with their EU counterparts through innovative products and services of higher added value. These firms can act as key enablers towards the creation of higher added value within the industrial ecosystem, since they do not only employ a large part of the industrial workforce, contributing significantly to their sector's value added, but also act as the "epicentre" for the operations of many smaller player within the ecosystem.

Initiative 6.5: Introduce "Sector-deals" with regards to Industry 4.0 applications for companies that are part of specific Industry sectors

This initiative will be focused on supporting these specific sectors (which could potentially come from sectors among the "high priority cases" selected in the lines of this project). On top of the already existing financial and other incentives that exist for the entire industrial sector, the Government will seek through this initiative to mobilise additional capital (ranging from 25% to 40%) and financially support the enterprises within these specific sectors, in selected areas of Industry 4.0 interest and specific technological applications for each one of them

Initiative 6.6: Standardisation Vouchers for enterprises of the Greek Industry

This initiative will aim to provide a small, but significant financing support to all types of enterprises across the industrial landscape of Greece, putting an emphasis on SMEs and mid-caps, in order to motivate them to invest in standardisation of products, services, processes etc.

Methodological approach for the selection of the three High Priority Cases

Complementary to the proposed Industry 4.0 Operational Plan and its initiatives as described above, industry and technology-specific lenses were applied in order to assess the potential for more targeted interventions within the Greek industry in order to conclude the three High Priority Cases. The areas that were examined are the following:

1) **Sectors of economic activity**
2) **Technological domains**
3) **Wider Industry 4.0 themes**

For each of the three areas a different set of industry and technology-specific lenses was applied in order to surface potential pilot areas of targeted interventions.

1. Sectors of economic activity

Regarding that area, all industrial sectors within the scope of our project were evaluated based on the following criteria:

- Gross Value Added (GVA)
- Industrial Production Index
- Turnover
- Exports
- Employment
- Investment in Technology & Innovation

After analysing the sectors through different combinations of the above criteria, the following sectors were highlighted in order to narrow down to the selected sectors of interest:

- The first analysis examined the following lenses: Gross Value Added and Investment in Technology & Innovation, highlighting the following sectors (including their NACE Rev_2 categorisation):
  - H: Transportation & storage
  - C10_C12: Food, Beverages & Tobacco
  - C24_C25: Metals
  - C21: Pharmaceuticals sectors
- The second analysis examined the following lenses: Investment in technology & innovation and the Industrial Production Index and Exports as a percentage of Greek Industry, highlighting the following sectors (including their NACE Rev_2 categorisation):
  - C10_C12: Food, Beverages & Tobacco
  - C24_C25: Metals
  - C21: Pharmaceuticals
- The second analysis examined the following lenses: Turnover, Industrial Production Index, Employment as a percentage of Greek Industry,

highlighting the following sectors (including their NACE Rev_2 categorisation):

- C10_C12: Food, Beverages & Tobacco
- C21: Pharmaceuticals
- C24_C25: Metals
- C26: Computer, Electronics & Optical

Namely the final suggested pilot areas were the following:

- C10_C12: Food, Beverages & Tobacco
- C21: Pharmaceuticals
- C24_C25: Metals

2. Technological domains

With regards to specific technological groups that could consist a High Priority Case for targeted interventions, the total set of Industry 4.0 technology trends was reviewed and evaluated to identify whether Greece demonstrates relative strengths or weaknesses in any of these.

At the same time, a review was performed to determine which of these (as primary candidates) could potentially accelerate the digitalisation of the Greek Industry. Following a dedicated workshop with the Ministry's team (on June 4th) in order to finalise the technology groups as presented below, the technological domains highlighted are:

Groups	I4.0 technologies
Group 1 AI & Big Data Analytics	• Cloud • Artificial Intelligence • Big Data • Internet of Things • 5G
Group 2 Smart Manufacturing Technologies	• Cloud • Big Data • Electronic Components & Systems • Machine-to-Machine (M2M) • Manufacturing Execution Systems (MES) • Simulation • Supervisory Control and Data Acquisition Systems (SCADA) • Distributed Intelligence • Additive Manufacturing

	• 5G
Group 3 Robotics	• Industrial Robots/ Robots
Group 4 Cybersecurity	• Cybersecurity • Blockchain
Group 5 Photonics	• Photonics, Automation, Sensors & Applications
Group 6 New Material	• New Materials (e.g. Graphene, composites, PVD, CVD)
Group 7 HPC	• High Performance Computing

3. Wider Industry 4.0 themes

Following further analysis on relevant wider Industry 4.0 themes, the Circular Economy theme was surfaced. This specific theme enjoys an increasing attention worldwide as a means to reduce dependency on primary materials and energy, while at the same time becoming an economically viable alternative to the linear economy.

On top of that, the European Commission has adopted several measures and regulations throughout the years to promote the circular economy. At a domestic level, Greece has thus far performed limited steps towards a Circular Economy, scoring last within EU with regards to the circular use of materials in its economy.

The final selection of the three High Priority Cases

Taking into account the performed analysis, the General Secretariat for Industry has suggested the development and focus on the following three High Priority Cases:

- **High Priority Case 1:** Smart Manufacturing Technologies
- **High Priority Case 2:** The Structural Materials Value Chain
- **High Priority Case 3:** The Circular Economy

High Priority Case 1: Smart Manufacturing Technologies

Regarding High Priority Case 1, **Smart manufacturing** is a technology-driven approach that utilizes Internet-connected machinery to monitor the production process, with the goal to identify opportunities for automating operations and use data analytics to improve manufacturing performance, realize operational efficiencies, reduce costs and improve production flexibility and capacity.

The key technologies that enable Smart Manufacturing practices are presented along with their definitions in the table below:

- Additive Manufacturing
- Big Data Analytics

- Cloud
- Distributed Intelligence
- Electronic Components & Systems
- Machine-to-Machine (M2M)
- Manufacturing Execution Systems (MES)
- Simulation
- Supervisory Control and Data Acquisition Systems (SCADA)

The initiatives developed for High Priority Case 1 are the following:

Initiatives for Smart manufacturing technologies
Initiative 7.1: Design a training curriculum and an online digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies The design of a targeted training curriculum as well as an online digital platform for the reskilling and up-skilling of Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies, can strengthen the digital skills of the Greek SMEs and enable them to further adopt these technologies to accelerate their Digital Transformation. Through the initiative, a follow-up on participants will be pursued in order to ensure that the newly acquired Smart Manufacturing skills are well-embedded and used in the Greek manufacturing organizations' business models as well as by the industrial workforce.
Initiative 7.2: Support the Setup of a Smart Manufacturing Competence Center The main objective of the Smart Manufacturing competence centre is to improve framework conditions for innovation in the area of Smart Manufacturing technologies. Results will be improved cooperation between R&D and business, where triple helix partners will be oriented to find and develop novel solutions across a set of manufacturing-related domains, such as the optimization of their production and supply chain processes and the production of smart products and services. (this initiative will be highly relevant to the Smart Manufacturing Industrial Park, Initiative 7.4 below, and could be located within it).
Initiative 7.3: Introduce a Smart Manufacturing Challenge Programme to develop innovative solutions for a modern, more productive, environmentally sustainable Greek Manufacturing The Smart Manufacturing challenge shall create a connected ecosystem harnessing the power of Greece's manufacturing companies large and small, large technology developers and new start-ups and spinouts, as well as the Greek academic/ research institutions, increasing the number of collaborations up the value chain.
Initiative 7.4: Set up a Smart Manufacturing Industrial Park The Smart Manufacturing Industrial park shall aim to create an emerging Industry 4.0 ecosystem and a flexible production network around the design and production of Smart Manufacturing solutions and applications. It can be located in a remote industrial land that could be transformed and equipped with modern working spaces and manufacturing facilities, where leading-edge anchor institutions and manufacturing companies shall cluster and connect with Industry

4.0 start-ups, business incubators, and accelerators. The Smart Manufacturing Industrial park could be developed in combination with the developed Just Transition Development Plan for lignite areas in Greece or could become a part of an already existing and successful Greek Industrial park, i.e. the Alexander Innovation Zone, in Thessaloniki.
Initiative 7.5: Smart Manufacturing Technologies within the Greek Industry 4.0 Standardisation Framework This initiative will aim to surface the important tasks that need to be carried out with regards to industrial standards and norms that are related to the key Smart Manufacturing technologies at hand.
Initiative 7.6: Enhancement of the Patents' Framework with regard to Smart Manufacturing Technologies This initiative is intended to place a special focus on patents within the manufacturing sector, aiming to enhance and improve the regulatory environment on that issue.

High Priority Case 2: Structural Materials

Regarding High Priority Case 2, the Structural materials value chain is a key part of Greek economy and industrial activities.

The initiatives developed for High Priority Case 2 are the following:

Initiatives for Structural Materials
Initiative 8.1: Develop a dedicated Industry 4.0 reskilling curriculum & certification programme for the Greek "Structural Materials" Workforce This dedicated Industry 4.0 reskilling curriculum & certification programme is deemed necessary for the Greek Structural Materials Workforce, in order to become up-to-speed with new technologies and enable their organizations' digital transformation.
Initiative 8.2: Develop a "Structural Materials apprenticeship" programme for STEM graduates & deploy a "matchmaking" platform This initiative will aim to enhance the vocational training and attract new, digitally adept workforce to the Structural Materials Industry through the introduction of a structured apprenticeship programme for STEM graduates that wish to work and become familiar with the industry. The programme will enable the future workforce to gain the practical skills and business acumen they need for this industry, become equipped with industry specific vocational skills and develop their network of social connections. It will also better interconnect Greek Structural Materials enterprises with academic and research institutions.
Initiative 8.3: Support the setup of a Structural Materials Test lab Based on the notion of "Smart Manufacturing" competence centre presented under initiative 7.2, that shall focus on Smart Manufacturing technologies and their implementation in the Greek manufacturing and industrial enterprises, the Structural Materials test lab will provide the required infrastructure, facilities and a safe and standardized environment for Greek Structural Materials organizations to experiment with the development and testing of Industry 4.0 products and

components as well as the associated digital processes and networked business models under realistic conditions.

Initiative 8.4: Introduce a "Structural Materials" Sector Deal

Through this initiative the Government will seek through this initiative to mobilise additional capital (ranging from 25% to 40%) and financially support the enterprises within the sectors that can be considered as Structural materials (e.g. the Metals sector), in selected areas of Industry 4.0 interest and specific technological applications for each one of them. In that sense, a co-investment scheme between the state and enterprises of all sizes that are part of this ecosystem will be created, allowing them to invest in technologies, human capital skills, applications, expert counselling in order to grow and prosper.

High Priority Case 3: Circular Economy

As far as High Priority Case 3 is concerned, the circular economy is gaining increasing attention worldwide as a means to reduce dependency on primary materials and energy, while at the same time becoming an economically viable alternative to the linear economy.

In fact, Industry 4.0 bears enormous opportunities to enable circular economy, in which end of life products are reused, remanufactured and recycled. Increasingly, companies are applying innovative solutions, including the "Internet of Things" (IoT), cloud computing and 3D printing that will enable more interoperability and flexible industrial processes and autonomous and intelligent manufacturing.

The initiatives developed for High Priority Case 3 are the following:

Initiatives for the Circular Economy
Initiative 9.1: Develop an online reskilling & up-skilling programme on Circular Economy & Industry 4.0 enabling technologies This online training programme will aim to highlight and explain the different circular business models that organizations could adopt, introduce IS concepts and terminologies and demonstrate how Industry 4.0 and Smart Manufacturing technologies can support organizations' transition to IS and Circular Economy business models.
Initiative 9.2: Support the Setup of an Industrial Symbiosis (IS) Competence Center The Competence Center shall focus on the design, testing, experimentation and development of new innovative Industry 4.0 solutions that will enable organizations of all sizes and types (i.e. SMEs, startups, midcaps, large organizations) to experiment with new circular economy business models and realize their benefits. Its focus can be wide in order to cover the full spectrum of the circular economy domains, with a specific emphasis on Industrial Symbiosis. This IS competence centre shall also set up and operate a national circular economy marketplace that can match the demand and supply for secondary raw materials in the Greek market and promote the Industrial Symbiosis model.

Initiative 9.3: Introduce a Green Innovation Challenge Fund to enhance innovation and collaboration for Green Economy & Industrial Symbiosis

The fund will provide assistance to Greek enterprises in the forms of grants for developing, testing and commercializing Industry 4.0 solutions and applications that addresses key challenges that Greece currently faces in the field of IS and circular economy. The challenges will be defined by a consortium of Greek academics & researchers, Greek Industry representatives, Circular Economy Experts and the Greek Government.

Initiative 9.4: Support the setup of an Industrial Symbiosis Eco-Industrial Park

The eco-industrial park shall be a dedicated area for industrial use at a suitable site that will ensure sustainability through the integration of social, economic, and environmental quality aspects into its siting, planning, management and operations.
The eco-industrial park shall bring direct and indirect, holistic benefits to the industrial sector in general, and resident enterprises in particular. Firms and industrial sectors in the park shall be able to improve capital efficiency, achieve utility cost savings, sustain business continuity, produce goods that are preferred by global buyers, attract foreign direct investment, increase exports and generate additional revenues.

Initiative 9.5: Develop the national standards for the Circular Economy and Industry

Through this initiative, key stakeholders from the Greek industrial sector as well as the Greek industrial landscape and wider ecosystem will be called to join forces in order to define and help industrial enterprises implement standards and norms that will lead to the circularity and the “greening” of the Greek industry.

Initiative 9.6: Regulatory reforms for a Circular Economy and Industry

The major goal of this initiative is, while pursuing the growth and revitalisation of the Greek Industry through the lens of Industry 4.0, to simultaneously develop a Green Industrial sector that will abide to the principles and practices of the Circular economy. In order to achieve that goal, a set of regulatory changes and reforms have to be implemented within the Greek industrial ecosystem, in order to create the right conditions for industrial enterprises of all sizes to make that shift toward circularity.

Initiative 9.7: Financial incentives to promote the Circular Economy and Industry

This initiative will seek to provide the right financial mechanisms and funding incentives to those industrial enterprises of all sizes (especially SMEs and Midcaps) that seek to restructure and relaunch their production line and overall business model. They should aim at minimising their waste products and proceed to become more environmentally friendly and sustainable. The initiative will place special emphasis on promoting the “cyclical transition” of smaller and medium sized enterprises within the Industrial ecosystem.

Involved stakeholders for the design and implementation of the initiatives for the 3 High Priority Cases

The following represents a list of stakeholders that should be actively involved in the design and implementation of the initiatives proposed for all three High Priority Cases:

Involved stakeholders for the 3 High Priority cases	
Ministry for Development and Investments	Ministry of Environment & Energy
Ministry of Digital Governance	Ministry of Finance
Ministry of Education & religious affairs	Ministry of Labour
General Secretariat of Industry	Ministry of Interior/ Ministry of Agriculture
General Secretariat for Research and Technology	Greek Industrial Standardisation Committee
Greek Organisation for Standardisation (ELOT)	National Certifications Center (EOPPEP)
Hellenic Development Bank	Private Accreditation Organizations
Industry Federations	Academic & Research institutions
Industrial Property Organisation	

"The Guide", regarding High Priority Case 1: Smart manufacturing Technologies

The Guide for High Priority Case 1 is laid out in the following steps:

- **Step 1**: It identifies the group of enterprises that each initiative refers to (i.e. SMEs, large enterprises, start-ups, etc.).
- **Step 2**: It briefly explain what the target group of enterprises should do to access/ implement this initiative (i.e. liaise with the Ministry/ bid for a proposal/ submit request for participation in financing scheme, etc.).
- **Step 3**: It demonstrates the benefits that each initiative can provide to the target group of enterprises. Benefits shall be viewed across two different dimensions:
  - Dimension 1: The area(s) across the companies' value chain where the initiative will have the most impact.
  - Dimension 2: The outcome that each initiative can have on organizations' high-level strategic objectives.
- **Step 4**: General guidelines and key initiatives that Greek Industrial and Manufacturing organizations could design and implement on their own in order to prepare, implement Smart Manufacturing Technologies and reap the maximum extent their benefits.

3 Key points of the proposed Industry 4.0 Strategy – Link between the proposed i4.0 Strategy and the Operational Plan

As pointed out in Deliverable 2, the national Industry 4.0 strategy aims to introduce a cohesive and comprehensive national agenda, under which all key stakeholders, i.e. the Greek Public Administration, the Greek Industry and the Greek research and academia will streamline their efforts to achieve the Greek Industry's Industry 4.0 transformation and to successfully realise the Greek Industry 4.0 vision. The Greek Industry 4.0 vision is stated below:

Greece's Industry 4.0 Vision

"An innovative, internationally competitive and extrovert Greek Industry with the leverage of digitisation and the continuous integration of new Industry 4.0 technologies & applications"

The strategic goals that the vision and the strategy overall aim to accomplish are the following:

- Increase the Greek Industry's overall digital maturity
- Digitally upskill and reskill the human workforce in the Greek industry
- Enhance the Greek Industry's applied R&D, innovation and production capabilities
- Support the Greek Industry to transition into the zero-carbon and low environmental footprint economy
- Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
- Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
- Increase the Greek Industry's potential to meet personalized needs and imminently respond to emergencies and crises (flexible processing)
- The enhancement of internationalization of the Greek Industry and its active participation in EU ecosystems
- Increase the overall contribution of Greek industry to the Greek economy

The Greek Industry 4.0 strategy shall holistically address the needs and support different groups of Greek stakeholders, in order to spur the rotation to Industry 4.0 both from a "demand" and a "supply" side. In other words, the strategy shall aim to:

- Increase the Industry 4.0 adoption of Greek Industrial and Manufacturing organizations, therefore ignite the Industry 4.0 demand.
- Accelerate the commercialization of Industry 4.0 innovation, therefore spur the Industry 4.0 "supply".

In more detail, examining the **Industry 4.0 "demand" side**, we have identified three different groups of organizations based on different levels of digital maturity, to which the strategy shall focus and provide targeted support for their adoption of Industry 4.0 technologies. Namely:

- Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate **limited knowledge/ low maturity** regarding Industry 4.0

  This group includes a significant number of Greek organizations with limited Industry 4.0 awareness that are yet to realize the benefits from adopting relevant Industry 4.0 solutions. In order to support this group to rotate to Industry 4.0, the Industry 4.0 strategy shall provide targeted initiatives to increase this group's awareness of how new Industry 4.0 technologies can transform the industry and to upskill and reskill these organizations' industrial workforce in the use of Industry 4.0 & Smart Manufacturing technologies. In addition, the strategy shall prompt this group of organizations to participate into new innovation and collaboration structures, that will create a visible and effective industrial ecosystem and will accelerate the innovation and diffusion of the technologies across the organizations' supply chains & production lines.
- Industrial/ Manufacturing organizations with **some knowledge/ moderate maturity** regarding Industry 4.0

  This group consists of organizations of various sizes that have started to implement some Industry 4.0 initiatives, nevertheless they are yet to define a holistic Industry 4.0 strategy for their organization, or they cannot easily justify return on investment, mitigate risk and start disrupting. The proposed Industry 4.0 strategy shall further incentivize this group of organizations to accelerate their investments in Industry 4.0, by introducing clear Industry 4.0 standards & regulations and by providing targeted fiscal incentives for the digital transformation of their end-to-end value chains. On top of the aforementioned, the strategy shall incentivize and enable them to participate in new, innovation structures and an emerging industrial ecosystem, where they will be able to participate into collaborative R&D programmes, proof of concepts, prototypes and open innovation events to actively experiment with new Industry 4.0 solutions and exchange knowledge and best practices with Industry 4.0 front-runners.
- Industrial/ Manufacturing organizations **with increased knowledge/ high maturity** regarding Industry 4.0

  These organizations shall act as the Industry 4.0 "champions" for the Greek Industry and undertake a leading role to increase Industry's awareness and adoption of Industry 4.0 technologies. These organizations shall be enabled through proposed initiatives to sit at the heart of innovation structures (i.e. testbeds and competence centers) and build around them emerging, industrial ecosystems. These ecosystems will bring together Greek industrial organizations, Industry 4.0 producers and/or academic/ research institutions and will establish close collaboration for co-designing tailored, innovative Industry 4.0 solutions and for addressing key challenges that the Industry faces.

With regards to the **Industry 4.0 "supply" side**, we have also identified three different groups of stakeholders that shall be enabled by the Industry 4.0 strategy to accelerate their efforts for the production of commercialized Industry 4.0 solutions:

- **ICT Services Organizations**, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps

  This group of organizations, with high maturity and expertise demonstrated on ICT and Industry 4.0 technologies shall be incentivized by the Industry 4.0 strategy to collaborate with industrial/ manufacturing organizations, as well as with newly established Industry 4.0 producers and provide active guidance and support for the organizations' rotation to Industry 4.0, their digital

upskilling, as well as their scale up and internationalization. ICT Services organizations could become the trainers or the implementors of new Industry 4.0 solutions to Industrial/ Manufacturing organizations with limited or moderate knowledge on Industry 4.0 and could also participate in innovation ecosystems and liaise with academic institutions and Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0, to develop innovative Industry 4.0 solutions and services.

- **Producers of Industry 4.0 solutions** (i.e. hardware, software, sensors, meters, new materials, etc.)
  These organizations represent the heart of Industry 4.0 innovation, nevertheless they are usually disconnected to large industrial organizations or ICT organizations, with whom they could cooperate to develop applied R&D and innovative solutions. As such, the Industry 4.0 strategy shall introduce relevant programmes and new innovation structures that will encourage the closer collaboration between Industry 4.0 "suppliers" and industrial/ manufacturing organizations. These structures shall create a collaborative industrial ecosystem and a flexible production network, where stakeholders shall utilize each other's expertise in order to resolve challenges they face through innovative Industry 4.0 solutions.
- **Academic/ research institutions and innovation hubs** focused at applied research for the Greek Industry & Manufacturing
  Our SWOT analysis for Greece's Industry 4.0 as-is state, indicated the disassociation that currently exists between academic research and applied research & industry implementation. As such, the Industry 4.0 strategy shall aim to leverage Greece's research strengths and innovation structures and assets to enhance applied innovation across the Greek Industry, as well as within specific Industry 4.0 value chains and technology groups and encourage collaboration and knowledge transfer between firms, research institutions and the Greek Government.

To operationalize the Industry 4.0 vision and achieve the set objectives, the strategy will be implemented through six discrete strategic pillars, which are briefly outlined below:

1. **Digital skills & human capital qualifications,** which aims at the provision of the current and future Greek industrial workforce with the appropriate digital knowledge and skills.
2. **Innovation & start-up supporting mechanisms in the Digital Age,** which focuses on the following:
   - the enhancement and promotion of innovation across the Greek Industry
   - the targeted mechanisms for the support of the booming start-up ecosystem in Greece
   - the incentives that will foster investment in innovation and applied R&D within the Greek industrial enterprises to contribute to the solution of industrial and societal problems (i.e. circular economy).
3. **Collaboration & synergies**, which focuses on the development of a collaborative industrial ecosystem, where Industry stakeholders shall cooperate and utilise each other's expertise in order to achieve greater goals.
4. **Standardisation & Norms**, which emphasises at setting key ICT standardisation priorities within the Industrial ecosystem to help ensure that the implemented Industry 4.0 technologies, systems and services retain the ability to connect and interoperate with each other, boosting innovation, and keeping the Greek ICT market open, competitive and interconnected with the rest of the Europe.

5. **Regulatory Environment**, which emphasises on improvements of the Greek regulatory environment, primarily in the areas of cybersecurity, data protection, free flow of data and Artificial Intelligence.
6. **Acceleration of investment in digital technologies**, which targets at creating the much needed financial incentivisation for Greek enterprises in order to invest and leverage Industry 4.0 technologies and applications.

As indicated in the next figure, these six execution pillars shall holistically benefit all groups of industrial stakeholders (both in the "supply" and the "demand" side) as identified and analysed above.

Key Stakeholders	Pillar 1 Digital skills & human capital qualifications	Pillar 2 Innovation & start-ups in the Digital Age	Pillar 3 Collaborations & synergies	Pillar 4 Standardisation & Norms	Pillar 5 Regulatory Environment	Pillar 6 Acceleration of investment in digital technologies
Industry 4.0 "Demand" – Increase the I4.0 adoption						
• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0	☑	☑			☑	☑
• Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0	☑	☑	☑		☑	☑
• Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0		☑	☑		☑	☑
I 4.0 "Supply" – Accelerate the commercialization of I4.0 innovation						
• ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps	☑	☑			☑	☑
• Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.)		☑	☑	☑	☑	☑
• Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing		☑		☑	☑	☑

Having set the Industry 4.0 Strategy 2021-2027 for Greece, the need for an elaborate Operational Plan is prevalent. The Operational plan essentially seeks to frame the future of the Greek industry, through initiatives targeted at the strengths, weaknesses, opportunities and threats as identified within Deliverable 2 and the SWOT analysis for the Greek industrial ecosystem. The Operational plan will essentially act as the implementation vehicle of the proposed Industry 4.0 strategy, acting as a valuable asset for stakeholders that will be called to collaborate within the Greek ecosystem and will be called to design and implement them in the following years. It provides step-by-step guidance which the stakeholders can rely to in order to achieve the digitalisation of the Greek industry in a swift and efficient manner. In order fully serve its purpose and achieve the expected results, it provides important information with regard to the following areas for each of designed initiatives (please refer to chapter 4.1.1 for more information on the below):

- Link of the initiative with the goals of the Industry 4.0 strategy
- Detailed description of the initiative and involved stakeholders for its design and implementation
- Key beneficiaries of the initiative (target group)
- Potential funding sources and Indicative budget
- Dependencies with other initiatives within the Operational plan
- Timeline of implementation and "Feasibility" and "Necessity" of the initiative
- Initiatives that can be identified as "Quick wins" for each of the six pillars

The initiatives proposed and outlined in the following chapters of the Deliverable have been developed based on best practices and initiatives that have been successful in other Industry 4.0 strategies of countries across Europe, always tailored to the needs and particularities of the Greek case. They have

also been fine-tuned through consultation meetings with key stakeholders from the Greek industrial ecosystem and Public sector, in order to incorporate valuable views and proposals within the Operational plan of the Greek industry for its successful transition to Industry 4.0.

4 Greece's Industry 4.0 Operational Plan

4.1 The methodological approach for the Operational Plan

In order to materialise the Greek Industry 4.0 vision and its strategic goals, discrete and targeted initiatives have been developed as part of the Operational plan for each of the execution pillars of the strategy. Each of the initiatives that are presented in the following chapters have been developed through working meetings with the General Secretariat's for Industry, as well as feedback received from DG Reform's project team. Moreover, the Operational plan's measures are a product of a series of meetings conducted between the project's working team (Contractor, Ministry's team & DG Reform) with selected stakeholders of the Greek industrial environment, namely the Federation of Enterprises and the General Secretariat for Research and Technology on the 20th of July, the Ministry of Digital Governance on the 22nd of July, the General Secretariat for Public Investments and ESPA on the 23rd of July, SEPE on the 24th of July and the Hellenic Development Bank and TANEO on the 28th of July. The meetings were focused at discussing all initiatives for the six pillars of the strategy, enhancing them with the stakeholders' input as well as "testing" their Feasibility and Necessity within the Greek industrial ecosystem.

The rationale behind the proposed initiatives was to introduce as many best practices of similar initiatives that have been rolled out successfully in other European countries that implement Industry 4.0 strategies, always tailored to the needs and particularities of the Greek Industrial ecosystem. For all of the Operational plan's initiatives presented in the following chapters, an analysis of the areas presented in Chapter 4.2 is performed. However, with regards to the methodological approach pursued in order to provide a holistic Operational plan, it is important to emphasize on the "Feasibility and Necessity of initiative".

With regards to the "Feasibility" dimension (scoring scale 1-5, "1" being the lowest and "5" being the highest score) examines how feasible each initiative is to implement, taking into account the following key variables:

- **Organisational culture of the involved stakeholders**, which examines whether it is flexible to change. A score of "5" would mean that the organisational culture is providing useful ground for the initiative to be implemented without delays or pushbacks from involved stakeholders (score 5) or whereas a score of "1" would indicate that it is resistant to changes and improvements of the industrial ecosystem.
- **Technological foundations**, which examines whether the technological foundations present are up-to-date and will promote the proposed initiative with ease scoring "5" in that case. On the other end, a score of "1" would indicate that a lack of the necessary technological foundations is prevalent and current technological tools and foundations are not sufficient to promote swiftly the implementation of the proposed initiative.
- **Regulatory framework**, which examines whether the current regulatory environment is in favour of the initiative proposed, in that case getting a score of "5". If however drastic regulatory or legal

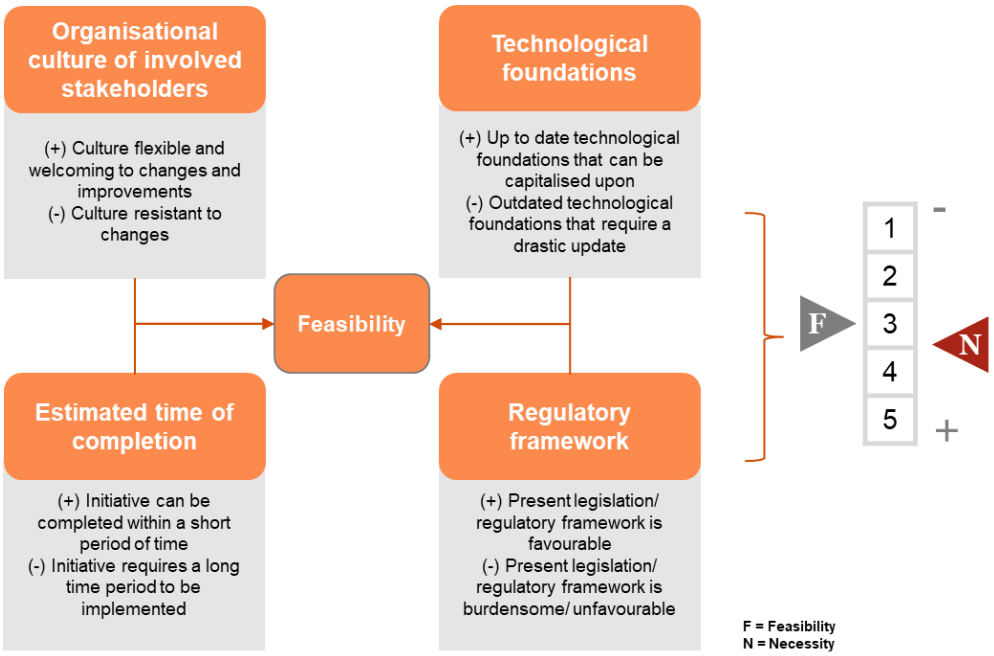
changes are required in order for the initiative to be implemented, then this would equal to a score of "1" for this dimension.

- **Estimated time of completion,** which examines how much time is required for the proposed initiative to be fully implemented within the Greek industrial ecosystem. Long completion times will receive the lowest score of "1" while very short completion times will receive the score of "5".

For all the above dimensions of "Feasibility", a score of "3" would indicate that the conditions prevalent within the industrial environment with regards to the implementation of the initiative cannot be characterised as neither ideal (score of "5") nor hindering (score of "1").

Also, the "Feasibility" dimension factors in if a similar or related initiative has been pursued in the past through a previous NSRF (i.e. NSRF 2014-2020) or if through a Ministry from the Greek Public Sector, taking into account how it unfolded and if it achieved the expected results.

Figure 1 Dimensions examined to evaluate the Feasibility of the proposed initiatives



The "Necessity" dimension (scoring scale 1-5, "1" being the lowest and "5" being the highest score) indicates the current need within the Greek Industrial ecosystem for the proposed initiative. More specifically, an initiative that scores "5" for the Necessity dimension is considered as crucial for the Greek industry and indicates that there either exists a lack of it within the Industrial environment or drastic improvement needs to be taken (and therefore the initiative is proposed). On the contrary, a score of "1" for this dimension would indicate that the proposed initiative would not be prioritised over other initiatives within the Greek industrial environment.

The final scoring provided for each initiative in the following chapters is provided as a result of a series of consultation meetings with stakeholders from the Greek public sector as well as other key Industrial stakeholders and representatives.

More specifically, the consultation meetings were conducted as per the table in the following page between the Contractor's, the Ministry's project team (and DG Reform's team in a number of those meetings), and the following stakeholders:

Stakeholder	Date of Meeting	Areas of discussion
General Secretariat for Research and Technology	Monday 20th July	Entirety of the Operational plan's measures
Federation of Enterprises	Monday 20th July	Entirety of the Operational plan's measures
Ministry of Digital Governance	Wednesday 22nd of July	Entirety of the Operational plan's measures
General Secretariat for Public Investments and ESPA	Thursday 23rd July	Entirety of the Operational plan's measures
SEPE	Friday 24th July	Entirety of the Operational plan's measures
Hellenic Development Bank	Wednesday 28th July	Emphasis on the initiatives of Pillar 6

4.1.1 Glossary of terms for the Operational Plan

The following table provides a brief explanation of all the terms the reader will come across in the following chapters of the current document, in order to navigate smoothly and grasp the essence of all the key details of the Operational Plan.

Term	Brief explanation
Title of the initiative	Refers to the name of the initiative, capturing the essence of its content.
Initiative's Coding	Refers to the discrete coding of the initiative, categorising is among all other initiatives of the Operational plan.
Pillar	Refers to the execution pillar of the proposed Industry 4.0 Strategy the initiative belongs in.
Area of focus	Refers to the discrete thematic area of the respective pillar this initiative is part of.
Link with strategic goals	Reflects how each respective initiative is linked directly linked with one or more strategic goals as proposed in the lines of the Industry 4.0 strategy.
Description of the initiative	Provides the rationale behind the need for each initiative within the Operational plan, presenting the link between the "As-is" study and the proposed Industry 4.0 strategy. It also provides more specific details with regards to the focus of the initiative, elaborating on how it should be implemented within the Industrial ecosystem.
Stakeholders	Presents the key stakeholders involved with regards to the design as well as the implementation of the respective initiative of the Operational plan.
Key beneficiaries (Target group)	Refers to the Group of individuals/ firms/ entities or other parties of the Greek industrial ecosystem that will ultimately benefit from the implementation of the respective initiative.
Potential funding sources	Refers to the sources the initiative can draw funding from (national or European sources) in order to be implemented.
Indicative Budget	Refers to an indicative budgeting range (regarding the initiatives such a budget is applicable for) covering their funding needs within the Operational plan's period.
Dependencies with other initiatives	Reflects how each respective initiative is linked/ interrelated with other initiatives within the same or the rest of the execution pillars of the Operational plan
Timeline of implementation	Refers to the timing of implementation for each respective initiative, seeking to place it within a discrete period of the Operational plan, categorising it as "Immediate" (1-2 years) – "short-medium term"(2-5 years) or "mid-long term"(5-7 years). It refers to amount of time required for its design and implementation.

Feasibility and Necessity of the initiative	Refers to the scoring of the respective initiative, after the meetings conducted with stakeholders for the development of the Operational Plan. The scoring examines the "feasibility" of the initiative, indicating the degree of readiness to implement it as well as the "necessity" of the initiative, indicating the need for the initiative within the Greek industrial ecosystem.
"Quick wins"	Refers to initiatives that based on the scoring they get with regard to the "Feasibility", "Necessity" and "Timeline of implementation" dimensions should be prioritised within each pillar in order to achieve some first positive and significant results that will build momentum for the rest of the initiatives of the respective pillar as well as the Operational plan in general.

4.1.2 Operational measures & initiatives: Pillar 1 - Digital skills and human capital qualification

4.1.2.1 Introduction & Key Definitions

Our thus far research within Deliverables 1 & 2 indicated that Greece demonstrates a technically adept human capital, with an overall high number of tertiary graduates and an adequate number of ICT and STEM graduates. However, these individuals are not significantly upskilled and reskilled when entering the Greek industry and progress their careers. In fact, evidence indicates that the Greek enterprises have performed limited investments in the digital upskilling and reskilling of their industrial workforce thus far. This was also verified by the Greek executives that we interviewed as part of our Industry 4.0 survey.

The provision of the appropriate Industry 4.0 knowledge and skills to the current and future Greek industrial workforce is nevertheless a fundamental prerequisite for the new Digital era and one of the most important building blocks in Greece's Industry 4.0 strategy. This is the reason why the digital upskilling and reskilling of the Greek workforce consists the first pillar of the Industry 4.0 strategy.

This pillar will seek to, first and foremost, digitally upskill and reskill all the current workforce of the Greek industry, mainly focusing on professionals with technical skills. By developing special training programmes based on the technologies to be adopted and already utilised by the Greek industry, employees will have the chance to learn new skills and better position themselves in their field of work, enabling them to perform better in the new setting of their current or future job.

At the same time, the pillar shall include dedicated initiatives for attracting and developing the future talent pipeline for the Greek Industry. This could be achieved by better equipping ICT and STEM students with the necessary skillsets to work in the Industry 4.0 environment, by enhancing the collaboration between the Greek academia and the Greek Industry, by enriching the education syllabus of the VET bodies to better match with industry needs and by increasing the attractiveness of the Greek Industry as a career destination for top talent. These initiatives shall provide to the future workforce a set of basic digital skills that they could further build upon throughout their career life.

Finally, this pillar shall include targeted initiatives for the repatriation of Greek human capital and the attraction of international human capital. This could be achieved through the design of targeted fellowship programmes for international PhD students/ researchers and Greek PhD students/ researchers working on Industry 4.0 technologies or Industry 4.0 value chains, or through the provision special benefits (i.e. tax benefits) for the incentivization of expatriates to return home.

It is important to state at this point that horizontal digital skills and human capital initiatives regarding the accelerating reskilling of the general population of the Greek society and the transformation of the Greek education system to embed the principles of the Digital age shall not be covered in this execution pillar. Although of great importance for Greece's digitisation and with incipient benefits for the Greek Industry, these horizontal initiatives consist part of Greece's national digital strategy and shall be included in the respective Bible of Digital Transformation, expected to be published soon by the Greek Ministry of Digital Governance. However, and as described before, through workshops and discussion will all relevant stakeholders within the Greek ecosystem (such as the Ministry of Digital Governance), so much the 1st Pillar as well as all other Pillars of the Operational plan ensure that the initiatives proposed are in line, complement, and provide synergies with horizontal initiatives that are currently being pursued by the relevant Ministries and stakeholders within the Greek industrial ecosystem.

4.1.2.2 *Initiative 1.1: Develop an Industry 4.0 reskilling & certification programme for the Greek Industry Workforce*

Title of the Initiative	**Develop an Industry 4.0 reskilling & certification programme for the Greek Industry Workforce**
Initiative's Coding	Initiative 1.1
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Upskill and reskill the Industrial workforce
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Our research on Greece's As-Is situation indicated that the Greek enterprises perform only limited investments with regards to their personnel's digital upskilling and reskilling. At the same time, the Industry 4.0 Questionnaire (ran as part of Deliverable 1) confirmed that Greek executives consider the lack of digital skills and technical know-how as a major impediment for their digital transformation.[1] This challenge appears even greater for the very small and small enterprises that we surveyed. Towards this direction, the introduction of a dedicated Industry 4.0 reskilling & certification programme for the Greek Industry Workforce will benefit the Greek economy and society in three different levels: - Micro level (individual level): the digital and Industry 4.0 reskilling of individuals shall reduce their skill mismatch with the Greek Industry, integrate them into the labour market with higher wages & earning, and provide them with further career development opportunities and professional status. - Meso level (enterprise level): the digital and Industry 4.0 reskilling of individuals will act as an accelerator for companies' Industry 4.0 transformation, shall increase the organizations' performance, profitability and innovativeness and increase the employees' productivity - Macro level (economy level): Ultimately a highly skilled and digitally adept Greek human workforce, shall enable Greece's digital transformation, contribute to its economic growth and increase the country's competitiveness *Details of the initiative* Design and launch a dedicated Industry 4.0 reskilling programme, in collaboration with Industry Federations, academia and private sector stakeholders to digitally upskill & reskill the existing workforce of the Greek Industry (with specific emphasis given to Greek SMEs). The Industry Federations can act as the coordinators and matchmakers between the trainers

[1] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development and Investments, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.

(private sector organizations/ academic or research institutions) that will provide training on Industry 4.0 technologies) and the potential trainees (enterprises of the Greek Industry).

Key audience of the Industry 4.0 reskilling & certification programme

The Industry 4.0 reskilling programme shall be customized to the specific needs of each sector/ organization segment and the most relevant technology groups for these. In more detail, it is advised that tailored curricula should be developed according to:

- Different economic sectors of the Greek Industry:
  - Mining & Quarrying
  - Manufacturing (and its key sub-sectors, i.e. Food & Beverages, Textiles, Pharma & Chemicals, etc.)
  - Water supply, sewerage, waste management and remediation
  - Construction
  - Transportation & Storage
- The size of the organizations participating in the Industry 4.0 reskilling programme: Tailored content shall be provided to SMEs' and midcaps' labour force, since their digital skill needs may significantly differ from these of larger organizations. In fact, the programme shall provide training for different digital skill maturity levels (from basic to advanced)
- The types of profession existing in each Greek sector of economic activity: On this front information from the National Institute of Employment & Human Workforce (ΕΙΕΑΔ) could be used to identify what type of professions exist in each sector.

Key skills addressed by the Industry 4.0 reskilling & certification programme:

The impacts of Industry 4.0 on industrial and manufacturing enterprises result in a specific set of competences with which workforce of the future should be equipped. Current literature has shown, different competence profiles a company's workforce should develop in order to handle a complex Industry 4.0 work environment). According to Germany's Platform Industrie 4.0 (2018)[2] the following competences are suggested for industrial & manufacturing workforce.

- **Information technology:** Cloud computing, Databases, Infrastructure and integration, Security, server and storage technologies, Network protocols/IP addressing, Network technology, virtualisation, Software development, Application development
- **Interdisciplinary skills:** Lean, Media, Project management, Process management, Self-guided learning, Self-management, Systematic thinking, Knowledge management
- **Electronics:** Embedded systems, Identification systems, Sensors/actuators, Robotics
- **Business administration:** Data analytics, Business model development and planning
- **Mechanical engineering:** Product Lifecycle Management (PLM) software

Key technologies addressed by the Industry 4.0 reskilling programme:

The programme shall provide basic to advanced digital information technology skills across the following types of Industry 4.0 technology groups:

- AI & Big Data Analytics (Cloud/ Artificial Intelligence/ Big Data/ Internet of Things/ 5G)
- Smart Manufacturing (Additive Manufacturing, Big Data Analytics, Cloud, Distributed Intelligence, Electronic Components & Systems, Machine-to-Machine (M2M),

[2] Platform Industrie 4.0, „Employee Qualification as Key Success Factor in Digitalised Factories", https://www.plattform-i40.de/PI40/Redaktion/DE/Downloads/Publikation/China/employee-qualification.html

	Manufacturing Execution Systems (MES), Simulation & Modelling, Supervisory Control and Data Acquisition Systems (SCADA), Internet of Things, Photonics, 5G) - Robotics (incl. Industrial Robots) - Cybersecurity & Blockchain - New Materials (e.g. Graphene, composites, PVD, CVD) - Hyper Performance Computing **Structure of the programme** The initial step for setting up this programme is to conduct a research to: - Map the Industry 4.0 and digital skillset to the set of Greek jobs and professions across the Greek Industrial Sectors - Identify jobs in selected professions that shall be affected (and the extent to which this will happen) by digitisation regarding work processes, activities and qualification requirements - Evaluate the digital skills maturity of each profession across the Greek Industry - Identify the new Industry 4.0 and digital skills that each profession should demonstrate - Propose new Industry 4.0 and digital qualifications that the Greek professions per economic sector should demonstrate. The outcome of this initial piece of work will lead to the design of training curricula based on the needs and specific requirements of each sector/ organization segment/ profession. This design can be led by Ministry of Development & Investments, that will be responsible for the implementation of the national Industry 4.0 strategy, in collaboration with a consortium of Industry Federations and the Ministries of Education and Digital Governance. Each curriculum developed for each of the dimensions presented above shall be linked to a respective accreditation & certification, that will be provided to employees to verify their digital knowledge on respective I4.0 skills and technologies. The accreditation and certification can be provided either by National Certifications Center (EOPPEP) or through external technical support (private accreditation organizations) that shall work together with EOPPEP and the involved ministries towards this direction. The Government shall cover the expenses for the development of the training curricula and their respective content tailored to the needs of each segment (where no existing content is already available). Government can also investigate a potential collaboration with large industrial organizations, which have already developed training schemes for their employees or liaise with academic/ research institutions that may also have relevant training materials.
Stakeholders (Design & Implementation)	• General Secretariat of Industry • General Secretariat of Lifelong Learning/ Ministry of Education & religious affairs • Ministry of Labour • Ministry of Digital Governance • National Certifications Center (EOPPEP) • Private Accreditation Organizations • Industry federations
Key beneficiaries (Target group)	• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited or moderate knowledge regarding Industry 4.0
Potential funding sources	• Current NSRF/ ESF (OP Human Resources Development, Education and Lifelong Learning) • Future NSRF

Indicative Budget	€2.000.000 - €5.000.000 for the development of the Industry 4.0 curricula and their content
Dependencies with other initiatives	• N/A
Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

4.1.2.3 *Initiative 1.2: Develop a dedicated Industry 4.0 apprenticeship programme for STEM undergraduates & graduates*

Title of the Initiative	**Development of a dedicated Industry 4.0 apprenticeship programme for STEM undergraduates & graduates**
Initiative's Coding	Initiative 1.2
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Attract and develop the future talent pipeline for the Greek Industry
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Although Greece demonstrates an overall high number of tertiary graduates and an adequate number of ICT and STEM graduates, their skills often appear to have limited relation and relevance to the skills required by the Greek Industry and economy. In this context, the enhancement of the vocational training through the introduction of a structured apprenticeship programme for STEM undergraduates and graduates is an initiative of high importance. The apprenticeship programme shall enable the future workforce to gain the practical skills and knowledge they need to succeed in their chosen industry, become equipped with professional and vocational qualifications that are 'job-role' and industry specific and develop their network of social connections in their industry of choice. At the same time, this programme will connect and establish long-term collaboration between enterprises of the Greek Industry and the ICT sector and the Greek academic institutions. This will enable organizations to start bridging the existing skills gap and actively invest in the training and developing of people in a way that promotes the specific skills required by the business and industry, therefore investing in the future of their workforce and their business as a whole. *Details of the initiative* Design an Industry 4.0 apprenticeship programme targeted primarily to STEM undergraduates and recent graduates of the Greek Universities. The programme shall provide the opportunity to STEM undergraduates and recent graduates to work within Greek Industry's SMEs and midcaps for a certain period of time (i.e. 6 months) and receive market-relevant training that improves their chances on the fast-evolving labour market. Within the universities, the apprenticeship could qualify for credits towards certificate/ degrees. In addition, it could be explored whether apprenticeships can be considered mandatory for students to graduate from STEM departments. The programme could incentivize Greek Manufacturing and Industrial SMEs and midcaps, to participate as employers through the provision of a respective grant for the apprenticeships they provide (part of it could be provided as a stipend to the trainees), or

through receiving a tax allowance or tax refund of the employer's share of social security costs for the apprentices (similar cases take place in France & Luxembourg)[3]. Apprenticeship companies shall be approved as training and learning venues to ensure that they live up to specific standards in terms of learning as well as work and salary conditions.

Germany, Austria and Denmark are considered pioneers in implementing apprenticeship programmes within their economies. In fact, Germany has launched an online "Apprenticeship Toolbox" to provide support for decision-makers throughout Europe who want to implement the key principles of dual apprenticeship schemes. The development of high-quality vocational education and training is also the guiding principle of bilateral cooperation under the Berlin Memorandum of December 2013 with Greece, Portugal, Italy, Slovakia and Latvia.[4]

Scope of apprenticeships

The apprenticeship system shall offer a wide range of programmes at different qualification levels. These programmes will focus and evolve around the implementation and use of Industry 4.0/ Smart Manufacturing technology groups across the value chain of Greek Industrial and manufacturing enterprises. In more detail, apprenticeships will focus on the following Industry 4.0/ Smart Manufacturing technologies.

- AI & Big Data Analytics (Cloud/ Artificial Intelligence/ Big Data/ Internet of Things/ 5G)
- Smart Manufacturing (Additive Manufacturing, Big Data Analytics, Cloud, Distributed Intelligence, Electronic Components & Systems, Machine-to-Machine (M2M), Manufacturing Execution Systems (MES), Simulation & Modelling, Supervisory Control and Data Acquisition Systems (SCADA), Internet of Things, Photonics, 5G)
- Robotics (incl. Industrial Robots)
- Cybersecurity & Blockchain
- New Materials (e.g. Graphene, composites, PVD, CVD)
- Hyper Performance Computing

The apprentices will have a chance to gain hands-on experience and practice on these technologies across different activities of the organizations' value chain, i.e.:

- Design & Engineering
- Sourcing & Procurement
- Manufacturing & Assembly
- Distribution & Logistics
- Reuse & Recycle

Access to the apprenticeship programme

The liaison between the STEM departments and the Greek Industrial/ Manufacturing SMEs and midcaps should be performed by the Universities' career offices and the respective Industry Federations, monitored by the Ministry of Development & Investments, the Ministry of Education and the Ministry of Labour. Universities and Industry Federations should closely collaborate and should be responsible for:

- liaising with Greek Industrial SMEs and midcaps to receive open apprenticeship positions

[3] Cedefop, „Using tax incentives to promote education and training", https://www.cedefop.europa.eu/files/5180_en.pdf
[4] https://www.cedefop.europa.eu/en/news-and-press/news/germany-2012-berlin-memorandum-cooperation-vet-europe-brings-positive-outcome

	- organizing "matchmaking" events where future employers could come in contact with students aiming at undertaking an apprenticeship - receiving students' apprenticeship requests - proving one-to-one careers advice appointments with students to guide them through the process and the required skills for the apprenticeship, etc.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments Ministry of Education & religious affairs Ministry of Labour Industry Federations Greek Manufacturing and Industrial SMEs and midcaps
Key beneficiaries (Target group)	STEM Undergraduates & Graduates
Potential funding sources	- Current NSRF/ ESF (OP Human Resources Development, Education and Lifelong Learning) - Future NSRF
Indicative Budget	€2.000 Euros could be provided per apprenticeship slot. €20.000.000 – 100.000.000 (for multiple years of duration)
Dependencies with other initiatives	N/A
Timeline of implementation	Midterm/ Long-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

4.1.2.4 Initiative 1.3: Develop Postgraduate conversion programmes in Smart Manufacturing Technologies

Title of the Initiative	**Develop Postgraduate conversion programmes in Smart Manufacturing Technologies**
Initiative's Coding	Initiative 1.3
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Upskill and reskill the Industrial workforce
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Our research on Greece's As-Is situation and the Industry 4.0 Questionnaire (ran as part of Deliverable 1) highlighted that Greek executives consider the lack of digital skills and technical know-how as a major impediment for their digital transformation.[5] This challenge appears even greater for the very small and small enterprises that we surveyed. Towards this same direction, third party data from CEDEPOF indicates that there are concerns that Europe currently faces a skill mismatch problem: employers struggle to recruit people with the skills they need while unemployment levels remain relatively high following the economic crisis. In fact, in Greece, the following two occupations appear to currently demonstrate (and continue to demonstrate in the future) the highest shortage[6]: - ICT operations and user support technicians - Mining and construction labourers As such, we propose the development of postgraduate conversion courses in Smart Manufacturing technologies in cooperation with the Greek academia and with the support of the Greek Industry & Manufacturing sectors. Key aim for this programme will be to increase the number of people from groups currently underrepresented in the Smart Manufacturing technology fields, and to encourage graduates from diverse backgrounds to consider a future in these occupations. *Details of the initiative* Design and launch in collaboration with the Greek academia/ research institutions and representatives of the Greek Industry a set of new postgraduate conversion courses in Smart Manufacturing Technologies. These postgraduate programmes could also be offered online and shall offer to individuals from both STEM and computer science and non-STEM backgrounds an opportunity to understand how Smart Manufacturing Technologies can be

[5] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development and Investments, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.

[666] https://skillspanorama.cedefop.europa.eu/en/analytical_highlights/greece-mismatch-priority-occupations

	applied to support the Greek manufacturing and Industry progress in an increasingly complex world. Examining every aspect of Smart Manufacturing technologies from 5G and cloud to big data analytics and machine learning, these postgraduate programmes are expected to equip tertiary graduates with the skills to secure one of a growing number of careers in this new and challenging field. The postgraduate programmes can provide the flexibility to students to select their career path or area of interest: 1) Technical focus: for students wishing to specialise in the more technical side of Smart Manufacturing technologies, this route can place a greater emphasis on leveraging Smart Manufacturing technologies for the development of new products/ services. 2) General: for students from less technical backgrounds who want to understand Smart Manufacturing technologies in context, this pathway can offer a broader introduction to all aspects of these technologies and their implementation in the Industry. Although previous STEM/ Smart Manufacturing technologies' experience shall not be required to study these courses, maths experience shall be essential. The curricula of these postgraduates programmes shall be designed by the Greek academic institutions, with the input of the respective federations of industry and the contribution of leading Greek Industrial/ ICT and Manufacturing organizations in order to help for the postgraduate programmes to address and progress precisely the skills that Greek Industry employers are looking for. In addition, these postgraduate programmes could be linked to the Industry 4.0 apprenticeship programme (as a compulsory module) that will provide the opportunity to students to work within Greek Industry's SMEs and midcaps for a certain period of time (i.e. 6 months) and practice on Smart Manufacturing technologies of their choice and specialization.
Stakeholders (Design & Implementation)	• General Secretariat of Industry • General Secretariat of Lifelong Learning/ Ministry of Education & religious affairs • Ministry of Digital Governance • Industry federations • Academic & Research institutions that are focused on Smart Manufacturing technologies • Greek Industrial Organizations that shall participate in the design of the educational curricula
Key beneficiaries (Target group)	Tertiary graduates from multi-discipline backgrounds that wish to get upskilled in Smart Manufacturing Technologies
Potential funding sources	N/A
Indicative Budget	N/A
Dependencies with other initiatives	Initiative 1.2: Develop a dedicated Industry 4.0 apprenticeship programme for STEM undergraduates & graduates

Timeline of implementation	Long term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 3

4.1.2.5 *Initiative 1.4: "Back to I4.0 School" - Incentivize Greek enterprises to support employees to participate in I4.0/ Smart Manufacturing postgraduate convention programmes*

Title of the Initiative	**"Back to I4.0 School" - Incentivize Greek enterprises to support employees to participate in I4.0/ Smart Manufacturing postgraduate convention programmes**
Initiative's Coding	Initiative 1.4
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Upskill and reskill the Industrial workforce
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Our research on Greece's As-Is situation indicated that the Greek industrial enterprises perform only limited investments with regards to their personnel digital upskilling and reskilling. At the same time, the Industry 4.0 Questionnaire (ran as part of Deliverable 1) confirmed that Greek executives consider the lack of digital skills and technical know-how as a major impediment for their digital transformation. To enhance life-long learning, we propose an incentivization scheme for enterprises to support their employees to participate in Industry 4.0 post-graduate programmes. This shall enable the digital and Industry 4.0 upskilling of individuals, while at the same time will infuse enterprises with advanced Industry 4.0 know-how that will enable their digital transformation. *Details of the initiative* The "Back to Industry 4.0 School" programme aims to incentivize Greek Manufacturing & Industrial SMEs & midcaps to motivate and support their employees to participate in existing postgraduate programmes (part-time or full-time), with a focus on the Industry 4.0 area or the new postgraduate convention programmes (as proposed under initiative 1.3). The employees shall jointly select with their enterprise one of the available postgraduate programmes provided by Greek academic institutions focused on the following Industry 4.0 technology groups: - AI & Big Data Analytics (Cloud/ Artificial Intelligence/ Big Data/ Internet of Things/ 5G) - Smart Manufacturing (Additive Manufacturing, Big Data Analytics, Cloud, Distributed Intelligence, Electronic Components & Systems, Machine-to-Machine (M2M), Manufacturing Execution Systems (MES), Simulation & Modelling, Supervisory Control and Data Acquisition Systems (SCADA), Internet of Things, Photonics, 5G) - Robotics (incl. Industrial Robots) - Cybersecurity & Blockchain - New Materials (e.g. Graphene, composites, PVD, CVD) - Hyper Performance Computing as well as on Industry 4.0 related value chains, where Greece demonstrates a competitive advantage (i.e. Smart Food, Smart Health, Smart Factories, Structural Materials, etc.). The

	postgraduate programme's theme shall be applicable and relevant to the enterprise's focus. At the end of their programmes the employees will need to re-join their enterprise for at least two years. The enterprises could fund up to 80% of the overall postgraduate tuition fees of their employees. Out of this amount, 60% could be subsidized directly by this programme.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments General Secretariat of Lifelong Learning/ Ministry of Education & religious affairs Ministry of Labour Greek Manufacturing and Industrial SMEs and midcaps
Key beneficiaries (Target group)	Employees working in the Greek Manufacturing and Industrial SMEs and midcaps that wish to become digitally upskilled in Industry 4.0 technologies
Potential funding sources	- Current NSRF/ ESF (OP Human Resources Development, Education and Lifelong Learning) - Future NSRF
Indicative Budget	€10.000 – 20.000 Euros for each postgraduate candidate €5.000.000 - 10.000.000
Dependencies with other initiatives	Initiative 1.3: Develop Postgraduate conversion programmes in Smart Manufacturing Technologies
Timeline of implementation	Short-term
Feasibility and Necessity of initiative	Feasibility= 4 Necessity= 4

4.1.2.6 Initiative 1.5: Revamp of the STEM departments' & Technical/ VET (Vocational Education Training) bodies' educational curricula to reflect current needs across Industry 4.0

Title of the Initiative	**Revamp of the STEM departments' & Technical/ VET (Vocational Education Training) bodies' educational curricula to reflect current needs across Industry 4.0**
Initiative's Coding	Initiative 1.5
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Upskill and reskill the Industrial workforce
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* At the heart of any 'future-ready' education ecosystem are curricula designed to impart the knowledge and skills that have purchase in the modern workplace. Given the rapid evolution of the job market, most individuals relying on just one skill set or narrow expertise are unlikely to sustain long-term careers in economies of the future. Greece currently demonstrates a high number of tertiary graduates and an adequate number of ICT and STEM graduates. Nevertheless, ICT and STEM educational curricula appear outdated, with limited new/ updated skills on Industry 4.0 and smart manufacturing technologies being incorporated in their existing educational curricula. At the same time, the Greek Technical and VET institutions demonstrate a lower performance human capital usually also with limited digital skills. In addition, several specializations provided in these institutions incorporate labour-intensive activities that could potentially soon become automated due to Industry 4.0, while their transactional and routine tasks will become defunct. For these reasons, we propose both for the STEM departments and the VET institutions to update their educational curricula, in order to reflect the current Industry 4.0 requirements for their offered professions and specializations, and equip the future employees of the Greek industry with the required skills to support the rise of machine-assisted work and to create new capabilities in the domain of human-machine interaction. *Details of the initiative* Update the educational curricula of the STEM university departments & VET institutions (vocational upper secondary schools (EPAL), post-secondary VET schools (IEK), apprenticeship schools (EPAS) operated by OAED) to reflect the current needs for the acquisition of I4.0 related skills required for the Greek Industry. The STEM & VET educational curricula shall include courses targeted to students' applied knowledge on leveraging and using Industry 4.0 technologies in the context of their future professions. In more detail, a set of digital skilling and upskilling courses could be introduced horizontally across all curricula to ensure that all students are equipped with the basic digital

	skills, (i.e. Information & data literacy, communication & collaboration, digital content creation, problem solving, etc.). Then according to the specialization and professions that each department/ institution addresses to, advanced courses can be provided in select technology groups. For instance, professions related to Mechanical Engineering, Tourism & Agri-food shall receive advanced courses on: - AI & Big Data Analytics (Cloud/ Artificial Intelligence/ Big Data/ Internet of Things/ 5G) - Smart Manufacturing (Additive Manufacturing, Big Data Analytics, Cloud, Distributed Intelligence, Electronic Components & Systems, Machine-to-Machine (M2M), Manufacturing Execution Systems (MES), Simulation & Modelling, Supervisory Control and Data Acquisition Systems (SCADA), Internet of Things, Photonics, 5G) - Robotics (incl. Industrial Robots) - Cybersecurity & Blockchain - New Materials (e.g. Graphene, composites, PVD, CVD) - Hyper Performance Computing This initiative aims at the revamping of the STEM & VET educational curricula; therefore, no costs are encountered in this. The design of the new I4.0 courses' content, as well as the resourcing plan for equipping STEM & VET institutions with the appropriate teachers and tutors shall be distinct initiatives that will follow up, upon the completion of this action. As a guiding principle it is advised that curricula must be: - updated and adapted on a rolling basis, based on insights and forecasting regarding the evolution of the Greek and the global labour markets and trends in skill demands - developed and revised collaboratively, with input from all relevant stakeholders, including businesses - subject to regular review, in order to avoid the disruption and implementation time-lag associated with major but infrequent curricular overhauls.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments General Secretariat of Lifelong Learning/ Ministry of Education & religious affairs Ministry of Labour Ministry of Digital Governance Industry federations
Key beneficiaries (Target group)	Greek STEM & VET students on I4.0 areas of focus
Potential funding sources	N/A
Indicative Budget	N/A
Dependencies with other initiatives	N/A
Timeline of implementation	Midterm/ Long term

Feasibility and Necessity of initiative	Feasibility= 1 Necessity= 4

4.1.2.7 Initiative 1.6: Introduce an Industry 4.0 Fellowship programme for PhD, Post-PhD Students & researchers

Title of the Initiative	**Introduce an Industry 4.0 Fellowship programme for PhD, Post-PhD Students and researchers**
Initiative's Coding	Initiative 1.6
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Attract and develop the future talent pipeline for the Greek Industry • Repatriate Greek human capital & attract international human capital
Link with strategic goals	• Digitally upskill and reskill the human workforce in the Greek industry • Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
Description of the initiative	*Rationale behind the need for the initiative* To direct research and the production of innovative thought capital to Industry 4.0 areas and relevant value chains that could increase the Greek Industry's competitiveness, the Government could support and incentivize Greek Manufacturing and Industrial SMEs and midcaps to hire PhD, post PhD students and researchers to conduct applied research engagements within the organizations' working environment. Industry 4.0 Fellowships will nurture future leaders in both industry and the research base, promote greater mobility between them and ensure that a variety of Greek industrial sectors have a supply of skilled researchers. *Details of the initiative* The Industry 4.0 fellowship programme aims to support Greek & international PhD and post-PhD candidates as well as researchers, whose applied research is focused on Industry 4.0 technologies: - AI & Big Data Analytics (Cloud/ Artificial Intelligence/ Big Data/ Internet of Things/ 5G) - Smart Manufacturing (Additive Manufacturing, Big Data Analytics, Cloud, Distributed Intelligence, Electronic Components & Systems, Machine-to-Machine (M2M), Manufacturing Execution Systems (MES), Simulation & Modelling, Supervisory Control and Data Acquisition Systems (SCADA), Internet of Things, Photonics, 5G) - Robotics (incl. Industrial Robots) - Cybersecurity & Blockchain - New Materials (e.g. Graphene, composites, PVD, CVD) - Hyper Performance Computing as well as on Industry 4.0 related value chains, where Greece demonstrates a competitive advantage (i.e. Smart Food, Smart Health, Smart Factories, Structural Materials, etc.).

	According to the Industry 4.0 Fellowship programme, the PhD/ Post-PhD candidates, researchers could spend at least 25% of their research time in a Greek industrial/ manufacturing, with an emphasis given on SMEs and midcaps as a first option. The theme of the research should be proposed and jointly agreed between the industrial enterprise and the academic/ research institution. This programme could subsidize 50% of the overall PhD/ post PhD costs for as long as their research lasts (up to 5 years). **Proposed Financial aid** The programme could cover all eligible costs for the PhD/ Post-PhD candidates (in case of international candidates, a part of their accommodation & living expenses could also be covered). In addition, private organizations, where the PhD/ post PhD student performs their research could co-fund up to 30% of the overall PhD/ post PhD costs. A tax exemption/ lower tax rate could be applied for this funding. For researchers, the programme could subsidize their salaries of the new researchers for their first two years. Similar initiative is currently implemented in the United Kingdom (Innovation Fellowship programme).[7] This end-to-end programme could motivate the PhD and Post-PhD graduates that complete their research, to then get hired by the same organization as researchers (where they performed their PhD/ post PhD engagement) to continue their applied research for them.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments Ministry of Education & religious affairs General Secretariat for Research and Technology/ Ministry of Development & Investments Ministry of Digital Governance
Key beneficiaries (Target group)	PhD and Post-PhD students in Industry 4.0 technologies & value chains
Potential funding sources	• Current NSRF/ ESF (OP Human Resources Development, Education and Lifelong Learning) • Future NSRF
Indicative Budget	• €10.000 – 20.000 per year for PhD Graduate/ PhD Post-Graduate, 100 PhD – Post-PhD students, for 5 years, Total of €5.000.000 – 10.000.000 • 20,000 – 30,000 Euros per researcher per year, 100 researchers for 2 years, Total of € 4.000.000 – 6.000.000 • Overall funding: €9.000.000 – 16.000.000
Dependencies with other initiatives	N/A
Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 3

[7] https://www.ukri.org/funding/funding-opportunities/future-leaders-fellowships/

4.1.2.8 Initiative 1.7: Incentivise Greek mid-level and senior workforce working abroad on I4.0 areas to repatriate

Title of the Initiative	**Incentivise Greek mid-level and senior workforce working abroad on I4.0 areas to repatriate**
Initiative's Coding	Initiative 1.7
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Repatriate Greek human capital & attract international human capital
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
Description of the initiative	*Rationale behind the need for the initiative* Greece's current economic turbulence has led a high number of highly calibre personnel to move abroad during the last years. According to a study performed by Endeavor[8], Greece's first "export" is none other than human resources, or what critics refer to the infamous "brain drain". Based on the cumulative figures presented by Endeavor, more than 200,000 Greeks, most of them younger than 35 years old, have left the country and are currently employed abroad. Greek "brain drain" generates more than 50 billion euros in host countries (this figure includes the increased GDP, tax revenues and social security contributions, VAT taxes etc. contributed by the expatriates). At the same time, Greece appears to lag behind in terms of its workforce's digital skills, while the interviewed Greek organizations also testify limited know-how in the Greek market in terms of Industry 4.0 technologies, products & applications. To address both issues identified above, Greek enterprises need to reinforce primarily their mid-level and senior level executives by infusing in these levels expatriates with an already gained experience in Industry 4.0 levels. The enhancement of the mid and senior level will enable the enterprises to accelerate their digital transformation and rotate to Industry 4.0. As such, a set of financial and tax incentives could be provided to Greek expatriates, working in the Industry 4.0 area at mid or senior levels, to return and work in Greece. *Details of the initiative* Financial and tax benefits shall primarily target experienced personnel/ executives working abroad (with more than 5 years of experience that currently hold mid-level/ senior- level positions) that currently work on Industry 4.0 technologies: - AI & Big Data Analytics (Cloud/ Artificial Intelligence/ Big Data/ Internet of Things/ 5G) - Smart Manufacturing (Additive Manufacturing, Big Data Analytics, Cloud, Distributed Intelligence, Electronic Components & Systems, Machine-to-Machine (M2M),

[8] Endeavor Greece, Creating Jobs for Youth in Greece, 2016, http://endeavor.org.gr/wp-content/uploads/2015/07/Endeavor-Greece-Creating-jobs-for-youth-in-Greece.pdf

	Manufacturing Execution Systems (MES), Simulation & Modelling, Supervisory Control and Data Acquisition Systems (SCADA), Internet of Things, Photonics, 5G) - Robotics (incl. Industrial Robots) - Cybersecurity & Blockchain - New Materials (e.g. Graphene, composites, PVD, CVD) - Hyper Performance Computing as well as on Industry 4.0 related value chains, where Greece demonstrates a competitive advantage (i.e. Smart Food, Smart Health, Smart Factories, Structural Materials, etc.). With regards to tax benefits, expatriates relocating to Greece (irrespective of their tax residency or domicile status) could be eligible to the following income tax exemption on employment income: 3) 50% of the remuneration from any employment exercised in Greece by an individual who was resident outside Greece before the commencement of his/her employment in Greece. The exemption can apply for a period of ten years starting from the first year of employment provided that the employment income of the employee exceeds €50,000 per annum. Nevertheless, as this measure refers to tax benefits, the overall duration of the initiative shall be evaluated in the context of the wider fiscal strategy for the country and become calibrated accordingly. 4) In addition, a relocation financial benefit of approximately 10,000 Euros per expatriate can be provided. It is important to state here, that contrary to other countries (i.e. Cyprus) that provides tax exemptions only to executives relocated to Cyprus (with an employment income that exceeds €100,000 per annuum), Greece is in absolute need of not only attracting executives but also mid-level employees (with an indicative employment income exceeding €50,000 per annuum). This is mainly due to the fact that Greek Manufacturing & Industrial organizations are in need of both executives that will draw these organizations' Industry 4.0 and Smart Manufacturing vision, but also of mid-level management that will operationalize this Smart Manufacturing vision.
Stakeholders (Design & Implementation)	• General Secretariat of Industry/ Ministry of Development & Investments • Ministry of Labour • Ministry of Digital Governance • Ministry of Finance
Key beneficiaries (Target group)	Expatriates in senior positions that work in the Industry 4.0 area that wish to return to Greece
Potential funding sources	N/A
Indicative Budget	€ 20.000.000 for the relocation financial benefit (10,000 Euros for 200 expatriates)
Dependencies with other initiatives	N/A
Timeline of implementation	Midterm/ Long-term

Feasibility and Necessity of initiative	Feasibility= 1 Necessity= 4

4.1.2.9 Timeline of implementation of the initiatives of Pillar 1 and "Quick wins"

In this paragraph we present an indicative implementation timeline of Pillar 1 initiatives. Given the high necessity of all skill-related initiatives, we suggest that all our initiatives start within the first two years of the Operational Plan. As it can be seen, the first initiatives to be implemented are the ones directly associated with the current industrial workforce and its digital upskilling and reskilling though the new Industry 4.0 reskilling and certification programme (1.1), the development of the Industry 4.0 apprenticeship programme (1.2) and the "Back to School" initiative (1.4).

Initiatives 1.3 and 1.5 that refer to new conversion post-graduate programmes in Smart Manufacturing Technologies and the revamping of STEM, Technical and VET curricula may require additional time and effort to align the needs and agendas of all stakeholders involved in their design. Therefore, these are suggested to start during the 2nd year of the operational plan.

Finally, the design of new tax incentives for the incentivization of Greek and international workforce to return to Greece, is an ambitious initiative, that shall fall under the wider fiscal strategy of the country. For this reason, detailed preparation shall take place before the initiation of its design. This is why this initiative is suggested to start towards the start of the 3rd year of the Operational Plan.

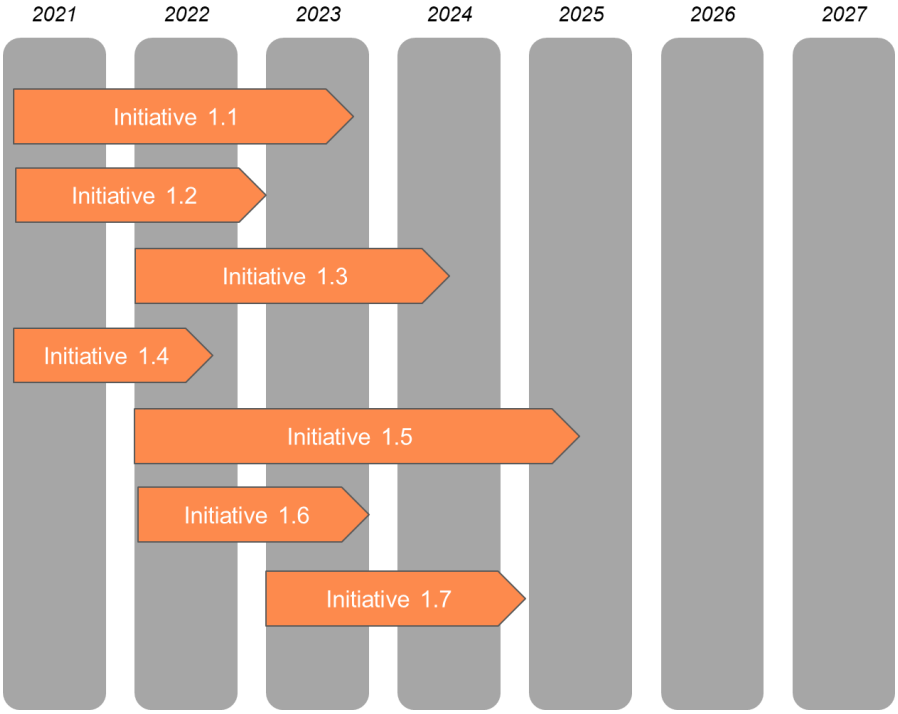


Figure 2: Timeline of initiatives' implementation for Pillar 1

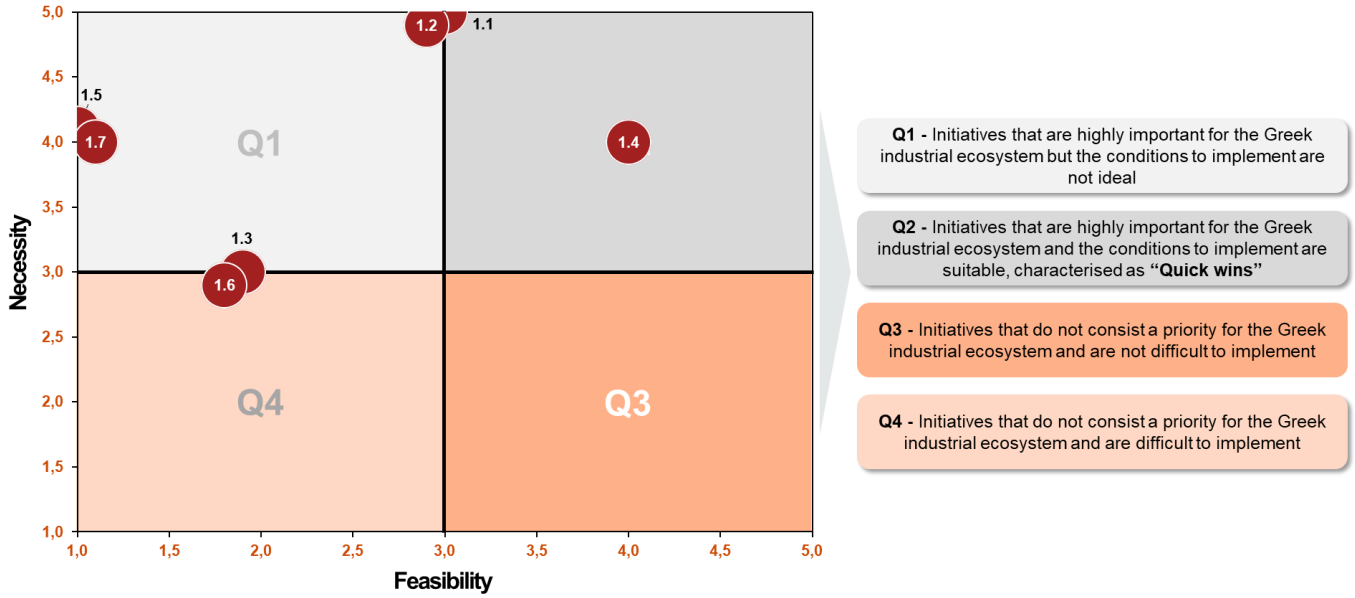


Figure 3 Pillar 1 "Quick wins"

Moving forward, we depict the distribution of the initiatives of Pillar 1 according to their "Feasibility" and "Necessity" scoring and we identify the set of "Quick Wins", which refer to initiatives that demonstrate high Feasibility (therefore they are easier to be implemented) and high Necessity (therefore they are expected to have a significant impact towards Greek Industry's rotation to Industry 4.0). These initiatives are the ones that fall under Q2 as also explained in the Figure below.

For Pillar 1, we observe that one initiative falls under the "Quick Wins" category. Namely these are the following:

- Initiative 1.4: "Back to I4.0 School" - Incentivize Greek enterprises to support employees to participate in I4.0/ Smart Manufacturing postgraduate convention programmes

These initiatives refer mainly to actions of low complexity that require minimum changes in the existing Greek regulatory framework and that are mainly dependent on pure financial support (i.e. through subsidies and funds) that the Greek Government shall provide to enhance the Industry 4.0 upskilling of the current and future industrial workforce. These "Quick wins" also appear in the abovementioned timeline to start first, during the 1st year of the Operational Plan.

4.1.3 Operational measures & initiatives: Pillar 2 - Innovation & start-ups in the Digital Age

4.1.3.1 Introduction & Key Definitions

Major outcome both from our As-Is Analysis on Industry 4.0 and the design of Greece's Industry 4.0 strategy has been the great significance that the Greek innovation ecosystem shall play for Greece's Industry 4.0 transformation. Currently, the country ranks low in terms of innovation and R&D, both with regards to their R&D intensity and with regards to the overall number of the issued Greek patents. What is more worrying nevertheless, is the disassociation that appears to exist between the R&D and the applied research & industry implementation. Contrary to the EU average, where the business sector appears highly involved in R&D, the Greek R&D is mainly dominated by the higher education sector, while Greek organisations appear reluctant to invest in applied R&D.[9]

For these reasons, this pillar aims to cover a set of initiatives with a threefold focus. Firstly, the pillar shall focus on the enhancement and promotion of innovation and respective innovation structures across the Greek Industry and the closer and more targeted collaboration of the Greek Government, Industry and Research & Academia (triple helix innovation model). To achieve this, we shall propose a set of targeted initiatives for directly supporting innovation in specific Industry 4.0 value chains and technology groups, i.e. measures to encourage collaboration and knowledge transfer between firms and between firms and research institutions and initiatives for the set up innovation structures to promote the triple helix model. With regards to the existing innovation structures, i.e. the Greek Digital Innovation Hubs, the introduction of a structured policy evaluation mechanism shall be proposed, in order to evaluate their impact and efficiency.

Secondly, the pillar shall focus on the targeted initiatives and mechanisms to support the booming start-up ecosystem in Greece. Apart from the innovation structures, into which Greek start-ups can participate to access necessary resources, capabilities and networking, Greek start-ups could benefit from targeted funding schemes, networking and mentoring programs tailored to their needs, etc.

Finally, this pillar shall also incorporate a set of initiatives for the enhancement of the applied R&D and dissemination of innovation across the Greek Industry. Relevant initiatives may include the establishment of Industry 4.0 test labs or testbeds and the introduction of funds to support the applied research for addressing big industrial and societal challenges (i.e. the circular and green economy) that the Industry faces today.

The measures of pillar 2 shall allow the Greek Government to target the specific barriers that affect innovation performance (as these were identified in Deliverables 1 & 2), i.e. the lack of different forms of co-operations, the lack of Greek Industry 4.0 ecosystems and networks in which to innovate, the limited commercialization of R&D and innovation and to target on specific Industry 4.0 areas considered to have high social and economic returns.

In this context, it is worth mentioning that Industry 4.0 strategy shall not be confused with a national start-up or innovation strategy. In other words, this pillar shall not aim primarily to include a set of horizontal initiatives that cover the wider Greek innovation and R&D ecosystem. On the contrary, we shall apply an

[9] For more information please refer to Deliverable 2, paragraph 7 "SWOT Analysis, Analysis & evaluation of the current situation for Greece".

Industry 4.0 lens and identify targeted initiatives that promote the innovation and applied R&D across the identified Industry 4.0 technology groups and value chains (pls see Figure 3).[10]

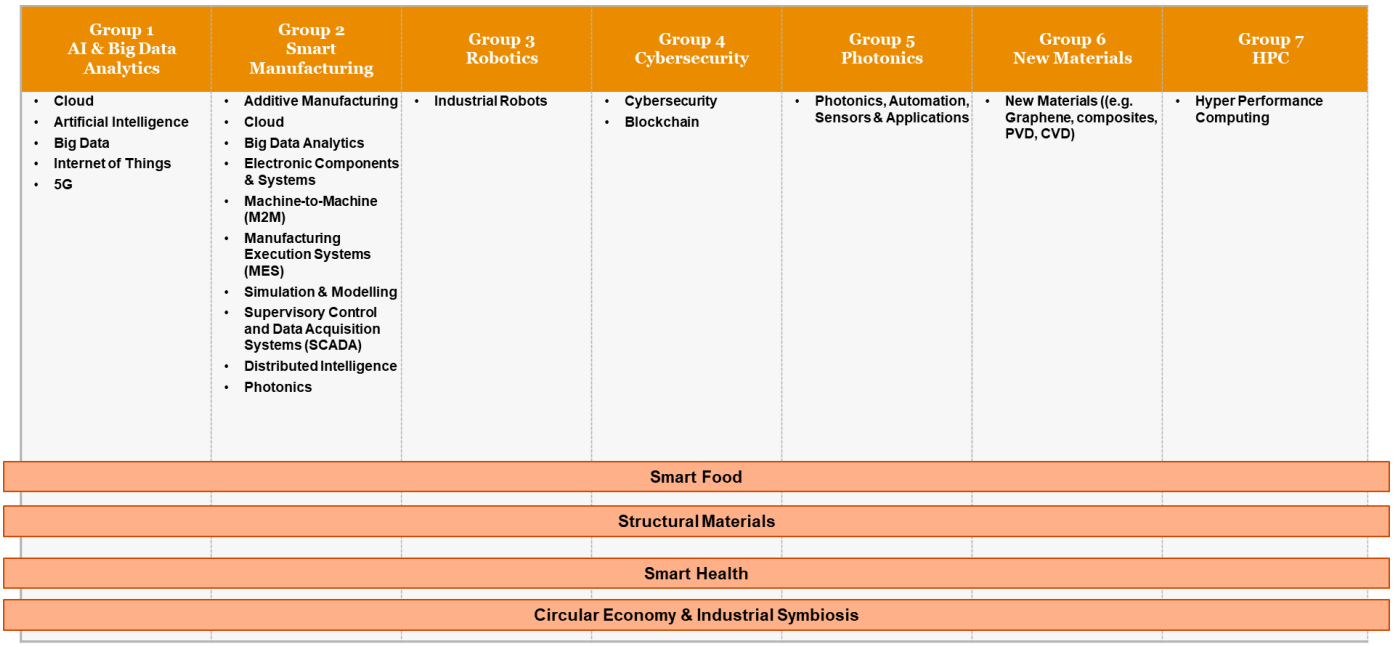


Figure 4: Select technology groups & value chains

In addition, key target of the proposed initiatives shall be the enhancement of the commercialization and application of research and innovation ideas and the maturity increase of Industry 4.0 technology groups (instead of merely the development and experimentation of Industry 4.0 technologies in a research/ academic environment). In order to adopt a common language and understanding, we shall use the Technology Readiness Level (TRL) scale, that was introduced into the EU funded projects arena in 2014 as part of the Horizon 2020 framework program.

Technology Readiness Levels	Definition
TRL 1	Basic principles observed
TRL 2	Technology concept formulated
TRL 3	Experimental proof of concept
TRL 4	Technology validated in lab
TRL 5	Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 6	Technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
TRL 7	System prototype demonstration in operational environment
TRL 8	System complete and qualified
TRL 9	Actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

[10] For an analysis for how these technology families and value chains have been identified, please refer to paragraph 5.1.

According to this scale, the initiatives that we will propose shall mainly cover Technology Readiness Levels 4 to 9. Simply put – this means that the initiatives shall not primarily cover R&D-intensive projects, typical of products positioned in lower TRL levels. Rather, they shall focus more on promoting mature projects with higher probability of getting to the market.

Finally, it shall be mentioned that Pillar 2 includes a set of initiatives that also cover the focus of Pillar 3. These initiatives although mentioned and analysed in this part shall also be reviewed as key contributors for enhancing the collaboration between large, digitally advanced enterprises and Greek SMEs and mid-caps to enhance the latter's digital awareness. This set of initiatives contributing to Pillar 3 will be flagged in our analysis below.

Innovation Structure Definitions

Innovation structures (i.e. Digital hubs, innovation districts, etc.) can act as the catalysts for unlocking the benefits of the Industry 4.0 economy.

In more detail, innovation structures:

- Providing the ingredients to accelerate ideas, to tackle intractable social challenges and for business to succeed
- Localize and promote innovation culture
- Attract, retain and build talent
- Facilitate ecosystem growth and the collision of ideas
- Create spaces for agile economic re-invention outside traditional constraints
- Plug gaps in the innovation infrastructure & environment
- Support diffusion of the benefits of Industry 4.0 into the wider economy

Not all innovation structures are the same. We have identified six different archetypes that are used to drive innovation and economic development:

Innovation Structure	Definition
Digital Innovation Hub[11]	The European Commission defines Digital Innovation Hubs as ***"A group of organizations with complementary expertise and a non-profit objective, offering a set of services to companies – especially SMEs (incl. start-ups) and mid-caps – to support their digital transformation through a one-stop-shop".*** Digital Innovation Hubs can provide the following types of services: - **Test Before Invest:** awareness raising, digital maturity assessment, demonstration activities, visioning for digital transformation, fostering the integration, adaptation and customization of various technologies, testing and experimentation with digital technologies (software and hardware), knowledge and technology transfer - **Support to find investments:** access to financial institutions and investors, support the use of relevant financing mechanisms. For the public sector in particular, as one of the largest purchasers of ICT, this service could furthermore provide support to leverage the purchasing power of the public sector, transforming it into a large innovation buyer

[11] https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs

	- **Skills & Training:** advertising, hosting or providing of training, boot-camps, traineeships, as well as supporting the implementation of the short-term advanced digital skills training courses and job placements - **Innovation ecosystem and networking:** act as facilitator to bring together industry, businesses and administrations which are in need of new technological solutions on one side, with companies, notably start-ups and SMEs that have market-ready solutions on the other side" As of January 2020, on a national level Greece has 14 of them (9 fully operational and 5 in preparation status.[12]
Competence Centre	Competence Centres are structures of public-private partnership that aim at providing specialized innovation & knowledge transfer services (usually across a technology/ group of technologies) and at bridging the gap between demand and supply on the technology group they focus on. These innovation services are usually used to promote applied R&D across specific value chains. Italy currently has eight competence centers defined by the Ministry of Economic Development for access to applied research projects, technology transfer, advanced technology training and 4.0 technology demonstrators. Their establishment and management involve the involvement of universities and research centers of excellence, but also private companies in the form of public-private partnerships.[13]
Science & Technology Park	Out of town dedicated spaces for companies to locate, network and grow – often combining multiple elements of the ecosystem. The official definition adopted by the International Association of Science Parks (IASP) in February 2002 goes as follows: "A science park is an organization managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a science park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities."[14] In terms of size, parks range from those which are essentially city centre incubators to large tracts of urban or suburban land which not only offer incubation space, but also accommodation for companies at very different stages of maturity. Further variety exists in the technologies they support, with some focusing on one technology while others cover most. On-site management can vary from a lone manager to a full team of experts; however, the larger the team, the greater the overhead and, unless these costs are subsidized, this kind of burden can make a park an unattractive location for cost-conscious companies.

[12] For more information, please refer to Deliverables 1 and 2
[13] smile-dih.eu/relationship-with-the-eight-italian-competence-centers/?lang=en
[14] http://www.unesco.org/new/en/natural-sciences/science-technology/university-industry-partnerships/science-and-technology-park-governance/concept-and-definition/

	The park may be a not-for-profit or for-profit entity owned wholly or partially by a university or a university related entity. Alternatively, the park may be owned by a non-university entity but have a contractual or other formal relationship with a university, including joint or cooperative ventures between a privately developed research park and a university. According to UNESCO, Greece currently has four science parks: Patras Science Park, Science Technology Park Crete, Thessaloniki Technology Park, Science & Technology Park of Epirus.[15]
Innovation District	Dense urban spaces/ districts that bring together all sides of the ecosystem in well connected, mixed-use locations that are attractive places to live, work and play. Innovation districts are zones in cities where public and private actors work to attract entrepreneurs, startups, business incubators, generally with the aim of revitalizing depressed downtown areas. The first, 22@ in Barcelona, Spain (an urban innovation district focused on fostering innovation and connections while facilitating urban, economic and societal re-generation) was launched in 2000; as of 2019, there are more than 80 worldwide. The Ministry of Development & Investments has recently announced the setup of two new innovation districts are currently developed in Greece, one in Athens and one in Thessaloniki.[16]
Industry 4.0 Test Bed/ Test Lab	The test execution environment configured for testing new Industry 4.0 products and applications. Test beds consist of specific hardware, software, operating system, network configuration, the product under test, other system software and application software. Test laboratories (test labs) can be based in specialist Industry 4.0 facilities at research and education organisations like universities. Testlabs are where Industry 4.0 within a manufacturing context can be being designed, developed and trialed in partnership with industry and other stakeholders. Test labs can incorporate the abovementioned test beds. A Testlab is a “minimum Industry 4.0 viable facility” that demonstrates an Industry 4.0 production lifecycle. The following core technology features are characteristic of an Industry 4.0 Testlab and support technological feasibility: • **Digital Twin:** The aerospace and defense industry developed the concepts of digital thread and digital twin for military aircraft. The aim was to improve the performance of future programs by applying lessons learned in current programs via these digital versions of physical things. The digital thread and digital twin now find utility with the digital manufacturing and cyber-physical production system of Industry 4.0. • **Connectivity**: All Testlab objects and resources (machines, products, humans, etc) are connected through sensors, actuators, and interfaces to a connectivity layer for control and optimisation purposes, such as through the Manufacturing Execution System (MES). • **Intelligent modules in production**: Testlabs use flexible, modular production assets like robots, storage vehicles, and

[15] http://www.unesco.org/new/en/natural-sciences/science-technology/university-industry-partnerships/science-parks-around-the-world/science-parks-in-europe/#c99655
[16] https://www.fortunegreece.com/article/innovation-district-dio-nea-kentra-kenotomias-pou-fernoun-konta-megales-eteries-me-ellinikes-startups-etimazi-i-kivernisi/

	fixtures that are flexibly integrated into the production flow as required by the current production process. • **Flexible production methods**: Testlabs incorporate flexible production processes such as 3D printing to support a high variant diversity, significantly increasing flexibility. • **Process visualization**: Testlabs will develop visualisation technologies as decision support systems. Processes are visualised through mobile apps that combine VR and AR solutions on tablets/digital glasses/LCD monitors • **Manufacturing Execution System (MES):** Testlabs have integrated planning and scheduling systems from machine level up over an MES, allowing for immediate reaction to changes in resource availability, and supporting "just-in-sequence" delivery of components • **Big data/analytics:** Testlabs employ sophisticated analytics to identify patterns in the massive volume of data to get value out of the data to optimize production processes and product quality. The Netherlands has identified the setup of Industry 4.0 test labs as a key pillar of its Smart Industry strategy. Key aim of this strategy is the creation of ecosystems – interrelated networks of companies and knowledge institutions - around the core principles of Smart Industry such as automation, zero defect manufacturing, flexible production, chain collaboration, customer intimacy, value creation based on big data and on a number of core technologies such as 3D printing and robotics. A lot of knowledge and expertise is already present but fragmented. Therefore, Smart Industry has opted for an approach with Field Labs. Field Labs are practical environments in which companies and knowledge institutions develop, test and implement effective Smart Industry solutions. Currently Netherlands has 32 test labs across Industry 4.0 technologies & value chains.[17]
Public Sector Innovation Labs	Public Sector Innovation Labs are interdisciplinary laboratories fostering innovation in the public sector. They are usually operated jointly by an academic institution and the respective Public Sector authorities (i.e. in Austria the GovLab Austria is run by the University Krems and the Austrian Federal Ministry of Civil Service and Sport). While labs are generally regarded as experimental in some sense, they vary significantly in their proximity to executive power. Some are centrally located within the executive branches of government; others sit between multiple government agencies and departments; while others operate as non-governmental organisations that are contracted to work on policy and public sector innovation. Public Sector innovation labs target central challenges of the public sector, looking for intersectoral approaches while integrating relevant stakeholders in an academic and practical context in an open and interdisciplinary experimental space. The core targets of the Public Sector Innovation labs shall be: • the prototypical implementation of research and development projects in the field of public sector innovation and evidence-based policy making

[17] https://smartindustry.nl/wp-content/uploads/2019/04/Fieldlabs-poster-EN.pdf

	• international observation of innovative projects, methods and solutions in and beyond the public sector • the integration of expertise from administration, academia, private sector and the public, as well as the dissemination of knowledge through education, training and communication

4.1.3.2 Initiative 2.1: Introduce an "Industry 4.0 labs/testbeds" programme

Title of the Initiative	**Introduce an "Industry 4.0 labs/testbeds" programme**
Initiative's Coding	Initiative 2.1
Area of focus	Design of new and/or enhance existing innovation structures to ensure the diffusion of expertise and best practices between all the players of the Industrial ecosystem
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Increase the Greek Industry's potential to meet personalized needs and imminently respond to emergencies and crises (flexible processing)
Description of the initiative	*Rationale behind the need for the initiative* Evidence indicates that the Greek enterprises lag across the adoption of Industry 4.0 and Smart Manufacturing technologies and applications. In addition, Greek industrial and manufacturing enterprises perform limited investments on applied R&D and Industry 4.0 technologies' implementation. This can be partially attributed to the limited Industry 4.0 and R&D infrastructure and facilities that enterprises possess to develop, simulate and test Industry 4.0 applications, as well as the lack of technical expertise to conduct in house these activities. The introduction of the "Industry 4.0 labs/testbeds" programme will offer to organizations of the Greek Industry & Manufacturing and more specifically the Greek Industrial SMEs and midcaps, equipment, resources (data) and competence (feasibility assessment, prototypical solutions for use cases) not usually available to them, allowing them to compete with bigger firms on innovation. *Details of the initiative* The "Industry 4.0 labs/ testbeds" programme will financially support: - individual Greek Industrial & Manufacturing companies - consortiums of Greek Industrial & Manufacturing companies - partnerships between Greek Industrial & Manufacturing companies and academic/research institutions to setup Industry 4.0 test labs/testbeds. This shall be done through the issuing of relevant call for tenders that will ask participants (please see above) to submit their business plan for setting up and operating an Industry 4.0 test lab/ testbed. Each call for tender shall specifically prescribe the minimum criteria that the participants shall fulfill in order to participate in this call. These could refer to the type and business activity of private organizations that will be eligible to participate in the tender, the type and

	the composition of the consortiums (i.e. at least one of their members shall be a Greek Manufacturing SME/ midcap), the legal structure of the consortium, etc. The awardees will receive a financial aid for the setup of the test beds/test labs and the first years (1-2 years) of their operations. Indicative costs are presented also in the analysis. The Government is often a crucial partner to start an initiative to establish a test lab, since they align test labs with their (regional) smart specialization strategy, but it shall be the private partners (individual companies, joint foundations, etc.) who are in the lead. For this programme, we propose that the Government funds the setup of these test labs through relevant call for tenders, with no participation/ representation in their legal structures. **Indicative Areas of Focus of the Test Labs/ Testbeds** Test labs/ test beds usually cover wider fields of technology or ecosystem plays. We propose that the Greek Industry 4.0 test labs/ testbeds shall evolve around a wider set of Industry 4.0 technology groups, as these have been identified in paragraph 4.1.3.1. Special emphasis shall be provided to Smart Manufacturing Technologies (i.e. Smart Manufacturing (Cloud/ Electronic Components & Systems/ Machine-to-Machine (M2M)/ Manufacturing Execution Systems (MES)/ Simulation & Modelling/ Supervisory Control and Data Acquisition Systems (SCADA)/ Distributed Intelligence/ Industrial Internet of Things, Photonics), as these permeate all key value chain activities of manufacturing and industrial enterprises. **Indicative Services Provided** The Industry 4.0 test labs/ testbeds shall provide end-to-end services for the design, development and testing of smart, Industry 4.0 products & applications. Namely: - Concept Validation of new Industry 4.0 products & applications - Proof of concept of new Industry 4.0 products & applications - Simulation of new Industry 4.0 products & applications - Testing of new Industry 4.0 products & applications - Standardization of new Industry 4.0 products & applications - Accreditation of tested Industry 4.0 products & applications **Description of their structure** The test labs/ testbeds will provide an operational industrial environment where I4.0 applications and products are developed, tested and/or implemented and where also people learn how to apply and implement Smart Manufacturing technologies. The test labs will aim at enhancing academic & private sector collaboration in non-commercial industrial operational environments (TRL 4-7). The test labs/ testbeds shall have a physical location (either at research institutions or in the premises of Greek Industrial/ Manufacturing enterprises) and a dedicated test lab program coordinator. The test labs/ testbeds can have any legal organization structure and shall have their finance and control boards. Leading practices indicate that some are organized as a foundation, some are cooperation agreements, and some are even established as a not-for-profit company. Test labs/ testbeds can be developed as part of an existing digital innovation hub or a new competence centers (i.e. the competence centre for Artificial Intelligence & Big Data Analytics proposed under initiative 4.1.3.4). **Indicative, non-exhaustive costs and expenses covered by the programme**

	The programme could indicatively cover the following cost/expense types: 5) Expenses for purchasing & maintenance of infrastructure, machinery and equipment 6) Connectivity expenses 7) Personnel expenses for operating the testbeds/ test labs **How to motivate enterprises to use the new testbeds/ test labs** Greek Manufacturing SMEs, midcaps and startups could be further motivated to use the testbeds/ test labs through the "acceleration of investments for Industry 4.0 SMEs & Mid-Caps" (initiative 6.3). This means that enterprises could use and claim funding for testing their developed Industry 4.0 applications and products in the new testbeds/ test labs. In addition, discount in fees could be performed by the testbeds/ test labs to enterprises leveraging the "Smart Manufacturing" programme to test their new products & applications.
Stakeholders (Design & Implementation)	• General Secretariat for Research and Technology • General Secretariat for Industry • Ministry of Digital Governance
Key beneficiaries (Target group)	• Greek enterprises (including SMEs, midcaps & start-ups), Greek enterprises from the Business Services & ICT Sector • Greek Academic Institutions • Research Centres • Industry Federations
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • Future NSRF • Horizon Program • Digital Europe Program • Private Funding
Indicative Budget	€ 1.000.000 – 5.000.000 per testlab, 10 testlabs to be created € 10.000.000 – 50.000.000 in total
Dependencies with other initiatives	Initiative 6.3: Acceleration of investments (funding scheme) for Industry 4.0 SMEs & Mid-Caps
Timeline of implementation	Mid-term/ Long-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

4.1.3.3 *Initiative 2.2: Support the setup of a dedicated competence centre for Artificial Intelligence & Big Data Analytics for the Greek Industry*

Title of the Initiative	**Support the setup of dedicated competence centre for Artificial Intelligence & Big Data Analytics for the Greek Industry**
Initiative's Coding	Initiative 2.2
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	Design of new and/or enhance existing innovation structures to ensure the diffusion of expertise and best practices between all the players of the Industrial ecosystem
Link with strategic goals	- Enhance the Greek Industry's applied R&D and the innovation capabilities - Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* Although Greek manufacturing & industrial enterprises overall lag behind the adoption of Industry 4.0 and digital technologies and applications, it appears that they demonstrate an increased sensitivity and place specific emphasis on big data analytics. In fact, in 2019, 13% of Greek enterprises (compared with 12% of the EU) actively invested in the collection and Big Data analytics.[18] This combined with the fact that global leaders in the ICT industry increasingly invest in the Greek workforce creating global Analytics Centres of Excellence (i.e. Accenture, Cosmote, SAP, Nokia, Microsoft, IBM etc.) and the fact that Artificial Intelligence is a technology of significant focus for the European Commission, indicates that Greece could intensify its efforts in this particular technology group and become a leader in technical know-how and the development and commercialization of relevant manufacturing applications, services and products. *Details of the initiative* The Government shall issue a call for tender for the setup and operation of an AI Competence Center for the Greek Industry. Potential participants can be consortiums of Greek Industrial & Manufacturing companies, ICT and IT Service companies and relevant academic/research institutions. The relevant call for tender will require that the participants (see above) submit their business plan for setting up and operating the AI Competence Center for the Industry. In addition, it can also require the submission of a set of first AI concepts and proof of concepts/ prototypes for the industrial/ manufacturing companies, that could be the first applications to be fully developed and tested in the Competence Center. The call for tender shall specifically prescribe the minimum criteria that the participants shall fulfill in order to participate in this call. These could refer to the type and the composition of

[18] Eurostat, Big data analysis, https://ec.europa.eu/eurostat/web/products-datasets/product?code=isoc_eb_bd

	the consortiums (i.e. at least one of their members shall be a Greek Manufacturing SME/ midcap), the legal structure of the consortium, the business activity of its members, etc. The awardee will receive a financial aid for the setup of the Competence Center and the first years (1-2 years) of their operations. Indicative costs are presented also in the analysis. The Competence Center shall aim at providing next generation AI & Big Data Analytics solutions and services for the Greek industrial/ manufacturing sector and act as the bridge between SMEs & midcaps and large enterprises. The Competence Center will support the Greek manufacturing enterprises to experiment with the development of AI & big data analytics solutions to: - further digitize their production lines by leveraging Industry 4.0 technologies - automate and interconnect their supply chains - design and produce smart products and services This competence center and its aspiration shall also be aligned with Greece's AI strategy, soon to be designed by the Greek Ministry of Digital Governance. **Indicative Areas of Focus** AI & Big Data Analytics applications and solutions can cover a wider field of technology or ecosystem plays. Indicatively, participants in the Competence Center shall be able to experiment with the following I4.0 technology family (as this has been identified in paragraph 4.4.2.1): - Artificial Intelligence - Big Data Analytics - Internet of Things - Cloud - 5G Potential cases (non-exhaustive) of how to implement AI in Manufacturing are presented below: - An important task performed by AI in the production environment is the evaluation of collected data. The collection of machine data like pressure, temperature, or flow provides the supply of information about the system status and enables condition monitoring. - Collected data, processed by the appropriate mathematical data analytics (Anomaly Detection), can also support plant operators to predict on time possible system malfunctions. The impending failure can be remedied in advance by Predictive Maintenance, which in turn, minimizes plant downtime and repair time. - Augmented Reality (AR) also can guide the operator, perhaps assisted by data glasses, through the servicing procedures at the unit. In this case, for example, the worker sees information and instructions projected in the smart glasses, leaving both hands free to perform and complete the required work steps. The result is an intuitive and improved issue resolution. **Indicative Services Provided** The Competence Center can provide a range of services to its visitors/ clients.

- Visioning & strategy development: Design Greek Manufacturing enterprises' AI & Data Strategies and perform data diagnostics to assess their data quality and quantity consolidated
- Collaborative R&D: Provide support for the design and implementation of R&D projects for the development of AI solutions for manufacturing
- Testing and validation: Provide technical and specialized services for design, testing & validation of new solutions including product demonstration & product qualification
- Technical support on scale up: Provide support for solutions' technology concept development, proof of concept, prototyping & small series production
- Skills & education: provide digital upskilling & reskilling training (i.e. workshops, seminars, courses, etc.) to the centre's customers, tailored to their digital maturity level & their business area; offer technological infrastructure for educational purposes. This could be significantly beneficial for Greek manufacturing SMEs and midcaps.
- Community building: Support the creation of a collaborative, innovation-driven ecosystem, instigate awareness, act as the broker to bring in contact enterprises, etc.
- In addition, the Competence Center will act as an ecosystem accelerator for start-ups, active in the AI & Big Data fields for the development of manufacturing solutions.

Description of its structure

Prerequisite for the establishment, development and efficient steering of the national competence is the development of a governance model with the active engagement from leading industry & academic/ research stakeholders. In this context, it is suggested that the Competence Center shall be run by a consortium/ private-public partnership (as a unique private sector legal entity, i.e. S.A, IKE, etc.) that will be formulated by at least 1 research/ academic entity (i.e. Academic Institution, Research entity, etc.) with a specialization on technologies of AI & Big Data Analytics or Manufacturing/Engineering, and at least 5 private enterprises (according to other EU competence centre cases, i.e. in Germany etc.) that also demonstrate an expertise in the respective fields. It could be also required that at least one of them is a Greek SME.

Indicative, non-exhaustive costs and expenses covered by the programme

Funding provided by the call for tender shall cover the setup and first years of operation of the Competence Center. The programme could indicatively (and non-exhaustively) cover the following cost/expense types:

- Costs for the setup of the Competence Center, i.e.:
    - Infrastructure, Equipment purchasing & maintenance costs
    - Intangible SW Costs (i.e. S/W Licenses, Application S/W, Patents & IPs)
    - Personnel Costs for running the Competence Center
- R&D Costs, i.e.:
    - Feasibility Study Costs
    - Contractual Costs to perform R&D engagements

Relevant call for tender for the setup of competence centres has already been published by the General Secretariat for Research & Technology in June 2020.

Stakeholders (Design & Implementation)	• General Secretariat for Research and Technology • General Secretariat for Industry • Ministry of Digital Governance • Private Organizations active in the AI and Big Data Analytics space
Key beneficiaries (Target group)	• Greek enterprises (including SMEs, midcaps & start-ups), Greek enterprises from the Business Services & ICT Sector • Greek Academic Institutions • Research Centres • Industry Federations
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation • Future NSRF • Horizon Program • Digital Europe Program
Indicative Budget	€ 2.000.000 – € 5.000.000
Dependencies with other initiatives	• Initiative 2.1: Introduce an "Industry 4.0 labs/testbeds" programme • Initiative 2.5: Introduce the "Adopt an Industry 4.0 start-up" programme This initiative is linked to initiatives 2.1and 2.5. The AI competence centre for Manufacturing can incorporate AI & Big Data test labs in it. In addition, future entrepreneurs with innovative AI ideas can start their start-ups within the Competence centre.
Timeline of implementation	Short term/ Mid term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

4.1.3.4 Initiative 2.3: Introduce the "GovTech Programme for Manufacturing SMEs/start-ups"

Title of the Initiative	**Introduce the "GovTech Programme for Manufacturing SMEs/start-ups"**
Initiative's Coding	Initiative 2.3
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	• Enhance the applied R&D and Innovation
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* The Public Sector can be considered a key player for spurring demand at an industry and manufacturing level and promoting a pro-growth agenda of productivity, income, and demand. This can be achieved through government contracts with manufacturing and industrial enterprises to cover public sector needs in key areas and sectors, i.e. the defence and health industries. This measure is already undertaken by several countries worldwide. The United Kingdom has been one of those.[19] The introduction of a GovTech Manufacturing SMEs/ start-ups scheme will: - Spur the demand for the design and development of innovative Industry 4.0 and smart manufacturing solutions to address some of the key challenges that the Public Sector currently faces e.g. Smart Cities, Circular Economy, Defence, Health, etc. - Facilitate the access of new innovative Manufacturing and industrial start-ups and SMEs to the public procurement market. - Share the risks and benefits of designing, prototyping, and testing new products and services between Public Sector and the manufacturers. - Create optimum conditions for wider commercialisation and take-up of R&D results. - Reduce market fragmentation, reducing costs for procurers and creating wider markets for companies. - Act as a seal of approval for innovative companies confirming the market potential of new emerging technological developments, thereby attracting new investors. *Details of the initiative* The GovTech Manufacturing SMEs/start-ups initiative is a programme, which challenges industry from the demand side to develop innovative solutions for public sector needs and it provides a first customer reference that enables Manufacturing SMEs and start-ups to create competitive advantage on the market. This programme shall enable public procurers to

[19] https://gds.blog.gov.uk/2020/06/23/how-the-govtech-catalyst-is-helping-to-grow-the-govtech-sector/

	compare alternative potential Industry 4.0 solution approaches and filter out the best possible solutions that the market can deliver to address the public need. Public procurers can drive innovation from the demand side by acting as technologically demanding customers that buy the development and testing of new solutions. This enables public bodies to modernize public services faster and to create opportunities for companies to take international leadership in new markets. Creating a strong Greek market for innovative products and services is an important step towards creating growth and jobs in quickly evolving markets. **How the programme shall work** The programme shall be organized in seven discrete steps, during which active collaboration between the Greek Government and the small businesses (SMEs or start-ups) shall take place: 1) Challenge Identification: Anyone in the public sector can submit a problem (also called a 'challenge') they need help to solve. This shall be submitted to the GovTech coordination team. 2) Challenge selection: Challenges shall be selected based on predefined selection criteria. Challenges shall be assessed by a GovTech coordination team and a cross-government assessment panel of senior officials. A shortlist shall be drawn up and contacted by the GovTech coordination team. 3) Finding suppliers to work on the challenge: The next phase is about finding SMEs and start-ups active in the Industry 4.0 space (suppliers) to work on the selected challenges. Potential suppliers shall submit their proposals, explaining how the plan to design and develop the challenge solution. Additional points could be gained during the evaluation of the proposals, in case the described solution uses existing research and R&D coming from the Greek academic and research community. Successful suppliers (up to 5 each time) shall get up to 50,000 Euros to build a proof of concept. 4) Building a prototype: The selected suppliers shall develop the prototype. The GovTech coordination team shall support the suppliers to build a functioning prototype. 5) Evaluation of prototypes: Out of the 5 developed prototypes, up to 2 of them can be selected to proceed to a full-scale implementation. For this, the selected suppliers can be funded with up to 300,000 Euros. 6) Implementation of the full-scale solution: Step 6 shall result in a product or service that the public sector team has tested in an operational environment and is confident will help to address user needs. 7) Procurement and adoption: The public sector team must intend to procure the successful step 6 solutions.
Stakeholders (Design & Implementation)	• General Secretariat for Research and Technology • Ministry of Digital Governance (together with its supervising entities, i.e. EDYTE)
Key beneficiaries (Target group)	The Greek Public Sector, Greek enterprises (including SMEs, midcaps & start-ups) active in the GovTech sector, Greek Academic Institutions, Research Centres

Potential funding sources	• European Investment Fund • Public Investments Programme
Indicative Budget	For each challenge ~850.000 Euros will be funded. For 5 – 10 challenges addressed the overall amount will be € 4.000.000 – 8.000.000
Dependencies with other initiatives	This initiative shall also be reviewed as part of Pillar 3, as it contributes towards enhancing the collaboration between large, digitally advanced enterprises and Greek SMEs and mid-caps to enhance the latter's digital awareness
Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 4

4.1.3.5 *Initiative 2.4: Introduce a program to prepare and educate future Smart Industrial & Manufacturing entrepreneurs*

Title of the Initiative	**Introduce a program to prepare and educate future Smart Industrial & Manufacturing entrepreneurs**
Initiative's Coding	Initiative 2.4
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	• Support the Greek start-up ecosystem and create the right conditions for ambitious entrepreneurs of the Greek Industry
Link with strategic goals	• Digitally upskill and reskill the human workforce in the Greek industry • Enhance the Greek Industry's applied R&D and the innovation capabilities
Description of the initiative	*Rationale behind the need for the initiative* Greece is home to a burgeoning start-up scene. From 2012 to 2016, investment in Greek start-ups grew by a factor of 18, from 5 to 90 million Euros in annual start-up funding per year in 2012 and 2016 respectively, totalling 250 million in the span of five years.[20] Nevertheless, up to now, the traditional approach adopted by most investors in Greece is deemed passive. It mainly includes sporadic presence at industry events, corporate start-up competitions and hackathons, or a few talks, leading to a limited potential pool of founders being made aware of opportunities. In fact, this approach, sets as a prerequisite that potential companies and founders are already sophisticated enough to pursue the opportunities offered and be able to identify the available funding sources on their own. What is more important, is the limited support that future entrepreneurs appear to have during the pre-seed period. STEM graduates, that may also wish to set up and start an Industry 4.0 related enterprise are generally quite competent technically, however, when it comes to creating future entrepreneurs, they lack in know-how, training and access to the market. Developers and engineers appear also not to be adequately prepared for an entrepreneurial approach. In the technology & Industry 4.0 areas, the norm is leading developers to expect a career within larger corporations.[21] To address this gap and further prepare the future Smart Industrial & Manufacturing entrepreneurs, we introduce this respective initiative. The initiative will prepare and educate future entrepreneurs that wish to set up a Smart Industrial & Manufacturing start-up and will set the foundations and enhance the Manufacturing start-up ecosystem in Greece in the following ways: - It will promote the spirit of entrepreneurship, which can lead to strengthening the financing of start-ups and to tackling skill shortage - It will act as an accelerator towards the development of new Industry 4.0 products and services, expanding the business environment for start-ups

[20] SEV& BCG, „The Greek startup Ecosystem" Report, http://www.sev.org.gr/Uploads/Documents/50906/BCG_Greeces_Startup_Ecosystem_Apr_2018.pdf
[21] https://thefoundation.gr/wp-content/uploads/2020/05/Foundation_EIT_Startups_Greece_report.pdf

	Details of the initiative Introduce a programme (similarly to Lithuania's "Futurepreneurs program"[22]) to prepare and educate future entrepreneurs and their teams through a business development training package. It will be a short period (e.g. three-months long) pre-incubation program for young people (e.g. under 35), that have innovative business ideas across the Industry 4.0/ Smart Manufacturing technology groups and value chains (as these are presented in paragraph 4.4.2.1), are willing to become entrepreneurs and want to build an impact-driven business socially, environmentally and economically wise. **Indicative Services Provided** The programme will provide the aspiring entrepreneurs with the following types of support/ services (non-exhaustively): - Support in the process of developing their Smart Manufacturing business idea/ business case - Aid in verifying the market demand for the Smart Manufacturing solution and adjusting it to the expectations of investors and institutions providing grants - Professional assessment of the market potential, project innovativeness or its profitability - Access to services required for market verification of the invention - Support in indicating a path for further commercialisation - Aid in applying for funds – both national funds and EU funds, within the scope of existing programmes - Financial & legal aid for starting a business activity in the form of a company This program could provide a certification upon completion and can become a prerequisite in order for future start-ups to apply for the "Industry 4.0 funding scheme for start-ups" (please refer to pillar 6). In addition, new Smart Manufacturing start-ups that aim to participate in relevant competence centres/ test-labs (please refer to initiatives 2.1, 2.2) shall also have to demonstrate this certification. The services could be provided a consortium of Industry 4.0/ Smart Manufacturing experts including representatives from research & academic institutions, the Manufacturing and ICT sector, finance & legal experts, as well as established Smart Manufacturing start-upers/ entrepreneurs.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments General Secretariat for Research and Technology/ Ministry of Development & Investments Ministry of Digital Governance
Key beneficiaries (Target group)	Aspiring entrepreneurs with innovative business ideas across the select Industry 4.0 technology groups and value chains
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • Future NSRF • EquiFund

[22] https://futurepreneurs.eu/lithuania/

Indicative Budget	The cost per participant that the Government could cover is 20.000 – 30.000 Euros. For 50 to 100 participants over a duration of 2 years the overall cost could be: € 1.000.000 – 3.000.000
Dependencies with other initiatives	This initiative can be interconnected with Initiative 6.2: Acceleration of investments (funding scheme) for Industry 4.0 start-ups
Timeline of implementation	Short-term
Feasibility and Necessity of initiative	Feasibility= 4 Necessity= 5

4.1.3.6 Initiative 2.5: Introduce the "Adopt an Industry 4.0 start-up" programme

Title of the Initiative	**Introduce the "Adopt an Industry 4.0 start-up" programme**
Initiative's Coding	Initiative 2.5
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	• Support the Greek start-up ecosystem and create the right conditions for ambitious entrepreneurs of the Greek Industry
Link with strategic goals	• Digitally upskill and reskill the human workforce in the Greek industry • Enhance the Greek Industry's applied R&D and the innovation capabilities
Description of the initiative	*Rationale behind the need for the initiative* Key issue for Greek start-ups has been their "scale up" (i.e. Greek start-ups that have already launched their products, aim to gain additional momentum and expand their footprint both within Greece and internationally). Key reasons for this, amongst others, has been their difficulty to scale up in the Greek market due to its size, their limited networking with big organizations (both Greek and international) to develop products tailored to the Industry's needs and their limited know-how on setting up an effective business & revenue model that shall allow them to scale up their business. The introduction of the "Adopt a start-up" programme will allow large Greek and international Industrial & manufacturing organizations (with a presence in Greece) to host in their premises and support new Industry 4.0 start-ups for a specific period of time (i.e. 6 – 12 months). This programme shall allow young entrepreneurs to take another step in the development of their business. Large organizations shall provide guidance, networking as well as valuable knowledge to help the start-ups expand their network, further develop their business model, improve their product or service and enter into new partnerships. This initiative is implemented by large organizations worldwide (i.e. Google).[23] In addition, in Greece a similar engagement ran in 2018 under the auspices of the French-Greek innovation network Mazinov.[24] *Details of the initiative* The "adopt an Industry 4.0 start-up" programme will provide certain tax benefits to large Greek Industrial & Manufacturing organizations, to host in their premises and support new start-ups, that are producers of Smart Manufacturing/ Industry 4.0 solutions, for one to two years. Large enterprises could provide the following type of services/ capabilities to the "hosted" start-up: - Office space - Percentage funding of the start-up's operational costs - Business Support & Mentoring

[23] https://events.withgoogle.com/adoptastartup/
[24] https://energypress.gr/news/yiothesia-20-ellinikon-start-ups-apo-megales-gallikes-epiheiriseis-elliniki-apostoli-stin

	- Co-development of new Smart Manufacturing solutions that could also be implemented by the hosting organization - Testing Facilities - Networking opportunities & introduction of the start-up to new international markets and partners **How this programme shall work** The programme shall be organized in discrete steps, during which active collaboration between the Greek Government, industry federations, large Industrial and manufacturing organizations and Industry 4.0 start-ups shall take place: 1) The Ministry of Development and Investments and the industry federations shall run an awareness campaign to their members (large Industrial and manufacturing organizations and Industry 4.0 start-ups) with regards to the importance of this programme and the key reasons for joining this. 2) Large Industrial and manufacturing organizations shall express their interest to the … and their industry federation on adopting an "Industry 4.0 start-up". 3) The Ministry of Development and Investments and the industry federations shall ensure that the organizations expressing their interest fulfil a set of criteria (i.e. financial robustness, size, existence of modern, digitized infrastructure & testing facilities, etc.) 4) Start-ups also interested in being adopted, should state their interest to the Ministry of Development and Investments. To be selected, start-ups should also meet specific criteria (i.e. have launched to the public and have revenue generating customers, are already exporting or ready to export internationally, their headquarters are based in Greece, they design and produce Industry 4.0 solutions and services, etc.) 5) The Ministry of Development and Investments shall organize a set of "matchmaking" events, where start-ups will be able to present their business idea/ product and meet their potential hosts. At the end of this matchmaking events, the large organizations shall come to an agreement with their selected start-ups, to be "adopted". 6) At the end of this programme, the start-ups participating will present the progress they have made to a panel of judges, comprised by the Ministry of Development & Investments, industry federations and representatives from large industrial/ manufacturing organizations.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments General Secretariat for Research and Technology/ Ministry of Development & Investments Ministry of Digital Governance
Key beneficiaries (Target group)	Greek start-ups active in the Industry 4.0 area and large Industrial & manufacturing organizations
Potential funding sources	- N/A
Indicative Budget	As the funding of large organizations cannot be easily supported, we propose that tax benefits are provided to large organizations that participate in this initiative.

Dependencies with other initiatives	This initiative shall also be reviewed as part of Pillar 3, as it contributes towards enhancing the collaboration between large, digitally advanced enterprises and Greek SMEs and mid-caps to enhance the latter's digital awareness This initiative can be interconnected with Initiative 6.2 "Acceleration of investments for Industry 4.0 start-ups"
Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 5

4.1.3.7 Initiative 2.6: Introduce an Industrial Strategy Challenge Fund to enhance innovation & collaboration across the Greek Industry

Title of the Initiative	**Introduce an Industrial Strategy Challenge Fund to enhance innovation & collaboration across the Greek Industry**
Initiative's Coding	Initiative 2.6
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	• Enhance the applied R&D and Innovation
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains • Increase the Greek Industry's potential to meet personalized needs and imminently respond to emergencies and crises (flexible processing)
Description of the initiative	*Rationale behind the need for the initiative* Our research in Deliverables 1 and 2 indicated that the Greek R&D appears disassociated with applied research & industry implementation. In fact, the Greek R&D is mainly dominated by the higher education sector, while Greek organisations appear reluctant to invest in applied R&D. This leads to limited commercialization of Industry 4.0 ideas and sporadic infusion in the Greek Industry. To address this disassociation and bring closer the Greek Government, Industry and research & academic community to target and tackle a set of existing industrial challenges, we propose the introduction of the Industrial Strategy Challenge Fund. *Details of the initiative* The introduction of the Industrial Strategy Challenge Fund (following the example of the United Kingdom[25]) can act as a long-term plan to increase the applied R&D and innovation in the Greek Industry and Manufacturing sector. The overall aim of the challenge will support the Greek Government to tackle the major industrial and societal challenges (thematic areas) that Greece faces today and put the country in the best position to take advantage of future market opportunities. The challenges will be defined by a consortium of Greek academics & researchers, Greek Industry representatives and the Greek Government. The challenges shall mainly evolve around areas of the Greek Industry and Manufacturing, where: - Greece demonstrates a competitive advantage and the Greek businesses appear ready to innovate (i.e. Smart Health, Smart Food, Structural Materials, etc.) - there is a large or fast-growing and sustainable global market

[25] https://www.ukri.org/innovation/industrial-strategy-challenge-fund/

It should be mentioned that the thematic areas selected shall be in total accordance with the national digital strategy (as this is presented in the Bible of Digital Transformation), with the updated RIS3 strategy, with the new NSRF plan as well as with the areas to be addressed by Greece's recovery fund.

How this programme shall work

The programme shall be organized in a set of discrete steps:

1) The listed challenges and thematic areas of priority for the Greek Government are broken down into more detailed fields of focus. An example for this could be that the thematic area: "Energy Efficiency" could incorporate the field of focus "deployment of energy efficiency technologies in industry".
2) For each of these fields of focus, respective programmes will be issued by the Greek Government.
3) The participants shall submit their proposals for engagements that will aim to develop Industry 4.0 solutions and services to contribute to the field of focus. The participants could be:
    - individual industrial/ manufacturing enterprises
    - consortiums of industrial/ manufacturing enterprises
    - partnerships between industrial/ manufacturing enterprises and academic/research institutions
    - The consortiums/ partnerships could also include at least one industrial/ manufacturing SME or start-up relevant to the field of focus.
4) Upon the submission of the proposals, a selected panel of assessors will review all proposals. A portfolio selection approach will be applied to the top scoring proposals, with a certain number of proposals being invited to an interview and a presentation with an expert panel. This panel could consist of academics and researchers specialized in Industry 4.0 topics, as well as Public Sector employees certified in Industry 4.0 technologies.
5) Final recommendations of proposals to fund will be made by the expert panel and will be awarded the allocated fund per field of focus. Additional points could be gained during the evaluation of the proposals, in case the described solution uses existing research and R&D coming from the Greek academic and research community.
6) The selected companies/ consortiums/ partnerships shall develop a challenge specific I4.0 solution (TRL>5) and shall testify that this can be industry applicable within a predefined period of time (i.e. 6 to 8 months).

It should be mentioned that for each of the challenges the Greek Government could closely work with industry and partners to find co-investment alongside the money that Government is prepared to make available and to work up the detailed business case with direct input from industry. In this context, a senior industry leader for each challenge could help the Greek Government secure investment from industry and refine the vision for the challenge.

This initiative is expected to work complementary to the financial incentives proposed under pillar 6. This initiative is targeted to the financial enhancement of Industrial and Manufacturing enterprises for promoting applied R&D and develop targeted Industry 4.0 solutions that will directly resolve challenges that the Greek Industry and economy currently face. On the contrary, pillar 6 financial incentives are more horizontal and cover the wider

	needs that Greek industrial and manufacturing enterprises have regarding their rotation to Industry 4.0.
Stakeholders (Design & Implementation)	• General Secretariat of Industry/ Ministry of Development & Investments • General Secretariat for Research and Technology/ Ministry of Development & Investments • Ministry of Digital Governance
Key beneficiaries (Target group)	Greek enterprises (including SMEs, midcaps & start-ups) across the select value chains that the challenges cover, Greek Academic Institutions, Research Centres, Industry Federations
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • Future NSRF • European Investment Fund • Public Investments Programme
Indicative Budget	€ 500.000. – 1.000.000 per field of focus. Each challenge can incorporate 4-5 fields of focus (2.500.000 – 5.000.000) The overall programme can incorporate 5 challenges € 12.500.000 – 25.000.000 costs in total
Dependencies with other initiatives	This initiative shall also be reviewed as part of Pillar 3, as it contributes towards enhancing the collaboration between large, digitally advanced enterprises and Greek SMEs and mid-caps to enhance the latter's digital awareness
Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

4.1.3.8 Timeline of implementation of the initiatives of Pillar 2 and "Quick wins"

This paragraph presents an indicative implementation timeline of Pillar 2 initiatives. The suggested initiatives are spread across the first three years of the Operational Plan. First in priority to start, are initiatives with a high necessity in order to boost the applied innovation and R&D across the Greek Industry and introduce the concept of innovation ecosystems. These ecosystems will support the quicker Industry 4.0 transformation of the Greek Industry's organization (with an emphasis given on SMEs, start-ups and mid-caps) through their closer collaboration with each other and also with Greece's academia and research institutions. In addition, the Ministry of Development appears to have already taken important steps to promote these innovation ecosystems. In June 2020 the General Secretariat for Research & Technology has issued a relevant call for tender for the setup of national competence centres. For all these reasons, we suggest that during the first year, initiatives 2.1 (Industry 4.0 test beds/ test labs), 2.2 (Competence Center for AI & Big Data Analytics for the Greek Industry) and 2.6 (Industrial Strategy Challenge Fund). In addition, initiative 2.4 (future entrepreneurs programme) could be initiated in the 1st year of the Operational Plan, as it is an initiative of lower complexity to design and it will have an immediate impact on the start-up community.

During the 2nd year of the Operational plan, stakeholders should align to start the design of the "Adopt an Industry 4.0 start-up" programme, while in the 3rd year of the plan, we propose the initiation of initiative 2.3 (GovTech Programme for Manufacturing SMEs/start-ups). This initiative is expected to have a significant, nevertheless implicit benefit on the Greek Industry, as it is expected to increase the demand of the Public Sector for Industry 4.0 innovation solutions and services.

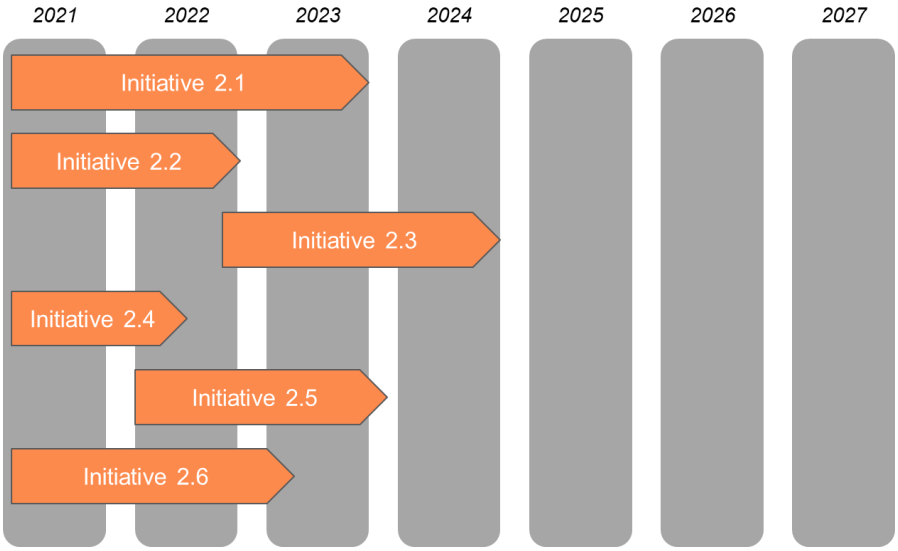


Figure 5: Timeline of initiatives' implementation for Pillar 2

Moving forward, we depict the distribution of the initiatives of Pillar 2 according to their "Feasibility" and "Necessity" scoring and we identify the set of "Quick Wins", which refer to initiatives that demonstrate high Feasibility (therefore they are easier to be implemented) and high Necessity (therefore they are expected to have a significant impact towards Greek Industry's rotation to Industry 4.0). These initiatives are the ones that fall under Q2 as also explained in the Figure below.

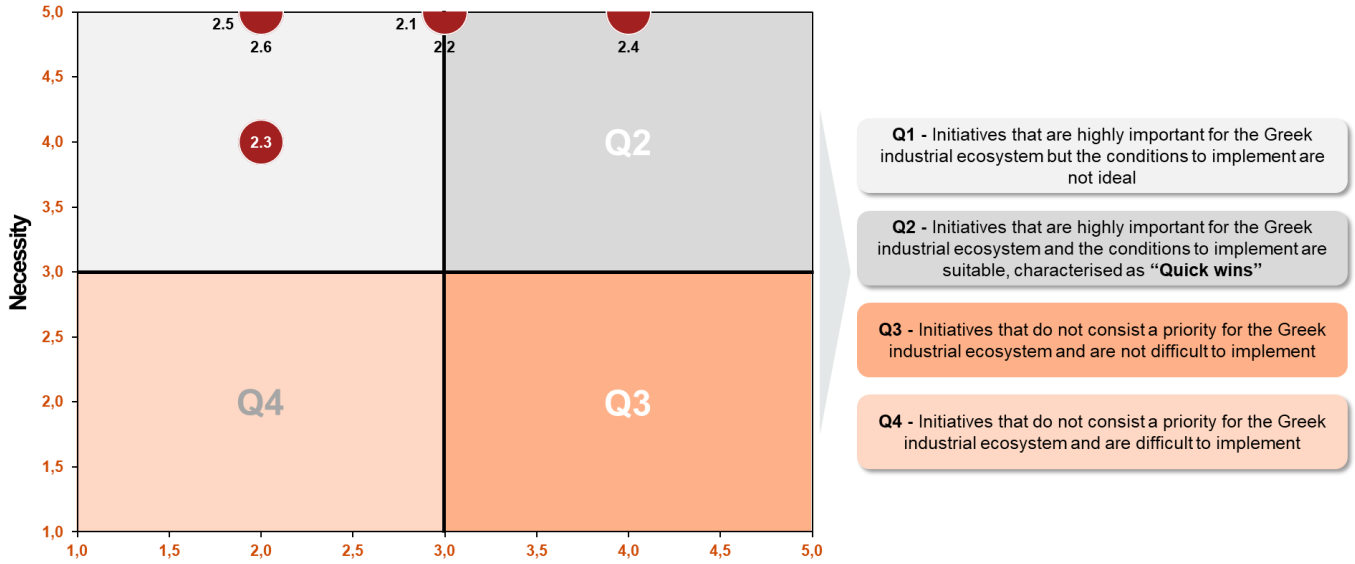


Figure 6: Pillar 2 "Quick wins"

For Pillar 2, we observe that only one initiative falls under the "Quick Wins" category. Namely this is the following:

- Initiative 2.4: "Introduce a program to prepare and educate future entrepreneurs interested in Industry 4.0 areas"

This initiative is estimated to be of lower complexity and mainly requires financial support (i.e. through subsidies and funds) by the Greek Government. This Quick win also appears in the abovementioned timeline to start first, during the 1st year of the Operational Plan.

4.1.4 Operational measures & initiatives: Pillar 3 - Collaborations & synergies

4.1.4.1 Introduction & Key Definitions

The third Pillar will seek to develop a collaborative industrial ecosystem where Industry stakeholders shall cooperate and utilise each other's expertise in order to achieve greater goals. This is expected to accelerate the digitisation of the Greek SMEs and mid-caps, as well as to increase their thus far limited awareness on digital and Industry 4.0. Ultimately assist the Greek industry to advance "as one" to the Industry 4.0 era and cumulatively reap the benefits that it has to offer, instead of having a few i4.0-advanced groups of firms and many i4.0-laggards operating in two different speeds.

Collaborations should be pursued across many different levels ranging from the provision of technical know-how and expertise from large, digitally-advanced enterprises to Greek SMEs and mid-caps to the setup of industrial platforms on specific areas of economic activity that will enable the creation of ecosystems of market actors in a multi-sided marketplace. These ecosystems will enable the creation of new innovative products and services and accelerate the development of worldwide standards. Moreover, tailored measures shall also be included in the remits of this pillar in order to promote the internationalization of the Greek enterprises and their participation in EU value chains and global emerging ecosystems.

Adding to the above and as it happens for all other Industry 4.0 strategies across Europe, Greece has to establish its own Industry 4.0 platform. This platform will not only act as communication tool for the dissemination of the strategy to the various stakeholders, but also as a forum that will invite all involved actors in order to participate and take action throughout the various initiatives pursued. It is important to mention here that a first positive step has been made towards this direction, through the sign off of the relevant memorandum of cooperation between the General Secretariat for Industry and the Ministry of Digital Governance.

Finally, as also mentioned under Pillar 2, there is a set of initiatives residing in that pillar, that also contribute to Pillar 3. These are the following:

- Initiative 2.3: "Introduce the "GovTech Programme for Manufacturing SMEs/start-ups"
- Initiative 2.5: "Adopt an Industry 4.0 start-up" programme
- Initiative 2.6: "Introduce an Industrial Strategy Challenge Fund to enhance innovation & collaboration across the Greek Industry"

All these initiatives achieve a double benefit. On the one hand, they enhance the promote the applied R&D and Innovation through a closer collaboration between the Greek Industry and the Greek academic/ research institutions, promoting in this way the "triple helix model". On the other hand, the forge closer working relationships and enhance collaboration between large, digitally advanced enterprises and Greek SMEs and mid-caps to enhance the latter's digital awareness and enable their scale-up. As such, they should be also considered part of Pillar 3.

4.1.4.2 Initiative 3.1: Introduce the "Idea Agora" Pitch Programme

Title of the Initiative	**Introduce the "Idea Agora" Pitch Programme**
Initiative's Coding	Initiative 3.1
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Enhance the collaboration between large, digitally advanced enterprises and Greek SMEs and mid-caps to enhance the latter's digital awareness
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* Key lever for the development and scale-up of the Greek SMEs and start-ups is their participation in wider industrial ecosystems and the establishment of collaborative relationships with larger organizations. In addition, the concept of Open Innovation – the increasing embrace of external cooperation opposed to exclusively internal and traditional research – is a must for all companies, regardless of their size, industry or age. However, in Greece we see that the majority of enterprises are still out of the game. This initiative shall support the Greek start-ups and SMEs with a focus on developing Industry 4.0 solutions to help mid-size/large Industrial/ Manufacturing companies accelerate to their growth and resolve existing business challenges by developing new, innovative Industry 4.0 solutions and applications. In addition, the competitions that shall take place within the context of this initiative shall enable start-ups and SMEs to potentially meet new partners and potential clients, expand their knowledge about the current needs of the market, and help them convince recipients to their solutions' effectiveness. *Details of the initiative* The "Idea Agora" Pitch programme consists of a set up competitions, that give Industrial/ Manufacturing start-ups and SMEs an opportunity to design, develop and present their solutions to large businesses and corporations. Individual companies/ industry federations or innovation structures (presented under pillar 2) shall be able to publish on a dedicated platform the problem that they would like to resolve/ a challenging area that they wish to address. Then the SMEs and start-ups can register on the platform, select the topics, in which they are interested in and submit their proposal for the high-level solution for the specific topic. Prerequisite for participants in the competition shall be their leveraging of Smart Manufacturing technologies to respond to the challenge imposed and develop a proposal that will explain how they plan to design and develop the Industry 4.0 solution.

	The requestor shall be able to evaluate the proposals and ask a select number of them (based on a predefined set of criteria) to present the proposals to them. The selected SME's/ start-ups will then take part in one-day "elevator pitch" workshops. The presentation of the solution will consist of two parts. The first one – lasting about 30 minutes – will aim at introducing and explaining the SME's/ start-up's solution. In the second one, lasting another 20 minutes, they will answer questions from the audience. Presentations will be followed by a networking session, during which the competition jury will get to know the presented ideas in greater detail. At the end of the event, winners will be selected, and will be given the opportunity to establish cooperation with the partner of the competition. The requestor will then sign a contract with the SME/ start-up for the development of the full-scale solution. For its development, the SME/ start-up will directly get a funding of 80% of the total costs (up to 200,000 Euros) to develop the defined solution. This amount should be discounted by the overall solution cost estimated by the SME/start-up/ midcap and paid by the large organization.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments Ministry of Digital Governance
Key beneficiaries (Target group)	All Greek Industry Enterprises (including SMEs/ midcaps/ start-ups) Industry Federations Innovation Structures (as these are presented in pillar 2)
Potential funding sources	Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) Future NSRF
Indicative Budget	€ 500.000 – 1.000.000 for the development of the platform Up to € 200.000 for the development of the solution ~50 SMEs/ start-ups to benefit Total Cost: € 10.000.000 – 15.000.000
Dependencies with other initiatives	N/A
Timeline of implementation	Short-term/ Mid-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

4.1.4.3 Initiative 3.2: Introduce an Industry 4.0 Awareness Programme

Title of the Initiative	**Introduce an Industry 4.0 Awareness Programme**
Initiative's Coding	Initiative 3.2
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Enhance the collaboration between large, digitally advanced enterprises and Greek SMEs and mid-caps to enhance the latter's digital awareness
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* The introduction of an Industry 4.0 awareness programme is of paramount importance for the Greek Industrial enterprises and particularly the Greek SMEs and midcaps, the majority of which appear to demonstrate limited knowledge on what Industry 4.0 consists of and how this is expected to radically change the Industrial paradigm. In addition, the awareness programme could also benefit the Greek Industry and more specifically the manufacturing sector, raise its profile and brand recognition and attract more young people to enter the industry. Finally, the programme shall coordinate all Industry 4.0 awareness initiatives that currently are sporadic, can be overlapping and lack a targeted vision and direction. *Details of the initiative* Introduce an Industry 4.0 awareness programme, ran by the Ministry of Development & Investments in collaboration with Industry Federations and the Chamber of Commerce, dedicated for Greek SMEs & midcaps that will aim at providing information and raising awareness on topics related to the Greek economy's Industry 4.0 rotation and will support Greek SMEs & midcaps on their digital transformation. The programme shall indicatively include the following actions: - Organization of dedicated presentations and workshops on the benefits of Industry 4.0; these presentations/ workshops shall be tailored to different industrial sectors and/or to the different size of the companies participating - Presentation of Industry 4.0 best practices and use cases of SMEs/ organizations that have implemented I4.0 technologies to digitally transform - Organization of networking and matchmaking Industry 4.0 events, where organizations of the Greek Industry (with an emphasis on SMEs, midcaps) can communicate and exchange ideas/ solutions with top-level executives and decision-makers from leading large companies and build strategic partnerships for long-term business growth - Design and creation of content for promoting and providing information on Industry 4.0 and digital technologies; this content shall also be published and accessed through the Industry 4.0 platform - Organization of "Open Doors" Days, an initiative highly promoted by the European Commission and applied in multiple countries, i.e. Finland, France, Spain and Germany. The scheme aims at incentivizing Greek industrial enterprises of various sizes, as well

	as factories active in diverse industrial areas to offer guided tours, training sessions and workshops to their facilities, physical infrastructure and technological equipment with the aim to raise the participants Industry 4.0 awareness, acquaint people with the different work procedures, products and job opportunities in their sectors and allow the apprehension of the i4.0 concepts and their practical application. Guests can be students (of secondary or tertiary education) and recent graduates. These days can be organized in collaboration with the respective industry federations.
Stakeholders (Design & Implementation)	• General Secretariat of Industry/ Ministry of Development & Investments • Ministry of Digital Governance
Key beneficiaries (Target group)	All enterprises of the Greek Industry & Manufacturing sector, with an emphasis on SMEs and midcaps
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • Future NSRF • European Investment Fund • Public Investments Programme
Indicative Budget	€2.000.000 – 5.000.000
Dependencies with other initiatives	Industry 4.0 Awareness initiatives can be demonstrated and promoted through the "Industry 4.0 platform for Greece" (initiative 3.4)
Timeline of implementation	Short-term
Feasibility and Necessity of initiative	Feasibility= 5 Necessity= 4

4.1.4.4 Initiative 3.3: Evaluate and set up of Industry 4.0 value chain Innovation Districts

Title of the Initiative	**Evaluate and set up of Industry 4.0 value chain Innovation Districts**
Initiative's Coding	Initiative 3.3
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Set up industrial platforms on specific areas of economic activity to enable the creation of ecosystems and achieve the scaleup of the Greek SMEs and mid-caps
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
Description of the initiative	*Rationale behind the need for the initiative* Although recently great steps have been performed with regards to the setup of innovation districts[26], these appear to lack focus on specific Industry 4.0 technologies and value chains of competitive advantage for Greece. In addition, Greek enterprises perform limited investments on applied R&D and industry implementation. This can be partially attributed to the limited digital and R&D infrastructure and facilities that enterprises possess to develop Industry 4.0 applications, as well as the lack of technical expertise to conduct in house these activities. For the abovementioned reasons, we propose the setup of Innovation Districts focused on select Industry 4.0 value chains. *Details of the initiative* Following the 22@Barcelona example and the new Greek Innovation Center "Politeia", we propose the setup of urban innovation districts focusing on fostering innovation and connections while facilitating urban, economic and societal re-generation. The innovation district shall focus on Industry 4.0 and more specifically it shall focus on the following value chains: - Smart Health & Pharma - Smart Food - Structural Materials - Smart, Connected Factories The Industry 4.0 innovation district shall transform dedicated industrial urban land into an innovative district offering modern walkable spaces for the strategic concentration of intensive knowledge-based Industry 4.0 activities, that shall connect research institutions with large firms and small start-ups and enable their cooperation and development of new Industry 4.0 solution in the value chains of focus.

[26] https://www.fortunegreece.com/article/innovation-district-dio-nea-kentra-kenotomias-pou-fernoun-konta-megales-eteries-me-ellinikes-startups-etimazi-i-kivernisi/

Description of the structure

The Industry 4.0 innovation districts shall run under the auspices of the Greek Government (similarly to the Alexander Innovation Zone S.A.). The district shall be run and monitored by a consortium of Government stakeholders, research/ academic entities (with a specialization on the select value chains) and industry federations. Leading country with regards to the creation of a collaborative governance model is the United Kingdom. In 2012, UK's Prime Minister, David Cameron, appointed Joanna Shields (Facebook Managing Director EMEA) as the CEO of UK's leading innovation district, the Tech City. Similarly, in Sweden's innovation district, Kista Science City, a collaborative governance board was formulated that included the VP of Ericsson, the mayor of Stockholm and deans of key Swedish universities.

Participation in the Innovation District

All enterprises that operate within the Industry 4.0 value chains shall be eligible to participate and relocate in the innovation district. The Governance body could introduce a set of due diligence criteria (similarly to the Alexander Innovation Zone) with regards to:

- their innovation/technology/ know-how
- strategy/ vision and business plan
- development collaborations & strategic alliances
- human resources, etc.

that new entrants shall comply with to become accepted in the district

Indicative Services Provided by the Innovation District

- Provision of office spaces/ working locations/ accommodation to enterprises to locate in this
- Networking & Community building: Support the creation of a collaborative, innovation-driven ecosystem, instigate awareness, act as the broker to bring in contact enterprises, etc.
- Collaborative R&D: Bring together academic/ research institutions with private sector enterprises located in the district and fund them for the design and implementation of Industry 4.0 R&D projects in the value chains of focus
- Hosting of events & conferences: 22@Barcelona sponsors events like Expo 2020 and conferences like SAP Start-up Focus events
- Workshops, training and incubation sessions: Organize workshops, training sessions for digital upskilling and reskilling of SMEs, set up incubation sessions to support the for the development of new start-ups in the Industry 4.0 area. For instance, 22@Barcelona organises the In5 programme to support start-up development, etc.

Provided incentives to join the Industry 4.0 innovation districts

A set of incentives shall be provided to the Greek Industrial and Manufacturing enterprises, operating in the select value chains, in order to spur them to relocate into the Industry 4.0 innovation districts. Indicatively, these could be:

- Attractive rates for renting/ buying land and building new facilities within the innovation districts
- Tax credits and/or favorable loan interest rates for relocating into the innovation district
- Tax incentives for net new capital investment and job creation

	- Easier access to funding and higher amount of funding for setting up and operating innovation structures (i.e. testbeds/ test labs) within the innovation district - Specific tax allowances for researchers working for academic/ research institutions located in the innovation districts - Limited “red tape” and bureaucracy for setting up an enterprise in the Innovation District In addition, the Industry 4.0 Innovation District could provide Free Technological Zones (following the leading case of Portugal) that will allow the elaboration of a more flexible legislative framework that promotes and streamlines experimentation activities in a cross-sector manner in order to take advantage of all the opportunities brought by the I4.0 technologies. The Free Technological Zones go beyond the creation of disparate "regulatory sandboxes", "innovation spaces", "experimental spaces" or "living labs" that are setup by sector or predefined area. This approach is, in fact, a coherent and aligned approach for experimentation activities, aimed at facilitating the testing of products, services (including public services), processes and models that are cross-sector and integrated (i.e., that cross more than one sector and may therefore be subject to different regulations and regulators), thus reducing burdens and promoting a culture of experimentation. The flexible legal framework should take into account, for example: - mechanisms for legal flexibilization (such as exception or experimentation regimes), whenever possible, when the legal framework limits innovation or is unclear in this respect - mechanisms for incentives for experimentation, including when it is not possible to make the legal framework more flexible.
Stakeholders (Design & Implementation)	• General Secretariat for Research and Technology/ Ministry of Development & Investments • General Secretariat for Industry/ Ministry of Development & Investments • Ministry of Digital Governance • Greek Academic Institutions • Research Centres
Key beneficiaries (Target group)	Greek enterprises (including SMEs, midcaps & start-ups) operating in the Industry 4.0 value chains Industry Federations
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • Future NSRF • Horizon Program • Digital Europe Program
Indicative Budget	€ 20.000.000 – 50.000.000
Dependencies with other initiatives	Innovation Districts could host at their premises Industry 4.0 labs/ testbeds” (initiative 2.2)
Timeline of implementation	Long-term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 5

4.1.4.5 Initiative 3.4: Develop a dedicated Industry 4.0 platform for Greece

Title of the Initiative	**Develop a dedicated Industry 4.0 platform for Greece**
Initiative's Coding	Initiative 3.4
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Set up industrial platforms on specific areas of economic activity to enable the creation of ecosystems and achieve the scaleup of the Greek SMEs and mid-caps
Link with strategic goals	• Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* Similarly to other EU countries, it is essential for Greece to establish its own Industry 4.0 platform. The Industry 4.0 platform will not only act as communication tool for the dissemination of the strategy to the various stakeholders, but also as a forum that will invite all involved actors in order to participate and take action throughout the various initiatives pursued. The first positive step has been made towards this direction, through the sign off of the relevant memorandum of cooperation between the General Secretariat for Industry and the Ministry of Digital Governance. *Details of the initiative* Design, develop and deploy a national Industry 4.0 digital platform (portal) for the Digital Transformation of the Greek Industry. The portal will enclose all the necessary information regarding the Greek Industry 4.0 strategy and will act as an umbrella that will embrace all the initiatives & supporting mechanisms that will be promoted and pursued through the Industry 4.0 strategy and its six execution pillars. The portal will in fact materialize the memorandum signed between the General Secretariat for Industry and the Ministry of Digital Governance in 2019. The platform will act as the "single source of truth" for information, awareness, networking and promotion of Greek companies on topics related to "Industry 4.0". In more detail, the platform could indicatively include: • Greece's Industry 4.0 vision, goals, defined strategy & operational plan (as part of this engagement) • Educational material on Industry 4.0, its key benefits and the key I4.0 technologies • Information & update on implementation of relevant Industry 4.0 initiatives • Information and online access to available supporting mechanisms, services & regulatory frameworks that could benefit the digital transformation of the Greek Industry • Information, update, newsroom on the "Industry 4.0 Awareness" initiatives (please refer to initiative 3.3) To maximise its potential and operational effectiveness, the Industry 4.0 platform could be procured as a Public Private Partnership project between the Greek public sector and a qualified private entity that will be responsible to design, operate and maintain the platform and its servers throughout a certain medium to long term period.

Stakeholders (Design & Implementation)	• General Secretariat for Industry/ Ministry of Development & Investments • Ministry of Digital Governance
Key beneficiaries (Target group)	All enterprises of the Greek Industry The overall Greek society that shall be informed on Industry 4.0 strategy & initiatives that Greece undertakes
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • European Investment Fund • Public Investments Programme
Indicative Budget	€ 500.000 – 800.000 for the design, develop and set up of the platform (potentially through the PPP scheme)
Dependencies with other initiatives	The platform will incorporate information with regards to all other initiatives mentioned in this pillar
Timeline of implementation	Short-term
Feasibility and Necessity of initiative	Feasibility= 5 Necessity= 5

4.1.4.6 Initiative 3.5: Design a national portal for Industrial patents

Title of the Initiative	**Design a national portal for Industrial patents**
Initiative's Coding	Initiative 3.5
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Set up industrial platforms on specific areas of economic activity to enable the creation of ecosystems and achieve the scaleup of the Greek SMEs and mid-caps
Link with strategic goals	• Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* Currently there is no platform dedicated to consolidating all Greek industrial patents that can be accessed by the wider public (including organizations, academic and research institutions). As such, there is no overview on the progress performed in the innovation and R&D field, while researchers cannot easily identify whether an idea that they made has already been patented or not. For this reason, the design of a national portal for Industrial patents is proposed. *Details of the initiative* Design and develop a national, publicly available portal in which all Industry related patents will be filed and organized in an intelligible and transparent manner. The portal will gather the Industrial patents already developed in the past, under a central node, and is going to operate as a tool of registry for the patents that will be developed in the future by Greek Enterprises and/ or research institutions and academia. This portal shall be linked to the existing official patent registries and will consist their "front-end". The portal, along with the designated registry, will enable all interested stakeholders to record and review the life cycle of each patent, from the patent application filing to its granting and publication, and even possible subsequent developments, gaining valuable insights and protecting the intellectual rights of its owners/ inventors. Indicative information to be included: • Inventor(s) and clear description of the patent with drawings (technical details), accompanied by the filing date • Technological domain the patent refers to with appropriate classifications and patent family (if applicable) • Citing and/ or cited documents of the patent • Publication date and publication number • Legal events (any procedural step during the grant procedure or at the post-grant stage) with effective (came into force) and event (publicly disclosed) dates and event indicators (e.g. change of ownership) • Digital application forms for a patent

	• News in the domestic & international Industrial R&D space The national portal for Industrial patents will be established by a dedicated technical team with members from the Ministry of Development and Investments and the Ministry of Digital Governance, in close collaboration with the Hellenic Industrial Property Organisation (HOBI). The portal will be interconnected with HOBI's portal (www.obi.gr), expanding its rendered services, as well as with the Industry 4.0 platform for the Greek Industry.
Stakeholders (Design & Implementation)	General Secretariat for Industry/ Ministry of Development & Investments Ministry of Digital Governance Hellenic Industrial Property Organisation (HOBI)
Key beneficiaries (Target group)	Greek enterprises that aim at investing in innovation and R&D, research and academic institutions
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • European Investment Fund • Public Investments Programme
Indicative Budget	€ 500.000 – 800.000 for the design, develop and set up of the platform
Dependencies with other initiatives	N/A
Timeline of implementation	Short-term
Feasibility and Necessity of initiative	Feasibility= 5 Necessity= 3

4.1.4.7 Initiative 3.6: Introduce a "scale up and internationalization" programme for Greek Industrial SMEs/ start-ups

Title of the Initiative	**Introduce a "scale up and internationalization" programme for Greek Industrial SMEs/ start-ups**
Initiative's Coding	Initiative 3.6
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Promote the internationalization of the Greek enterprises and their participation in EU value chains
Link with strategic goals	• Digitally upskill and reskill the human workforce in the Greek industry • Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
Description of the initiative	*Rationale behind the need for the initiative* One of the key issues that Greek start-ups and SMEs currently face during their "scale up" phase (i.e. Greek start-ups/ SMEs that have already launched their products and aim to gain additional momentum and expand their footprint both within Greece and internationally), is their inability to secure additional funding due to the following main reasons:[27] • Difficulty to scale up in the Greek market due to its size • Start-ups'/ SMEs limited ability & know-how to expand the product or service to other markets • Start-ups' / SMEs limited knowledge on how to construct and present their organization's business & revenue model to the investors • Start-ups' / SMEs failure at preparing and making efficient research that will enable them to contact the funds that suits their organization To enable Greek start-ups/ SMEs that operate in the Industry 4.0 space to become better equipped to seek and secure additional funding and expand their presence internationally, we propose the introduction of a "scale up and internationalization" programme. *Details of the initiative* Introduce a "scale up & internationalization" programme for Industrial Greek start-ups/ SMEs. The programme will provide funding for consulting, training and implementation services to start ups/ SMEs that wish to scale up either within Greece or abroad. In more detail the program shall be addressed to Greek start-ups/ SMEs that: • run their operations in Greece and they have closed at least one financial year

[27] https://www.eitdigital.eu/fileadmin/newsroom/publications/Startups_in_Greece_2019.pdf

	• aim to ask for additional funding from VCs (i.e. from the "Growth Stage Window" from Equifund) (in case of start-ups) • demonstrate a high potential of internalization of their products, service or technology • plan to expand in foreign markets **Indicative Services Covered by the Programme:** The programme shall indicatively cover the following type of services for start-ups/ SMEs (non-exhaustively): • Mechanical, laboratory equipment and quality control equipment • ICT & software equipment, software licenses • Product design, intellectual property, patent and certification costs • Branding activities • Consultancy services for the design of a viable revenue & business plan for the start-up • expert consultancy services, e.g. marketing or legal, necessary to develop a strategy for expansion of the product, service or technology for a selected foreign market; • Advisory on the best choice of VCs to address according to needs and requests of the start-up (in case of start-ups) • Presentation & training services for pitching to VCs, etc. (in case of start-ups) • Participation costs in international networking events, where Greek start-ups/ SMEs will be able to visit the country where they would like to locate, join the respective local start-up hub and establish business contacts with representatives, take part and present their project during local start-up events, etc. The program can fund up to 80% of the start-up's/ SME's costs. The funding cannot exceed 200.000 Euros. Funding can be provided in conjunction with the "Industry 4.0 funding scheme for start-ups" (please refer to pillar 6). As a next step, this initiative should be further discussed with the Ministry of Foreign Affairs and Enterprise Greece S.A., which are the key responsible stakeholders for boosting the internationalization of Greek entrepreneurship.
Stakeholders (Design & Implementation)	• General Secretariat of Industry/ Ministry of Development & Investments • General Secretariat for Research and Technology/ Ministry of Development & Investments • Ministry of Digital Governance
Key beneficiaries (Target group)	Start-ups in the Industry 4.0 area that are in the scale up phase and/or aim to expand internationally
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) • Future NSRF • Equifund (in case of start-ups)
Indicative Budget	Max 200.000 Euros per SME/ startup, approximate number to cover ~50 - 100 SMEs/ Startups Total Cost: € 10.000.000 - 20.000.000
Dependencies with other initiatives	This initiative can be interconnected with Initiative 6.2 "Acceleration of investments for Industry 4.0 start-ups" and 6.3 "Acceleration of investments for Industry 4.0 SMEs & Mid-Caps"

Timeline of implementation	Mid-term/ Long-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 4

4.1.4.8 Timeline of implementation of the initiatives of Pillar 3 and "Quick wins"

This paragraph presents an indicative implementation timeline of Pillar 3 initiatives. The suggested initiatives are mainly spread across the first two years of the Operational Plan. This pillar appears to include a set of "Quick Wins" (as we also see further down this paragraph). These initiatives appear to be of lower complexity to design and of great importance (high necessity) for the Greek industry's digitization. For this reason, these initiatives are proposed to start during the 1st year of the Operational Plan. These initiatives are 3.1 (the "Idea Agora" Pitch programme), 3.2 (the Industry 4.0 Awareness programme), 3.4 (the set-up of the Industry 4.0 platform) and 3.5 (the setup of the national portal for Industrial patents).

The "scale up and internationalization" programme (initiative 3.6), although it refers mainly to a financial support mechanism, requires more time to be designed and is suggested to start during the 2nd year of the Operational Plan.

Finally, the setup of the Industry 4.0 Value Chain Innovation Districts (initiative 3.3) is an initiative of high complexity, with multiple stakeholders from the private and public sectors as well as the Greek academic and research community to participate. The alignment of them, as well as the setup of the required infrastructure to host these innovation districts lead to an extended design time period, that could start after all Quick Wins are in place and the collaboration between the Greek Industrial enterprises has been forged. For this reason, we suggest that initiative 3.3 starts at the end of the 2nd year of the Operational Plan.

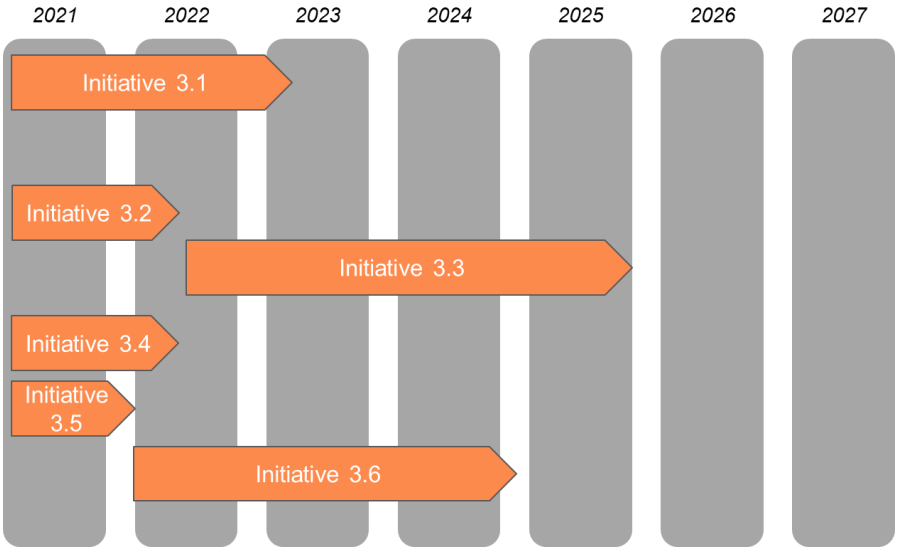


Figure 7: Timeline of initiatives' implementation for Pillar 3

Moving forward, we depict the distribution of the initiatives of Pillar 3 according to their "Feasibility" and "Necessity" scoring and we identify the set of "Quick Wins", which refer to initiatives that demonstrate high Feasibility (therefore they are easier to be implemented) and high Necessity (therefore they are expected to have a significant impact towards Greek Industry's rotation to Industry 4.0). These initiatives are the ones that fall under Q2 as also explained in the Figure below.

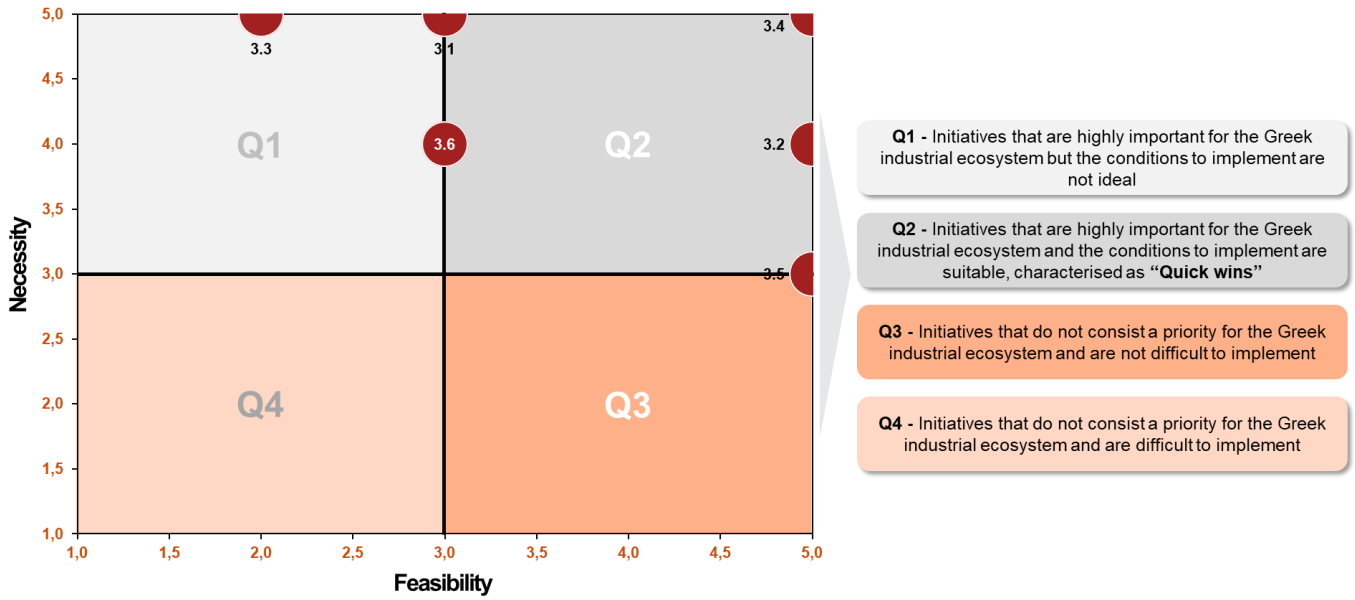


Figure 8: Pillar 3 "Quick wins"

For Pillar 3, we observe that three initiatives fall under the "Quick Wins" category. Namely these are the following:

- Initiative 3.2: Introduce an Industry 4.0 Awareness Programme
- Initiative 3.4: Develop a dedicated Industry 4.0 platform for Greece

These initiatives refer mainly to actions of low complexity that require minimum changes in the existing Greek regulatory framework and that are mainly dependent on pure financial support (i.e. through subsidies and funds) that the Greek Government shall provide to enhance the collaboration & synergies between the Greek Industrial enterprises. These Quick wins also appear in the abovementioned timeline to start first, during the 1st year of the Operational Plan.

4.1.5 Operational measures & initiatives: Pillar 4: Standardisation and norms

4.1.5.1 Introduction & Key Definitions

The purpose of Pillar 4 is to analyse the key actions and initiatives that have to be carried out within the Greek industrial ecosystem in order to promote the introduction, implementation and further development of industrial standards. By underlining these actions and initiatives, it seeks to create an industrial ecosystem where due to standards and norms, all implemented Industry 4.0 technologies, systems and services among enterprises of different size and scale retain the ability to connect and interoperate with each other, boosting innovation.

Achieving that in the long term ensures that the Greek ICT market remains open, competitive and interconnected with the rest of the Europe.

First, this pillar focuses on setting the key ICT standardisation priorities, in accordance to the European Commission's ICT Standards plan and communication. The Greek industrial ecosystem needs to move forward with regards to the adoption and development of industrial standards. This is mainly pursued through the introduction of Greek Industrial standardisation Committee, being responsible to orchestrate the actions of all key stakeholders within the industrial standardisation landscape of Greece. It will be responsible to map out the current state of Greek industrial standards as well as design the next steps that will allow Greece to co-operate in the medium-to-long term on equal terms with other EU countries that are advanced in that area.

Moreover, the purpose of this pillar is to raise awareness on the importance of standardisation and the benefits it comes with for all industrial enterprises, regardless of economic activity and size. This will seek to encourage as many players as possible to educate themselves on the benefits of industrial standards and norms, following the example of other countries that have already begun their standardisation journey and are growing within their respective sectors.

Furthermore, another important need this pillar will cover is that of the accreditation with regards to industrial standards within the Greek ecosystem. Businesses should strive to adopt standards within their day-to-day operations and products and services produced. Recognising this effort would work as an indication that they strive to become better and modernise their operations, allowing for more and better collaborations with more advanced enterprises within and outside the Greek industrial ecosystem.

In the following pages, the initiatives under Pillar 4 are analysed and elaborated, following the methodology outlined in the previous chapters.

4.1.5.2 Initiative 4.1: Introduce a Greek Industrial Standardisation Committee

Title of the Initiative	Introduce a Greek Industrial Standardisation Committee
Initiative's Coding	Initiative 4.1
Pillar	Pillar 4: Standardisation & Norms
Area of focus	• Set up of a task force from the private and public sector to identify needs for ICT standards • Pursue collaboration on standards across the European and International landscape
Link with strategic goals	• Increase the Greek Industry's overall digital maturity. • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains and ecosystems.
Description of the initiative	*Rationale behind the need for the initiative* The Greek industrial ecosystem has been falling behind in terms of standards with regards to the products and services developed within it. As a result the need for a solid entity that will pursue the following is prevalent: • Be responsible to improve current standards within the industrial ecosystem. • Develop new and modern standards specifically for promoting products and services produced through Industry 4.0 applications. • Assist all existing and new players of the industrial ecosystem to adopt and institutionalise these standards as part of their business model. • Pursue a closer/ more active collaboration with international/ European standardisation ecosystems and their key players *Details of the initiative* The Greek Industrial Standardisation Committee will be responsible to develop the Industrial standards for the country. On that note, seeking to support the changes proposed throughout the operational plan of the i4.0 strategy, it will develop discrete standards and norms throughout the Greek industry, in collaboration with key stakeholders from the Greek industrial ecosystem, such as the Hellenic Organisation for Standardisation (ELOT). It should examine which of industrial standards adopted among EU countries or internationally are applicable for the case of Greece (further to the ones already adopted within the Greek environment) and pursue to introduce them to the Greek Industrial environment, encouraging industrial enterprises to adopt them. Further to that, an ambitious outlook would be to support industrial enterprises to develop new industrial standards. These new Greek standards could be exploited and marketed in other EU or international markets by the companies that developed them and implemented them in their business models. The outputs of the Committee's work will have to be utilised and adopted to the best possible extend by the stakeholders of the industrial ecosystem (SMEs, mid-caps, established enterprises etc.) in order to adhere to the same rules and collaborate efficiently and effectively, keeping the Greek market open and interconnected with other industrial markets across Europe. Once the standardisation landscape in Greece is more mature than it currently is, and Greek industrial standards have been sufficiently developed and adopted by industrial stakeholders, the Committee should seek to forge close collaborations with peer standardisation Committees within the EU or operating at an international level. On that

	note it will pursue to gain insights on best practices and different standardisation approaches so as to implement them within the Greek Industrial ecosystem and at the same time be more effective and develop a stronger presence within international standardisation bodies. It is suggested that a strong collaboration should be pursued with Germany, France and Italy, which have formed a standardisation trilateral cooperation scheme, having developed a shared standardisation action plan across the three countries. This can serve as a link between the experience built within Greece on standards and norms throughout the next programming period, so as to introduce high-end standardisation techniques and protocols such as the Reference Architecture Model Industry 4.0 introduced by Germany.
Stakeholders (Design & Implementation)	• General Secretariat for Industry • Greek Industrial Standardisation Committee • Hellenic Organisation for Standardisation (ELOT) • Industry stakeholders • Research institutions/ Academia members
Key beneficiaries (Target group)	Greek industrial enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	N/A
Indicative Budget	N/A
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 4
Timeline of implementation	Immediate
Feasibility and Necessity of initiative	Feasibility = 4 Necessity = 5

4.1.5.3 Initiative 4.2: Develop the Greek Industry 4.0 standardization framework

Title of the Initiative	Develop the Greek Industry 4.0 standardization framework
Initiative's Coding	Initiative 4.2
Pillar	Pillar 4: Standardisation & Norms
Area of focus	• Set key ICT standardisation priorities, in accordance to the European Commission's ICT Standards plan and communication
Link with strategic goals	• Increase the Greek Industry's overall digital maturity. • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains and ecosystems.
Description of the initiative	*Rationale behind the need for the initiative* As described in Initiative 4.1, there exists a great need to promote existing and develop new modern industrial standards for the Greek ecosystem, essentially seeking to develop a modern and updated Greek i4.0 standardisation framework. In order for this critical venture to succeed, the "As-is" has to be thoroughly mapped out and evaluated in order to understand where the country stands as of today in terms of industrial standards and norms. Further to that, a gap analysis in comparison with other EU countries is essential, in order to identify how wide the gap between Greece's and other countries' industrial standards is, essentially setting realistic "standardisation" goals for the near future. Following that second step, a strategic design of the "To-be" state of the Greek standardisation landscape has to be laid out, acting as a compass for the Greek Industrial Standardisation Committee as well as all other stakeholder of the Greek industry designing standards and norms within it. *Details of the initiative* The Greek Industry 4.0 standardization framework to be developed for the Greek Industry, always consistent with EU's ICT Standardisation priorities, will be based on a three-stepped approach that will be performed within the Greek Industrial environment: 1. Map-out of the "as-is" state of play with regards to the major I4.0 building blocks (I4.0 technologies & applications) around Standardisation within the Greek Industrial ecosystem. This 1st step is rather crucial, since it will lay the foundations for the future development of Greek Industrial standards, and therefore it needs to be carried out as efficiently and go into good detail and depth of information gathered. In the lines of this, working groups across all the sector of economic activity of the Greek industry should conduct focus groups including interviews and surveys with a representative number of industrial enterprises, so as to infer the true state of standardisation. The team responsible to carry out this exercise (it consisting of the Greek Industrial Standardisation Committee's members as well as experts from the Greek industry if deemed necessary), in very close collaboration with ELOT's databases and staff, will have to identify and create a registry of all the so far developed standards. Moreover, they should interview

	key enterprises of the Greek industry that have developed or adopted standards within their business operations, in order to identify how key players of the Greek ecosystem adopt and utilise standards so far. 2. Perform a Gap Analysis between the Greek and other EU Industrial standards, examining what standardisation pioneers (such as Germany and France) and in general more "standards' advanced" EU countries are pursuing. This will essentially seek to uncover how wide the gap between the Greek industrial standards is, compared to other European countries. A close collaboration with technical experts or standardisation organisations within the EU or other international countries is advisable for this step in order to result in a broad comparison with standardisation practices and readiness levels abroad. 3. Utilising the results of Steps 1 and 2, the final step will be to develop a Standardisation Action Plan for the Greek Industrial enterprises, with regards to groups of i4.0 technologies and applications. The goal is to set the short and mid-term targets of the Greek industrial landscape, with regards to the standards that will be developed and adopted by all the players of the ecosystem. The target of the "To-be" state should be realistic yet ambitious, seeking to upgrade the ecosystem and its players with regards to standards holistically, being able to communicate and collaborate efficiently with the rest of the enterprises within the Greek and the EU industrial ecosystem. This will subsequently lead to enhanced results, higher added value for all involved parties as well as new standards and norms to be developed through innovative collaborations and synergies. It is crucial to mention that the Standardisation Action Plan should take into account the respective standardisation initiatives and measures developed within the three High priority cases, and vice versa, pursuing the optimal interconnection and complementarity between the initiatives developed. More specifically, it should put heavy emphasis on High Priority Case 1 which concerns the Smart Manufacturing Technologies as well as High Priority Case 3 which relates to the Circular Economy and the "Greening" of the Greek industrial ecosystem as well as the concept of industrial symbiosis. (for more information, please refer to Annex A and Annex C).
Stakeholders (Design & Implementation)	• Greek Industrial Standardisation Committee • Technical industrial advisors
Key beneficiaries (Target group)	Greek industrial enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	New NSRF (2021-2027)
Indicative Budget	€1.500.000-2.250.000 (a budget from €500.000 to €750.000 should be foreseen for each of the 3 stages of this initiative, covering their distinct needs regarding mapping activities, stakeholder focus groups, collaborations with standardisation committees/ organisations from other EU/ international countries or etc. as described above)
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 4
Timeline of implementation	Immediate – Short term / mid-term

Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

4.1.5.4 Initiative 4.3: Awareness campaign on standardisation within the Greek industrial landscape

Title of the Initiative	Awareness campaign on standardisation within the Greek industrial landscape
Initiative's Coding	Initiative 4.3
Pillar	Pillar 4: Standardisation & Norms
Area of focus	• Raise awareness on the importance of standardisation across the Greek Industry
Link with strategic goals	• Increase the Greek Industry's overall digital maturity.
Description of the initiative	*Rationale behind the need for the initiative* As described earlier, standards and norms can prove significantly useful and result in enhanced results and more efficient collaborations with other ecosystem players. To that purpose, an Industry 4.0 campaign is necessary, so as to inform all the players of the Greek industrial ecosystem the key benefits that they can derive through adopting them. *Details of the initiative* Design and roll-out a targeted campaign on standardisation at the Greek landscape, presenting to all stakeholders across the Greek Industry what the benefits of Standards and Norms are, highlighting their importance and the need for action at the Greek Industrial ecosystem. In order to reinforce their potential impact, the campaign should also refer to best practices and results for industrial enterprises across the EU, showcasing how they achieved greater results, enhanced synergies with other enterprises, suppliers, vendors etc. The campaign will aim to attract as many enterprises as possible to take part in the Greek standardisation landscape that will evolve. On that end, it should revolve around organising workshops for enterprises, engaging Federations across the Greek industry to invite and encourage their members to actively adopt standards and norms. On another note, an official advertising campaign should be rolled out through the Industry 4.0 Greek platform as well as these federations and other key stakeholders of the Greek industrial ecosystem such as the Federation of Enterprises (SEV), to inform participants on the values of standardisation across the different sector of economic activity of the Greek industry.
Stakeholders (Design & Implementation)	• Greek Industrial Standardisation Committee • General Secretariat for Industry • Federation of Enterprises (SEV)
Key beneficiaries (Target group)	Greek industrial enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	New NSRF 2021-2027

Indicative Budget	€50.000-75.000
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 4
Timeline of implementation	Immediate
Feasibility and Necessity of initiative	Feasibility = 5 Necessity = 5

4.1.5.5 *Initiative 4.4: Enhance the accreditation of enterprises on industrial standards, including technical skills*

Title of the Initiative	Enhance the accreditation of enterprises on industrial standards, including technical skills
Initiative's Coding	Initiative 4.4
Pillar	Pillar 4: Standardisation & Norms
Area of focus	• Reinforce and raise awareness on the importance of standardisation across the Greek Industry
Link with strategic goals	• Increase the Greek Industry's overall digital maturity
Description of the initiative	*Rationale behind the need for the initiative* In order to promote the Greek industry 4.0 standardisation framework, an accreditation of industrial enterprises with regards to the adoption of standards that relate to processes and production systems, products and services produced etc. will have to be pursued. *Details of the initiative* This initiative aims to further strengthen the accreditation activities already present within the Greek environment with regards to industrial standards on products, services and production systems. This has been pursued with great results within the European environment, by organisations such as Afnor Groupe based in France, whose main objective is to "design and deploy solutions based on voluntary standards around the world". Their most relevant services that could be pursued in the lines of this initiative, tailored to the case of Greece include: • Trainings to personnel on management systems and standards, customised solutions, diagnostics and support plans etc. • Certifications of systems, products, services, competences and assessment of performance in a wide range of areas. Along the above lines, the main objective for the Greek Industrial Standardisation Committee and the key stakeholders that are already providing certification services within the Greek environment to industrial enterprises will be to incentivise them to both adopt standards in their business models as well as get certified for their use. The achievement of this milestone will benefit the industrial environment as per below: 1. On one hand, more industrial enterprises will realise the benefit of operating more efficiently so much on an enterprise level as well as with regards to the collaboration with other enterprises. 2. Enterprises will receive through this accreditation framework a certificate that will highlight that they belong in a group of enterprises seeking to achieve industrial excellence. This certification will also result in new stronger collaborations with their peers as well as established enterprises (which in many cases might have not been feasible in the past). Adding to the above, a smart way to incentivise more enterprises to become part of this initiative and in general the Greek industry 4.0 standardisation framework would be to link their certification/ accreditation on adopting industrial standards with the financial incentives developed within Pillar 6.

Stakeholders (Design & Implementation)	• Greek Standardisation Committee • Greek Organisation for Standardisation (ELOT) • Enterprises from the private sector offering accreditation on industrial matters (products, services, production systems etc.)
Key beneficiaries (Target group)	Greek industrial enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	New NSRF 2021-2027
Indicative Budget	N/A
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 4
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 4

4.1.5.6 Timeline of implementation of the initiatives of Pillar 4 and "Quick wins"

The implementation timeline of Pillar 4's initiatives is briefly presented below. As it can be seen, Initiative 4.1 which refers to the introduction of the Greek Industrial Standardisation Committee should be the first to be implemented within this pillar, since it the Committee will be responsible to design and implement all other initiatives included in Pillar 4.

Following that, the remaining 3 initiatives should be pursued simultaneously by the Greek Industrial Standardisation Committee in order to be efficient and provide for the expected results. It is crucial that Initiative 4.3 "Awareness campaign on standardisation within the Greek industrial landscape" is designed and rolled out efficiently and in due time in order to lay the ground and inform industrial enterprises on the benefits of standardisation, inviting them to actively take part in this effort within the Greek industry.

At the same time, Initiative 4.2 "Develop the Greek Industry 4.0 standardization framework" is expected to be designed and implemented within a four and half year period, demanding the utmost commitment and organised efforts of the Greek Industrial Standardisation Committee and all other involved stakeholders in all three of its stages, as previously described. As far as Initiative 4.3 "Enhance the accreditation of enterprises on industrial standards" is concerned, it should be pursued and implemented before the 1st half of the period 2021-2027 of the i4.0 strategy and operational plan, ensuring that industrial enterprises pursue to get certified on the adoption and implementation of industrial standards within their operating model.

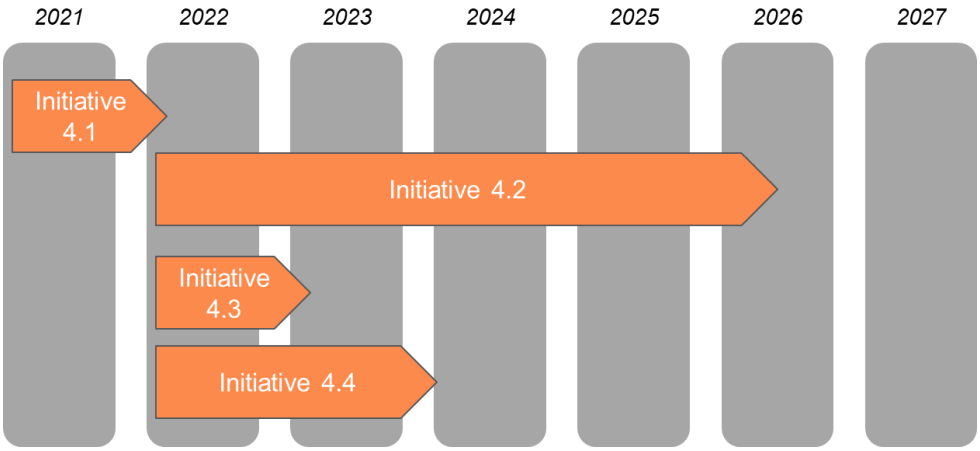


Figure 9 Timeline of initiatives' implementation for Pillar 4

In the following page, the "**Quick wins**" for Pillar 4 are presented, taking into account their "Feasibility" and "Necessity" scoring as presented above as well as taking into account the factor of time, i.e. the "Timeline of implementation" dimension as described above. For Pillar 4, these are Initiative 4.1 and Initiative 4.3. This comes as a result from the fact that the setup of the Greek Industrial Standardisation Committee as well as the Awareness campaign on industrial standard will kick-start and significantly boost all other activities within Pillar 4.

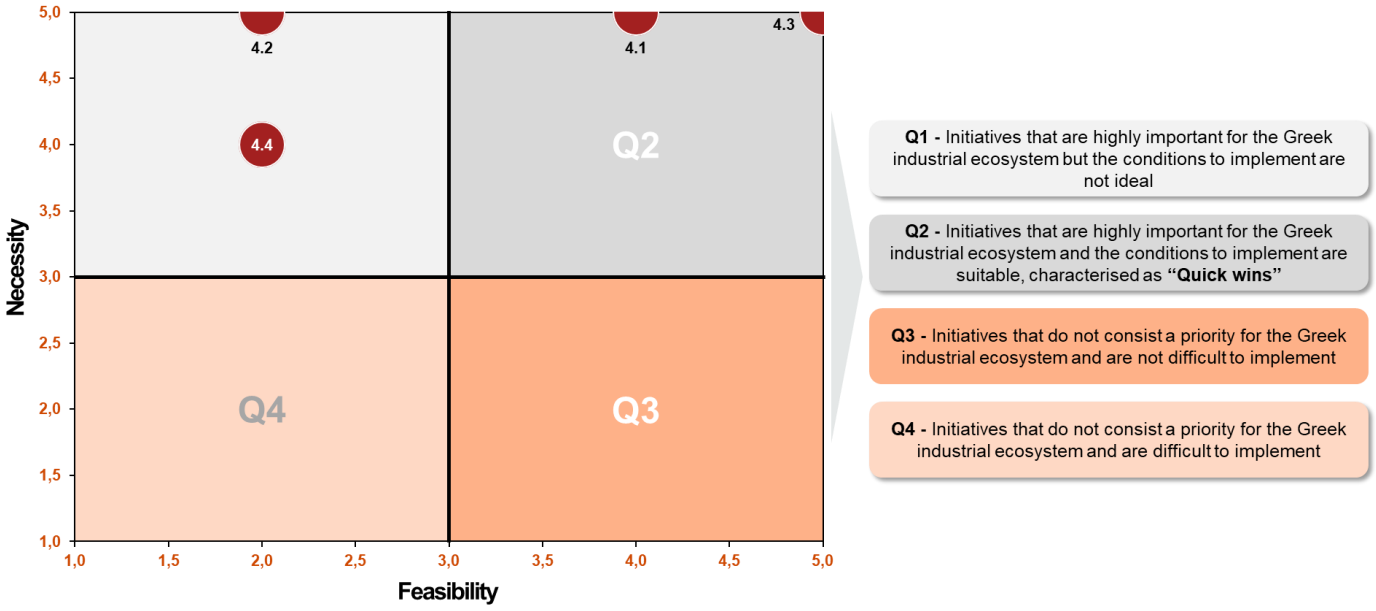


Figure 10 Pillar 4 "Quick wins"

4.1.6 Operational measures & initiatives: Pillar 5: Regulatory Environment

4.1.6.1 Introduction & Key Definitions

The purpose of Pillar 5 is to modernise and update the Greek regulatory environment in order to become business and industry friendly. As it has already been mentioned, the Greek regulatory environment is a rather complex and non-business-friendly one, ranking 79th amongst 190 economies. This means that companies in Greece face an adverse regulatory system, which can be considered as a critical reason for continuous exodus of capital, labour and entrepreneurship from Greece

In that sense, the removal of unnecessary obstacles that currently exist for businesses and hinder them in conducting their operations and collaborations efficiently is crucial, meaning that its revamp in various areas is necessary.

By doing so, enterprises will be able to operate with less “red-tape” across the various facades of the Greek industry and throughout their day-to-day operations, allowing for better results and overall growth.

This pillar is focused on prioritising the importance of cybersecurity within the industrial landscape. Enterprises that seek to enjoy the benefits of Industry 4.0 by continuously upgrading their systems and technological applications, should also prioritise the issue of cybersecurity. By ensuring that their systems and operations are safeguarded, they as well as their business partners (suppliers, vendors etc.) will be able to conduct business freely and under safe terms. For that reason, this pillar focuses on providing the right directions that should be pursued to modernise the Greek regulatory environment on that note.

Equally important within the framework of Industry 4.0 is the subject of intellectual property, which this pillar also seeks to highlight and address. On that note and based on the practice of other European countries that have pursued similar changes within their Industry 4.0 strategies, Pillar 5 outlines the areas that need to be updated within the Greek regulatory environment as far as intellectual property rights are concerned.

Furthermore, focusing on the European agenda on achieving a “Green Industry” status in the near future, this pillar sets the tone with regard to the actions that have to implemented by the key stakeholders of the Greek industrial environment so as to achieve this critical milestone.

In the following pages, the initiatives under Pillar 5 are analysed and elaborated, following the methodology outlined in the previous chapters.

4.1.6.2 Initiative 5.1: Strengthen the Cybersecurity framework of Greece with regards to Industry 4.0

Title of the Initiative	Strengthen the Cybersecurity framework of Greece with regards to Industry 4.0
Initiative's Coding	Initiative 5.1
Pillar	Pillar 5: Regulatory Environment
Area of focus	• Prioritise the area of cybersecurity
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities
Description of the initiative	*Rationale behind the need for the initiative* Industry 4.0 and the benefits it has to offer revolve around ground-breaking technologies and applications, innovative productions systems and smarter ways of conducting day-to-day business so much within each firm as well as with regards to the collaboration with external partners. If the aforementioned are one side of the coin, then cybersecurity constitutes the other side, ensuring that all the aforementioned are utilised on a safe and structured way, protecting businesses and individuals in the Digital Era. It is only logical that Greece has to act and improve the cybersecurity framework especially with regards to Industry 4.0. *Details of the initiative* In this effort to strengthen the cybersecurity framework of Greece, the following actions will have to be pursued and implemented: 1. Participate in the Cybersecurity Competence Network and Centre that is currently being developed by the EU. This European initiative will be pursued under the next programming period 2021-2027 and will aim to support industrial technologies and design measures with regard to research and innovation, always within the domain of Cybersecurity. Currently, many Greek organisations and entities that are active in this field have participated in the survey that is being run by the EU in order to determine the structure and exact scope of activities for the Cybersecurity Competence Network and Centre. It is crucial that this collaboration continues and Greek cybersecurity-related organisations are actively involved in the activities of this EU initiative, seeking to gain the most out of it through best practices and EU peer organisations, at the same time assisting in the shaping of this important subject for the EU, transferring the knowledge gained in the Greek industrial sector. 2. Promote a closer and more efficient collaboration between the General Administration of Cybersecurity of the Ministry of Digital Governance which operates as the «National Cybersecurity Authority» (appointed by Law 4577/2018) and all competent authorities and stakeholders (CERT institutions etc.) within the Greek Public sector, by focusing on a more interlinked network of operating and communication systems, so as to efficiently address cybersecurity challenges within the Industry 4.0 landscape of Greece. The Ministry of Digital Governance should allow for an open forum-platform for communication and information exchange between the involved participants, allowing for an efficient and smooth collaboration among them. Moreover, the roles and responsibilities of key involved parties (such as the General Administration of Cybersecurity and the Information Society) will have to be carefully evaluated and set out from the beginning of these actions.

	3. Create an industry-wide campaign on the significance of cybersecurity that will be targeted to public organisations and enterprises of the Greek Industry. This will aim to inform all stakeholders within the Greek industrial ecosystem on the benefits and importance of cybersecurity for their day-to-day operations as well as collaborations in the Digital Age, encouraging them to invest in this important area. Same as for all other awareness actions that are proposed as part of the Operational plan, this action will be part of the "Industry 4.0 awareness programme" rolled out centrally. 4. Introduce a cybersecurity certification for private organizations (with special focus on SMEs/ midcaps) that will certify the implementation of IT security measures within their organization. This certification could become a prerequisite for SMEs/ midcaps in order to join thematic clusters (initiative 3.2) or initiatives under Pillar 2.
Stakeholders (Design & Implementation)	• General Secretariat for Industry • Ministry of Digital Governance (General Administration of Cybersecurity & Information Society S.A.) • Greek Cybersecurity expertise centres
Key beneficiaries (Target group)	• Greek Industry Enterprises (Established/SMEs/ midcaps/ startups) • Public sector stakeholders
Potential funding sources	New NSRF 2021-2027
Indicative Budget	Action 1,2,4: N/A Action 3: €50.000-75.000
Dependencies with other initiatives	
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

4.1.6.3 Initiative 5.2: Enhance the Greek industrial ecosystem with regards to intellectual property

Title of the Initiative	Enhance the Greek industrial ecosystem with regards to intellectual property
Initiative's Coding	Initiative 5.2
Pillar	Pillar 5: Regulatory Environment
Area of focus	• Address the subject of intellectual property
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities
Description of the initiative	*Rationale behind the need for the initiative* Currently, there exists a need within the Greek industrial ecosystem to revisit holistically the framework around intellectual property rights and patenting of new offerings. The current framework could be characterised as complex and, in many cases, it is rather ambiguous for researchers/ research groups and research institutions/ universities with regards to percentages of ownership of the offering (either it being a product or a service). At the same time, it does not offer the right financial motives to research groups/ researchers so as urge them to innovate, benefiting the entire ecosystem. Therefore, the framework for Intellectual Property (IP) should be adequately adjusted in order to allow the digital and green economy to benefit significantly from the innovation of the industrial ecosystem. *Details of the initiative* The target of the initiative will be to re-design the Greek framework around intellectual property following the example of the European Commission and EU member countries that have pursued to adjust their legislation and regulatory environment in order to promote competitiveness, innovation and growth of their industrial sector. The purpose of the European Commission's Intellectual Property Action Plan is to develop "well calibrated and modern IP policies contributing to the resilience and competitiveness of the EU's economy and facilitate the digital and green transition, benefitting the EU society as a whole." The main objectives of the Plan are the following: • Upgrading the system for IP protection • Promoting a better uptake and deployment of IP • Fighting IP theft • Promoting a global fair play EU's IP Action Plan includes objectives regarding industrial and i4.0 technology challenges, such as the protection of inventions generated or implemented using Artificial Intelligence (AI). AI has given rise to important questions regarding data and the IP system including the legal nature of data as well as the ownership of and access to data. Furthermore, AI and IP protection issues emerge, such as the treatment of different AI technologies in assessing patentable subject matter, interpreting and applying patentability criteria across different jurisdictions and refining/making additions to the patent system to accommodate AI specificities.

	Additionally, due to the high level of connectivity between i4.0 technologies, such as AI, the Internet of things (IoT) and augmented and virtual reality, new challenges regarding the management and protection of IP rights will emerge. This is especially relevant for the manufacturing sector, since it begins to transition to the i4.0 integrated life cycle model and use digital threads across the supply chain to maximise efficiency and flexibility. The potential loss of such valuable confidential information could cause serious damage to businesses, underlining the challenge of securing and commercialising IP and formulating relevant business strategies and practices. This suggests that governments shall not only adjust the regulatory framework to accommodate these developments but also consult the industrial sector accordingly. Germany, one of the global champions with regards to newly introduced products and their respective patents, has developed a national strategy which includes the component of IP and has adapted its IP legislative measures for AI. No measures/provisions have been enacted specifically for AI with regard to copyrights yet, but a copyright exemption has been enacted for text and data mining, which constitutes a necessary basis for machine learning and thus for AI. Currently, the German government coordinates the work on national data strategy to address questions regarding access to and use of data. For the case of Germany, the responsible entity for addressing issues of industrial property protection is the German Patent and Trade Mark Office (DPMA). The following represent a brief overview with regards to the areas which can be registered at the DPMA: • Patents (especially with regard to ICT patents) • Trademarks • Utility models • Registered design • Topographies The above are also applicable for the Greek case, and therefore it is necessary that the respective legislation/regulations are revisited and made more concrete in order to set solid basis with regards to industrial intellectual property rights. It is critical to mention that only through a regulatory system that it focused on “outcomes” and at the same time is flexible, dynamic and continuously evolving (making sure that the regulatory system keeps up with the rate of innovation within the EU and Greek industrial ecosystem), can innovation thrive and drive the industrial ecosystem forward. Therefore, the goal of this initiative for the Greek case is the holistic revamp of the Greek legislative framework on intellectual property as well as the keeping up to date with European developments.
Stakeholders (Design & Implementation)	• General Secretariat for Industry
Key beneficiaries (Target group)	• Researchers/ Research institutions & universities • Greek Industry Enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	N/A
Indicative Budget	N/A

Dependencies with other initiatives	
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

4.1.6.4 Initiative 5.3: Reinforce the free-flow of non-personal data within the Greek Industrial Sector

Title of the Initiative	Reinforce the free-flow of non-personal data within the Greek Industrial Sector
Initiative's Coding	Initiative 5.3
Pillar	Pillar 5: Regulatory Environment
Area of focus	• Update of the regulatory environment towards being more "Industry-friendly"
Link with strategic goals	• Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* Collaboration among industrial enterprises and their suppliers and vendors is crucial in the Digital Age. Modern collaborations can achieve greater efficiency and enhanced results through the exchange and use of business data with regards to production time, product characteristics and services produced etc. It is therefore crucial that the Greek industrial regulatory environment is well established and well-defined when it comes to the free flow of non-personal data of industrial enterprises. *Details of the initiative* In order to achieve more and better collaborations among industrial enterprises (regardless of their size and sector of economic activity), the following two key actions should be pursued and tailored to the Greek industrial sector: 1. Utilize the European Regulation 1807/2018/EU for the Free Flow of Non-Personal Data (applicable as of May 28 2019) in order to develop the respective laws that will be targeted to the Greek Industrial ecosystem, specifically targeted at Industry 4.0 in order to promote the flow of data among businesses within the Greek industry, setting specific rules with regards to the procedures and processes that have to be followed by individual enterprises in order to receive from or share data with business partners. 2. Adopt the European Strategy for Data that is currently under development as well as the wider Data Act (expected in Q4 2021) that are seeking to enhance the performance and competitiveness of the European Industry. The European Strategy for Data will aim in the following areas, which are rather important for industrial enterprises: ○ Set specific measures on data governance, access and reuse of data ○ Development and roll-out of publicly held databases across the EU, allowing for the reuse of data from peer or other enterprises operating across the EU economy ○ Promote the design and utilisation (by all types of enterprises) of data processing infrastructures and data sharing tools, architectures and governance mechanisms ○ Ensure that businesses can have secure, fair and competitive access to cloud services. This will be pursued through the setting up a devoted procurement marketplace for data processing services, at the same time ensuring transparency with regards to the applicable regulatory framework on cloud framework of rules on cloud; ○ Optimal utilisation of data, at the same time investing in capacity building for small and medium-sized enterprises and digital skills;

	○ Promote the use of common data spaces across the EU in targeted sectors of the such as industrial manufacturing, green deal etc.
Stakeholders (Design & Implementation)	• General Secretariat for Industry
Key beneficiaries (Target group)	• Researchers/ Research institutions & universities • Greek Industry Enterprises (Established/SMEs/ midcaps/ startups) • Public sector stakeholders
Potential funding sources	N/A
Indicative Budget	N/A
Dependencies with other initiatives	
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 3 Necessity = 5

4.1.6.5 Initiative 5.4: Green Industry 4.0 initiative

Title of the Initiative	Green Industry 4.0 initiative
Initiative's Coding	Initiative 5.4
Pillar	Pillar 5: Regulatory Environment
Area of focus	• Update of the regulatory environment towards being more "Industry-friendly"
Link with strategic goals	• Support the Greek Industry to transition into the zero-carbon and low environmental footprint economy • Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* The major goal of the strategy and operational plan is, while pursuing the growth and revitalisation of the Greek Industry through the lens of Industry 4.0, to simultaneously develop a Green Industrial sector. This will be achieved through due care for the environmental footprint all industrial enterprises will have, embracing actions and set by the EU in this increasingly important for the environment area. At the same time, by embracing these Directives, Greek industrial enterprises can enter new areas of economic activity which can help them diversify from their current business and seek new growth opportunities. *Details of the initiative* In order to make products fit for a climate-neutral, resource-efficient and circular economy, reduce waste and ensure that the performance of front-runners in sustainability progressively becomes the norm, it is necessary that the Greek Government pays close attention to what the European Commission aims at when proposing sustainable product policies or legislative initiatives. Key stakeholders of the Greek industrial environment (i.e. the Federation of Enterprises and other Federations across the Industrial sector) and Greek public sector (i.e. General Secretariat for Industry, Ministry of Development and Investments etc.) should critically pursue the adoption of such policies that are currently being promoted at EU level as part of the new "Circular Economy Action Plan", the "Green Deal", the "EU Plastics Strategy" or other similar core initiatives. This effort will ensure that EU Directives and important initiatives that aim at the "Greening" of the European and consequently the Greek industry will be actively pursued and taken into account when designing the next day of the Greek industry. This initially will therefore allow to tailor targeted and actionable initiatives that should be pursued by the various sectors of the Greek industry. For instance, with regards to the "Circular Economy Action Plan", the core of the initiative pursued will be to widen the Ecodesign Directive beyond energy-related products so as to make the Ecodesign framework applicable to the broadest possible range of products and make it deliver on circularity. Priority should be given to addressing product groups identified in the context of select value chains of the Greek industry, such as electronics, ICT and textiles but also furniture and high impact intermediary products such as steel, cement and chemicals. In the lines of the above and with regards to the legislative initiatives pursued, Greek authorities shall step up efforts, in cooperation with the EU, on enforcement of applicable sustainability requirements for Greek products, in particular through targeted inspections

	and market surveillance actions. These monitoring actions will ensure that Greek enterprises abide to the EU Directives, actively seeking to achieve the "greening" of their operations, setting the example for their peers.
Stakeholders (Design & Implementation)	• General Secretariat for Industry • Ministry of Environment & Energy • Ministry of Digital Governance
Key beneficiaries (Target group)	• Greek Industry Enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	N/A
Indicative Budget	N/A
Dependencies with other initiatives	
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

4.1.6.6 Timeline of implementation of the initiatives of Pillar 5 and "Quick wins"

The implementation timeline of Pillar 5's initiatives is briefly presented below. As it can be seen, all initiatives are aimed to begin within the 1st year of the Operational plan, in order to be pursued simultaneously by the key stakeholders that will be called to design and implement them.

Since Pillar 5 focuses on changes within the Regulatory Environment of the Greek industrial ecosystem and in many cases the initiatives will need to initiate changes in laws, all four initiatives outlined within Pillar 5 are expected to be implemented within a four year timeline, given the complex and not so business-friendly regulatory environment of Greece.

For initiatives such as Initiative 5.1 "Strengthen the Cybersecurity framework of Greece with regards to Industry 4.0" that include many actions, priority should be given to the industry-wide campaign on the significance of cybersecurity as well as the cybersecurity certification for private organisations. However, at the same time, the other two actions, namely the participation in the Cybersecurity Competence Network and Centre as well as the promotion of a closer and more efficient collaboration between the General Administration of Cybersecurity and all competent authorities and stakeholders within the Greek Public sector are equally important and should be pursued. The latter two actions affect the overall timeline of implementation stretching it to close to four (4) years, since they are directly linked with EU initiatives that are currently under development. The same holds for 2nd action within Initiative 5.3, which is linked with the European Strategy for Data that is currently under development. However, Action 1 of the same initiative should be pursued independently and in due time according to the timeline below.

Similar to the above, Initiatives 5.2 "Enhance the Greek industrial ecosystem with regards to intellectual property" and 5.4 "Green Industry 4.0 initiative" the responsible stakeholders will have to pursue them independently and in a swift mode of work in order to achieve the expected benefits within the Greek industrial ecosystem the soonest.

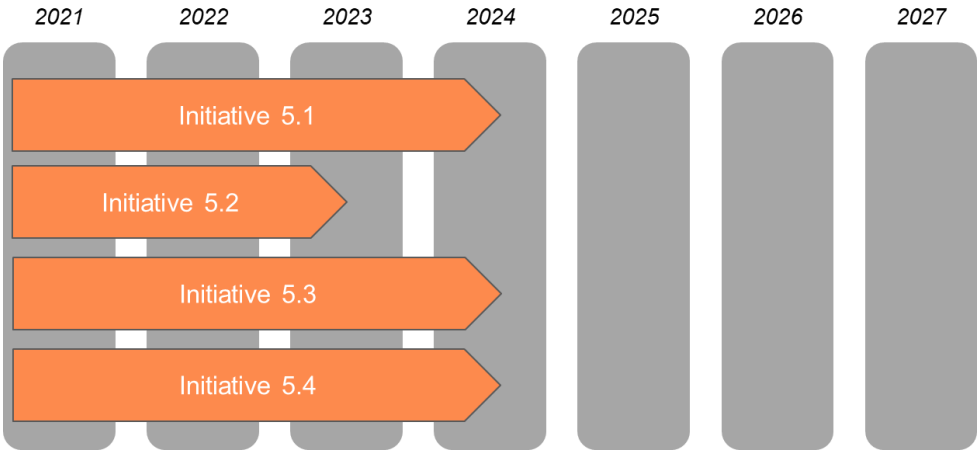


Figure 11 Timeline of initiatives' implementation for Pillar 5

In the following page, the "**Quick wins**" for Pillar 5 are presented, taking into account their "Feasibility" and "Necessity" scoring as presented above as well as taking into account the factor of time, i.e. the "Timeline of implementation" dimension as described above. For Pillar 5, this initiative is Initiative 5.3 "Reinforce the free-flow of non-personal data within the Greek Industrial Sector", where the relevant stakeholders can utilise the European Regulation 1807/2018/EU for the Free Flow of Non-Personal Data, in order to allow businesses to share industrial data in a more structured and efficient way. It is

important to note that for Pillar 5, which refers to the Regulatory environment which includes a lot of "red-tape" including legislative and other obstacles, it is rather difficult for initiatives to stand out as "quick wins" without this meaning that they are not critical for the industrial ecosystem.

Figure 12 Pillar 5 "Quick wins"

4.1.7 Operational measures & initiatives: Pillar 6: Acceleration of investment in digital technologies

4.1.7.1 Introduction & Key Definitions

Pillar 6 is meant to provide to enterprises of the industrial ecosystem the financial incentives in order to invest in and leverage Industry 4.0 technologies and applications. That being said, the Pillar will overall place a special emphasis in assisting enterprises of the industrial ecosystem financially in order to enable them to make the much needed investments and upgrade their fixed capital assets, which, for a large part of the ecosystem can be considered as outdated, In that sense, it also seeks to act as a link between all the other initiatives proposed through the remaining 5 execution pillars of the strategy and the financial incentives that will be rolled out to support industrial enterprises embark on their Industry 4.0 journey. It is important to note that all other human capital and industry 4.0 skills, collaboration and synergies, industrial standardisation etc. initiatives and their respective budgeting is analysed within the previous chapters of the Operational plan, and this pillar addresses the financing and funding assistance enterprises of the Greek industrial environment will receive with regard to Industry 4.0 technologies and applications.

More specifically, the pillar includes measures that seek to boost and support financially enterprises of all different sizes within the Greek industrial ecosystem, so as to enable them to make their Digital leap (i.e. both adoption of new technologies and the upskilling/reskilling of employees). That being said, two key initiatives of Pillar 6 provide an outline on the financial tools and measures targeted at upgrading Greek industrial startups, SMEs, mid-caps and large industrial enterprises, as well as enterprises that seek to scale up their operations towards a “holistic” upgrade of the ecosystem.

Furthermore and adding to the above, the pillar seeks to introduce other financial tools and adjustments that will ultimately allow for a more “investment friendly” environment to promote its growth within the following years.

Last but not least, Pillar 6 aims to promote investments in specific sectors of the Greek industrial environment, seeking to identify what sectors of economic activity within the Greek industry will be the champions of tomorrow, taking into account variables such as their value added, their technological advancement in recent years etc. This will be key for the Greek industrial ecosystem, so as to leverage its key strengths and grow significantly in the following years, contributing the most to the Greek economy overall.

In the following pages, the initiatives under Pillar 6 are analysed and elaborated, following the methodology outlined in the previous chapters.

4.1.7.2 Initiative 6.1: Accelerated depreciation scheme

Title of the Initiative	Accelerated depreciation scheme
Initiative's Coding	Initiative 6.1
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Introduce adjustments to allow for a more "investment friendly" environment
Link with strategic goals	• Increase the Greek Industry's overall digital maturity
Description of the initiative	*Rationale behind the need for the initiative* Other than providing direct financing or funding to enterprises in order to satisfy their investment needs while transitioning into Industry 4.0, indirect motives have to be utilised in order to promote this transition through multiple ways. Such a motive would be an accelerated depreciation scheme, aiming at encouraging businesses to invest in new Industry 4.0 technologies to improve and modernise their products, services and business models. *Details of the initiative* The aim of the accelerated depreciations' initiative for enterprises is that while investing in new technologies as analysed above, their taxed profits will be reduced due to the application of this accelerated depreciation to their technological assets. For many enterprises this tool can prove a great "relief" in financial terms, since they will not be deterred to invest in their holistic upgrade, thinking of the high taxes they will have to pay at the end of the year. However, it is important to note that for this initiative to be even more effective, enterprises that become part of it will have to re-invest the amount not paid as taxes to the same or similar areas related to their Industry 4.0 upgrade (i.e. in training their employees with the aim to upskill/ reskill them in order to become Industry 4.0 ready). The aim of this re-investment cycle is to incentivise enterprises to continuously invest in their holistic Industry 4.0 upgrade.
Stakeholders (Design & Implementation)	• General Secretariat for Industry • Ministry of Finance
Key beneficiaries (Target group)	Greek Industry Enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	N/A
Indicative Budget	N/A

Dependencies with other initiatives	Highly interconnected with Initiatives from Pillars 1-3
Timeline of implementation	Immediate
Feasibility and Necessity of initiative	Feasibility = 4 Necessity = 5

4.1.7.3 Initiative 6.2: Acceleration of investments (funding scheme) for Industry 4.0 startups

Title of the Initiative	Acceleration of investments for Industry 4.0 startups
Initiative's Coding	Initiative 6.2
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Design financial tools and measures targeted at upgrading enterprises on multiple areas (i.e. both adoption of new technologies and the upskilling/reskilling of employees) towards a "holistic" upgrade of enterprises
Link with strategic goals	• Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* By pursuing the goal to increase the overall contribution of the Greek industry to the Greek economy, this initiative is targeted at new emerging businesses will be adding value to the Industrial production of the country through innovative products and services. This initiative is expected to play a crucial role in the Industrial ecosystem of Greece by helping these new enterprises grow. Its need in the Greek Industrial ecosystem is prevalent since startups that do not have a proven track record of operations find it difficult to gain access to capital in order to support their growth (according to the European Digital City Index, Athens ranks 56th and 60th among 60 cities on with regards to access to capital and early stage financing). More specifically, the scheme will support the Greek start-up ecosystem and create the right conditions for ambitious entrepreneurs of the Greek Industry through targeted support. That being said, it will allow to build a strong start-up ecosystem for the Greek Industry, allowing for synergies and diffusion of best practices across its participants, leading to higher innovation. *Details of the initiative* This initiative essentially represents a funding scheme that will provide funding for aspiring and newly established start-ups in the area of Industry 4.0, through different types of financial tools that will aim to support Industrial start-ups make their digital leap. More specifically, it will involve a series of different types of financial support: • Startups will be supported through grants that will assist them in their early stages of operation, attaining the necessary i4.0 technologies/ applications or growing in terms of space and size (same format as the Industry 4.0 vouchers, as in the case of Portugal). Innovation grants (in the form of an innovation voucher) can assist startups at the inception stage with the feasibility and development of innovative products, processes or services. The i4.0 innovation voucher should be targeted to the i4.0 related applied R&D & digitization projects that could cover the following technology families (non-exhaustively): ○ AI, Big Data, Internet of Things, 5G, Cloud ○ Smart Manufacturing (i.e. Electronic Components & Systems, Machine-to-Machine (M2M), Manufacturing Execution Systems (MES), etc.) ○ Robotics, Cybersecurity & Blockchain ○ Photonics, New Materials or HPC activities At the same time, financial instruments will be designed and rolled out through this initiative:

	• Microfinancing loans without collateral can help startups cover their early stage liabilities such as operating costs. • "Start-up loans" that can help the startup better prepare for the fundraising stage(s). (as done by Bpifrance). • Innovation loans to help launch innovative products/ services in the market (as done by Bpifrance). • Loans with preferential interest rates/ no interest rates or balloon type loans (free of payback for the first 3-4 years of operations) can greatly help startups expand their business and grow in the early stages. • Equity financing, which seeks to provide the startups with the needed liquidity, with the investor gaining in return part of the company's equity through stocks. The initiative will focus on startups that seek to grow as: • Industry 4.0 service providers (e.g. on robotics, artificial intelligence, Industrial Internet of Things, cloud services etc. for established industrial enterprises). For example an industry 4.0 service provider by utilising an Industry 4.0 technology or application, for example the IIoT, could assist a more established industrial company measure their performance and enhance their production/ interconnection of products/ services. • Industry 4.0 producers (i.e. for startups that seek to become part of the value chain of industrial enterprises, for example by producing through additive manufacturing a specific set of complex product parts, or by producing a set of products that are currently not produced domestically and established firms have to import them so to be utilised for the operations, or for startups that produce materials/ product components that can lead to energy savings and efficiencies for established Industrial companies). • Enterprises that assimilate Industry 4.0 applications to produce higher end manufacturing products (i.e. a company producing higher quality fabrics or materials). The above will be combined with the respective initiatives that will be designed within Pillar 2, so as to allow startups to receive funding in order to be coached by Industry experts on financial, tax, business strategy and other development aspects newly established businesses are in need of. It is important to note that this initiative could be complemented by and collaborate with the "Elevate Greece" registry/ initiative, which has been recently announced by the Greek Government in order to support startup enterprises in their early steps.
Stakeholders (Design & Implementation)	• Ministry of Development and Investments • Hellenic Development Bank
Key beneficiaries (Target group)	• Greek Industry startups
Potential funding sources	• European Structural and Investment Funds (ESIF) (through the new NSRF) • European Investment Fund • Public Investments Programme • Horizon Europe • Private Funding
Indicative Budget	€30.000.000-36.000.000 (an indicative target would be to assist financially 300 startups within the industrial environment, each receiving circa €100.000-€120.000).
Dependencies with other initiatives	Highly interconnected with all initiatives of Pillar 2 regarding startups
Timeline of implementation	Short term / mid-term

Feasibility and Necessity of initiative	Feasibility = 3 Necessity = 5

4.1.7.4 *Initiative 6.3: Acceleration of investments (funding scheme) for Industry 4.0 SMEs & Mid-Caps*

Title of the Initiative	Acceleration of investments for Industry 4.0 SMEs & Mid-Caps
Initiative's Coding	Initiative 6.3
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Design financial tools and measures targeted at upgrading enterprises on multiple areas (i.e. both adoption of new technologies and the upskilling/reskilling of employees) towards a "holistic" upgrade of enterprises
Link with strategic goals	• Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* Greek industrial SMEs and mid-caps should be placed in the epicentre of the Industry 4.0 strategy's effort to contribute to the utmost degree for the Greek economy, since they constitute the majority of companies within the Industrial sector. This will be the target group of beneficiaries for this initiative, seeking to assist them significantly in making their digital leap with regards to all aspects of their business operations and products or services produced. Same as for startups, and although in recent years some significant efforts have been rolled out by the Greek government (with the utilisation of state or European funds) in order to support these enterprises, the pace and level of financial support have to be stepped up in order to help them become digital as soon as possible. That being said, this initiative will act as a "financial umbrella" initiative aiming at building a solid industrial ecosystem of SME mid-cap enterprises, providing for their investment needs and allowing for value-adding synergies and diffusion of best practices among them. In order to further boost Greek Industrial/ ICT production-oriented start-ups, SMEs and mid-caps to: • further digitize their production lines by leveraging Industry 4.0 technologies • automate and interconnect their supply chains • design and produce smart products and services we propose this initiative which will act in a complementary way to initiative 6.2 above. *Details of the initiative* This initiative essentially represents a funding scheme that will provide funding or financing for any direct investment needs the above enterprises may pose, through different types of financial tools that will aim to support them make their digital leap. It will place a strong emphasis on Smart Manufacturing technologies as they have been pinpointed and selected for the current project (for more information please refer to High Priority case 1). The overall goal of this initiative will be to adequately support SMEs and midcaps within the industrial ecosystem in order to allow them to make the necessary steps and grow into larger industrial enterprises (since currently many mid-sized enterprises face difficulties in making the leap to growth) in the future, allowing them to drastically impact the ecosystem and increase their added value to the Greek industry. The programme shall provide funding for consulting, IT infrastructure and implementation services to SMEs/ mid-caps that wish to:

- implement Smart Manufacturing technologies and tools to digitize their production lines to improve cost-effectiveness, quality assurance and risks management
- perform early feasibility studies to analyse and evaluate the potential of developing a new smart product/ service, including market research
- conduct industrial research, with the intention that the skills and knowledge acquired will lead to an improvement and smartification and servitization of existing products, processes or services
- develop these new smart products, processes or services through activities including prototype testing, piloting and demonstration, that can be also offered "as-a-service".

Indicative Services Covered by the Programme:

The programme shall indicatively cover the following type of services (non-exhaustively):

- Ultra-high speed/ 5G network infrastructure
- Mechanical, laboratory & manufacturing equipment and quality control equipment
- ICT & software equipment, software licenses, cloud licenses
- Implementation services for the new IT infrastructure and S/W
- IT Security services
- Product design, intellectual property, patent and, certification costs
- Technical consultancy services for the implementation of new IT infrastructure/ S/W or for conducting the feasibility analysis for the development of new smart products and services

For that purpose, it will involve a series of different types of financial/ funding support as per below:

- Financing loans with preferential interest rates (reduced up to a certain amount, based on the needs/ financials and profile of the enterprises that will apply for it), or
- Financial loans with a significant grace period (from 2 to 3 years) in order to invest directly to their digital transformation in the areas already mentioned above.

Same as for the case of France and many other EU countries that have developed similar tools, these loans should focus on supporting enterprises that have embarked on a digital transformation journey and seek partial financial assistance in order to materialise their transformation goals. The contribution from the state could be 2 to 1 (for every €2 of the loan, the respective enterprise would have to match that investment with own funding equal to €1) for SMEs and 2 to 3 for midcaps and in general should reach up to €500,000. This could also be based on specific criteria set for the different activities enterprises would seek to engage in with the acquired financing, combined with their respective size and their annual turnover.

- Innovation loans to that will help them finance directly a new product or service that they plan on introducing to the Greek market, therefore supporting innovation throughout the industrial ecosystem.

The amounts for the above financing tools could range from €75,000 up to €500,000, based on the needs of each company and the investing focus area are they are targeting for. The loans' payback duration could range from 5 to 7 years, adjusted on a case-by-case basis depending on the type of investment and the size of the company.

With respect to funding the following should be pursued:

- "Industry 4.0 training grants" for established SMEs, scaleups or mid-caps, utilising it in order to invest to their human capital reskilling/ upskilling, equipping them with the right skills in order to be efficient within their new Industry 4.0 roles and job positions.

It is also important to mention that in order to further support innovation and research within the industrial environment, businesses that will apply to receive funding from this initiative will also be evaluated on the basis of utilising already existing research work in

	the industrial ecosystem, thus promoting innovation for the sector. This is expected to have a significant impact in the ecosystem, since enterprises will be encouraged to collaborate with research groups/ institutions in order to develop and capitalise on innovative industrial products and services.
Stakeholders (Design & Implementation)	• Ministry of Development and Investments • Hellenic Development Bank
Key beneficiaries (Target group)	• Greek Industry SMEs, scaleups & mid-caps
Potential funding sources	• European Structural and Investment Funds (ESIF) (through the new NSRF) • European Investment Fund • Public Investments Programme • Horizon Europe • Private Funding
Indicative Budget	€320.000.000 - €400.000.000 (an indicative target would be to assist financially 1,000 SMEs and Midcaps within the industrial environment, it amounting from €75.000 up to €500.000.
Dependencies with other initiatives	Highly interconnected with all initiatives of regarding Industrial SMEs across Pillars 1-5, as well as Execution Pillar 3 regarding Collaborations and Synergies
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 3 Necessity = 5

4.1.7.5 *Initiative 6.4: Acceleration of investments (funding scheme) for large scale industrial enterprises to become "game changers" for the Greek industry*

Title of the Initiative	Acceleration of investments (funding scheme) for large scale industrial enterprises to become "game changers" for the Greek industry
Initiative's Coding	Initiative 6.4
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Design financial tools and measures targeted at upgrading enterprises on multiple areas (i.e. both adoption of new technologies and the upskilling/reskilling of employees) towards a "holistic" upgrade of enterprises
Link with strategic goals	• Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* By taking into account the pivotal role that industry can play within the context of the country's economy, it is crucial for Greece to reshape its industrial ecosystem not only by transferring programs and actions planned at European level, but also by adapting them to the current domestic base of the country and launching the necessary transformations. In this effort, it is more than critical to engage the large industrial firms (based on 2017 list there are 56 businesses that their annual revenue is categorized as large businesses) that can be characterised as the country's "Industrial stars", since they actively support and drive the growth of the ecosystem, always seeking to compete on par with their EU counterparts through innovative products and services of higher added value. These firms can act as key enablers towards the creation of higher added value within the industrial ecosystem, since they do not only employ a large part of the industrial workforce, contributing significantly to their sector's value added, but also act as the "epicentre" for the operations of many smaller player within the ecosystem. It is therefore key to support as much as possible these enterprises, acting as pioneers towards the development of innovative and collaborative ecosystems within the industry. This shall be pursued in a highly collaborative and innovative manner, which will seek to mobilise SMEs which constitute the backbone of the Greek economy as well as significant stakeholders from the Greek innovation and research sector. *Details of the initiative* In the above context, this programme seeks to provide financing in large firms that are willing to develop innovative products and services as well as sustainable tools around activities that create product "value-chains" and can have major spill-over effects across the economy, paving the way to the desired change of industry's growth pattern. The support of the above businesses will come in the form of loans (with low preferential interest rates) from the Greek state, aimed to be invested at transformative changes across their operating systems. Any investments related to the adoption of the latest Industry 4.0 trends and technologies (as they have been analysed for the High Priority Case 1: Smart Manufacturing Technologies), R&D expenses and training of the staff fall within the scope of this programme's financing eligibility. • The financing loans will provide a significant grace period (from 4 to 5 years) in order to provide to them adequate time to build the necessary capacity for the transformative change. These loans could range from €25.000.000 and reach up to €40.000.000 for

	complete investment plans. All firms that want to participate in this programme will have to submit a detailed proposal for their envisaged investment plan by laying out on how they will seek to act as the main drivers for the development of new products and services within the industrial ecosystem as well as information on time schedule, cost etc. It is critical to note however that the proposal should describe in detail how they will seek to collaborate with research institutions/ universities as well as industrial SMEs innovating in specific industrial segments, pursuing collaborations in the lines of the "triple helix" model that has been pursued across many EU countries. That being said, these large firms should have already joined forces with the respective SMEs/ startups or research institutions in order to formulate an aspiring yet achievable investment plan, explicitly mentioning how and for what purpose there are going to collaborate over the course of the period the plan will be implemented, including all products and services and R&D activities that will be pursued. The proposals submitted will be assessed by the Greek state as well as key stakeholders of the sixth Execution Pillar's working group, mainly focusing on the following parameters: (a) development of innovative industrial products and services (b) creation of synergies with other players of the ecosystem (number of research institutions and other enterprises engaged as part of the plan) (c) expected impact on the industrial sector (number of new job positions as well as % expected increase in the gross value added) (d) sustainability and "green" elements of the proposal (in line with High Priority Case 3: Circular Economy) (e) replicability of the project for "adjacent" industrial segments
Stakeholders (Design & Implementation)	• Ministry of Development and Investments • Hellenic Development Bank
Key beneficiaries (Target group)	• Greek Industry large scale enterprises
Potential funding sources	• European Structural and Investment Funds (ESIF) (through the new NSRF) • European Investment Fund • Public Investments Programme • Horizon Europe • Private Funding
Indicative Budget	Approximately €500.000.000 (an indicative target would be to assist financially 10-20 Large scale industrial enterprises through a financing of circa €40-50.000.000 for a complete digitisation investment plan).
Dependencies with other initiatives	Highly interconnected with all initiatives of Pillar 3 regarding collaborations and synergies
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 3 Necessity = 5

4.1.7.6 Initiative 6.5: Introduce "Sector-deals" with regards to Industry 4.0 applications for companies that are part of specific Industry sectors

Title of the Initiative	Introduce "Sector-deals" with regards to Industry 4.0 applications for companies that are part of specific Industry sectors
Initiative's Coding	Initiative 6.5
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Design financial tools and measures targeted at upgrading enterprises on multiple areas (i.e. both adoption of new technologies and the upskilling/reskilling of employees) towards a "holistic" upgrade of enterprises
Link with strategic goals	• Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* It is rather crucial that the Greek state prioritises a select of sectors of the Greek Industry in order to be promoted and supported to the utmost extent, aiming to become "Industrial Champions". By pursuing this, the Greek industry will be revitalised and will grow around these areas that constitute the competitive industrial advantage of Greece, allowing for collateral benefits for all other professions and sectors directly or indirectly related to them. *Details of the initiative* Same as for the case of the UK[28], the Sector-deals initiative will be focused on supporting these specific sectors (which could potentially come from sectors among the "high priority cases" selected in the lines of this project). Therefore, on top of the already existing financial and other incentives that exist for the entire industrial sector, the Government will seek through this initiative to mobilise additional capital (ranging from 25% to 40%) and financially support the enterprises within these specific sectors, in selected areas of Industry 4.0 interest and specific technological applications for each one of them. In that sense, a co-investment scheme between the state and enterprises of all sizes will be created, allowing them to invest in technologies, human capital skills, applications, expert counselling in order to grow and prosper. Then on a frequent basis (four to six years), the Greek state should re-evaluate the significance and contribution of the Industrial sectors in the economy and accordingly redesign more tailored supporting mechanisms and initiatives, or even placing a special emphasis on upcoming promising industrial sectors. The percentage (%) of investment between the state and the enterprises will be defined and adjusted on a case-by-case basis, based on their size, their turnover and capacity to invest in such areas.
Stakeholders (Design & Implementation)	• Ministry of Development and Investments • Ministry of Finance • Hellenic Development Bank
Key beneficiaries (Target group)	• Greek Industry SMEs, scaleups & mid-caps

[28] https://www.gov.uk/government/publications/industrial-strategy-sector-deals/introduction-to-sector-deals

Potential funding sources	• European Structural and Investment Funds (ESIF) (through the new NSRF) • European Investment Fund • Public Investments Programme • Horizon Europe • Private Funding
Indicative Budget	€100.000.000 – 140.000.000 (an indicative target would be to assist financially 1.000 SMEs and Midcaps within the industrial environment within the selected industrial sectors, on average assisting with additional financial incentives/ support of 25-40% of what is already present in terms of financial incentives, approximately between €100.000-120.000 per enterprise).
Dependencies with other initiatives	Highly interconnected with the three High Priority Cases (especially the Sector deal for the Structural materials sector, Initiative 8.4)
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 1 Necessity = 5

4.1.7.7 Initiative 6.6: Standardisation Vouchers for enterprises of the Greek Industry

Title of the Initiative	Standardisation Vouchers for enterprises of the Greek Industry
Initiative's Coding	Initiative 6.6
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Design financial tools and measures targeted at upgrading enterprises on multiple areas (i.e. both adoption of new technologies and the upskilling/reskilling of employees) towards a "holistic" upgrade of enterprises
Link with strategic goals	• Increase the Greek Industry's overall digital maturity.
Description of the initiative	*Rationale behind the need for the initiative* In order to promote the adoption of standards and norms within the Greek industrial ecosystem by all players, it is important to provide the appropriate funding motives to do so. This initiative will aim to provide a small, but significant financing support to all types of enterprises across the industrial landscape of Greece, putting an emphasis on SMEs and mid-caps, in order to motivate them to invest in standardisation of products, services, processes etc. *Details of the initiative* The Standardisation Voucher will be granted to enterprises that seek to apply new standards on their products and services produced, as well as their internal processes. Once they receive the respective funding, which is estimated to amount to approximately €20,000, they will be able to invest it in covering the costs related to their standardisation of their production processes, products etc. Moreover, they can utilise the amount provided by the voucher in order to train their employees on the new standards used throughout the business. Being able to engage on the standardisation journey through this initial financial help is rather important. It is expected that once companies begin realising the benefits of standardisation through this initial investment, they will seek to further invest in that important area for the Greek industry.
Stakeholders (Design & Implementation)	• Ministry of Development and Investments • Hellenic Development Bank
Key beneficiaries (Target group)	• Greek Industry SMEs, scaleups & mid-caps
Potential funding sources	• European Structural and Investment Funds (ESIF) (through the new NSRF) • European Investment Fund • Public Investments Programme • Horizon Europe • Private Funding

Indicative Budget	€15.000.000 – 20.000.000 (an indicative target would be to assist financially 750-1000 industrial enterprises with the amount of the voucher which would amount approximately €20.000).
Dependencies with other initiatives	Highly interconnected with all initiatives of Pillar 4 regarding industrial standards
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 3 Necessity = 5

4.1.7.8 Timeline of implementation of the initiatives of Pillar 6 and "Quick wins"

The implementation timeline of Pillar 6's initiatives is briefly presented below. All initiatives are aimed to begin within the 1st year of the Operational plan, in order to be pursued simultaneously by the key stakeholders that will be called to design and implement them. This is essential since the initiatives of Pillar 6 are focused at assisting industrial enterprises to adopt and utilise Industry 4.0 technologies in their business models and operations, acting as the first step to make the leap to the Digital age.

As it can be seen in the figure below, Initiative 6.1 "Accelerated depreciation scheme", Initiative 6.2 "Acceleration of investments for Industry 4.0 startups", Initiative 6.3 "Acceleration of investments for Industry 4.0 SMEs & Mid-Caps" and Initiative 6.4 "Acceleration of investments (funding scheme) for large scale industrial enterprises to become "game changers" for the Greek industry" should be prioritised as far as their design and implementation is concerned, since right conditions exist so that they are rolled-out the soonest in order for industrial enterprises to receive funding and start the digital transformation journey. Especially Initiative 6.1 is expected to be "easier" to roll-out (and therefore should take less time to implement) compared to Initiatives 6.2 and 6.3 which require a more complex and elaborate planning and collaboration among the relevant stakeholders in order to start financing and funding industrial startups, SMEs and Midcaps.

Initiative 6.5 "Introduces "Sector-deals" with regards to Industry 4.0 applications for companies that are part of specific Industry sectors" is expected to start after the 2nd year and before the 1st half of the Operational plan's duration since it would be wise to allow for careful consideration on the part of the Greek public sector in order to choose and assist with the right tools the sectors to become "Greek industrial champions". Last, Initiative 6.6 "Standardisation Vouchers for enterprises of the Greek Industry" is directly related to Initiative 4.2 regarding the development of the future Greek industrial standards, therefore it should be designed as soon as they are finalised in order to define what exactly the voucher will fund with regard to standardisation.

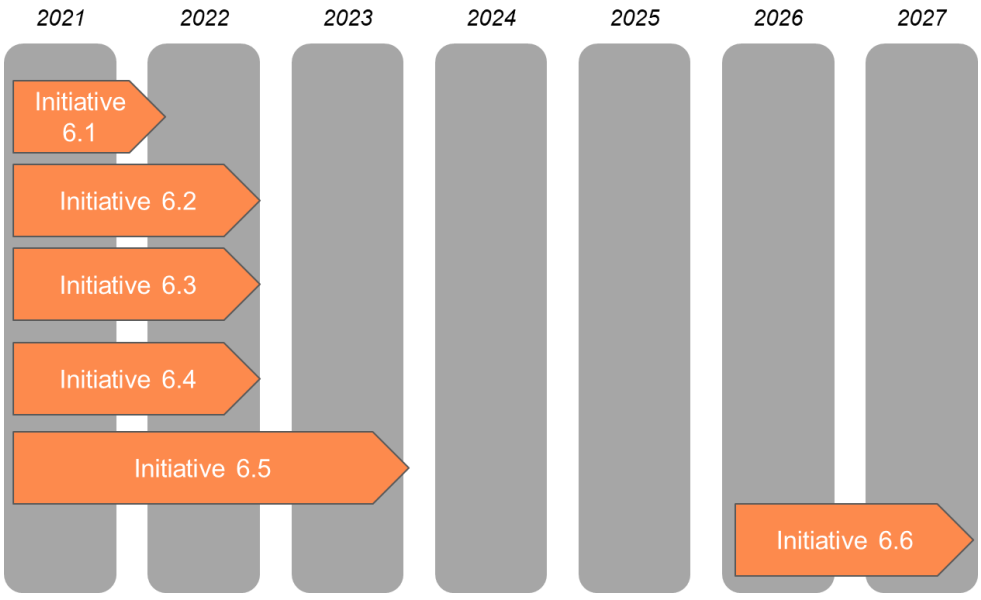


Figure 13 Timeline of initiatives' implementation for Pillar 6

Below the "**Quick wins**" for Pillar 6 are presented, taking into account their "Feasibility" and "Necessity" scoring as presented above as well as taking into account the factor of time, i.e. the "Timeline of implementation" dimension as described above. For Pillar 6, this initiative is Initiative 6.1 "Accelerated depreciation scheme" where the Greek state can put this into effect rather swiftly, given the other similar initiatives that are currently being pursued within the industrial ecosystem (i.e. the tax deductions being pursued by the General Secretariat for Research and Technology). It is also logical that not many initiatives within Pillar 6 can be characterised as "Quick wins" since the design and roll-out of financial and funding incentives is a rather complex and time consuming process that needs to be carefully planned to bring the expected benefits to the industrial sector.

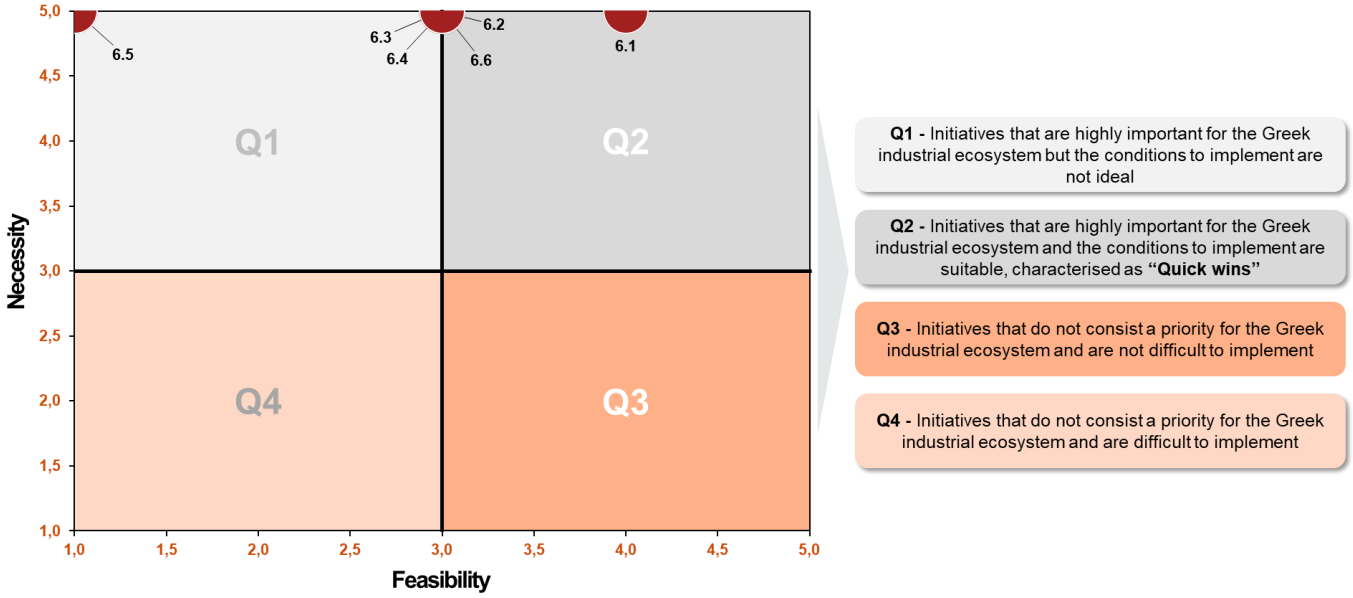


Figure 14 Pillar 6 "Quick wins"

5 Operational plan's High priority cases

5.1 The methodological approach for and selection of the High priority cases

Complementary to the proposed Industry 4.0 Operational Plan, whose initiatives mostly affect horizontally the Greek Industry, we applied industry and technology-specific lenses to assess the potential for more targeted interventions within the Greek economy.

To achieve this, we looked at three different groups of areas:

1) Sectors of economic activity
2) Technological domains
3) Wider Industry 4.0 themes

For each of the three groups of areas, we applied a different set of industry and technology-specific lenses to surface potential pilot areas of targeted interventions.

5.1.1 Sectors of economic activity

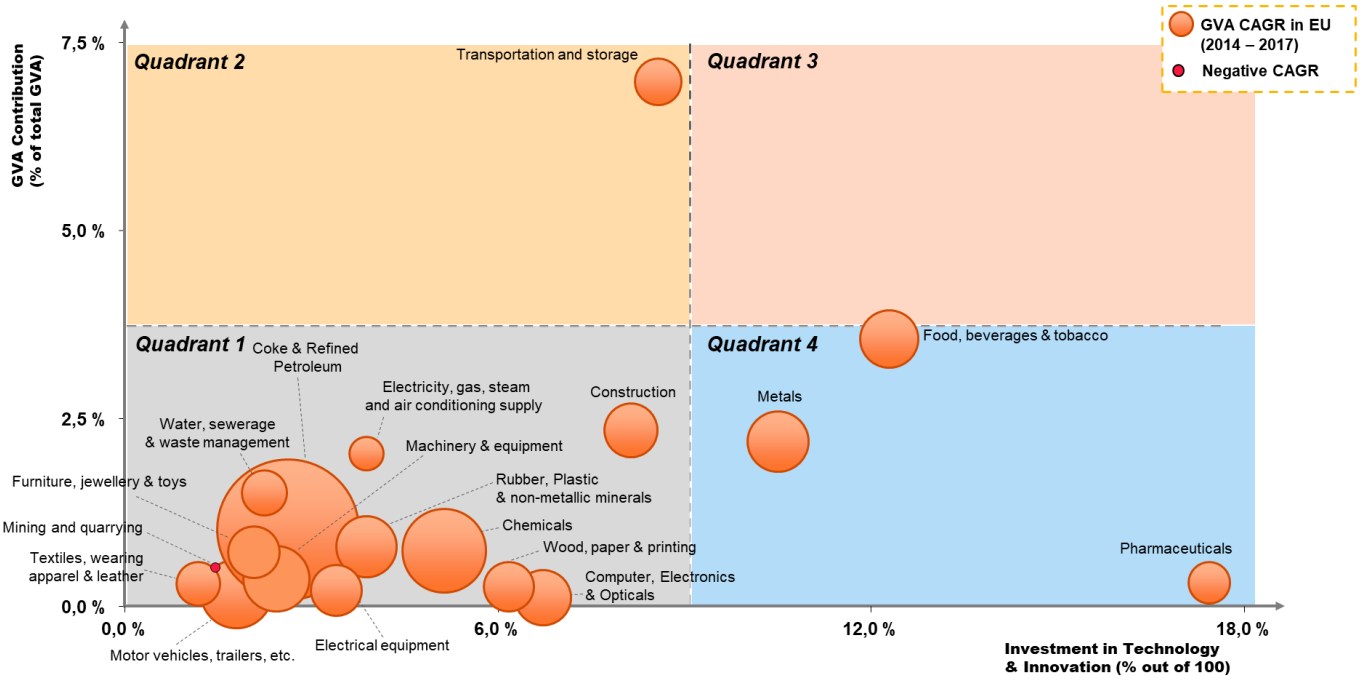
In order to identify select areas of economic activity, where we could further focus our attention and propose targeted interventions, we applied six (6) lenses to the total set of the Greek Industry sectors and Manufacturing sub-sectors. These lenses were selected in order to holistically review all aspects of the economic sectors within the perimeter of our analysis. In addition, these lenses were chosen amongst others, as data from reliable 3rd party sources were available.

The chosen lenses, their definition and the reason of their selection are presented in the table below:

Selected Lens	Definition	Reason for Selection	Data Source
Gross Value Added (GVA)	Gross value added is the value of output less the value of intermediate consumption for a specific sector/ sub-sector; it is a measure of the contribution to GDP made by an individual sector/sub-sector	Indicates the **contribution** and **significance** of each sector/sub-sector to the overall economy	Eurostat
Industrial Production Index	An economic indicator measuring real output in the manufacturing, mining, electric and gas industries, relative to a base year (2015)	Indicates the volume of **production** of each sector/ sub-sector and the sector's **efficiency**	Eurostat/ Stochasis
Turnover	Turnover is used to understand how quickly a company collects cash from accounts receivable or how fast the company sells its products/ inventory. Turnover is a synonym for an organization's total revenues	Indicates the **size** and the **strength** of each sector/sub-sector	Eurostat
Exports	Goods and services that are produced in one country and sold to buyers in another. Exports, along with imports, make up international trade.	Indicates the **competitiveness** of each sector/sub-sector	Eurostat
Employment	The number people engaged in productive activities in an economy. The concept includes both employees and the self-employed.	Indicates the political **importance** and **sensitivity** of each sector/sub-sector	Eurostat
Investment in Technology & Innovation	Composite index that indicates the investment that a sector/sub-sector performs on the following dimensions: - Computing & Communication Equipment - Computer Software & Databases & R&D	Indicates the steps that each sector/sub-sector has taken towards **Industry 4.0**	EU Klems

As a next step we combined the six lenses to produce three different 2x2 selection matrixes, that will help us surface potential pilot areas for further exploration. An analysis of the three matrixes is presented below.

1st selection Matrix - Lenses applied: Gross Value Added, Investment in Technology & Innovation, CAGR GVA at an EU level



Analysis of the Matrix

The first selection matrix categorizes the Industry's sectors & manufacturing sub-sectors across the following dimensions:

- **Horizontal Axis (Axis X):** Indicates the percentage of investment in technology and innovation, that each Industry sector and each Manufacturing sub-sector performed in 2017 over the total investment in technology and innovation performed at an Industry level in the same year.
- **Vertical Axis (Axis Y):** Indicates the percentage of Gross-Value Added contribution that each Industry sector and each Manufacturing sub-sector contributes over Greece's overall Gross Value Added in 2017.
- **Size of bubble:** Indicates the Compound Annual Growth Rate of the respective European Industry sector and Manufacturing sub-sector for the time period 2014 – 2017.

The selection matrix positions the Industry sectors and Manufacturing sub-sectors into 4 different quadrants, each of which having a different set of characteristics.

- **Quadrant 1:** Incorporates Industry sectors and Manufacturing sub-sectors with low investments for 2017 in technology and innovation and with a relatively small contribution to Greece's overall Gross Value Added. Sectors and sub-sectors in this quadrant are the following:

  - B: Mining and quarrying
  - C13_C15: Textiles, wearing apparel & leather
  - C16_C18: Wood, paper & printing
  - C19: Coke & Refined Petroleum
  - C20: Chemicals
  - C22_C23: Rubber, Plastic & non-metallic minerals
  - C26: Computer, Electronics & Opticals
  - C27: Electrical Equipment
  - C28: Machinery & equipment
  - C31_C33: Furniture, jewellery & toys
  - E: Water, sewerage & waste management
  - F: Construction

- **Quadrant 2:** Incorporates Industry sectors and Manufacturing sub-sectors with low investments for 2017 in technology and innovation but with a relatively high contribution to Greece's overall Gross Value Added. The sector included in this quadrant is the H: Transportation & storage sector.
- **Quadrant 3:** Incorporates Industry sectors and Manufacturing sub-sectors with high investments for 2017 in technology and innovation and a relatively high contribution to Greece's overall Gross Value Added. This quadrant includes no Greek Industry sector or Manufacturing sub-sector.
- **Quadrant 4:** Incorporates Industry sectors and Manufacturing sub-sectors with high investments for 2017 in technology and innovation but with a relatively low contribution to Greece's overall Gross Value Added. The sectors included in this quadrant are the C10_C12: Food, Beverages & Tobacco, C24_C25: Metals and C21: Pharmaceuticals sectors.

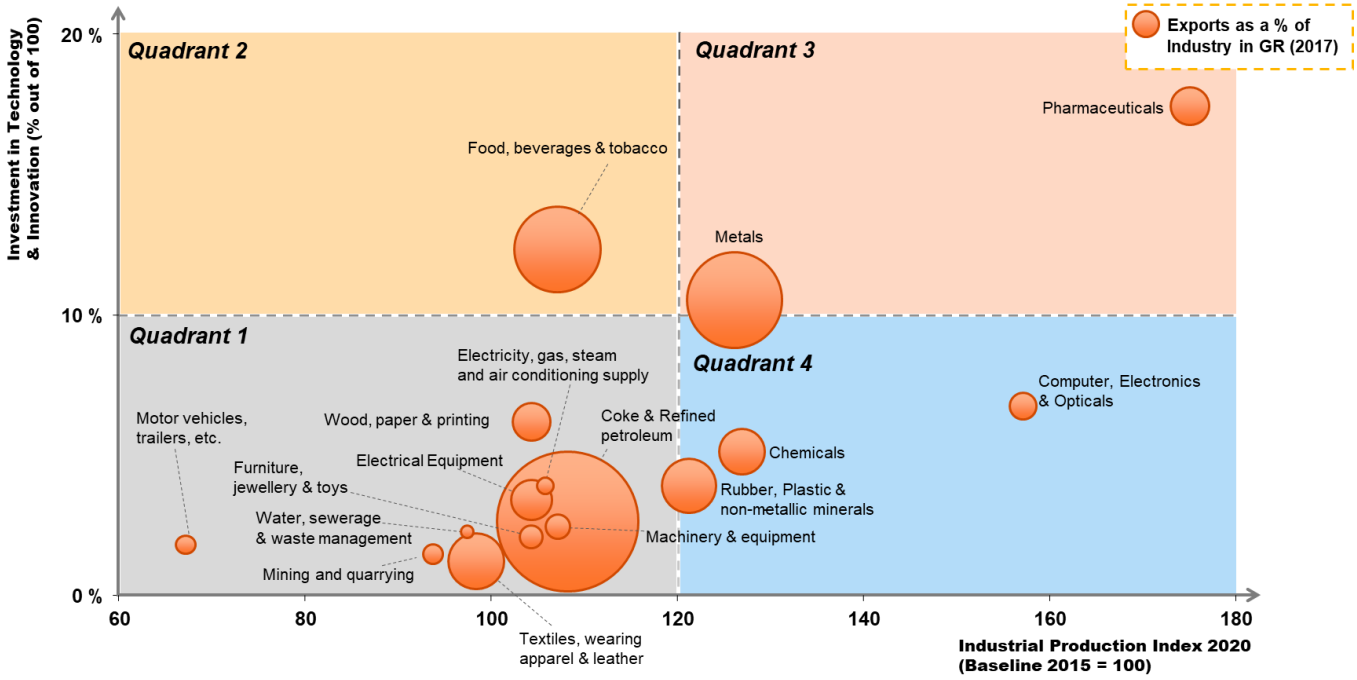
Suggested Pilot Areas

Out of the first selection matrix we recommend sectors:

- H: Transportation & storage
- C10_C12: Food, Beverages & Tobacco
- C24_C25: Metals
- C21: Pharmaceuticals sectors

as the pilot areas to be evaluated for targeted interventions. Targeted interventions across these sectors and sub-sectors could further grow them and increase their contribution to the Greek economy.

2nd selection Matrix - Lenses applied: Investment in technology & innovation, Industrial Production Index, Exports



Analysis of the Matrix

The second selection matrix categorizes the Industry's sectors & manufacturing sub-sectors across the following dimensions:

- **Horizontal Axis (Axis X):** Indicates the industrial production index for 2020 that represents the increase of industrial production for each Greek Industry sector and each Manufacturing sub-sector for the time period 2015 – 2020.[29]
- **Vertical Axis (Axis Y):** Indicates the percentage of investment in technology and innovation, that each Greek Industry sector and each Manufacturing sub-sector performed in 2017 over the total investment in technology and innovation performed at an Industry level in the same year.
- **Size of bubble:** Indicates the exports of each Greek Industry sector and each Manufacturing sub-sector in 2017, as a percentage of the overall Industry Gross Value Added.

The selection matrix positions the Industry sectors and Manufacturing sub-sectors into 4 different quadrants, each of which having a different set of characteristics.

- **Quadrant 1:** Incorporates Industry sectors and Manufacturing sub-sectors with low investments for 2017 in technology and innovation and with either a decrease in production between 2015 – 2020 (industrial production index lower than 100) or a rather small increase in production between 2015 – 2020 (industrial production index higher than 100). Sectors and sub-sectors in this quadrant are the following:

[29] Please note that no data is available for sectors F: Construction and H: Transportation and storage, therefore these sectors have not been included in this selection matrix

- B: Mining and quarrying
- C16_C18: Wood, paper & printing
- C19: Coke & Refined Petroleum
- C27: Electrical Equipment
- C28: Machinery & equipment
- C29_C30: Motor vehicles, trailers, etc.
- C31_C33: Furniture, jewellery & toys
- D: Electricity, gas, steam and air conditioning supply
- E: Water, sewerage & waste management

Since this quadrant includes sectors and sub-sectors with both low investments in technology and innovation and decrease/ low increase of production, we suggest that none of these areas should be considered as pilot areas for targeted interventions.

- **Quadrant 2:** Incorporates Industry sectors and Manufacturing sub-sectors with high investments for 2017 in technology and innovation but with a relatively low projected production increase for the time period 2015 – 2020. The sector included in this quadrant is the C10_C12: Food, Beverages & Tobacco sector.
- **Quadrant 3:** Incorporates Industry sectors and Manufacturing sub-sectors with high investments for 2017 in technology and innovation and with a high projected production increase for the time period 2015 – 2020. This quadrant includes sectors: C24_C25: Metals and C21: Pharmaceuticals. In addition, Metals demonstrate a strong export activity in 2017 (size of bubble).
- **Quadrant 4:** Incorporates Industry sectors and Manufacturing sub-sectors with low investments for 2017 in technology and innovation but with a relatively high projected production increase for the time period 2015 – 2020. The sectors included in this quadrant are: C20: Chemicals, C22_C23: Rubber, Plastic & non-metallic minerals and C26: Computer, Electronics & Optical.

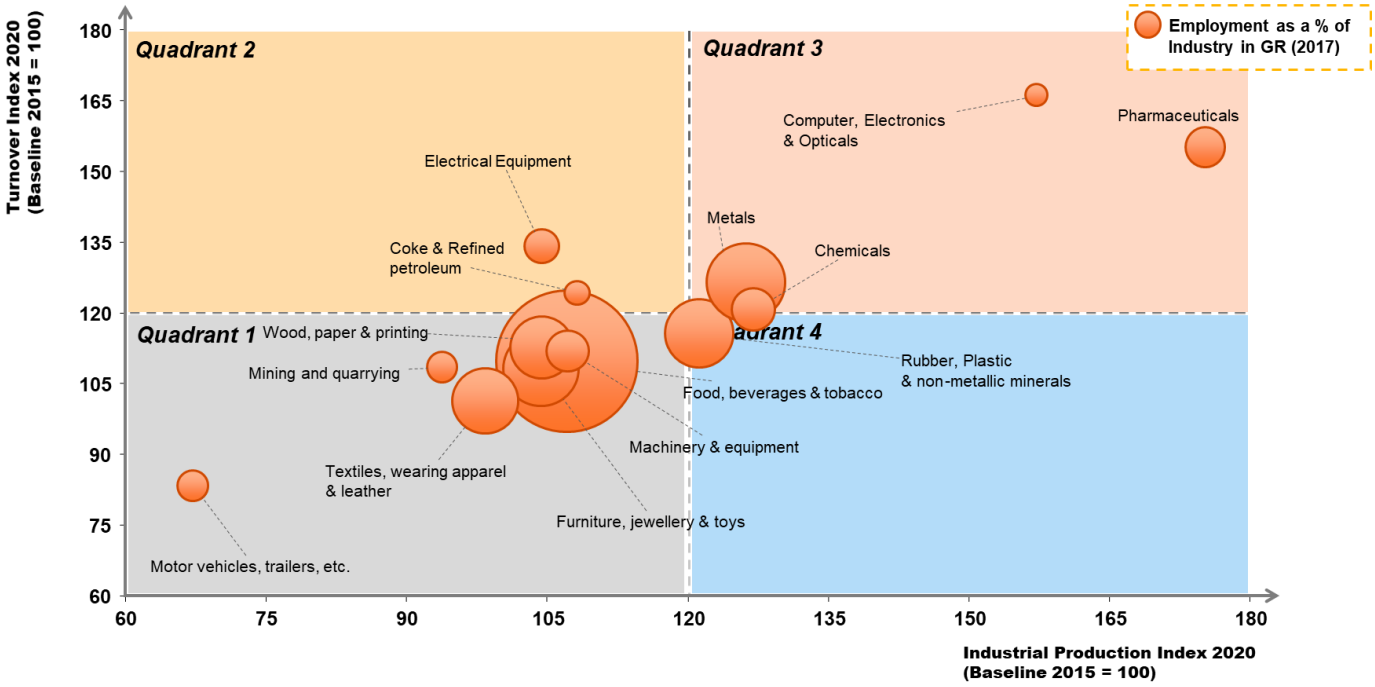
Suggested Pilot Areas

Out of the second selection matrix we recommended sectors:

- C10_C12: Food, Beverages & Tobacco
- C24_C25: Metals
- C21: Pharmaceuticals

as the pilot areas to be evaluated for targeted interventions. These sectors are suggested being selected as pilot areas for targeted interventions, as they appear to be sectors that already invest in technologies, they are projected to increase their productions within the next years and demonstrated significant exporting activity in 2017 (size of bubble). Therefore, through targeted interventions, these sectors could be further digitised, become even more competitive against their EU counterparts and increase their production volumes in the next years.

3rd selection Matrix - Lenses applied: Turnover, Industrial Production Index, Employment



Analysis of the Matrix

The third selection matrix categorizes the Industry's sectors & manufacturing sub-sectors across the following dimensions:

- **Horizontal Axis (Axis X):** Indicates the industrial production index for 2020 that represents the increase of industrial production for each Greek Industry sector and each Manufacturing sub-sector for the time period 2015 – 2020.[30]
- **Vertical Axis (Axis Y):** Indicates the turnover index for 2020 that represents the turnover increase for each Greek Industry sector and each Manufacturing sub-sector for the time period 2015 – 2020.[31]
- **Size of bubble:** Indicates the percentage of employment for each Greek Industry sector and each Manufacturing sub-sector over the overall employment of the Greek Industry.

The selection matrix positions the Industry sectors and Manufacturing sub-sectors into 4 different quadrants, each of which having a different set of characteristics.

- **Quadrant 1:** Incorporates Industry sectors and Manufacturing sub-sectors with either a decrease or a rather small increase in turnover and production volume between 2015 – 2020. Sectors and sub-sectors in this quadrant are the following:
    - B: Mining and quarrying

[30] Please note that no data is available for sectors F: Construction and H: Transportation and storage, therefore these sectors have not been included in this selection matrix
[31] Please note that no data is available for sectors D: Electricity, gas, steam and air conditioning supply, E: Water, sewerage & waste management, F: Construction and H: Transportation and storage, therefore these sectors have not been included in this selection matrix

  - C10_C12: Food, Beverages & Tobacco
  - C16_C18: Wood, paper & printing
  - C29_C30: Motor vehicles, trailers, etc.
  - C13_C15: Textiles, wearing apparel & leather
  - C28: Machinery & equipment
  - C31_C33: Furniture, jewellery & toys
- **Quadrant 2:** Incorporates Industry sectors and Manufacturing sub-sectors with a high projected turnover increase between 2015 and 2020 but with a decrease or a rather small increase in production volume between 2015 – 2020. The sectors included in this quadrant are the following:
  - C19: Coke & Refined Petroleum
  - C27: Electrical Equipment
- **Quadrant 3:** Incorporates Industry sectors and Manufacturing sub-sectors with high projected increases both regarding turnover and production volumes between 2015 – 2020. This quadrant includes sectors:
  - C20: Chemicals
  - C21: Pharmaceuticals
  - C24_C25: Metals
  - C26: Computer, Electronics & Optical
- **Quadrant 4:** Incorporates Industry sectors and Manufacturing sub-sectors with a low projected turnover increase but with an important increase in production volume between 2015 – 2020. The sector included in this quadrant is C22_C23: Rubber, Plastic & non-metallic minerals.

Suggested Pilot Areas

Out of the third selection matrix we recommend sectors:

- C10_C12: Food, Beverages & Tobacco
- C21: Pharmaceuticals
- C24_C25: Metals
- C26: Computer, Electronics & Optical

as the pilot areas to be evaluated for targeted interventions. These sectors are suggested being selected as the pilot areas for targeted interventions, as these appear to be sectors with a very strong growth both with regards to their production and turnover. In addition, Metals demonstrate a high percentage of employment (size of bubble). An additional sector that could be included as a pilot area is sector C10_C12: Food, Beverages & Tobacco, that demonstrates a very high percentage of the total industry employment and at the same time demonstrates a relatively high projected turnover and production volume increase between 2015 and 2020. As such, targeted interventions could accelerate the sector's digitisation, could positively affect a large number of employees and improve their working conditions.

Collection of suggestions from selection matrixes and recommendation of the final list of the pilot areas

The consolidation of the suggestions from the three different selection matrixes leads to the following table:

1st Selection Matrix – Key suggestions	2nd Selection Matrix – Key suggestions	3rd Selection Matrix – Key suggestions
• C10_C12: Food, Beverages & Tobacco • C21: Pharmaceuticals • C24_C25: Metals • H: Transportation & storage	• C10_C12: Food, Beverages & Tobacco • C21: Pharmaceuticals • C24_C25: Metals	• C10_C12: Food, Beverages & Tobacco • C21: Pharmaceuticals • C24_C25: Metals • C26: Computer, Electronics & Optical

We suggest that the common suggestions from all three selection matrixes should be used as the pilot areas for targeted interventions. Namely the final suggested pilot areas are the following:

- C10_C12: Food, Beverages & Tobacco
- C21: Pharmaceuticals
- C24_C25: Metals

5.1.2 Technological domains

With regards to specific technological groups that could consist pilot areas for targeted interventions, we reviewed the total set of Industry 4.0 technology trends, as these were presented in Deliverable 1, and evaluated whether Greece demonstrates relative strengths or weaknesses in any of these, as well as which of these (as primary candidates) could potentially accelerate the digitilisation of the Greek Industry.

A concise analysis of the technological domains and Greece's performance across these, is presented in the table below:

Groups	I4.0 technologies included	Rationale for Grouping	Greece's performance across these
Group 1 AI & Big Data Analytics	• Cloud • Artificial Intelligence • Big Data • Internet of Things • 5G	• Artificial Intelligence and Data Science are the two major technologies of the future. At the core of AI sits big data. Data is captured through the network of interconnected sensors that communicate via standard protocols (Internet of Things) and is stored in the Cloud. The speed of communication between the sensors and other IoT devices is defined and accelerated by the introduction of 5G networks	• Contrary to all other technology groups, Greece demonstrates a particularly strong performance across this set of Industry 4.0 technologies • Greek companies already exploit the potential of Big Data Analytics. This is evidenced by the fact that 13% of Greek enterprises (compared with 12% of the EU) invest in the collection and Big Data analytics[32] • 1 out of 3 respondents of the Industry 4.0 survey cited that their organisations have already adopted big data & analytics capabilities, while an approximately equally percentage is planning to do so in the next five years[33]

[32] Eurostat, Big data analysis, http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_eb_bd&lang=en
[33] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.

Groups	I4.0 technologies included	Rationale for Grouping	Greece's performance across these
Group 2 Smart Manufacturing Technologies	• Cloud • Big Data • Electronic Components & Systems • Machine-to-Machine (M2M) • Manufacturing Execution Systems (MES) • Simulation • Supervisory Control and Data Acquisition Systems (SCADA) • Distributed Intelligence • Additive Manufacturing	• This grouping includes all Industry 4.0 technologies & trends that permeate the manufacturing industry and enable the fusion of physical and virtual worlds through cyber-physical systems (CPS), which mark the advent of the fourth stage of industrial production • When implemented, these Industry 4.0 technologies enable the digital transformation and automation of production lines, the direct communication between devices using any communications channel, including wired and wireless and to the prototyping and production of customized, individual goods	• Greece appears to lag behind with regards to the adoption of some of the key technologies that consist the group • According to Eurostat, In Greece, enterprises show low rates of adoption regarding Cloud, with only 13% of enterprises making use of the technology, half the EU average[34] • In addition, with regards to additive manufacturing, only 2% of the Greek enterprises used 3D printing capabilities in 2018[35] • Finally, our Industry 4.0 survey indicated that less than 1 out of 4 interviewed enterprises have already implemented SCADA, MES, ECS and Simulation capabilities[36]
Group 3 Robotics	• Industrial Robots/ Robots	• Sits at the intersection between AI and Smart Manufacturing Technologies; Refers to automatically controlled, reprogrammable, multipurpose manipulators programmable in three or more axes, which can be either fixed in place or mobile for use in industrial automation applications	• According to Eurostat, just 2% of Greece's enterprises used industrial robot technology in 2018, demonstrating the country's slow rate of adoption in terms of industrial robotics[37]
Group 4 Cybersecurity	• Cybersecurity • Blockchain	• Refers to the security of equipment and products, which are connected through the internet or amongst themselves and create a fully interconnected industrial networked environment.	• According to the Global Cybersecurity Index (GCI) from ITU, Greece holds the 77th position across 175 countries worldwide, with regards to its cybersecurity

[34] Eurostat, Cloud computing services, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_cicce_use&lang=en
[35] Eurostat, 3D printing and robotics, https://data.europa.eu/euodp/data/dataset/yzsEuBlwUUxizsj3hSOdQ
[36] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.
[37] Eurostat, 3D printing and robotics, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_eb_p3d&lang=en

Groups	I4.0 technologies included	Rationale for Grouping	Greece's performance across these
		Blockchain is the major Industry 4.0 technology that ensures transparency & enhanced security	capabilities, much lower than the other EU countries (i.e. UK is 1st, France 3rd, Estonia 5th, etc.)[38]
Group 5 Photonics	• Photonics, Automation, Sensors & Applications	• Photonics, optical fiber transmission systems and their applications refer to backbone network infrastructure and move communications into the terabit era by dramatically increasing data capacity and data transmission speeds, while simultaneously reducing the networks' carbon footprint and the overall cost per bit • Although supporting the development of smart manufacturing applications, they act as enablers for these and cannot be grouped into a single group	• No hard data is provided for Greece across this Industry 4.0 technology • Our Industry 4.0 survey indicated that less than 10% of our sample claimed to already implement photonics and their applications in their organizations – limited use of this technology[39]
Group 6 New Material	• New Materials (e.g. Graphene, composites, PVD, CVD)	• The development of new materials and nanostructures (e.g. graphene, composites, PVD, CVD), enable the creation of new components with useful traits such as, durability, shape retention, lightweight, thermo-electric efficiency and re-usability	• No hard data is provided for Greece across this Industry 4.0 technology • Our Industry 4.0 survey indicated that 12% of our sample claimed to deal with the production/ use of new materials in their production lines – limited use of this technology[40]
Group 7 HPC	• High Performance Computing	• High-performance computing (HPC) is the use of parallel processing for running advanced application programs efficiently, reliably and quickly. The term applies especially to systems that function above a teraflop or 1012	• No information is provided for Greece across this Industry 4.0 technology • This is an advanced I4.0 technology, specialized and used by particular segments of the industry

[38] ITU, Global Cybersecurity Index, https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2018-PDF-E.pdf
[39] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.
[40] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.

Groups	I4.0 technologies included	Rationale for Grouping	Greece's performance across these
		floating-point operations per second	• Our Industry 4.0 survey indicated that only 6% of our sample claimed to currently use HPC capabilities – limited use of this technology[41]

Along these technological groups, the one that consists of essential components for a Digital Industry, in the Industry 4.0 context, is the 2nd group, **Smart Manufacturing Technologies**. From cloud capabilities and big data analytics, to additive manufacturing and the upcoming 5G connectivity, each and every one of them constitute structural ingredients of the Industry 4.0 era, implemented and used across every Industry's sector and function, providing competitive advantages to their adopters.

[41] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.

5.1.3 Wider Industry 4.0 themes

Finally, turning our focus to wider Industry 4.0 themes that may have a significant impact in the Greek Industry and the Greek economy, through future targeted interventions, the "Circular Economy" theme stands out, gaining increasing attention worldwide as a means to reduce dependency on primary materials and energy, while at the same time becoming an economically viable alternative to the linear economy.

The European Commission has adopted several measures and regulations throughout the years to promote the circular economy. Namely:

- In 2015, the European Commission adopted the EU Circular Economy Action Plan. The plan introduced several measures to help stimulate the European transition towards a circular economy, in order to boost global competitiveness, foster sustainable economic growth and generate new jobs.[42]
- The Green Deal: In order to support the sustainable growth and promote advances in the circular economy, the European Commission also introduced the European Green Deal in 2019. This is a set of policy initiatives with the overarching aim of making the European Union climate neutral by 2050.[43]
- The EU Plastics Strategy: In an effort to minimize the amount of plastics used in the European economy, the European Commission has devised the "European Strategy for Plastics in a Circular Economy".[44]

At a domestic level, Greece has thus far performed limited steps towards a Circular Economy, scoring last within EU with regards to the circular use of materials in its economy:

- According to Eurostat data, the average circular use of materials as a percentage of total material use averaged 12% in the EU in 2016. On the country level, the circularity of national economies varies highly with the Netherlands leading the way at 29% circular material use while Greece, Europe's lowest ranking country, reports only 1% circular material use.[45]

Given the significance that EU places on the circular economy, Greece's low performance on this area and the fact that Industry 4.0 bears enormous opportunities and can act as an enabler to move to a "Greener" economy, a final focus area should be the "Sustainable & Circular Industry".

5.1.4 The final selection of the three High Priority Cases

Taking into account the performed analysis, the General Secretariat of Industry has suggested the development and focus on the following three High Priority Cases:

- **High Priority Case 1: Smart Manufacturing Technologies**
- **High Priority Case 2: The Structural Materials Value Chain**
- **High Priority Case 3: The Circular Economy**

[42] European Commission, EU Circular Economy Action Plan, https://ec.europa.eu/environment/circular-economy/
[43] European Commission, Communication on The European Green Deal, https://ec.europa.eu/info/sites/info/files/european-green-deal-communication_en.pdf
[44] European Commission, European strategy for plastics, https://ec.europa.eu/environment/waste/plastic_waste.htm
[45] Eurostat, Circular material use rate, https://ec.europa.eu/eurostat/databrowser/product/view/cei_srm030?lang=en

Special note for High Priority Case 2

The outcome of our methodological approach, indicated the following three sectors of economic activity as potential candidates for the High Priority Cases:

- C10_C12: Food, Beverages & Tobacco
- C21: Pharmaceuticals
- C24_C25: Metals

The General Secretariat of Industry selected the Greek Metals industry as a High Priority Case to be included in the Industry 4.0 Operational plan. Nevertheless, acknowledging that:

- The sector of Metals demonstrates similar characteristics with sectors of other structural material (i.e. concrete, composites, masonry, timber, etc.)
- Industry 4.0 disrupts and blurs traditional sectoral boundaries and introduces cross-sectoral value chains

it has been suggested that we expand the perimeter of High Priority Case 2 from the “Smart Metals” industry to the “Structural Material” one. This expansion of the case’s scope is also expected to introduce greater synergies amongst High Priority Cases 2 and 3.

6 Annex A: Operational Plan for High Priority Case 1 – Smart Manufacturing Technologies

6.1 Introduction

An additional way in which Industry 4.0 can potentially catalyse the Greek Industry landscape and introduce opportunities for economic growth is Smart Manufacturing. Smart manufacturing is a technology-driven approach that utilizes Internet-connected machinery to monitor the production process. The goal of Smart Manufacturing is to identify opportunities for automating operations and use data analytics to improve manufacturing performance, realize operational efficiencies, reduce costs and improve production flexibility and capacity. The key technologies that enable Smart Manufacturing practices are presented along with their definitions in the table below:

Key Smart Manufacturing enabling technologies[46]	Definition
Additive Manufacturing	Additive Manufacturing, also defined as 3D Printing, refers to the prototyping and production of customized, individual goods based on specific customer requirements. Within the Industry 4.0 context, additive manufacturing and 3D printing methods will be used to produce small batches of customized products that offer construction advantages, such as complex, lightweight designs and lead to less stock on hand and overproduction. In addition, Industry 4.0 is expected to bring customers and suppliers closer together, and customers will be able to directly send production orders to the production partner in real-time. In this case, additive manufacturing can significantly improve speed to production, manufacturing design freedom, supply chain reductions, rapid prototyping and small-scale production experiments.
Big Data Analytics	Big Data Analytics is described as the collection and comprehensive evaluation of data from many different sources, from production equipment and systems to enterprise and customer-management systems to support real-time decision making and economically extract value through discovering, capturing and analysing very large volumes of a wide variety of data.
Cloud	The enablement of an on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned with minimal management effort.
Distributed Intelligence	Distributed intelligence systems are based on the use of cooperative agents, organized in hardware or software components, that independently handle specialized tasks and cooperate to achieve system-level goals and achieve a high degree of flexibility.
Electronic Components & Systems	Electronic Components and Systems (ECS), refer to components which are the hardware and software parts of the systems. The word “systems” is used in this context for the respective highest level of development targeted within the given part of the value chain.
Machine-to-Machine (M2M)	Machine-to-machine (M2M) refers to the direct communication between devices using any communications channel, including wired and wireless.

[46] A more analytical description of each of the technologies presented in this table and more can be found on Deliverable 1, Chapter 10.1

Manufacturing Execution Systems (MES)	Information systems used in manufacturing, to track and document the transformation of raw materials to finished goods. MES provides information that helps manufacturing decision makers understand how current conditions on the plant floor can be optimized to improve production output.
Simulation & Modelling	Simulation and modelling techniques focus on the use of models (e.g., physical, mathematical, or logical representation of a system, entity, phenomenon, or process) as a basis for simulations to develop data utilized for managerial or technical decision makings. Simulation and modelling techniques are used extensively in plant operations to leverage real-time data to mirror the physical world in a virtual model, which can include machines, products, and humans, thereby driving down machine setup times and increasing quality. Simulation & modelling is expected to enable manufacturers to prevent errors at an early stage that might otherwise result in substantial costs for plant operators. Simulation will also be used for preventive reasons, as it will enable organisations to optimize their manufacturing plants during ongoing daily operation.
Supervisory Control and Data Acquisition Systems (SCADA)	Supervisory control and data acquisition (SCADA) is a system of software and hardware elements that allows industrial organisations to control industrial processes locally or at remote locations, monitor, gather, and process real-time data, directly interact with devices such as sensors, valves, pumps, motors, and more through human-machine interface (HMI) software and record events into a log file.
The Industrial Internet of Things (IIoT)	The Industrial Internet of Things refers to the network of interconnected and uniform addressed objects that communicate via standard protocols. Through the Industrial Internet of Things, more devices and final products will be enriched with embedded computing and will be connected using digital technologies. This will allow field devices to communicate and interact both with one another and with centralized controllers, as necessary. It will also decentralize analytics and decision making, enabling real-time responses.
Photonics	New technologies such as Photonics, Automations, Sensors and Applications unlock advanced capabilities for seamless intercommunication throughout the production plant. The Photonics technology will help overcome the limitations of electronics in computers through all-optical computing or even quantum computing. Photonics will move communications into the terabit era by dramatically increasing data capacity and data transmission speeds, while simultaneously reducing the networks' carbon footprint and the overall cost per bit.

Contrary to other technology groups that are currently developed, smart Manufacturing technologies are already implemented by all Industrial sectors, to a significant extent and transform end-to-end Industrial organizations' value chains (see Figure 15). This has primarily to do with their current maturity, as well as with the range and scope of respective applications developed thus far for the Industrial & Manufacturing sectors. For this reason, it appears that Smart Manufacturing technologies appear to be one of the most important technology groups within Industry 4.0 and dedicated initiatives for their interweaving in the Greek Industry shall be further undertaken.

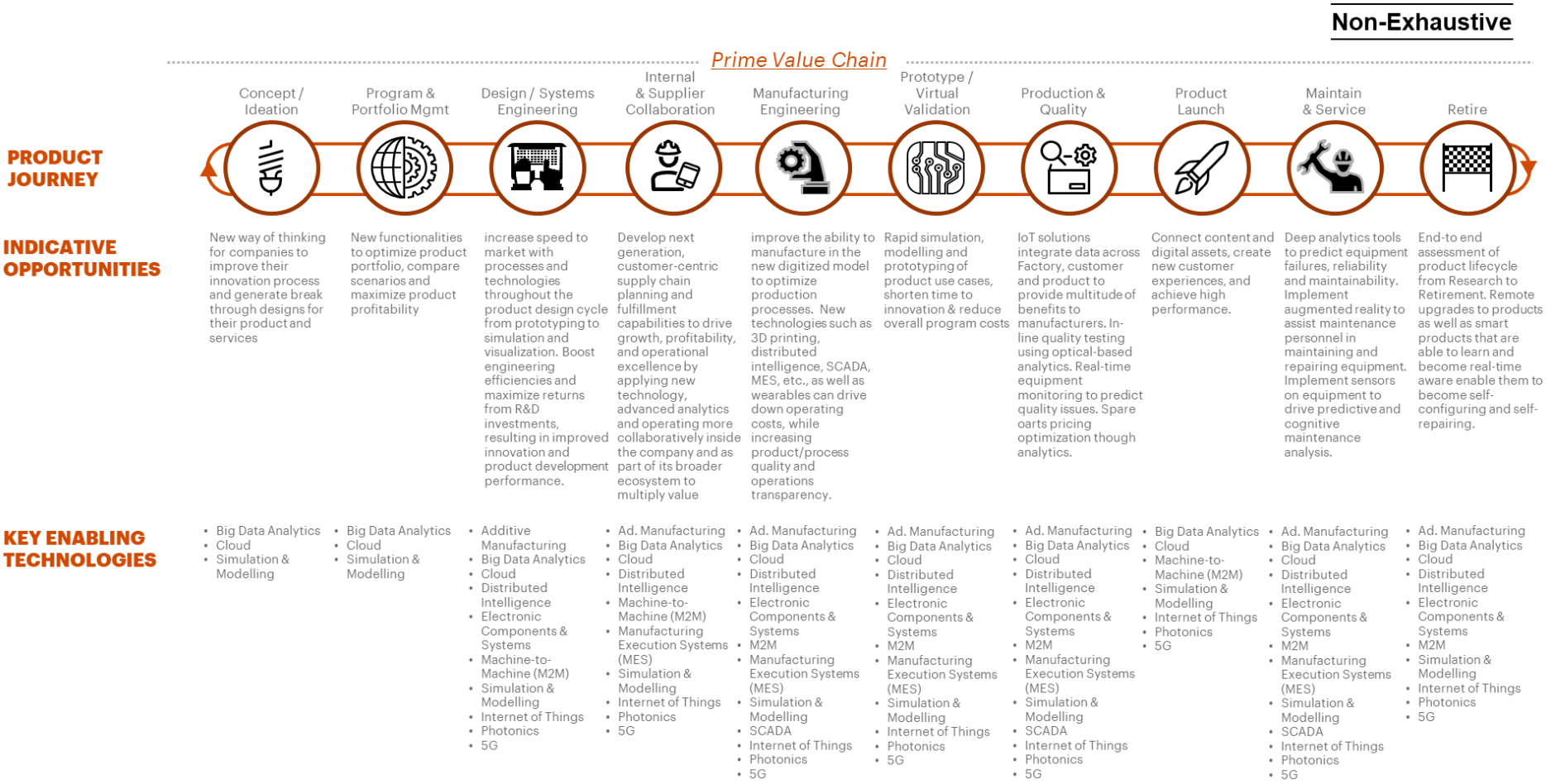


Figure 15: Current degree of implementation of Smart Manufacturing enabling technologies in Industry sectors - Source: Accenture Analysis

6.1.1 Smart Manufacturing Case Studies

Before we move to the specific set of initiatives with regards to the acceleration of adoption of Smart Manufacturing technologies by the Greek Industrial and Manufacturing organizations, we present a set of international and Greek case studies that demonstrate the breadth and depth of their Smart Manufacturing transformation and exemplify the importance of Industry 4.0 adoption.

6.1.1.1 Daimler-Benz reduces costs & increases efficiency with 3D printed spare parts

Daimler-Benz, one of the largest automotive companies worldwide, has established a particularly strong relationship with 3D printer system OEM EOS. Since 2017, the two companies work together on the NextGenAM project, which developed a workflow for industrializing metal powder bed fusion (PBF) technology for large-scale serial automotive manufacturing, with a particular focus on aluminium alloys. 3D printing technology is fully integrated into the development process and series production within the commercial vehicles segment at Daimler. All the innovations pertaining to the 3D printing process for Daimler Trucks & Buses have been introduced and undergone crucial development in an extremely short period of time by way of a Group-wide research and advanced development project in which the area of business innovation also plays an important role.

Along with the NextGenAM project, which came to its conclusion and is now being implemented in production workflows at factories such as Siemens Materials Solutions, Daimler-Benz Group companies are carrying out several activities focused on serial part production via additive manufacturing, both primarily centred on spare parts.

In the automotive sector, the NextGenAM platform is already being utilized for the production of truck parts and its potential is being evaluated for the production of car and electric car parts. The first replacement parts for Mercedes Benz trucks are brackets for truck diesel engines, while 3D printed aluminium replacement parts for Daimler buses are being examined at Daimler Buses' Centre of Competence for 3D printing. Daimler aims to leverage the automated and scalable process for series production of parts that have been optimized for 3D printing, benefiting from reduced weights and costs. In terms of replacement parts, the company is looking forward to further digitizing its part inventory—or Digital Stock—to cut down on warehousing needs.

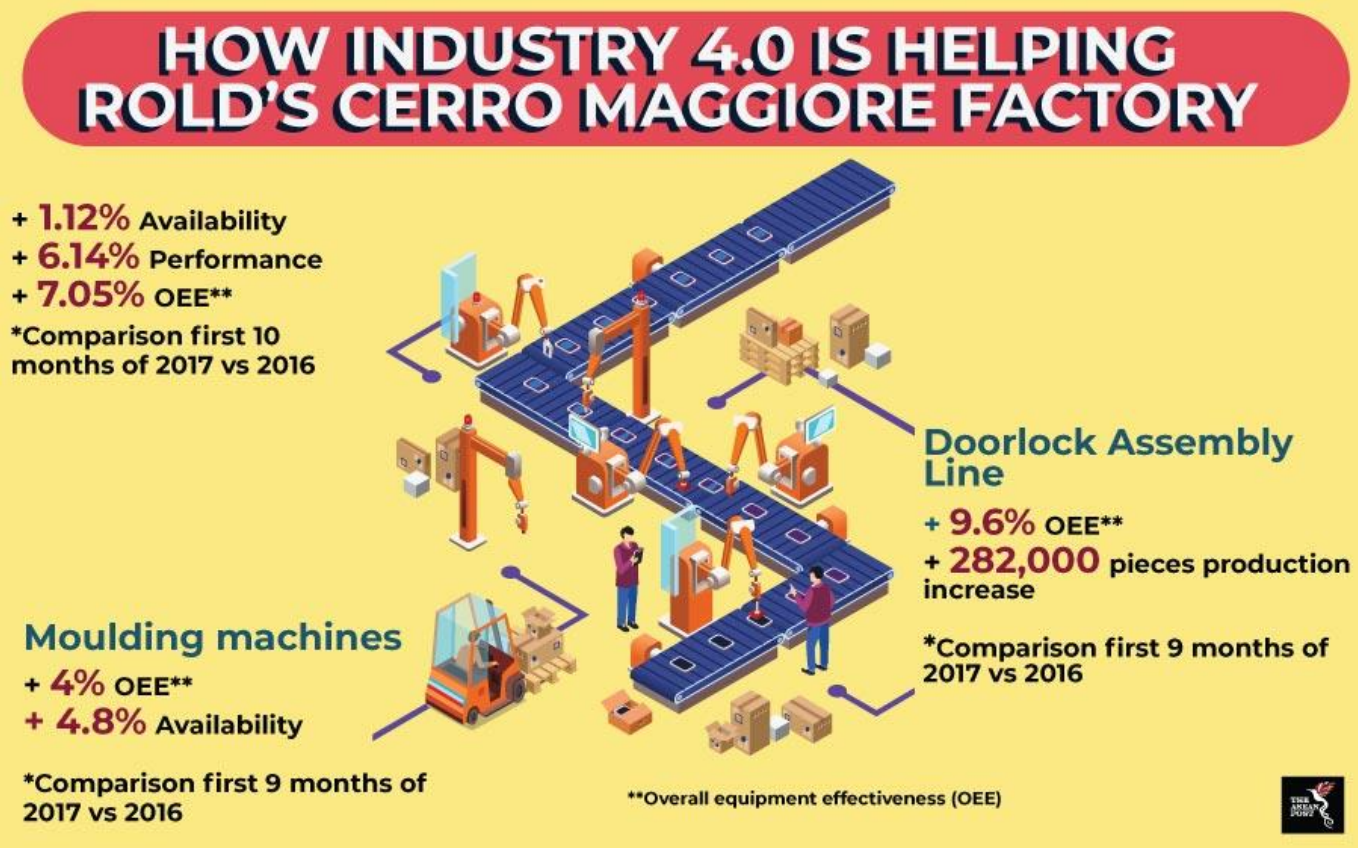
Source: https://www.3dprintingmedia.network/daimler-benz-additive-manufacturing/

6.1.1.2 Rold Smart Factory

Rold, a 240-employee Italian business makes locking mechanisms for washing machines and dishwashers. Rold's factory in Cerro Maggiore, about 20 kilometres northwest of Milan, was recently named one of WEF's 'Lighthouse of the Fourth Industrial Revolution' – a term WEF uses to describe advanced manufacturing sites which have successfully implemented Fourth Industrial Revolution technologies to drive financial and operational gains. Of the 16 factories chosen from a shortlist of 1,000 factories to join WEF's 'Factories of the Future' network, Rold's Cerro Maggiore factory stands out as the only SME on the list.

Applying digital manufacturing technology to increase productivity and quality in the context of a small organisation, Rold – which only has 250 full-time employees – has demonstrated that SMEs can adopt

Industry 4.0 even with limited investment by using off-the-shelf technology and collaborating with technology providers and universities. In Rold's case, for example, only three programmers were hired.



Source: https://www.rold.com/industrial/

Rold's SmartFab system uses everyday devices such as touch screens, smartphones and smartwatches to drive notifications from sensors on machines to operators in real time, resulting in quicker responses to potential emergencies by remaining constantly connected. Touch screens are installed along the production lines to control and analyse the most important information, making data readily available for operators to analyse and act on. Meanwhile, offices are remotely connected with touch screens so that management can comprehensively oversee production.

In addition, cost modelling to support make-versus-buy decisions uses data collection based on Internet of Things (IoT) devices on the shop floor, which combined with business intelligence tools, helps increase the accuracy of Rold's cost models. Meanwhile, rapid design prototyping through 3D additive manufacturing has shortened time to market for new product introductions. Overall, these implementations have helped Rold report a financial impact of seven to eight percent growth of total company revenue from 2016 to 2017, driven by an overall equipment effectiveness (OEE) increase of 11 percent.

While large firms are perceived to be the biggest benefactors of Industry 4.0, Rold has shown that SMEs can incorporate such processes if they have the right combination of factors.

Source: https://www.rold.com/industrial/

6.1.1.3 *BMW uses design simulation tools to test parts, not only for shape and structural integrity, but to see how well they fit into modern plant assembly operations and real-world driving conditions*

"Could a plastic, injection-molded support offer as much passenger protection as the steel assemblies it would replace? Could employees install the single piece in a space designed for a multi-part assembly? Would the bending and twisting of the part in the assembly process hurt structural integrity?" With these and other questions unanswered, building molds and creating test parts consists an expensive, time-consuming risk. For this reason, BMW's designers have turned to the use of a simulation software to create CAD files of parts and vehicle designs and run these digital files through simulations of the part-creating process, vehicle assembly operations, and crash-test conditions.

In fact, OEMs usually are not interested in simulating a single part, but they want to see how the part interacts within the system. Engineers are going beyond the discrete part and seeing simulation of the manufacturing and mounting of the different pieces and the installation on the final vehicle.

Cutting weight would be useless if it risked the company's reputation for safe cars. So, BMW used simulation to test the quality of the seating supports. Using Autodesk's simulation software, the automaker was able to design the seating supports and optimize its shape and material properties. The software analysed the efficiency of the part in terms of what moulds would be needed for manufacturing it, how assemblers would fit into the car, and its durability.

Source: https://www.todaysmotorvehicles.com/article/tmv0514-design-simulation-software/

6.1.1.4 *Cosmos' Robot-powered Warehouse Management System*

Cosmos Aluminum, a Greek aluminum manufacturer, made use of robotics for the complete automation of the process of product management in its warehouse. Cosmos' state-of-the-art Warehouse Management Software controls the full process of storing, packaging, and preparing its Aluminum products for delivery.

Cosmos' robotics-powered warehouse management system succeeded in fully automating all warehouse processes to the point where no human intervention is required, other than supervising the warehousing software. The use of barcodes enabled full traceability and proper routing each of product shipment throughout the process. Moreover, the process of placing the product packages in trucks is also automated, as the mounting positions determined by the program, which takes into account the quality of the product (figure, length, weight, volume, etc.) throughout the whole process.

Source: SEV, https://www.sev.org.gr/Uploads/Documents/Manufacturing4.0_deep_dive_new.pdf

6.1.1.5 *Mytilineos' Digital Aluminium Smelter*

Mytilineos, a leading Greek aluminum producer, leveraged Industry 4.0 related technologies to develop the first recorded, on a global level, digital solution for the process of electrolysis.

The 'Digital Smelter' developed by Mytilineos through the use of IoT and cloud computing technologies, empowers the smelter's operators to constantly assess, in real time, the smelter's operational parameters. This allows plant operators to determine ex-ante the sustainability and overall status of electrolysis basins.

The Digital Smelter has brought about measurable outcomes for Mytilineos's operations. For one, the Digital Smelter has reduced the number of unexpected metal leaks from the walls of electrolysis basins (known as Basin Jabs) by 43%. Secondly, the Digital Smelter reduced raw material consumption (in particular aluminum fluoride which is used as a thermal additive adjustment of the basin). Finally, it reduced special energy consumption (KWh per ton of aluminum) by 0,22%. The investment is expected to reach its full returns by the third year of operation.

Source: SEV, https://www.sev.org.gr/Uploads/Documents/Manufacturing4.0_deep_dive_new.pdf

6.2 Measures & Initiatives

6.2.1.1 *Initiative 7.1: Design a training curriculum and an online digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies*

Title of the Initiative	**Design a training curriculum and an online digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies**
Initiative's Coding	Initiative 7.1
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Upskill and reskill the Industrial workforce
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Our research on Greece's As-Is situation indicated that Greek industrial and manufacturing enterprises perform poorly with regards to the use of Smart Manufacturing Technologies overall. In fact, the Industry 4.0 Questionnaire (ran as part of Deliverable 1) highlighted that Greek executives consider the lack of digital skills and expertise in new technologies as a major impediment for meeting their Industry 4.0 needs. They believe that sourcing skilled workforce on Smart Manufacturing Technologies, stressing out Cloud, Big Data & Analytics and ECS among others, will be one of their greatest obstacles towards their digital transformation.[47] This challenge appears even greater for the Greek manufacturing and industrial SMEs that we surveyed. Simultaneously, as Smart Manufacturing Technologies overhaul and "reimagine" traditional job roles and re-write job descriptions, the need for the Greek Industrial Workforce's continuous reskilling and life-long learning becomes a prerequisite for their career progression and development, as well as for Greek corporations' survival. In the light of the aforementioned, the design of an online digital platform for the reskilling and up-skilling of Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies, can strengthen the digital skills of the Greek SMEs and enable them to further adopt these technologies to accelerate their Digital Transformation. *Details of the initiative* Establish a modern digital delivery platform that will provide scalable, relevant, timely, and easily 'digestible' content for upskilling and reskilling on Smart Manufacturing technologies. This would enable all companies, but particularly SMEs, to play their part in the Fourth Industrial Revolution, with incentives and networks in place to drive adoption. The platform

[47] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development and Investments, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.

	can adopt the guiding principles of the Digital Academy platform (developed by the Ministry of Digital Governance) or can be adopted and incorporated within the actual Digital Academy platform. Similar platforms have also been developed abroad, i.e. Futurelearn[48] or the IET online platform[49]. The platform shall provide an accessible, customised and relevant set of online modules which could be used as part of a learning pathway to reskill and upskill SME's workforce on Smart Manufacturing technologies. The platform shall be accessible on a Greece-wide basis to employers of Greek industrial and manufacturing SMEs and shall be populated from industry-provided and certified competence- and capability-based content which will be freely shared with the education and skills system as required. Its content shall be regularly updated and targeted at the skills in most demand in the most relevant sectors. It will provide short-form, modular resources, that are industry supported and quality assured. The platform could be used as a standalone resource or in blended form in environments such as competence centres, higher education institutions, VET training units, etc. The completion of predefined training programmes (comprising from a set of online courses) could also be accompanied by a certification scheme that will be provided after the participants' online examination. The platform shall provide a set of online modules which could be used as part of a learning pathway to reskill and upskill SME's workforce on Smart Manufacturing technologies. Indicatively: • Cloud: Introduce trainees to cloud storage & computing and its capabilities. Define how the remote connection to infrastructure and data centres hosted around the world can lower the costs of services to a business or an individual, avoiding investment in expensive infrastructure when trying to deploy the services locally and hyper-multiplying the computing capabilities of a business. Introduce the workforce in famous cloud platforms such as Amazon Web Services, Microsoft Azure, Google Cloud Platform, etc. Employees who are willing/ need to get advanced training will learn how to design distributed cloud computing applications, will be taught the fundamentals around efficient cloud architecture and will understand how to implement cloud security features to be protected against cyber-attacks. • Big Data & Analytics: Introduce employees to the concepts of Big Data & Analytics and provide them with the right tools in order to untap the previously locked value within their organisations, by gaining valuable insights. They will realize how data is literally everywhere around them and they will be equipped with incremental knowledge around their preferred structure and collection as well as programming tools for their mining and analysis, such as R, Python, SPSS, etc. The target for the participants, upon the course's completion, is to no longer treat data and analytics as a black box, but rather as a valuable way to gain information. • Electronic Components & Systems (ECS): Introduce employees to the fundamental knowledge around electronics, its components and the systems they compose. Show how electronic devices and systems pervade almost every daily activity within an enterprise and outside of it. After its completion, participants will be able to recognise a variety of high-tech products enabled by electronics, to manipulate voltages, currents

[48] https://www.futureleam.com/
[49] https://www.theiet.org/career/courses-training/online-leaming/

	and resistances in an electronic circuit and to demonstrate familiarity with electronic components and use them in the designation of electronic circuits. • Machine-to-Machine (M2M): Provide the workforce with the insights and perspectives around business and technical aspects of Machine-to-Machine communications and M2M ecosystems. Apart from a comprehensive overview, it will shed light into areas such as M2M architecture, M2M applications, M2M networks & communication technologies, M2M market and business dynamics, M2M security, M2M challenges and case studies. Upon its completion, employees will be able to not only understand and describe M2M business cases, but also identify appropriate business models for their implementation, perform technical analysis and will have gained a thorough knowledge, from design & deployment to operations and support around M2M. • Manufacturing Execution Systems (MES): Help the participants understand the MES environment their organisations implement, or plan to implement, and provide a standard terminology and model that they can use to specify manufacturing execution systems. It will start with standards and models (ANSI/ISA95.00.01Standard, ANSI/ISA95.00.03 Standard, MESA International Model) and then will cover production processes, from detailed production scheduling to production dispatching and product analysis, along with maintenance, quality and inventory processes. Upon The course's completion, employees will be able to describe the requirements for their enterprise's MES, analyse the manufacturing operations, determine the lines of responsibility and technical integration between operations and logistics, and identify critical manufacturing processes that need information from business systems. • Simulation & Modelling: Introduce participants in the concept of simulation & modelling and its use and exemplify how computer science can improve modelling and simulation within different scenarios coming from the manufacturing and the industrial sector. In addition, trainees could also undertake a variety of programming courses designed to introduce them to the fundamental computer programs and mathematical modelling underlying simulation programs. • Supervisory Control and Data Acquisition Systems (SCADA): Introduce participants to the parts and basic principles of SCADA systems and the important role they play in industrial automation. It will focus in SCADA system components, architecture protocol, provisioning, configuring alarms and displaying them, industrial network security and other topics for a SCADA project execution. Upon the course's completion, employees will be able to describe the various components of a SCADA system, understand the terms used in describing the technology, recognize the base elements that apply to SCADA as well as the potential benefits of applying SCADA within their organization • Distributed Intelligence: Introduce to participants the notion of distributed intelligence that aims at introducing horizontal as well as vertical flexibility into the manufacturing and plant control structure. This flexibility can be reached by using mobile and residential agents to establish distributed intelligence on the level of manufacturing execution systems and integration of distributed intelligence on the field control level. • Additive Manufacturing: Provide to participants the understanding of the production span of additive manufacturing, from the design level to the final part, along with the business benefits it offers. It will cover additive manufacturing processes, the advantages and limitations of these processes, and the approaches to be used in considering the material properties and design for additive manufacturing, as well as the applications

	and means through which additive manufacturing influences performance and growth within Industry's corporations. Upon the course's completion, participants will be able to explain the available processes as well as their underlying physical principles, present practical examples on additive manufacturing, and recognize long lasting opportunities that emerge from this technology within their organization. • 5G: Introduce participants to the forthcoming 5G network and the tremendous possibilities it can offer to the Industry, radically transforming processes, products, and business models, as we know them. It will cover 5G concepts and ecosystems, standardization schemes, broadcast broadband architecture, integrations & challenges as well as security issues. Upon the completion of the course, participants will be able not to only explain 5G's limitless capabilities, but to also have a comprehensive understanding behind its technical specifications. • The Industrial Internet of Things (IIoT): Introduce participants to tomorrow's industrial infrastructure and closely examine emerging markets, technology trends, applications and skills required to explore in the IIoT space. Participants will become familiar with top application areas of IIoT, operating systems are that are used in IIoT deployments, networking and wireless communication protocols used in IIoT deployments and encryption techniques and secure methods for insuring data integrity and authentication. • Photonics: Introduce participants to an overview of modern photonic manufacturing processes, the working operations of DC and AC analog electrical components as discrete devices and as part of larger electrical circuits, and to tools and methods used for measurement, testing, and quality control, and for repair, with emphasis on those used in photonic systems. • Over and above the aforementioned technologies and their respective modules, the digital platform could provide dedicated courses tailored to the training needs of machine operators and maintainers that shall quickly become up-to-speed with the new smart manufacturing skills to operate equipment. The content of the online modules presented below, as well as its customization to the needs of the different industrial and manufacturing sectors shall be undertaken by a newly introduced "Smart Manufacturing Skills" Committee. This Committee shall consist by Greek Industry & ICT stakeholders and academics with an expertise on Smart Manufacturing technologies. This Committee will be responsible not only to design and regularly update the training curricula and the content of the online modules, but also to train the Smart Manufacturing "trainers", i.e. the trainers that will deliver the online modules to the Greek manufacturing organizations. An accreditation scheme could also be introduced and provided by this Committee both to "certified" Smart Manufacturing trainers. Finally, in order to ensure that the newly acquired Smart Manufacturing skills are well-embedded and used in the Greek manufacturing organizations, both organizations and their certified "graduates" could be asked after a certain period of time (i.e. 1 year) to undertake a "Smart Manufacturing assessment". During this assessment, organizations shall demonstrate how they have incorporated Smart Manufacturing technologies and capabilities in their operations, while their employees shall manifest how they use their digital skills in their roles and whether new, additional skills are required for them to further increase their efficiency.

	Government shall cover the expenses for the development of the training platform and training curriculum. It is important to state here that the Greek Government can ask large private organizations to provide content and support for this platform, such that the content is kept current and owned/curated by the appropriate industry experts.
Stakeholders (Design & Implementation)	• General Secretariat of Industry • General Secretariat of Lifelong Learning/ Ministry of Education & religious affairs • Ministry of Labour • Ministry of Digital Governance • National Certifications Center (EOPPEP) • Private Accreditation Organizations • Industry federations
Key beneficiaries (Target group)	Employees from Greek Industrial enterprises (including SMEs & midcaps)
Potential funding sources	• Current NSRF/ ESF (OP Human Resources Development, Education and Lifelong Learning)/ Future NSRF
Indicative Budget	€2.000.000 - €3.000.000 for the development of the platform & the training curriculum
Dependencies with other initiatives	• Initiative 3.4: Develop a dedicated Industry 4.0 platform for Greece
Timeline of implementation	Midterm
Feasibility and Necessity of initiative	Feasibility= 4 Necessity= 5

6.2.1.2 Initiative 7.2: Support the Setup of a Smart Manufacturing Competence Center

Title of the Initiative	**Support the Setup of a Smart Manufacturing Competence Center**
Initiative's Coding	Initiative 7.2
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	Design of new and/or enhance existing innovation structures to ensure the diffusion of expertise and best practices between all the players of the Industrial ecosystem
Link with strategic goals	- Enhance the Greek Industry's applied R&D and the innovation capabilities - Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* Manufacturing industry represents a generator of Research and Development, innovation, growth and employment. Based upon increasing pressure on manufacturers (increased production capacity in low-cost economies and increased level of sophistication of supply chains in high-cost economies), the manufacturers need to embrace novel technologies, principles and approaches. In other words, manufacturers need to digitize their production, while taking into consideration also improvement in processes and human resource management. Nevertheless, as our research has indicated that still a high percentage of Greek industrial enterprises fall significantly behind in terms of adoption and implementation of major Manufacturing technologies, like Cloud, 3D printing, Supervisory Control and Data Acquisition Systems (SCADA), Manufacturing Execution Systems (MES), Electronic Components & Systems (ECS) and Simulation.[50] This challenge appears even greater for the very small and small enterprises that we surveyed. The main objective of the Smart Manufacturing competence centre is to improve framework conditions for innovation in the area of Smart Manufacturing technologies. Results will be improved cooperation between R&D and business, where triple helix partners will be oriented to find and develop novel solutions across a set of manufacturing-related domains, such as the optimization of their production and supply chain processes and the production of smart products and services. *Details of the initiative* **Scope of the Center** Encourage the setup of a Smart Manufacturing Competence Center that shall focus on Smart Manufacturing technologies and their implementation in the Greek manufacturing and industrial enterprises. The Smart Manufacturing Competence Center shall aim to create a platform for applied research, development and innovation in Greek manufacturing

[50] The performed analysis and the respective conclusions were based on data recorded through the "Industry 4.0" survey ran by the Ministry of Development and Investments, PwC and Accenture, with 152 Greek executives across the following sectors: B. Mining & Quarring, C: Manufacturing, E: Water supply; sewage, waste management and remediation activities, F: Constuction, H: Transportation, J: Information & Communication, which was launched on November 2019 and closed in February 2020.

enterprises (including SMEs, midcaps & startups) focusing on the development of innovative world-class manufacturing solutions.

The Greek Smart Manufacturing Competence Center shall act as the bridge between manufacturing and industrial SMEs and midcaps with large enterprises of the ICT and Manufacturing sectors as well as with academic and research institutions. The Competence Center will provide the resources, space and facilities to SMEs and midcaps to experiment with the development of Smart Manufacturing solutions, as well as with the associated digital processes and new business models under realistic conditions.

Participants in the Competence Center shall be able to experiment with the implementation of Smart Manufacturing technologies in their business operations.

Indicative areas of focus for the experimentation of the Smart Manufacturing technologies could be:

- Cloudification of Production Engineering: In order to boost the competitiveness of the Greek manufacturers (especially SMEs & midcaps), innovative solutions need to consider technological and commercial scalability from the beginning. From this perspective, the cloudification of services shall become the ideal enabler in the manufacturing digitalization. Successful European initiatives such us CloudFlow[51], cloudSME[52] or Fortissimo[53] have demonstrated the benefits of cloudification for engineering services, by means of combining HPC resources, computational tools, and cloud computing platforms. Cloudification of Production Engineering can empower SMEs to compute and solve problems that cannot be tackled without cloud, making them more competitive by reducing development times for innovative product with better performance.
- Digitization of manufacturing operations: Explore the use of additive manufacturing to produce rapid prototypes or low-volume spare parts, develop and implement cognitive bots and autonomous robots to effectively execute routine processes, design digital twins to digitize operations and move beyond automation to integration and predictive analytics.
- Logistics automation for Manufacturing SMEs: It will enable inexpensive deployment of small and flexible logistics solutions requiring no infrastructure change, no production downtime and no in-house expertise. The investment in logistics automation will become extremely attractive for manufacturing SMEs and Mid-Caps. The potential use of mobile robots will not only automate the logistics but will also provide unprecedented flexibility on the factory floor for batch production.
- Environmental, health and safety: Design and implement sensors to geofence dangerous equipment from operating in close proximity to personnel and adapt sensors on employees' equipment to monitor environmental conditions, lack of movement of other potential threats.

[51] eu-cloudflow.eu
[52] cloudsme.eu
[53] https://www.fortissimo-project.eu/

Sectors of economic activity to be served

The Competence Center shall primarily target and offer services to enterprises of the Greek manufacturing and the Greek Industry. This shall cover (non-exhaustively) NACE categories:

- B: Mining & Quarrying
- C: Manufacturing
- D: Electricity, gas, steam and air conditioning supply
- E: Water supply; sewerage; waste management and remediation activities
- H: Transportation and storage

Indicative Services Provided by the Smart Manufacturing Competence Center

The Competence Center will enable its clients to innovate, build differentiated smart manufacturing solutions and applications. In more detail, the Competence Center could provide the following services (non-exhaustively), to support its clients:

- Visioning & strategy development: Support new start-ups/ SMEs to assess their current Industry 4.0 maturity and design their Industry 4.0 strategy
- Collaborative R&D: Provide support for the design and implementation of R&D projects on smart manufacturing; develop new smart manufacturing concepts, design and develop proof of concepts
- Testing and validation: Provide technical and specialized services for design, testing & validation of new solutions including product demonstration & product qualification
- Technical support on scale up: Provide support for solutions' technology concept development, proof of concept, prototyping & small series production
- Skills & education: provide digital upskilling & reskilling training (i.e. workshops, seminars, courses, etc.) to the centre's customers, tailored to their digital maturity level & their business area; offer technological infrastructure for educational purposes
- Community building: Support the creation of a collaborative, innovation-driven ecosystem, instigate awareness, act as the broker to bring in contact enterprises, etc.
- In addition, the Competence Center will act as an ecosystem accelerator for start-ups, active in the "smart manufacturing" field.

Description of its structure

Prerequisite for the establishment, development and efficient steering of the national competence is the development of a governance model with the active engagement from leading industry & academic/ research stakeholders. In this context, it is suggested that the Competence Center shall be run by a consortium/ private-public partnership (as a unique private sector legal entity, i.e. S.A, IKE, etc.) that will be formulated by at least 1 research/ academic entity (i.e. Academic Institution, Research entity, etc.) with a specialization on Smart Manufacturing technologies, and at least 5 private enterprises (according to other EU competence centre cases, i.e. in Germany etc.) that also demonstrate an expertise in the respective fields.

The Government shall issue a call for tender for the setup and operation of the Competence Center.The call for tender shall specifically prescribe the minimum criteria that the participants shall fulfill in order to participate in this call. These could refer to the type and

	the composition of the consortiums (i.e. at least one of their members shall be a Greek Manufacturing SME/ midcap), the legal structure of the consortium, the business activity of its members, etc. The awardee will receive a financial aid for the setup of the Competence Center and the first years (1-2 years) of their operations. Indicative costs are presented also in the analysis. It should be mentioned that the Smart Manufacturing Competence Center is highly relevant and in fact could be located in the Smart Manufacturing Industrial Park, presented under initiative 7.4. The Competence Center could consist the "heart" of the Industrial park and its founders could also be the ones that will initiate the setup of the Industrial park and act as its evangelists to attract additional manufacturing enterprises to be relocated in the area. **Indicative, non-exhaustive costs and expenses covered by the programme** Funding shall cover the setup and first years of operation of the Competence Center. The programme could indicatively (and non-exhaustively) cover the following cost/expense types: - Costs for the setup of the Competence Center, i.e.: • Infrastructure, Equipment purchasing & maintenance costs • Intangible SW Costs (i.e. S/W Licenses, Application S/W, Patents & IPs) • Personnel Costs for running the Competence Center - R&D Costs, i.e.: • Feasibility Study Costs • Contractual Costs to perform R&D engagements Relevant call for tender for the setup of competence centres has already been published by the General Secretariat for Research & Technology in June 2020.
Stakeholders (Design & Implementation)	• General Secretariat for Research and Technology • General Secretariat for Industry • Ministry of Digital Governance
Key beneficiaries (Target group)	• Greek manufacturing and industrial enterprises (including SMEs, midcaps & start-ups), Greek enterprises from the Business Services & ICT Sector • Greek Academic Institutions • Research Centres • Industry Federations
Potential funding sources	• Horizon Program • Digital Europe Program
Indicative Budget	€ 2.000.000 – € 5.000.000
Dependencies with other initiatives	Initiative 7.4: Set up a Smart Manufacturing Industrial Park
Timeline of implementation	Mid-term/ Long-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

6.2.1.3 *Initiative 7.3: Introduce a Smart Manufacturing Challenge Programme to develop innovative solutions for a modern, more productive, environmentally sustainable Greek Manufacturing*

Title of the Initiative	**Introduce a Smart Manufacturing Challenge Programme to develop innovative solutions for a modern, more productive, environmentally sustainable Greek Manufacturing**
Initiative's Coding	Initiative 7.3
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	• Enhance the applied R&D and Innovation
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains • Increase the Greek Industry's potential to meet personalized needs and imminently respond to emergencies and crises (flexible processing)
Description of the initiative	*Rationale behind the need for the initiative* Part of the Industrial Strategy Challenge Fund, proposed under pillar 2, is recommended to be the "Smart Manufacturing Challenge" that shall be dedicated to the innovation of Smart Manufacturing technologies within the Greek manufacturing. The Smart Manufacturing challenge shall create a connected ecosystem harnessing the power of Greece's manufacturing companies large and small, large technology developers and new start-ups and spinouts, as well as the Greek academic/ research institutions, increasing the number of collaborations up the value chain. The challenge shall harness the transformative power of this ecosystem to deliver a modern, connected, resilient and flexible, significantly more productive, and environmentally sustainable Greek manufacturing sector and a vibrant technology sector that shall enable this transformation. The creation of innovative new digital solutions across all manufacturing sectors, will ensure the long-term prosperity of the Greek Manufacturing, raising total productivity, and increasing its Industry 4.0 maturity. *Details of the initiative* Introduce a "Smart Manufacturing" challenge under the Industrial Strategy Challenge Fund that will aim to support the transformation of Greek manufacturing capabilities through the adoption of Smart Manufacturing technologies. The challenge shall be analysed across specific fields of focus, for which respective programmes will be issued. These specific fields of focus could indicatively be: - **Smart connected factory** - Harness Smart Manufacturing technologies to optimise the design and operations of current and future factories, including: o Manufacturing process and operations (use of robotics or additive manufacturing to accelerate processes, dynamic, real time production

	planning and scheduling, digital twins of facilities & processes to optimise future designs or current state, etc.) ○ Asset management optimisation ○ Use of robotics and autonomous systems to improve productivity or worker safety ○ Connected worker – augmented & virtual solutions for task assistance, training or safety - **Connected and versatile supply chain** - Harness Smart Manufacturing technologies to optimise the design and execution of current and future supply chains. ○ Interoperability and understandability of data across value chains ○ Supply chain design (i.e. end to end supply chain visibility and effective risk management, sustainable supply chains for increased flexibility, warehouse and logistic optimisation, etc.) ○ Supply chain execution (i.e. demand management, sensing and shaping, improved decision-making through analytics and artificial intelligence (AI), production planning or scenario modelling, track-and-trace technologies, traceability and provenance) - **Adaptable, flexible manufacturing operations** ○ Enabling customisation: adapting processes to smaller batch size production, rapidly configurable processes with reduction of design and production time. ○ Flexible /distributed manufacturing using a flexible network of supply and skills to manage volatility/disruption effectively. ○ Simulation and understanding of real work using data from people and industrial systems, efficient transfer of trial results to the workplace. **How this programme shall work** This initiative shall consist part of the Industrial Strategy Challenge Fund. As such, it will follow the same guidelines and way of implementation.
Stakeholders (Design & Implementation)	• General Secretariat of Industry/ Ministry of Development & Investments • General Secretariat for Research and Technology/ Ministry of Development & Investments • Ministry of Digital Governance
Key beneficiaries (Target group)	Greek enterprises (including SMEs, midcaps & start-ups) across the select value chains that the challenges cover, Greek Academic Institutions, Research Centres, Industry Federations
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation) / Future NSRF • European Investment Fund
Indicative Budget	€ 500.000. – 1.000.000 per field of focus. The challenge can incorporate 3-5 fields of focus (1.500.000 – 5.000.000)
Dependencies with other initiatives	• Initiative 2.6: Introduce an Industrial Strategy Challenge Fund to enhance innovation & collaboration across the Greek Industry

Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

6.2.1.4 Initiative 7.4: Set up a Smart Manufacturing Industrial Park

Title of the Initiative	**Set up a Smart Manufacturing Industrial Park**
Initiative's Coding	Initiative 7.4
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Set up industrial platforms on specific areas of economic activity to enable the creation of ecosystems and achieve the scaleup of the Greek SMEs and mid-caps
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
Description of the initiative	*Rationale behind the need for the initiative* The introduction of a smart manufacturing industrial park shall aim to create an emerging manufacturing ecosystem that shall accelerate the innovation and diffusion of the Smart Manufacturing technologies across the organizations' supply chains & production lines. In more detail, the smart manufacturing industrial park shall: - Boost Manufacturing SME Productivity: The industrial park shall bring together and enable manufacturing organizations of varying sizes to closely collaborate for the development of new Smart Manufacturing solutions regarding their supply chain and production operations. The park will therefore create a collaborative industrial ecosystem and a flexible production network, where stakeholders shall utilize each other's expertise in order to resolve challenges they face through innovative Industry 4.0 solutions. This ecosystem will also prompt Greek Manufacturing SMEs located in the park to increase their awareness on Industry 4.0 and Smart Manufacturing technologies and will encourage their widespread adoption. - Promote Entrepreneurship in the Smart Manufacturing area: This industrial park shall act as a catalyst for further industrialization and development of new Smart Manufacturing and Industry 4.0 enterprises, by putting into place an infrastructure that fosters and attracts Industry 4.0 entrepreneurs of all scale and size. - Provide shared digital infrastructure and facilities to its members to accelerate their digital transformation: The Smart Manufacturing industrial park shall offer all urban amenities that manufacturing businesses desire and benefit from like modern, digital & physical infrastructure. In addition, the industrial park can host relevant innovation structures, like Industry 4.0 testbeds and test labs and Industry 4.0 Competence Centres, that will create nuclei of innovation within the park and to which its members can have access. *Details of the initiative* Set up a Smart Manufacturing Industrial park that shall aim to create an emerging Industry 4.0 ecosystem and a flexible production network around the design and production of Smart

Manufacturing solutions and applications. The Smart Manufacturing Industrial park will in fact consist one of the "innovation districts" proposed under initiative 3.3, therefore it should adopt the majority of their characteristics, as these were described in the relevant initiative.

The Smart Manufacturing Industrial park can be located in a remote industrial land that could be transformed and equipped with modern working spaces and manufacturing facilities, where leading-edge anchor institutions and manufacturing companies shall cluster and connect with Industry 4.0 start-ups, business incubators, and accelerators. The industrial park shall also be physically compact, transit-accessible, and technically wired and offer mixed use housing, office, and retail.

The Industrial park could attract and host enterprises and academic institutions that are active/ involved in the Smart Manufacturing domain. In more detail, these can be:

- Manufacturing organizations (mainly SMEs and midcaps) (Industry 4.0 "users"), willing to relocate, to participate in this emerging ecosystem, where they will be able to liaise and collaborate closely with other manufacturing organizations and Industry 4.0 innovators and/or academic/ research institutions, to and will co-design tailored, innovative solutions to address their challenges.
- Organizations which are Industry 4.0 innovator/ solution designers (start-up, scale-up, SME or large organization) which want to work more with manufacturing companies looking to innovate.
- Organizations which are Industry 4.0 innovators/ solution designers and/ or academic/ research institutions, which are looking to understand the real-world challenges being faced by the Greek Manufacturing and how their research will be valid in a commercial setting.

Description of the structure

The Smart Manufacturing Industrial Park shall run under the auspices of the Greek Government, in cooperation with ETVA Industrial Parks S.A. and with organizations focusing and academic/ research institutions focusing on the Smart Manufacturing area (i.e. Departments of Mining & Metallurgical Engineering, Mechanical Engineering, etc.). The project can run as a PPP project with a co-investment both from the Greek Government and the Private Organizations that will participate as founding members in this.

As already stated in initiative 7.2, the founding members of the Industrial park could be the ones that will also set up the Smart Manufacturing Competence Center (initiative 7.2) that will be formulated by at least 1 research/ academic entity (i.e. Academic Institution, Research entity, etc.) with a specialization on Smart Manufacturing technologies, and at least 5 private enterprises. These enterprises will act as the "evangelists" that will attract further manufacturing organizations in the park.

Finally, acknowledging the challenging nature of this initiative, it should be evaluated whether this new Smart Manufacturing Industrial park could become a part of an already existing and successful Greek Industrial park, i.e. the Alexander Innovation Zone, in Thessaloniki, or follow the same principles with existing innovation districts for its development. In this way, the Smart Manufacturing industrial park will directly benefit from the existing structure and the benefits provided by other innovation zones to attract new participants.

An additional idea could be to evaluate the setup of a Smart Manufacturing Industrial park in combination with the developed Just Transition Development Plan of lignite areas[54]. According to the plan, specific incentives and subsidies are planned to be provided to Greece's geographic areas to support their phase-out lignite efforts. In these areas, a smart manufacturing industrial park could leverage both existing infrastructure (i.e. power energy plants), but also digitally skilled existing personnel that will be made redundant. In fact, the Smart Manufacturing Industrial park could be perfectly combined with the following initiatives, as these are presented in the Just Transition Development Plan:

- In Western Macedonia, the setup of an Industrial Electromobility Park is suggested, that will act as the central pillar of the industry in the region. Currently, there is interest from a nationwide group for the construction of a battery plant with a total investment of ~ €200M that could create up to ~ 600 total positions during operation. At the same time, the industrial electromobility park could attract raw material or charger manufacturing units for highways. There is already expressed investment interest in related investments, such as for example a factory for the production of car parts or spare parts with interest from an international company in the automotive sector for an investment of € 5.3M.
- In Megalopolis, the setup of a model pharmaceutical industrial district is suggested, with the aim of restarting the heavy industry in the Peloponnese. There is advanced interest from the pharmaceutical industry for an investment of ~ € 90M that could create up to ~ 400 direct positions during operation. At the same time, it is possible to cooperate with the University of Peloponnese for the development of relevant research programs.

Participation in the Industrial Park

The Smart Manufacturing Industrial park shall not be restricted to sectoral "silos". Instead, it shall aim to attract cross-sectoral organizations that will collaborate to develop high-end, smart solutions for the digitization of their production operations and supply chains. The Governance body could introduce a set of due diligence criteria for their acceptance, with regards to their innovation/technology/ know-how, their strategy/ vision and business plan, their business focus, etc.

Indicative Services Provided by the Industrial Park

- Provision of office spaces/ working locations/ accommodation to enterprises to locate in this
- Networking & Community building
- Collaborative R&D: Bring together academic/ research institutions with private sector enterprises located in the park for the design and implementation of Smart Manufacturing projects
- Hosting of events & conferences
- Digital upskilling and reskilling workshops for organizations located in the park
- Incubation sessions to support the for the development of new Smart Manufacturing start-ups, etc.

[54] http://www.opengov.gr/minenv/wp-content/uploads/downloads/2020/10/%CE%A3%CF%87%CE%AD%CE%B4%CE%B9%CE%BF-%CE%94%CE%AF%CE%BA%CE%B1%CE%B9%CE%B7%CF%82-%CE%91%CE%BD%CE%B1%CF%80%CF%84%CF%85%CE%BE%CE%B9%CE%B1%CE%BA%CE%AE%CF%82-%CE%9C%CE%B5%CF%84%CE%AC%CE%B2%CE%B1%CF%83%CE%B7%CF%82-%CE%BB%CE%B9%CE%B3%CE%BD%CE%B9%CF%84%CE%B9%CE%BA%CF%8E%CE%BD-%CF%80%CE%B5%CF%81%CE%B9%CE%BF%CF%87%CF%8E%CE%BD_fin-cons.pdf

	The industrial park could also host the Smart Manufacturing Competence center that shall aim to create a platform for applied research, development and innovation in Greek manufacturing enterprises (including SMEs, midcaps & startups) focusing on the development of innovative world-class manufacturing solutions. **Provided incentives to join the Smart Manufacturing Industrial park** A set of incentives, similar to the Innovation districts can be provided to the Greek Manufacturing enterprises, to encourage their relocation to the park. Indicatively, these could be: - Attractive rates for renting/ buying land and building new facilities within the innovation districts - Attractive pricing rates to access modern, high-end digital infrastructure - Tax credits and/or favorable loan interest rates for relocating into the park - Tax incentives for net new capital investment and job creation - Easier access to funding and higher amount of funding for setting up and operating innovation structures (i.e. testbeds/ test labs) within the park - Specific tax allowances for researchers working for academic/ research institutions located in the park, etc. - Provision of free tech zones with a flexible legislative framework, where enterprises will be able to experiment and test new Smart Manufacturing products/ solutions. In case the Smart Manufacturing Industrial park consists part of an existing innovation district, the park shall have access to the existing incentives and benefits already provided by the district.
Stakeholders (Design & Implementation)	- General Secretariat for Research and Technology/ Ministry of Development & Investments - General Secretariat for Industry/ Ministry of Development & Investments - Ministry of Environment & Energy - Ministry of Digital Governance - Greek Academic Institutions - Research Centres
Key beneficiaries (Target group)	- Greek enterprises (including SMEs, midcaps & start-ups) operating in the Industry 4.0 value chains - Industry Federations - Greek academic/ research institutions active in the Industry 4.0/ Smart Manufacturing area
Potential funding sources	- Horizon Program - Digital Europe Program
Indicative Budget	€ 2.000.000 – 5.000.000
Dependencies with other initiatives	- Initiative 2.1: Introduce an "Industry 4.0 labs/testbeds" funding scheme - Initiative 7.2: Support the setup of a Smart Manufacturing Competence Center - Initiative 7.3: Introduce a Smart Manufacturing Challenge Fund to develop innovative solutions for a modern, more productive, environmentally sustainable Greek Manufacturing

Timeline of implementation	Mid-term/ Long-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

6.2.1.5 *Initiative 7.5: Smart Manufacturing Technologies within the Greek Industry 4.0 Standardisation Framework*

Title of the Initiative	**Smart Manufacturing Technologies within the Greek Industry 4.0 Standardisation Framework**
Initiative's Coding	Initiative 7.5
Pillar	Pillar 4: Standardisation & Norms
Area of focus	• Set key ICT standardisation priorities, in accordance to the European Commission's ICT Standards plan and communication
Link with strategic goals	• Increase the Greek Industry's overall digital maturity. • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains and ecosystems.
Description of the initiative	*Rationale behind the need for the initiative* Further to the development of the Greek Industry 4.0 standardisation framework, the Greek Standardisation Committee should place a special emphasis on the Smart Manufacturing Technologies laid out within the first High Priority Case. This initiative will aim to surface the important tasks that need to be carried out with regards to industrial standards and norms that are related to the key Smart Manufacturing technologies at hand. *Details of the initiative* This initiative follows a three-stepped approach, as per below: 1. Further focus on the industrial standards that are currently applied as well as the future industrial standards that need to be developed within the Greek industrial environment with regard to the key Smart Manufacturing technologies of High Priority case 1, namely: ○ Additive Manufacturing ○ Big Data Analytics ○ Machine to Machine (M2M) ○ 5G On that note, the Standardisation Committee following a similar approach to the overall Greek Industry 4.0 Standardisation Framework ("As-is"-"Gap analysis"-"Design of To-be state"), in collaboration with other key stakeholders of the Greek industrial environment should perform a similar exercise focused on the above technologies. 2. Further strengthen the accreditation activities already present within the Greek environment with regards to industrial standards on products, services and production systems, that are related to the specific technologies, on top of the accreditation initiative (Initiative 4.4) outlined within Pillar 4. This will aim to accredit and these enterprises that pursue to develop, adopt and utilise industrial standards that are specifically focused on the select of the Smart Manufacturing technologies. This accreditation initiative should seek to distinguish them among their peers, highlighting their adoption of more advanced standards on cutting edge technologies, making it easier to pursued collaborations within the Greek as well as the European industrial ecosystem.

	3. The Greek Standardisation Committee should pursue international collaborations with relevant standardisation committees across the EU, in order to develop and promote common action plans with regard to Smart Manufacturing Technologies' standards and norms that already being developed and will be further developed in the future. This effort will seek to draw from best practices and applied standards that work within the European industrial ecosystem, seeking to transfer them and apply them to the Greek case, achieving greater benefits on the development of innovative industrial products.
Stakeholders (Design & Implementation)	• Greek Standardisation Committee • Greek Organisation for Standardisation (ELOT) • Enterprises from the private sector offering accreditation on industrial matters (products, services, production systems etc.)
Key beneficiaries (Target group)	Greek industrial enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	New NSRF 2021-2027
Indicative Budget	Action 1: €300.000-900.000 (same budgeting rationale as for Initiative 4.2) Action 2: N/A Action 3: N/A
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 4
Timeline of implementation	Mid-term/ Long-term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

6.2.1.6 *Initiative 7.6: Enhancement of the Patents' Framework with regard to Smart Manufacturing Technologies*

Title of the Initiative	Patents' Framework with regard to Smart Manufacturing Technologies
Initiative's Coding	Initiative 7.6
Pillar	Pillar 5: Regulatory Environment
Area of focus	• Address the subject of intellectual property
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities
Description of the initiative	*Rationale behind the need for the initiative* Smart Manufacturing technologies are continuously advancing and create more value for businesses across all sectors of the economy including the industrial once. This initiative is intended to place a special focus on patents within the manufacturing sector, aiming to enhance and improve the regulatory environment on that issue. *Details of the initiative* Through this initiative, the Greek state, through a set of selected stakeholders such as the General Secretariat for Industry, the Industrial Property Organisation and the Hellenic Organization for Standardization should explore how to improve and simplify the regulatory environment through the creation of an innovation friendly setting with regard to the patents framework around Smart manufacturing technologies. The main issue identified with regard to those patents is the creation of so called "thickets", formally identified[55] as "the dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology". Thickets tend to discourage firms within the manufacturing sector to further innovate and constitute a major problem. In order to deal with this issue and promote innovation within the ICT and manufacturing sector, the aforementioned stakeholders should examine the applicability and enhancement of the following within the Greek manufacturing ecosystem: 1. *Patent pools*, which essentially constitute a collaboration between two, or more, firms that own patents, so as to bundle them and make them available to third parties who are interested to utilise them for a set price. It should be noted that upon review of this option, careful consideration and monitoring should be given in order not to lead to collusion between the cooperating firms. 2. *Standard Essential Patents (SEPs),* which are referred to as "a patent protecting a component deemed as essential to the standard". This ensures compatibility between the patent and standardisation systems and constitutes the general obligation for standards development participants to declare intellectual property rights that might be relevant to the

[55] Article: "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard-Setting", Carl Shaphiro, March 2001

	implementation of the standard and to offer licenses of these intellectual property rights on a FRAND basis (“Fair, Reasonable And Non-Discriminatory”). For the above, a closer collaboration of the aforementioned key stakeholders could be pursued with the European Patent Office (EPO), which pursues high patent quality and standards within the manufacturing environment.
Stakeholders (Design & Implementation)	• General Secretariat for Industry • Industrial Property Organisation • Hellenic Organization for Standardization
Key beneficiaries (Target group)	• Researchers/ Research institutions & universities • Greek Industry Enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	N/A
Indicative Budget	N/A
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 5
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

6.3 Involved stakeholders for High Priority Case 1

In this paragraph we list the key authorities, as these are presented in the abovementioned initiatives that shall be the key responsible for operationalizing the High Priority Case 1. It should be mentioned that this is not an exhaustive list of all potential stakeholders that shall be involved in the development of each of the seven initiatives presented below. During the detailed design and implementation of each activity, a detailed mapping of both key accountable and responsible parties shall be performed.

- **General Secretariat of Industry**: The General Secretariat of Industry (Ministry of Development) is the key and interconnecting player that is the key responsible for the design and implementation of all the High Priority initiatives. The design and development of the High Priority Case shall be performed under its supervision and in accordance to the directions and objectives of the national Industry 4.0 strategy. It should be the overall accountable for all initiatives.
- **General Secretariat for Research and Technology**: Responsible for design of Smart Manufacturing initiatives that focus on the promotion of applied research and development for this technology group and the set-up structures that promote R&D. In this High Priority case, it will be mainly responsible for initiatives 7.2, 7.3 and 7.4.
- **Ministry of Education & religious affairs**: Responsible for co-designing with the other authorities, initiatives of pillar 1, namely initiatives 7.1. It will provide expertise and guidance on the areas of lifelong learning and the tertiary education, in which the three initiatives refer to.
- **Ministry of Labour**: Responsible for co-designing initiative 7.1 that refers to the Industry 4.0 reskilling/ up-skilling and certification programme for the Greek Industry Workforce. It can provide input on existing training modules for employees and suggest how the Smart Manufacturing training curriculum and programme could be designed for better addressing the needs of the Greek human capital.
- **Ministry of Digital Governance**: It can be considered the “Chief Digital Officer” of the Public Sector, since it has a horizontal role to direct and monitor all digital initiatives currently designed and implemented by the Greek Government. For the Smart manufacturing technologies case, the ministry of digital governance will participate in the design of all initiatives, providing guidance and ensuring that the initiatives are aligned with the Bible of Digital Transformation.
- **National Certifications Center (EOPPEP)**: The National Certifications Center (EOPPEP) shall be involved in the 7.1 initiative and shall be responsible for the development of an accreditation scheme supporting this Smart Manufacturing reskilling and upskilling programme.
- **Private Accreditation Organizations**: In collaboration with EOPPEP, private accreditation organizations can be also involved for the design of initiative 7.1 for the development of the accreditation scheme. Private Accreditation organizations may also be responsible for implementing and running the accreditation part of initiative 7.1.
- **Academic & Research institutions that are focused on Smart Manufacturing technologies**: Important role for the design of all Smart Manufacturing Technologies initiatives play the academic and research institutions with a focus on Smart Manufacturing technologies. The Greek Academia shall collaborate with the Public Administration stakeholders in order to support the design of the Smart Manufacturing reskilling/upskilling and certification programme for the Greek workforce (initiative 7.1). In addition, the academia shall collaborate with the research institutions and the private sector to jointly perform research and exploit new Industry 4.0 technologies and their implementation in the Greek industry through the setup of the Smart Manufacturing Center (initiative 7.4), their participation in the

Smart Manufacturing Challenge Programme (initiative 7.3) and their potential relocation in the Smart Manufacturing Industrial Park. Finally, the Greek academia shall provide expertise on the design of the new Smart Manufacturing technologies Standardization framework (initiative 7.5) and the enhancement of the patents' framework in the ICT space (initiative 7.6). Primary stakeholders for this could be (non-exhaustively) from an academic standpoint the National Technical University of Athens, the Technical University of Crete, the University of Patras, as well as the technological educational institutes, etc. focusing on STEM and ICT focus areas. With regards to research institutions on Smart Manufacturing technologies, these could be (non-exhaustively) the National Center for Scientific Research "Demokritos" (NCSR "Demokritos"), Athena RC, the Foundation for Research and Technology- Hellas, etc.

- **Greek Industrial Standardisation Committee**: The Greek Industrial Standardization Committee, introduced as a separate measure in initiative 4.1 will be responsible to develop the specific Smart Manufacturing standards for the country (initiative 7.5).
- **Greek Organisation for Standardisation** (ELOT): The Greek Organization for Standardisation (ELOT) shall also be involved in the development Smart Manufacturing standards for the country (initiative 7.5).
- **Industrial Property Organisation**: Finally, the Industrial Property Organisation will be involved in the enhancement of the patents' framework within ICT (initiative 7.6).
- **Industry Federations**: Finally, Industry federations (i.e. the Federation of Enterprises, the Federation of Hellenic Information Technology & Communications Enterprises, etc.) will have an important role to play in the design and the operationalisation of the High Priority Case 1, as they act as the interface between the Greek industrial organisations and the Public Administration, as well as to the academia and research institutes. Industry federations can bring significant expertise and know how on different elements for the design of the high priority initiatives.

It should be mentioned that the enhanced collaboration of these authorities sets as a prerequisite the set up of a dedicated Working Group that will further analyze and design the abovementioned initiatives. This will be further analyzed in the Deliverable 4, where a Governance mechanism will be set up for the design of the overall Industry 4.0 plan as well as for the High Priority cases.

6.4 Implementation of high-level timeplan

An indicative implementation timeline of High Priority Case 1 initiatives is briefly presented below. As it can be seen, all initiatives are aimed to begin within the 1st year and 2nd year of the Operational plan. More specifically, we consider that the initiative 7.1, 7.2 and 7.3 are three initiatives that can start immediately. The first one due to its absolute necessity and imminent scope to digitally upskill the current human capital. The second one, as there is a unique chance for the Greek Government to fund this through the relevant call for tender for the setup of competence centres has already been published by the General Secretariat for Research & Technology in June 2020. Finally, 7.3 can also be initiated immediately, as it will consist part of the Industrial Strategy Challenge Fund (initiative 3.3) that we suggest to start in year 1.

The rest of the initiatives could start within the 2nd year of the plan, as they are more complex activities requiring greater effort and coordination among the involved authorities.

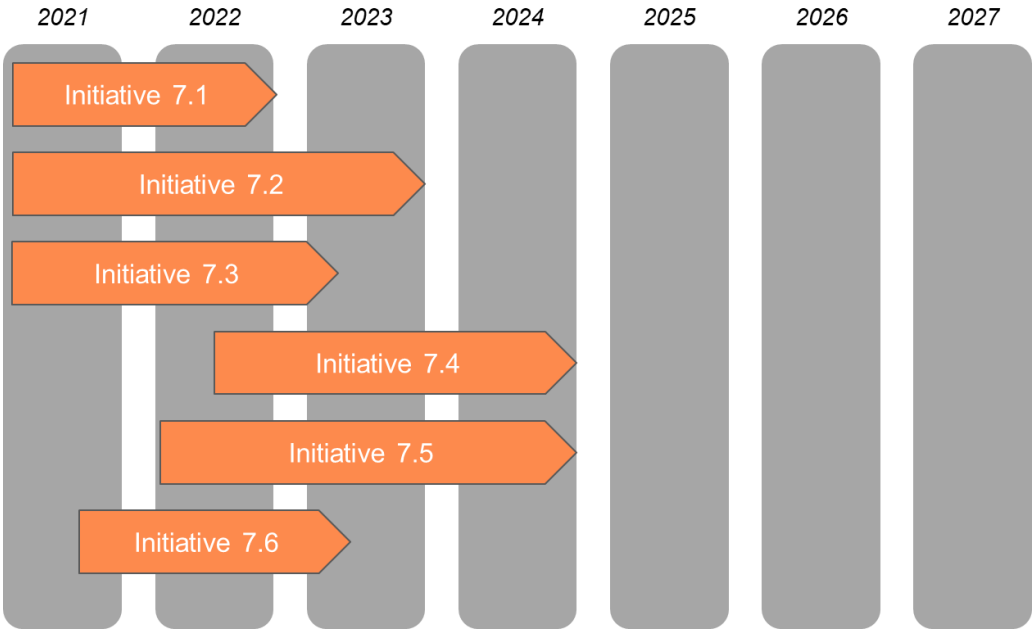


Figure 16: High level time plan for High Priority Case 1

7 Annex B: Operational Plan for High Priority Case 2 – Structural Materials

7.1 Introduction on High Priority Case 2: Structural Materials

High Priority Case 1 "Smart Manufacturing Technologies" highlighted the importance of Smart Manufacturing technologies by all Industrial sectors, to transform end-to-end the industrial organizations' value chains. A sector of particular interest and importance for the Greek Industry and Manufacturing is the "structural materials" sector, which as presented below consists key part of the Greek economy. As such, this sector is suggested to become one of the first areas that will further explore and accelerate the implementation of Smart Manufacturing technologies. As such, the initiatives presented in this High Priority Case should be evaluated as an additional specialization of those presented under High Priority Case 1. In other words, not only High Priority Case 1 initiatives are applicable for the "Structural Materials" case, but these are further enhanced and specialized by the four extra initiatives presented in this chapter. Before we start presenting and analysing the new initiatives, we present an overview of the Structural Materials sector to highlight its importance and key role in the Greek industry.

7.1.1 The "Structural Materials" Sector – A key part of the Greek economy

The "Structural Materials" sector[56] is a key part of Greek economic and industrial activities. Its landscape is outlined by more than 16 thousand individual enterprises 99.9% of which are SME's. Indicatively, over 95% of the enterprises that have been active in the "Structural Materials" industry over the 2014-2019 period are very small companies with fewer than 10 employees, while only a small handful employ more than 50 people.[57]

Harnessing the potential of the fourth industrial revolution could give the thousands of SMEs active in the "Structural Materials" industry a springboard to grow and expand, giving momentum to the rest of the manufacturing industry.

Type of Enterprise	2014	2015	2016	2017	2018	2019
0 - 9	16.359	15.010	15.070	15.470	15.331	15.698
10 - 49	812	636	616	606	584	563
50 - 249	78	75	97	88	80	73
250 +	27	22	19	17	14	11
Total	17.276	15.743	15.802	16.181	16.009	16.345

[56] We have included the following NACE categories as part of the „Structural Materials" Industry: C16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, C23 - Manufacture of other non-metallic mineral products, C24 - Manufacture of basic metals, C25 - Manufacture of fabricated metal products, except machinery and equipment
[57] Eurostat, Annual enterprise statistics by size class for special aggregates of activities (NACE Rev. 2) https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sbs_sc_sca_r2&lang=en
European Commission, Greece: SME Performance Review 2019 https://ec.europa.eu/growth/smes/sme-strategy/performance-review_en

% of SMEs to Total	99,84%	99,86%	99,88%	99,89%	99,91%	99,93%

The Structural Materials sectors provide a job to over 61 thousand individuals and has consistently been a bulwark of employment for the manufacturing sector contributing more than 18% to the overall Manufacturing sector employment over the period 2014-2019.[58]

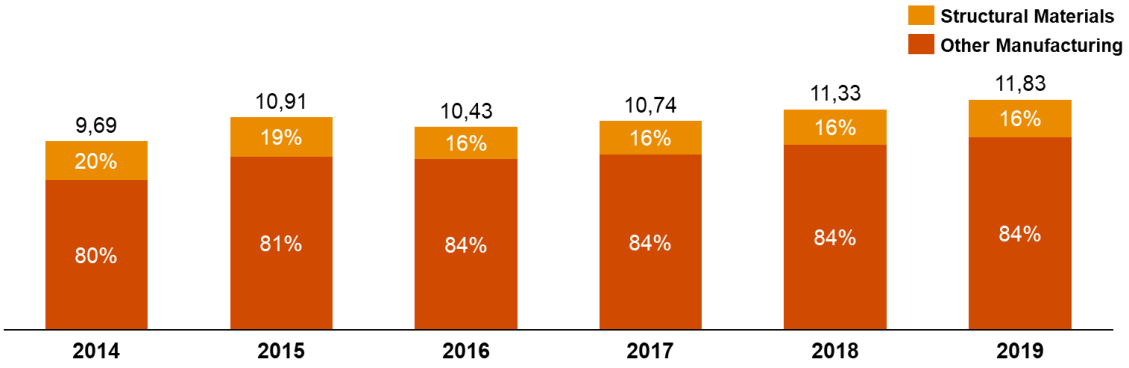


Figure 17:Employment in Structural Materials and Other Manufacturing in Greece, Total in thousands, Sources: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sbs_na_sca_r2&lang=en European Commission, https://ec.europa.eu/growth/smes/sme-strategy/performance-review_en

[58] Eurostat, Annual enterprise statistics for special aggregates of activities (NACE Rev. 2), https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sbs_na_sca_r2&lang=en
European Commission, Greece: SME Performance Review 2019 https://ec.europa.eu/growth/smes/sme-strategy/performance-review_en

Structural Materials also contributed more than 16% of all value added from the Manufacturing sector[59], as well as a total of ca. 1,9 billion euros of GVA to the country in 2019 and grew at an impressive 5,09% CAGR between the period 2016-2019.[60]

Additionally, the Structural Materials industry contributed handsomely to exports with ca. 4,9 billion euros in 2018, which corresponds to about 15,4% of all NACE exports, at an even more impressive 12,09% CAGR between the period 2014-2018.[61]

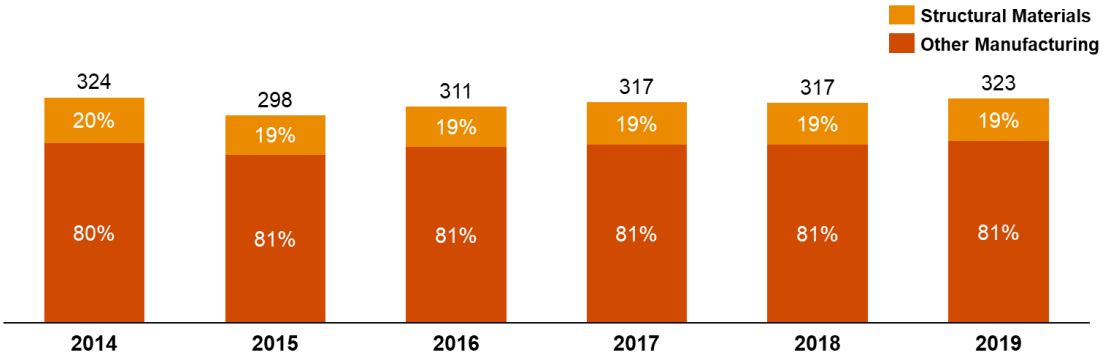


Figure 18: Value Added of Structural Materials and Other Manufacturing in Greece, Total in billion euros, Source: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_a64&lang=en European Commission, https://ec.europa.eu/growth/smes/sme-strategy/performance-review_en

With regards to the key players of the Structural Materials industry, Viohalco (incl. Sidenor), Alumil, Mytilineos and Titan are some of the biggest enterprises in the Greek industry and the Greek market as a whole.

Figure 19: Indicative Key Players of the Structural Materials Industry

Zooming in to the Greek Structural Materials industry, 4 major categories appear to be its exporting champions; Aluminium, Copper, Steel/ Nickel and Cement.

[59] Eurostat, National accounts aggregates by industry (up to NACE A*64)
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_a64&lang=en
European Commission, Greece: SME Performance Review 2019 https://ec.europa.eu/growth/smes/sme-strategy/performance-review_en
[60] Eurostat, National accounts aggregates by industry (up to NACE A*64)
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_10_a64&lang=en
European Commission, Greece: SME Performance Review 2019 https://ec.europa.eu/growth/smes/sme-strategy/performance-review_en
[61] Eurostat, Trade by NACE Rev. 2 activity and enterprise size class
https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ext_tec01&lang=en

Aluminium makes up most the key metal exports, with over 1,6 billion euros worth of exports annually and its exports have grown by 33% over the 5-year period 2014-2019.[62]

Aluminium of Greece S.A. (AoG) -one of the biggest aluminium producers in Greece- is the lowest cost producer in EU for both alumina and aluminium. Greece's rich bauxite reserves make AoG the only vertically integrated producer of refined and primary aluminium in South-East Europe. So far Greek aluminium prices have remained competitive through continuous cost cutting and extension of mining operations. Furthermore, the market for aluminium/ alumina saw a spike in 2018 after US-China sanctions, bringing in a windfall of gains for Greek exports. Industry 4.0 technologies can help maintain and increase Greece's competitive edge in aluminium, while at the same time ensure that Greek aluminium producers can meet growing demand over the coming years.

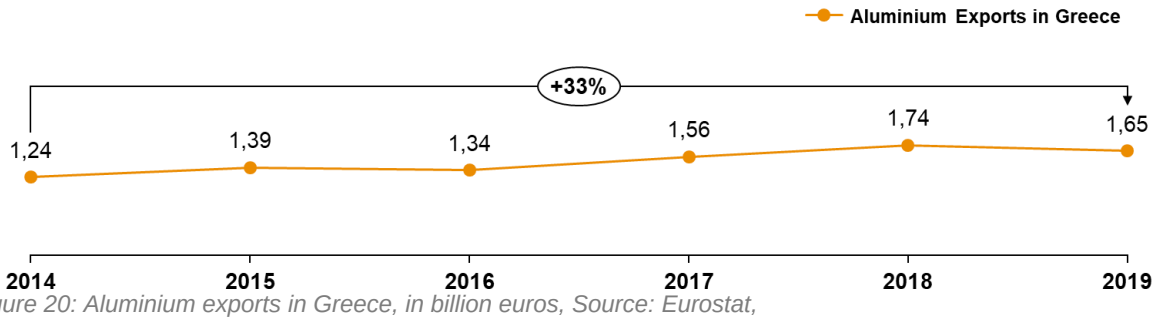


Figure 20: Aluminium exports in Greece, in billion euros, Source: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

[62] Eurostat, Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

Turning to Greek copper, exports amounted consistently over 0,5 billion euros from 2017 onwards and have grown by 39% over the 5-year period 2015-2019.[63]

Viohalco is the biggest Greek corporation and a European leader in the copper market. Through Halcor and other subsidiaries, Viohalco operates in over 55 countries and has over 80 years of experience with copper and copper processing. Additionally, copper is a resource with infinite recyclable life[64], that enables companies to harness new technologies and processes that drive down costs and are significantly more environmentally friendly. Viohalco's vast experience can be leveraged to transition the Structural Materials industry towards the digital age faster and more effectively, thus ensuring that Greek copper exporting prowess grows, while also having a positive environmental impact.

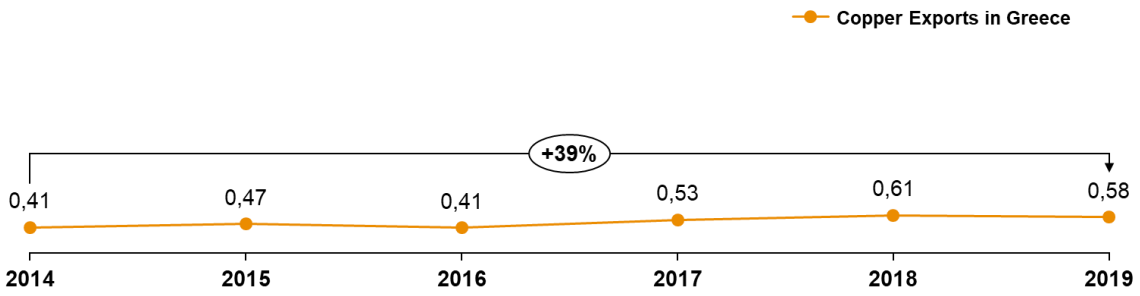


Figure 21: Copper exports in Greece, in billion euros Source: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

While the overall picture in Steel and Nickel exports is more attractive than Copper but not as attractive as Aluminium, with about 1,3 billion euros in exports, the growth rates are impressively higher compared to the previous cases. Greek Steel and Nickel exports have grown at an astonishing 128% over the 5-year period 2015-2019.[65]

Greece's steel manufacturers were significantly hurt by the crisis, a trend that was manifested in the 2014 bankruptcy of Hellenic Steel, a 50-year old company once central to the industry. Additionally, revival

[63] Eurostat, Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

[64] https://energyindustryreview.com/metals-mining/europe-leading-the-world-in-copper-recycling/

[65] Eurostat, Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-

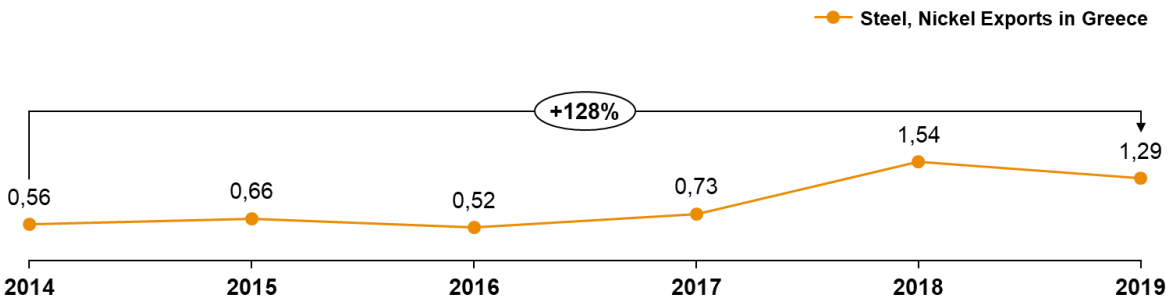


Figure 22: Steel, Nickel exports in Greece, in billion euros Source: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

efforts from the Greek government combined with a new investment in the bankrupt Hellenic Steel (from the US conglomerate Jordan International) is reversing expectations; and Hellenic Steel is currently set to restart operations in a Thessaloniki plant of the company which plans to employ about 400 workers.[66] Furthermore, Greece is home to the EU's last Nickel smelter. Its owner, Larco, has been facing financial difficulties gross mismanagement over decades and the government seeks to divest from this company. Reportedly, Larco has a year to find an investor before ultimately closing the plant, which currently employs over 1200 workers.[67] Larco sits at the centre of a $170m economy. In addition to its miners, smelters and office workers, more than 22,000 suppliers and contractors are dependent on it[68]. In conclusion, although Greece's Steel/ Nickel enterprises like Larco and Hellenic Steel have gone through difficult times, technologies and processes that rise from the fourth industrial revolution now afford them a great opportunity to transform and make Greece the European leader in Steel/ Nickel production.

1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

[66] https://www.insider.gr/epiheiriseis/emporio/125354/hellenic-steel-i-istoria-tis-allote-krataias-halyboyrgias-poy

[67] https://www.ekathimerini.com/249402/article/ekathimerini/business/larco-to-be-sold-within-a-year

[68] https://www.aljazeera.com/ajimpact/eu-nickel-smelter-heads-gallows-afterlife-200224231814389.html

In the Cement sector, the Greek landscape is somewhat less alluring. Greek Cement exports have declined 6% over the 5-year period 2014-2019, nevertheless being constantly over 0,2 billion euros annually over the same period. In 2019 Greek Cement reported 0,21 billion euros in exports.[69]

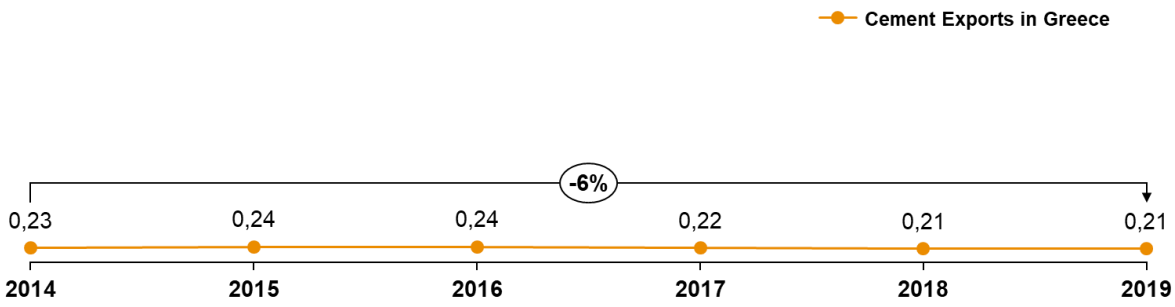


Figure 23: Steel, Nickel exports in Greece, in billion euros Source: Eurostat, https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

TITAN Group, established in 1902 in Greece, is a multiregional cement and building materials producer, with headquarters in Belgium, producing 27 million metric tons of cement a year. Business activities cover the production, transportation and distribution of cement, concrete, aggregates, fly ash, mortars and other building materials. Titan Group sits on a 1,6 billion euros economy, employs about 5,500 people and is present in more than 15 countries, operating cement plants in 10 of them, the USA, Greece, Albania, Bulgaria, North Macedonia, Kosovo, Serbia, Egypt, Turkey and Brazil. Throughout its history the Group has aspired to serve the needs of society, while contributing to sustainable growth with responsibility and integrity. In fact, upon its 100-year anniversary, TITAN becomes the first Greek company to sign the United Nations' Global compact, while a year later, in 2003, it becomes a full member of the World Business Council for Sustainable Development (WBSCD). In 2008 TITAN becomes a founding member of the Hellenic Federation of Enterprises Business Council for Sustainable Development (SEV BCSD) and in 2014 it signs the Charter for a Sustainable Greece in the context of the "Sustainable Greece 2020" initiative

[69] Eurostat, Sold production, exports and imports by PRODCOM list (NACE Rev. 2) - annual data https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-066341_QID_-651E2997_UID_-3F171EB0&layout=INDICATORS,C,X,0;DECL,L,Y,0;PRCCODE,B,Z,0;PERIOD,L,Z,1;&zSelection=DS-066341PERIOD,201852;DS-066341PRCCODE,07101000;&rankName1=PRCCODE_1_2_-1_2&rankName2=PERIOD_1_0_0_0&rankName3=INDICATORS_1_2_0_0&rankName4=DECL_1_2_0_1&sortR=DND_-1&prRK=FIRST&prSO=PROTOCOL&rLShi=0:13,1:22,2:8,3:15,4:32,5:10,6:7,7:12,8:26,9:11,10:4,11:20,12:33-1,14:31,15:30,17:21,16:25,19:9,18:38,21:18,20:16,23:6,22:24,25:19,24:29,27:5,26:27,29:14,31:36,30:39,34:0-1,32:35,33:37,38:3,39:2,36:17,37:23&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23

for sustainable development.[70] Given the multinational presence of TITAN Group, and its 118-year long experience, TITAN can pave the way for the absorption of Industry 4.0 technologies and solutions in the Greek Structural Materials Industry and will become a key connective link to enhance the realisation of I4.0 benefits throughout the Greek Economy.

Considering the exporting significance, size and potential, the Greek Structural Materials industry is poised to become a strategic platform for reviving industrial activity in Greece. Through the adoption of fourth industrial revolution technologies and processes that have the potential to improve working conditions, operational efficiency, safety, reduce costs and waste and make a positive environmental impact, the Greek Structural Materials industry can transform itself into a competitive industrial ecosystem and provide the impetus for the rest of Greece's industrial activity to follow suit.

The abovementioned data indicates the significance of the Greek Structural Materials Industry for the Greek economy. A set of dedicated initiatives is presented below with regards to the Greek Structural Materials' rotation to Industry 4.0.

[70] https://www.titan-cement.com/

7.2 Measures & Initiatives

7.2.1.1 Initiative 8.1: Develop a dedicated Industry 4.0 reskilling curriculum & certification programme for the Greek "Structural Materials" Workforce

Title of the Initiative	**Develop a dedicated Industry 4.0 reskilling curriculum & certification programme for the Greek "Structural Materials" Workforce**
Initiative's Coding	Initiative 8.1
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Upskill and reskill the Industrial workforce
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Prerequisite for the Industry 4.0 transformation of the Greek Structural Materials Industry is the empowerment of its human workforce with new digital skills and capabilities with regards to Industry 4.0 and Smart Manufacturing technologies. As our research indicated in Deliverable 1, Industry 4.0 technologies are currently implemented by all Industrial sectors, nevertheless to a different extent. This has primarily to do with the current maturity of each Industry 4.0 technology groups, as well as with the range and scope of respective applications developed thus far for each Industrial sector. The Structural Materials industry appears to be one of these sectors that has been already radically transformed by Industry 4.0 at a global scale, as it actively leverages Industry 4.0 technologies to transform its end-to-end value chain and it demonstrates leading case studies on how enterprises of this sector have transformed through rotating to Industry 4.0. As such, using initiative 7.1 as the baseline, we recommend the introduction of a dedicated Industry 4.0 reskilling curriculum & certification programme for the Greek Structural Materials Workforce, in order to become up-to-speed with new technologies and enable their organizations' digital transformation. *Details of the initiative* Design and launch a dedicated training curriculum for the Smart Materials Industry, in collaboration with: 1) Academics & Research institutions specialized on the respective area (i.e. Departments of Mining & Metallurgical Engineering, Mechanical Engineering, Chemical Engineering, Materials Science, etc.) 2) Industry Federations related to Structural Materials 3) Manufacturing Enterprises in the Structural Materials field, that can additionally provide real-life use cases regarding the implementation of Industry 4.0 technologies in the industry.

This curriculum will be one of the tailored curricula provided per sector under initiative 7.1 and as such it could be incorporated in the digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs (please refer to initiative 7.1). This curriculum shall be accompanied by a certification scheme that will be provided after the participants' completion of courses and examination.

This reskilling and certification programme shall be based on the curriculum developed for the Greek Manufacturing SMEs (described in initiative 7.1) since all Smart Manufacturing technologies are applicable for the Structural Materials Industry. Nevertheless, its scope should be extended to include also the following technologies that are also applicable for the Metal Industry:

- Artificial Intelligence

- Robotics (Industrial Robots/ Robots)

- Cybersecurity (Cybersecurity/ Blockchain)

- New Materials (e.g. Graphene, composites, PVD, CVD)

However, what is even more important besides the training on the Smart Manufacturing technologies, is for the training sessions to demonstrate to trainees how these technologies are expected impact the industry's value chain, its workforce, adjacent industries, the environment and wider society. For this reason, the training sessions shall be contextualized to the different themes and use cases that the Industry 4.0 technologies have in the Structural Materials industry. Indicative Industry 4.0 themes and use cases are presented below:

- **Automation, Robotics and Operational Hardware:** Deploying digitally enabled hardware tools to perform or improve activities that have traditionally been carried out manually or with human-controlled machinery.
    - Autonomous Operations and Robotics that can perform tasks with a high degree of autonomy, working for extended periods without any human intervention.
    - 3D Printing that has potential applications in internal part production, downstream direct-to-customer and consumer printing.
    - Smart Sensors that collect physical, biological or chemical input data and convert this into a digital format. They can also process the information they collect, make decisions based on it, and send and receive communications.
- **Digitally Enabled Workforce:** Industry 4.0 technologies that empower field workers are set to revolutionize mining and metals operations.
    - Connected worker: Employees can benefit from on-demand, real-time push and pull information and use mobile and wearable technologies (e.g. tablets, wearable glasses, watches, and vital trackers) to interact with sensors, robots and other systems around them.
    - **Remote Operations Centre:** Remote operations centres (ROCs) are centralized, connected control rooms for mines and metals plants, providing an offsite environment for personnel to collaborate on operations without travelling to the site itself. Thanks to improvements in connectivity, these control rooms can be located almost anywhere in the world.
- **Integrated Enterprise, Platforms and Ecosystems:** By connecting IT to operational technology and exchanging data throughout the supply chain and beyond, the metal industry could generate significant value for itself and for society

	○ IT/OT convergence: This digital initiative looks at linking OT, IT layers and devices or systems that are currently separate. End-to-end integration can take place within the traditional value chain or the industry's larger digital ecosystem. IT and OT are coming together via the Internet of Things (IoT), which connects objects to internet infrastructure via embedded computing devices such as radio frequency identification (RFID) chips and sensors. ○ **Asset Cybersecurity:** Asset cybersecurity is the collection of tools, policies, concepts, safeguards, guidelines, risk management approaches, actions, training, best practices, assurance and technologies that can be used to protect the cyber environment, and an organization's or user's assets within. - **Next-generation analytics and decision support:** Using algorithms and artificial intelligence to process data can help with real-time decision support and future projections. ○ **Advanced analytics and simulation modelling:** Structural Materials companies can use analytics and decision support to make better and faster decisions. From an input process-output perspective, analytics can optimize materials sourcing, enhance predictive maintenance to increase machine uptime, or adjust processes to create tailored products and services for the customer. Simulation modelling uses data to mimic reality. It projects operational performance by using what-if scenarios to test the outcomes of changing part or parts of an operation. For mining, it offers better understanding of key drivers, ore bodies or plant operations, and thus helps firms design, plan, decide and coordinate more effectively. In combination with 3D satellite imaging and large data sets, modelling can optimize design without drilling, thereby lowering the investment, waste and physical footprint of the operation. ○ **Artificial Intelligence:** To support humans in the processes of problem solving, machines must analyse massive amounts of data from various input sources such as mining equipment, worker equipment and databases. In this way, AI can help decisionmakers make more informed choices, optimize yields and minimize environmentally harmful inputs. It can also help companies exploit the full benefit of robotics by managing and continuously improving their performance. ○ Over and above the aforementioned technologies and their respective modules, the tailored curriculum shall provide dedicated courses tailored to the training needs of machine operators and maintainers that shall quickly become up-to-speed with the new smart manufacturing skills to operate equipment. First step towards the development of this dedicated Industry 4.0 reskilling curriculum for the Structural Materials workforce shall be the design and implementation of Industry 4.0 skills assessment study for the Structural Materials industry that will identify: - the existing professions within the Structural Materials Industry - the jobs within each profession that are highly prone to be automated - the required digital and Industry 4.0 skills and their proficiency level per profession - the digital & Industry 4.0 skills maturity of the Greek workforce across each profession - the relevant training, qualifications and accreditations that each workforce group should obtain at minimum to support the industry's rotation to Industry 4.0. Government shall cover the expenses for the development of the training curriculum.

	The training and accreditation costs for participants can be covered by Initiative 8.5: Introduce a "Structural Materials" Sector Deal.
Stakeholders (Design & Implementation)	- General Secretariat of Industry - Ministry of Education & religious affairs - Ministry of Labour - Ministry of Digital Governance - National Certifications Center (EOPPEP) - Private Accreditation Organizations - Industry federations
Key beneficiaries (Target group)	Employees from the Structural Materials Industry (with an emphasis given to SMEs & midcaps)
Potential funding sources	Initiative 8.4: Introduce a "Structural Materials" Sector Deal
Indicative Budget	€1.000.000 - €2.000.000 for the development of the Smart Metal curriculum and its content
Dependencies with other initiatives	- Initiative 7.1: Design an online digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies - Initiative 8.5: Introduce a "Structural Materials" Sector Deal
Timeline of implementation	Short-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

7.2.1.2 Initiative 8.2: Develop a "Structural Materials apprenticeship" programme for STEM graduates & deploy a "matchmaking" platform

Title of the Initiative	**Develop a "Structural Materials apprenticeship" programme for STEM graduates & deploy a "matchmaking" platform**
Initiative's Coding	Initiative 8.2
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Attract and develop the future talent pipeline for the Greek Industry
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Enhance the vocational training and attract new, digitally adept workforce to the Structural Materials Industry through the introduction of a structured apprenticeship programme for STEM graduates that wish to work and become familiar with the industry. The programme will enable the future workforce to gain the practical skills and business acumen they need for this industry, become equipped with industry specific vocational skills and develop their network of social connections. The programme will also better interconnect Greek Structural Materials enterprises with academic and research institutions. *Details of the initiative* Design a Structural Materials apprenticeship programme targeted primarily to STEM graduates from Greek and international Universities. The programme shall provide the opportunity to STEM graduates to work within Greek enterprises (with a focus given to SMEs and midcaps) for a certain period of time (i.e. 6 months or more) and practice on Industry 4.0 technologies of their choice and specialization. The Greek Government could incentivize Greek Structural Materials organizations, to participate as employers through the provision of a respective grant for the apprenticeships that could cover the apprentices' stipends and social security contributions. The liaison between the STEM graduates and the Greek enterprises can be performed through the design and deployment of a matchmaking platform. The platform could be used both by potential employers (Greek enterprises) to post open apprenticeship positions and by the graduates to review, select and apply for an open position, as well as to upload their CV and their areas of interest. The apprenticeship themes shall be jointly decided by the enterprise and the apprentice before the latter's apprenticeship initiation and shall be directly linked to the implementation and use of Smart Manufacturing technologies (High Priority Case 1) within the remits of the organization. At the end of the apprenticeship, the apprentice shall produce a report that will present the scope of the apprenticeship, the role and responsibilities that the apprentice has undertaken, how they have used and adopted Smart Manufacturing technologies to support their role and the potential benefits that their

	apprenticeship has provided to the enterprise. These final reports could be uploaded on the matchmaking platform and could be used as a repository of best practices for other enterprises to read and use if fit. The completion of the apprenticeship programme could be also considered a professional qualification for graduates that would enable them to find more easily their next permanent job in an enterprise within the Structural Materials sector. The matchmaking platform could be owned and governed by the Ministry of Development, in collaboration with relevant industry federations (i.e. SEV, Association of Greek Miners, Mining Businesses Association, Metal Production and Processing Business Association, the Aluminum Association of Greece (A.A.G.), etc.). In addition, within the scope of this initiative, the Ministry of Development could organize Structural Materials "matchmaking" events where Greek enterprises could come in contact with graduates aiming at undertaking an apprenticeship in the industry, present and advertise their enterprises and attract high calibre future employees.
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments Ministry of Education & religious affairs Ministry of Labour
Key beneficiaries (Target group)	- STEM Undergraduates/ postgraduates interested in being employed in the Structural Materials industry - Private Organizations (including SMEs & midcaps) operating in the Structural Materials value chain
Potential funding sources	- Initiative 8.4: Introduce a "Structural Materials" Sector Deal
Indicative Budget	€300K – 500K for the development of the matchmaking platform €2.000 Euros could be provided per apprenticeship slot. €20.000.000 – 100.000.000 (for multiple years of duration)
Dependencies with other initiatives	Initiative 8.4: Introduce a "Structural Materials" Sector Deal
Timeline of implementation	Midterm
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 4

7.2.1.3 Initiative 8.3: Support the setup of a Structural Materials Test lab

Title of the Initiative	**Support the setup of a Structural Materials Test lab**
Initiative's Coding	Initiative 8.3
Area of focus	Design of new and/or enhance existing innovation structures to ensure the diffusion of expertise and best practices between all the players of the Industrial ecosystem
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Link with strategic goals	- Increase the Greek Industry's overall digital maturity - Enhance the Greek Industry's applied R&D and the innovation capabilities - Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps - Increase the Greek Industry's potential to meet personalized needs and imminently respond to emergencies and crises (flexible processing)
Description of the initiative	*Rationale behind the need for the initiative* Based on the notion of "Smart Manufacturing" competence center presented under initiative 7.2, that shall focus on Smart Manufacturing technologies and their implementation in the Greek manufacturing and industrial enterprises, in this initiative we propose the introduction of a specialized structural materials test lab that shall focus on designing, developing, prototyping and testing new structural materials and respective technologies and applications. In fact, the introduction of a Structural Materials test lab shall aim to use some of these large players as Industry 4.0 "evangelists" and create an evolving Industry 4.0 ecosystem around them, that will attract Greek Structural Materials SMEs and mid-caps, production-oriented ICT enterprises and academic and research institutions and will enable the Greek Structural Materials Industry to: - Further increase its competitiveness: The Structural Materials test lab is seen as important to further boost the industry's competitiveness by facilitating the deployment of new technologies, boosting research and training. - Promote Innovation within the industry: Both the Structural Materials test lab and the Structural Materials Innovation District will help all companies (and especially SMEs and mid-caps) become more innovative by facilitating the move along TRL from proof-of-concept to production system and make their manufacturing and supply-chain processes more effective and optimized as a result. - Perform accurate solution benchmarking: the testing performed in the test lab could allow the comparison of different Structural Materials solutions and lead to establishing relevant benchmarks & standards for these. - Support Structural Materials & ICT SMEs: The test lab shall offer equipment, resources (data) and competence (feasibility assessment, prototypical solutions for use cases) not usually available to SMEs, allowing them to compete with bigger firms on innovation.

- Provide Knowledge & skills: Players in the Structural Materials ecosystem will learn more about Industry 4.0 applications and how to use them in their field of focus.
- Promote Sustainability & Circular Economy: the test lab should aim to make Structural Materials solutions more environmentally friendly by reducing among others energy consumption.

Details of the initiative

Scope of the test lab & Indicative Services Provided

The Structural Materials test lab will provide the required infrastructure, facilities and a safe and standardized environment for Greek Structural Materials organizations to experiment with the design, development, prototyping, standardization and testing of new Structural Materials and respective Smart Manufacturing technologies and applications, as well as the associated digital processes and networked business models under realistic conditions. In more detail, the test lab could provide the required facilities and testing infrastructure to enterprises to develop and test new Structural Materials and Smart Manufacturing solutions that could enhance the enterprises' supply chain and operations. Indicative areas of focus are:

- Research and Development on new Structural Materials: The test lab shall closely cooperate with European and National Centers for Research and Technological Development, Universities and Research Institutions and actively participate in European Networks focusing on the creation of new knowledge and technology transfer in the area of structural materials.
- Design and standardization of new Structural materials: Leverage Smart Manufacturing technologies and integrate end-to-end the supply chain processes to quickly respond to customer requirements and design, develop and standardize new, optimized structural materials tailor made to the specific customer needs. For instance:
    - Ceramics, Refractories and Building Materials: Development and pilot production of improved building materials, porous ceramics for environmental and other applications (filters, membranes, etc.), low thermal expansion ceramics, electronic ceramics, powders with controlled characteristics, ceramic nanomaterials, materials / technologies for combustion cells (production), laser microprocessing, thermal spray coatings and sputtering coatings.
    - Metallurgy & Metallic Materials: Improvement of material characteristics, connections of materials and new structures, analysis and modelling of structures, diagnosis of wear of materials and structures by non-destructive testing methods.
    - Environmental Control & Protection: Development of anti-pollution, smart manufacturing technologies, stabilization / inactivation and management of industrial waste / by-products but also their utilization for the development of new structural materials.
- Performance of technical studies on new structural materials: Material studies & material failure, investigation and analysis of deviations from the desired product quality limits, modelling and analysis of structures using finite elements, etc.
- Performance of inspections and provision of technical expertise
- Accreditation and Certification of tested Structural Materials products & applications

	Description of the lab's structure The Structural Materials test lab shall be set up under the auspices of EBETAM/ Mirtec, the company that came from the merger of three technological bodies in the field of materials: EVETAM SA - ΕΚΕΠΥ Α.Ε. - ΕΤΑΚΕΙ SA. The new EVETAM also includes the certification and laboratory testing activities of the Hellenic Standardization Organization (ELOT SA) that could significantly support the new Structural Materials test lab in its laboratory testing and accreditation activities. The new Structural Materials test lab could be also co-funded by a consortium of private sector Structural Materials companies in collaboration with academic/research institutions active in this field. The test lab shall have a physical location (either at research institutions or in the premises of private enterprises) or it could be also located in one of EBETAM's subsidiary locations in Athens, Thessaloniki, Volos or Thebes. Alternatively, this test lab could be incorporated into existing innovation structures (i.e. ELKEME – Hellenic Research Center for Metals). The test lab shall be run by a dedicated test lab program coordinator. The test lab can have any legal organization structure and shall have its finance and control boards. Leading practices indicate that some are organized as a foundation, some are cooperation agreements, and some are even established as a not-for-profit company. In addition, the test lab should include an accreditation and standardization committee as well as a Quality Assurance Committee that will be responsible for the successful and safe performance of laboratory testing of new structural materials. The funding for this test-lab could be provided through the issuing of relevant call for tender, as part of the initiative 2.1: Introduce an "Industry 4.0 labs/testbeds" funding scheme The awardees will receive a financial aid for the setup of the test beds/test labs and the first years (1-2 years) of their operations. Indicative costs are presented also in the analysis. **Indicative, non-exhaustive costs and expenses covered by the programme** The programme could indicatively cover the following cost/expense types: - Expenses for purchasing & maintenance of infrastructure, machinery and equipment - Connectivity expenses - Personnel expenses for operating the test lab
Stakeholders (Design & Implementation)	- General Secretariat for Research and Technology - General Secretariat for Industry - Ministry of Environment & Energy - Ministry of Digital Governance
Key beneficiaries (Target group)	- Greek enterprises (including SMEs, midcaps & start-ups) across the Smart Metal value chain - Greek Academic Institutions - Research Centres - Industry Federations (i.e. SEV, Association of Greek Miners, Mining Businesses Association, Metal Production and Processing Business Association, the Aluminum Association of Greece (A.A.G.), etc.)
Potential funding sources	- Initiative 8.4: Introduce a "Structural Materials" Sector Deal

Indicative Budget	€ 1.000.000 – 5.000.000
Dependencies with other initiatives	- Initiative 2.1: Introduce an "Industry 4.0 labs/testbeds" funding scheme - Initiative 7.2: Support the setup of a Smart Manufacturing Competence Center - Initiative 8.5: Introduce a “Structural Materials” Sector Deal
Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

7.2.1.4 Initiative 8.4: Introduce a "Structural Materials" Sector Deal

Title of the Initiative	**Introduce a "Structural Materials" Sector Deal**
Initiative's Coding	Initiative 8.4
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Design financial tools and measures targeted at upgrading enterprises on multiple areas (i.e. both adoption of new technologies and the upskilling/reskilling of employees) towards a "holistic" upgrade of enterprises
Link with strategic goals	• Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* As discussed for the broader Sector deals initiative (Initiative 6.5) t is rather crucial that the Greek state prioritises a select of sectors of the Greek Industry in order to be promoted and supported to the utmost extent, aiming to become "Industrial Champions". By pursuing this, the Greek industry will be revitalised and will grow around these areas that constitute the competitive industrial advantage of Greece, allowing for collateral benefits for all other professions and sectors directly or indirectly related to them. One of those sectors as they have been identified within the scope of this study (for the wider segment/ theme of High Priority Case 2) as well as promoted by the General Secretariat for Industry, a Sector deal programme could be focused on the segment of Structural Materials. *Details of the initiative* Same as for the Sector deals initiative within Execution Pillar 6 (Initiative I.6.5.) this initiative will be focused on supporting the Structural materials' sector. In the line of that, the Government will seek through this initiative to mobilise additional capital (ranging from 25% to 40%) and financially support the enterprises within the sectors that can be considered as Structural materials (e.g. the Metals sector), in selected areas of Industry 4.0 interest and specific technological applications for each one of them. In that sense, a co-investment scheme between the state and enterprises of all sizes that are part of this ecosystem will be created, allowing them to invest in technologies, human capital skills, applications, expert counselling in order to grow and prosper. Moreover, the Government will be responsible to evaluate on a frequent basis (four to six years) the dynamic of the Structural materials sector, allowing for more tailored adjustments in terms of supporting mechanisms, enterprises that should be further assisted (e.g. larger corporations over SMEs or vice versa), new technical skills that should be promoted and adopted as well as new technologies that need to be incorporated in businesses' operational and production models (through the respective funding or financing mechanisms). That being said, this re-evaluation and adjustment will allow for effective adaptations of the Structural materials sector to the Industrial needs present within the national and international ecosystem, allowing it to adapt quickly and efficiently.

	The percentage (%) of investment between the state and the enterprises will be defined and adjusted on a case-by-case basis, based on their size, their turnover and capacity to invest in such areas.
Stakeholders (Design & Implementation)	• Ministry of Development and Investments • Ministry of Finance • Hellenic Development Bank
Key beneficiaries (Target group)	Structural materials' SMEs, scaleups & mid-caps
Potential funding sources	• European Structural and Investment Funds (ESIF) (through the new NSRF) • European Investment Fund • Public Investments Programme • Horizon Europe • Private Funding
Indicative Budget	€30.000.000 – €45.000.000 (an indicative target would be to assist financially 300 SMEs and Midcaps within the industrial environment within the selected structural materials sectors, on average assisting with additional financial incentives/ support of 25-40% of what is already present in terms of financial incentives, approximately between €100.000-120.000 per enterprise).
Dependencies with other initiatives	Highly interconnected with the Initiative 6.5
Timeline of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 1 Necessity = 5

7.3 Involved stakeholders for High Priority Case 2

In this paragraph we list the key authorities, as these are presented in the abovementioned initiatives that shall be the key responsible for operationalizing the High Priority Case 2.

- **General Secretariat of Industry**: The General Secretariat of Industry (Ministry of Development) is the key and interconnecting player that is the key responsible for the design and implementation of all the High Priority initiatives. In High Priority Case 2, the General Secretariat of Industry has an even more important role to play in coordinating and being accountable of all four initiatives, since the Structural Materials Industry is under its direct areas of responsibility.
- **General Secretariat for Research and Technology**: Responsible for the design of the initiative 8.3 that focus on the promotion of applied research and development across the Structural Materials value chain.
- **Ministry of Education & religious affairs:** Responsible for co-designing initiative 8.1 through the provision of expertise and guidance on the areas of lifelong learning and the tertiary education.
- **Ministry of Labour**: Responsible for in contributing to initiative 8.1 for the performance of the I4.0 skills assessment study across the Greek Structural Materials sector.
- **Ministry of Digital Governance**: As the "Chief Digital Officer" of the Public Sector, the Ministry shall be consulted and informed on all initiatives of High Priority Case 2. Specifically, for the initiatives 8.1 and 8.3, the Ministry is expected to provide significant input on the design of these, as together with the Ministry of Development, it carries significant experience in the design and setup of digital upskilling programmes and Competence Centres.
- **National Certifications Center (EOPPEP)**: The National Certifications Center (EOPPEP) shall be involved in the 8.1 initiative and shall be responsible for the development of an accreditation scheme supporting the reskilling and upskilling programme for the Greek Metal workforce.
- **Private Accreditation Organizations**: In collaboration with EOPPEP, private accreditation organizations can be also involved for the design of initiative 8.1 for the development of the accreditation scheme. Private Accreditation organizations may also be responsible for implementing and running the accreditation part of initiative 8.1.
- **Academic & Research institutions with focus on STEM/ ICT & the Metal Industry**: Important role for the design of all High Priority Case 2 initiatives play the academic and research institutions with a focus on STEM/ ICT & the Materials Industry. The Greek Academia shall collaborate with the Public Administration stakeholders in order to support the design of the reskilling/upskilling and certification programme for the Greek Structural Materials workforce (initiative 8.1) and co-develop together with public authorities the dedicated "Structural Materials apprenticeship" programme (initiative 8.2). In addition, the academia shall collaborate with the research institutions and the private sector to jointly perform applied research and develop, test and implement new Industry 4.0 solutions in the Greek Metal Industry through the setup of the Structural Materials Test Lab (initiative 8.3).
- **Industry Federations**: Finally, Industry federations (i.e. SEV, Association of Greek Miners, Mining Businesses Association, Metal Production and Processing Business Association, the Aluminum Association of Greece (A.A.G.), etc.) will have an important role to play in the design and the operationalisation of the High Priority Case 2, as they act as the interface between the Greek Metal enterprises and the Public Authorities the Greek academic institutions and research institutes.

Apart from the listing of public authorities mentioned above, during Deliverable 4 we will suggest the development of a dedicated Working Group for Structural Materials to further analyze and design the abovementioned initiatives. This will consist part of the overall Industry 4.0 Governance mechanism to be designed.

7.4 Implementation of high-level timeplan

An indicative implementation timeline of High Priority Case 2 initiatives is briefly presented below. The first three initiatives can start from the 1st year of the operational plan, since they will consist in fact a specialization of relevant Operational initiatives (initiatives 1.1, 1.2, 2.1 and 6.5). These could be also developed as the "pilot" implementation of the overall respective initiatives.

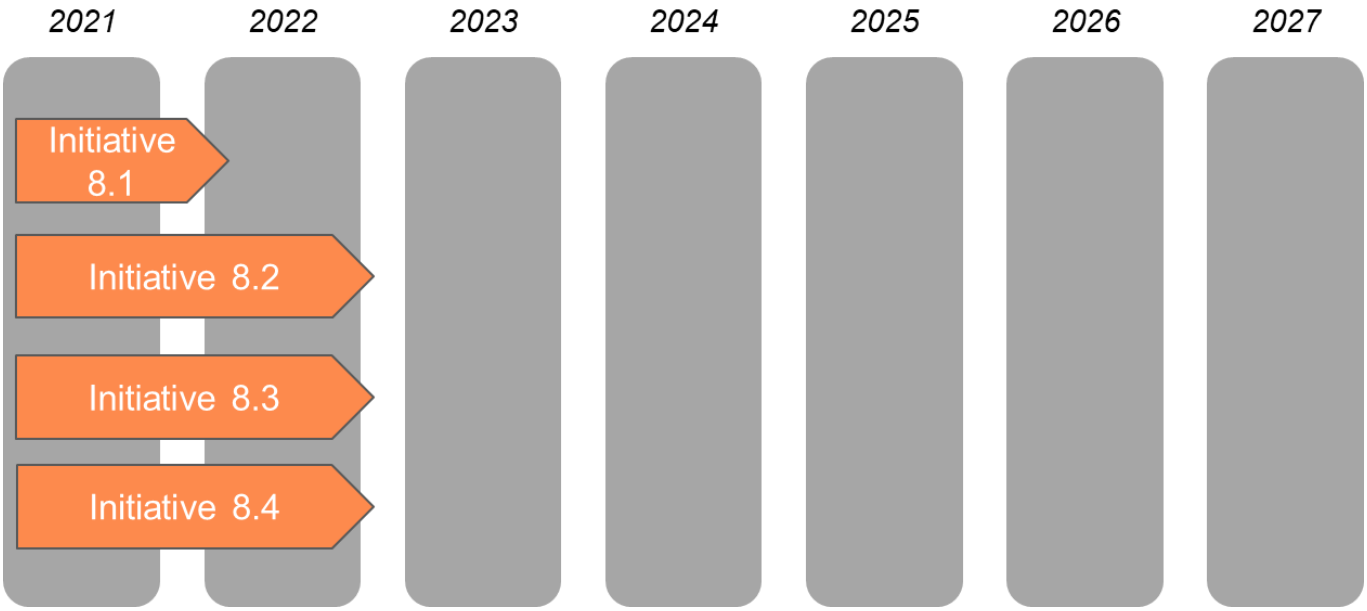


Figure 24: High level time plan for High Priority Case 2

8 Annex C: Operational Plan for High Priority Case 3 – Circular Economy

8.1 Introduction on High Priority Case 3: Circular Economy

Today's economy mainly supports a linear model, in which manufacturing takes raw materials from the environment and turns them into new products, which are then disposed after use. In this linear system raw materials might eventually run out while waste is accumulated. For this reason, multi-dimensional supply chains with new flows and formats and recovery loops for products and materials are needed. According to the first Circularity Gap Report[71], our world economy is only 9,1% circular, leaving a massive circularity gap. There is a growing need for material, water and energy because of both population growth and increased demand by infrastructure, industry and consumers in developing countries. Circular economy activities have the potential to address a significant share of this need— dampening or, possibly, reversing the raise in resource use, and in turn reducing resource depletion, climate change and the pollution of natural areas.

The circular economy is gaining increasing attention worldwide as a means to reduce dependency on primary materials and energy, while at the same time becoming an economically viable alternative to the linear economy. A circular economy is defined as an economy where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized. Essentially, as much as possible, everything is reused, remanufactured, recycled back into a raw material, used as a source of energy, or as a last resort, disposed of (see Figure 1).[72]

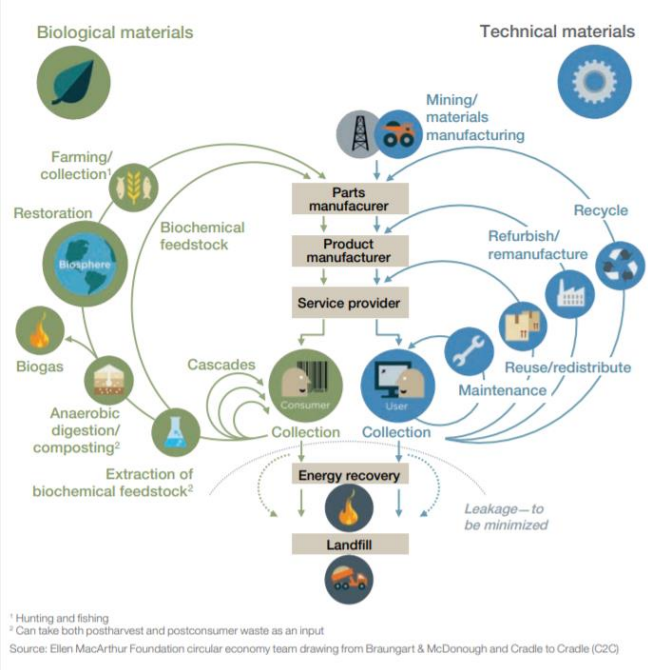


Figure 25: The Circular Economy – Source: Ellen MacArthur Foundation

[71] De Wit , M, at all (2018), Circularity Gap Report, Circle Economy, https://www.circle-economy.com/news/the-circularity-gap-report-our-world-is-only-9-circular
[72] http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf

The transition towards a circular economy requires systematic innovations including new innovative financing models, partnerships, business models and close integration of industry 4.0 technologies. In fact, Industry 4.0 bears enormous opportunities to enable circular economy, in which end of life products are reused, remanufactured and recycled. Increasingly, companies are applying innovative solutions, including the "Internet of Things" (IoT), cloud computing and 3D printing that will enable more interoperability and flexible industrial processes and autonomous and intelligent manufacturing. In fact, as the Ellen MacArthur Foundation explains, IoT and smart devices in industrial settings help companies unlock the circular economy potential thanks to three main value drivers: Knowledge of the location of the asset, knowledge of the condition of the asset and knowledge of the availability of the asset. Having an overview on these data in real time is of immense value to businesses.

In more detail, knowing the location of an asset allows for optimized routes for loading/unloading, maintenance and storage of spares.[73] Knowing the condition of an asset can lead to high uptime, as it allows for predictive maintenance instead of routine interventions. Parallelly, downtime is quickly detected and handled more efficiently. Thirdly, knowing the availability of an asset allows companies to optimize energy and other resources like raw materials based on usage patterns. Using these three levels, new insights are generated that enable organisations to rethink their production process and set more granular KPIs.

Industry 4.0 leads also to the advent of material science, which has introduced low-cost, low-waste synthetic alternatives to replace traditional materials used for a range of purposes, from clothing to construction.[74] Material science has also sought to replace beef with synthetic alternatives, with a track record of successful products currently in the market, such as Impossible burger.[75] Such a breakthrough may help curtail the environmental waste caused by the meat processing industry, thereby leading to a more circular global food economy. Furthermore, in agriculture, the application of artificial intelligence and image recognition to crop analysis can facilitate significant levels of reduction of fertilizer use[76], which can be detrimental to the nearby flora and fauna. Finally, advances in smart home and smart grid technologies have allowed utilities to minimize their energy consumption, while the auto-manufacturing industry is increasingly applying I4.0 applications to the energy efficiency of electric vehicles.[77] While leading to significant efficiency gains for businesses, the aforementioned Industry 4.0-related circular economy applications aim to disrupt business practices in ways which coincide with a significant reductions of the end customer's carbon footprint.

8.1.1 Selected Countries' Progress regarding the Circular Economy

Over the last few years, the concept of a Circular Economy has gained momentum internationally. The European Union and various member states have developed strategic plans for a transition towards a resource-efficient economic framework according to the principles of a Circular Economy. More information on the developments from a European Commission perspective has been captured in

[73] https://www.ellenmacarthurfoundation.org/circular-economy/concept
[74] https://sustainabledevelopment.un.org/content/documents/9539GSDR_Nano_brief%204.pdf
[75] https://www.forbes.com/sites/louisaburwoodtaylor/2019/07/31/impossible-in-full-scale-up-mode-with-new-burger-manufacturing-deal--fda-approval/#1a3aea1671a1
[76] https://news.developer.nvidia.com/ai-and-drones-help-farmers-detect-crop-needs/
[77] https://www.researchgate.net/publication/321140123_Big_Data_Analytics_for_Electric_Vehicle_Integration_in_Green_Smart_Cities

paragraph 5.1.3. Also, countries outside Europe follow this guiding principle, such as China, Japan or Canada.

Zooming into specific countries, Germany is a trailblazer in Circular Economy activities with many private companies onboarding the circular model to improve their sustainability impact in a variety of industries such as computing and e-waste[78], construction[79], fashion & sportswear[80], adhesives[81], plastics[82], the automotive industry[83], sea-waste[84], water[85] and many more. However, there is still no overarching strategy over how a Circular Economy can be achieved, although Germany considerably shaped the debate at the international level. Various strategies, platforms and initiatives already exist, on the political level, that promote alignment with the Circular Economy model. Those are, however, not yet integrated into one overarching strategy. The "Circular Economy Initiative Deutschland"[86] opens a science-based discourse about the potentials of a Circular Economy in Germany and develops a Circular Economy Roadmap for Germany.

Another European country that is a major contributor to the transition towards the circular economic model of production is France, whose "Roadmap for the Circular Economy" outlines 50 distinct measures across Production, Consumption, Waste Management and Cross-Platform Collaboration. The roadmap has clear objectives for each area and aims to ensure quick results by the year 2025 (50% reduction in non-hazardous waste volumes, 100% plastics recycling), as well as more long-term goals by 2030 (Reduce up to 30% of resource consumption in France, Create up to 300,000 additional jobs), while at the same time contributing to achieving some of the targets of 12 of the SDGs for France. Additionally, the French private sector has been remarkably innovative and active contributing to the circular economy model across various sectors such as e-waste[87], research[88], pallets[89], construction[90] and road construction[91], furniture[92], glass[93], fashion and textiles[94] and green cities[95].

A third European country that has contributed a very clear-cut strategy towards the circular economic model, as well as various initiatives & business models from the private sector, is Portugal. The country's "Leading the transition: A circular economy action plan for Portugal" is an in-depth strategic plan for transforming the Portuguese economy wholeheartedly into a circular economy production model. Although more long-term in its approach (2050), Portugal's action plan is characterized by 4 key goals:

[78] https://circulareconomy.europa.eu/platform/en/good-practices/circular-computing-remanufactured-laptops-go-mainstream
[79] https://circulareconomy.europa.eu/platform/en/good-practices/restado-marketplace-reuse-construction-material
[80] https://circulareconomy.europa.eu/platform/en/good-practices/adidas-and-stella-mccartney-present-prototypes-sustainable-and-recyclable-sportswear
[81] https://circulareconomy.europa.eu/platform/en/good-practices/adhesives-industry-water-soluble-adhesives-facilitate-return-and-reuse-bottle-schemes-and-end-life-recycling
[82] https://circulareconomy.europa.eu/platform/en/good-practices/plastics-recyclates-plastship-offer-services-better-quality-and-marketability
[83] https://circulareconomy.europa.eu/platform/en/good-practices/automotive-industry-plastic-recyclates-offering-prime-performances-new-parts
[84] https://circulareconomy.europa.eu/platform/en/good-practices/unique-wristbands-reduce-ghostfishing
[85] https://circulareconomy.europa.eu/platform/en/good-practices/re-salt-initiative-recycling-industrial-salty-process-water
[86] https://www.circular-economy-initiative.de/english
[87] https://circulareconomy.europa.eu/platform/en/good-practices/cant-find-spare-part-repair-your-home-appliance-pcdt-might-have-just-rescued-it-you
[88] https://circulareconomy.europa.eu/platform/en/good-practices/circular-economy-research-center-cerc
[89] https://circulareconomy.europa.eu/platform/en/good-practices/magicpallet-worlds-first-online-collaborative-solution-dedicated-exchange-reusable-pallets
[90] https://circulareconomy.europa.eu/platform/en/good-practices/cycle-terre-excavated-soil-urban-areas-becomes-construction-raw-material
[91] https://circulareconomy.europa.eu/platform/en/good-practices/port-dunkirk-reuses-contaminated-sediment-road-construction
[92] https://circulareconomy.europa.eu/platform/en/good-practices/chants-libres-pilot-project-combining-professional-furniture-upcycling-and-social-enterprise
[93] https://circulareconomy.europa.eu/platform/en/good-practices/saint-gobains-isover-pioneer-recycling-glass-wool
[94] https://circulareconomy.europa.eu/platform/en/good-practices/clothes-rental-helping-reduce-textile-waste-greenhouse-gas-emissions-and-water-footprint
[95] https://circulareconomy.europa.eu/platform/en/good-practices/lyon-metropole-regenerates-brownsites-fertile-ground

1. Carbon neutral, resource efficient and productive economy
2. Knowledge as an impulse
3. Inclusive, resilient and prosperous economy
4. Flourishing, responsible, dynamic and inclusive society

These goals are sought to be achieved by a multi-level national approach, international detailed benchmarking, input from national and international experts, and governance from the interministerial group while they consider actions and initiatives in the Macro, Meso and Micro level through Policy, Sectoral and Local actions that ensure that the circular economy transformation will penetrate all levels of society and economy.

On the private sector's side Portuguese companies are actively responding to the abovementioned action plan in areas such as e-waste[96], toys[97], furniture[98,99], plastics[100], food[101], water[102] and construction[103].

Greece has taken several steps to gradually transition towards a production model that is defined more and more by the circular economy concept. On a national level Greece's Governmental Economic Policy Council published the National Action Plan on Circular Economy[104] in early 2018 to set the country on a path towards the long-term adoption of circular economy principles, as well as to serve as an accelerator for achieving 11 different United Nations Sustainable Development Goals (SDGs)[105]. The long-term (2030) goals of the National Action Plan on Circular Economy can be summarised as follows:

- Improve waste hierarchy through waste prevention and recycling improvement
- Support of circular entrepreneurship by promoting "industrial symbiosis" and business clusters
- Support of circular consumption patterns (i.e. re-using, re-storing and re-pairing), rather than buying new products, especially for electrical and electronic devices
- Enhancement of multi-stakeholder partnerships across industry, academia, and civil society
- Monitor the progress towards a circular economic model through SMART (specific, measurable, achievable, relevant and time-bound) indicators

Furthermore, regional initiatives and fora across Athens[106], Thessaloniki[107], the Cycladic Islands[108] and more are focusing on reducing and managing waste and transforming the agricultural sector in alignment with the circular economy model. Additionally, industry leaders from the private sector like Titan[109], Viohalco[110] and Motor Oil[111] are rapidly advancing the integration of circular economy processes in their production model through re-cycling and re-purposing of waste and used materials. However, not only

[96] https://circulareconomy.europa.eu/platform/en/good-practices/circular-computing-remanufactured-laptops-go-mainstream
[97] https://circulareconomy.europa.eu/platform/en/good-practices/rag-doll-project-circular-portuguese-crafts-and-traditions-ready-cross-borders
[98] https://circulareconomy.europa.eu/platform/en/good-practices/recircularte-dusting-old-furniture-and-objects-give-them-new-life-circular-effort
[99] https://circulareconomy.europa.eu/platform/en/good-practices/mattresses-re-designed-re-use-and-recycling
[100] https://circulareconomy.europa.eu/platform/en/good-practices/closing-loop-incorporating-post-consumer-recycled-plastic-new-jeronimo-martins-products
[101] https://circulareconomy.europa.eu/platform/en/good-practices/jeronimo-martins-fighting-food-waste-all-fronts
[102] https://circulareconomy.europa.eu/platform/en/good-practices/saltgae-develops-microalgae-technology-sustainable-alternative-wastewater-treatment
[103] https://circulareconomy.europa.eu/platform/en/good-practices/do-you-see-building-or-bank-recyclable-materials
[104] https://circulareconomy.europa.eu/platform/en/strategies/national-action-plan-circular-economy
[105] https://sustainabledevelopment.un.org/partnership/?p=33843
[106] https://circulareconomy.europa.eu/platform/en/news-and-events/all-events/virtuous-circles-1st-circular-economy-forum-greece
[107] https://www.bbi-europe.eu/events/implementation-circular-economy-agriculture-and-livestock-farming-thessaloniki-greece
[108] https://ekogreece.com/wp-content/uploads/2018/10/EKO-Report-102018_Circular-Economy-in-the-Cycladic-Islands.pdf
[109] https://www.titan.gr/en/sustainability/environment/circular-economy
[110] https://www.viohalco.com/771/en/Environment-and-recycling/
[111] https://circulareconomy.europa.eu/platform/en/good-practices/life-diana-turning-petroleum-refinery-sludge-soil-added-value

industry leaders but Universities, Start-ups and SMEs like KLIMIS[112], ReWeee[113] and Thessaly TEI's "Close the Loop in the Ceramic Industry"[114] are contributing towards transforming the Greek industry by offering added-value re-cycling and re-purposing of agricultural byproducts from olive and apple trees, of e-waste and of inorganic and organic wastes to substitute clayey raw material.

8.1.2 Organizations' new circular business models and Industry 4.0's contribution for their realization

Circular Economy is a wide topic that as a concept has been around for a few decades. As it is known today, it refers to the decoupling of economic growth from the extraction and consumption of constrained natural resources, i.e. scarce resources with negative footprints, like fossil fuels or hard-to-recycle metals and minerals. For business, it's about turning waste into wealth. Importantly, "waste" here refers to more than just physical waste, i.e. rubbish. We can see "waste" in four different ways:

- **Wasted resources** are materials and energy that cannot be continually regenerated, but instead are consumed and forever gone when used.
- Products with **wasted lifecycles** have artificially short working lives or are disposed of even if there is still demand for them from other users.
- Products with **wasted capacity** sit idle unnecessarily; for instance, cars typically sit unused for 90% of their lives.
- **Wasted embedded values** are components, materials, and energy that are not recovered from disposed products and put back into use.

Together all this waste adds up to the biggest economic opportunity of our time. Finding business solutions to turn waste into wealth not only makes financial sense but also enables growing businesses and economies without growing the need for increasingly constrained natural resources.

But what has happened now and why circular economy is gaining so much attention? What are the key drivers behind the emergence of Circular Economy as a key topic for public debate? At a high level, there are three fundamental drivers of the circular economy with technology sitting at the heart of this.

- **Resource Constraints:** The current economy is wasteful and resources/ raw materials are getting scarce
- **Technological Development:** The introduction of new technologies and Industry 4.0 innovations is making the circular economy increasingly attractive and viable for business.
- **Socio-economic opportunity:** Decoupling constrained resources from growth not only enables inclusive growth but also empowers customers to squeeze the most value out of products and assets.

It appears that there is an intuitive business case behind circular economy. But at a practical level, it appears difficult for organizations to make this shift. Most of them are not simply built to capitalize on the opportunities the circular economy offers. Their strategies, structures, operations and supply chains are deeply rooted in linear approach to growth. Companies seeking the circular advantage will need to develop

[112] https://circulareconomy.europa.eu/platform/en/good-practices/production-agricultural-lime-summer-barbecues-olive-pits-make-perfect-circular-fuel
[113] https://www.reweee.gr/en
[114] https://circulareconomy.europa.eu/platform/en/good-practices/close-loop-ceramic-industry

new business models that are free of the constraints of linear thinking. These business models are presented below:

- **Circular Supply – Chain:** When a company needs resources that are scarce or environmentally destructive it can either pay more or find alternative resources. The Circular Supply-Chain introduces fully renewable, recyclable, or biodegradable materials that can be used in consecutive lifecycles to reduce costs and increase predictability and control.
- **Recovery and Recycling:** The Recovery and recycling model creates production and consumption systems in which everything that used to be considered waste is revived for other uses. Companies either recover end-of-life products to recapture and reuse valuable material, energy and components or they reclaim waste and by-products from a production process.
- **Product Life-extension:** Consumers discard products they no longer value, because the products are broken, out of fashion or no longer needed. But many of these products still hold considerable value and the Product Life-extension model seeks to recapture this. By maintaining and improving products through repairs, upgrades, remanufacturing or remarketing, companies can keep them economically useful for as long as possible. This means shifting from merely selling things to actively keeping them alive and relevant. It also means moving customers from transactions to relationships, tailoring upgrades and alterations to specific needs.
- **Sharing platform:** The Sharing Platform model, increasingly enabled by new forms of digital technology, forges new relationships and business opportunities for consumers, companies and micro-entrepreneurs that rent, share, swap or lend their idle goods. Fewer resources go into making products that are infrequently used, and consumers have a new way to both make and save money.
- **Product as a Service:** What if manufacturers and retailers bore the “total cost of ownership”? Many would immediately adjust their focus on longevity, reliability and reusability. When consumers lease or pay for products by use through the Product as a Service model, the business model fundamentally shifts. Performance trumps volume, durability tops disposability and companies can have an opportunity to build new relationships with consumers.

Adoption of the five circular models has technology at its core. In fact, Industry 4.0 technologies are required to be adopted to support and scale the new business models and use those technologies to effectively manage resources within markets, ensure waste is eliminated and monetized, serve customers and drive business and product development over time. In the table below, we present the Industry 4.0 technologies that enable the implementation of each business model.[115]

[115] This is a qualitative mapping based on Accenture’s experience on Industry 4.0 and the circular economy. Technologies not checked for a specific business model indicate that they are not so widely used for the business model’s implementation.

Technologies	Circular Supply-Chain	Recovery & Recycling	Product Life-Extension	Sharing Platform	Product as a Service
Additive Manufacturing	☑	☑	☑		
Artificial Intelligence			☑	☑	☑
Augmented Reality	☑	☑			
Big Data Analytics	☑	☑	☑	☑	☑
Blockchain	☑	☑			
Cloud	☑	☑	☑	☑	☑
Cybersecurity	☑	☑	☑	☑	☑
Distributed Intelligence	☑	☑	☑	☑	☑
Electronic Components & Systems	☑	☑			
High Performance Computing		☑			
Industrial Robots	☑	☑	☑		
Machine-to-Machine	☑	☑	☑	☑	☑
New Materials	☑	☑			
Photonics, Automation, Sensors & Applications	☑	☑			
Simulation	☑	☑			
Supervisory control and data acquisition systems – SCADA	☑	☑			
The industrial internet of Things	☑	☑	☑	☑	☑

8.1.3 The concept of Industrial Symbiosis (IS)

An important element that contributes towards the establishment of a circular economy is Industrial Symbiosis. According to Chertow, "the part of industrial ecology known as industrial symbiosis engages traditionally separate entities in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and by-products. The keys to industrial symbiosis are collaboration and the synergistic possibilities [often] offered by geographic proximity".[116] Explaining this definition further, Domenech et al. write 'IS involves organisations operating in different sectors of activity that engage in mutually beneficial transactions to reuse waste and by-products, finding innovative ways to source inputs and optimise the value of the residues of their processes, for instance by using waste or by-products from one activity as an input for another activity".[117] Recently, in 2018, a European Committee for Standardisation workshop agreement on industrial symbiosis was reached, defining industrial symbiosis as "Industrial symbiosis is the use by one company or sector of underutilised resources broadly defined (including waste, by-products, residues, energy, water, logistics, capacity, expertise, equipment and materials) from another, with the result of keeping resources in productive use for longer".[118] The definition of IS indicates that there is a need to go beyond optimisation at process and/or plant level, and to have a more systemic approach moving towards optimisation at multi-plant/cluster level and beyond (e.g. local communities). A holistic approach is required to achieve breakthrough improvements for resource and energy efficiency, which are necessary to move towards a zero-waste circular economy.

The European Commission already financially supports a set of projects that aim to address the challenge of identifying and establishing industrial symbiosis activities. These have been mainly part of the Horizon 2020 work programmes, published between 2014 and 2017. Their breadth of focus areas also indicates the broad support that industrial symbiosis receives from European Commission funding. Three emblematic projects on IS are presented below:

- [Scaling European resources with industrial symbiosis (SCALER)] aims to massively increase the implementation of industrial symbiosis, by developing mechanisms to retain the embedded value of European resources, thus, enabling the circular economy to achieve higher resource efficiency through systemic innovations led by intensified industrial symbiosis initiatives and enhanced by cross-sectorial collaboration and, to support the development of a roadmap to improve the adoption of industrial symbiosis in the European process industry at regional / national / European level. SCALER uses new and advanced practices in identifying value opportunities, use new methods to create a larger market for available resources, and use new methods to measure and manage the implementation and sustaining of new relationships. SCALER brings together qualitative and quantitative tools and methods to support self-organised initiatives on industrial symbiosis and to enhance facilitation processes and coordination actions. The creation of new spaces for interaction, collaboration and cooperation and the engagement of a broader set of stakeholders are crucial elements of the multiplier effect in industrial symbiosis implementation. SCALER provides a

[116] Chertow, M. R, 'Industrial Symbiosis: Literature and taxonomy', *Annual Review of Energy and the Environment*, Vol. 25, 2000, pp. 313-337.
[117] Domenech, T., Doranova, A., Roman, L., Smith, M. and Artola, I., *Cooperation Fostering Industrial Symbiosis: Market potential, good practice and policy actions*, Publications Office of the European Union, Luxembourg, 2018, p. 9, doi:10.2873/346873.
[118] European Committee for Standardisation and European Committee for Electrotechnical Standardisation, 'Industrial Symbiosis: Core elements and implementation approaches', workshop agreement, 2018, p. 5 (ftp://ftp.cencenelec.eu/EN/ResearchInnovation/CWA/CWA17354.pdf).

comprehensive solution for understanding, assessing and intensifying the potential of industrial symbiosis in Europe.[119]

- The [enhanced energy and resource efficiency and performance in process industry operations via onsite and cross-sectorial symbiosis (EPOS)] project develops a simple and single management tool for exploring industrial symbiosis (IS) across process sectors. A wide range of technology and management solutions is proposed for supporting collaboration between sectors, by making industrial sites more efficient, cost-effective, competitive and sustainable. Using the UGent cluster management surveys and the [École polytechnique fédérale de Lausanne (EPFL)] site optimisation platform, cluster sites were studied, references set, opportunities for cross-sectorial symbiosis spotted and IS potential was mapped for each EPOS cluster. [Several] IS pilot cases were investigated in detail' including assessments of greenhouse gas emissions reduction, investments, cost savings, etc. These "cases served as industry-driven input for developing a realistic IS methodology and building the prototype of the EPOS toolbox". The main focus of the EPOS project was the development of sector blueprints to solve confidentiality issues and to simplify the initiation of discussions.[120]
- [Human-mimetic approach to the integrated monitoring, management and optimization of a symbiotic cluster of smart production units (SYMBIOPTIMA)] developed an integrated Energy and Resource Management System (ERMS), which offers tools for production scheduling and demand response management and for Life Cycle Sustainability Assessments (LCSAs). It also created hardware for modular "plug and play" monitoring of production plants, as well as an integrated toolset for all thermal energy sources, flows and sinks. Additionally, to maximise the reuse of waste, it developed a unique de-polymerisation process for plastics (PET)' (25). This includes a scalable network of low footprint sensors for process monitoring and control, as well as tools for energy-aware scheduling of operations in cross-sectoral operations (i.e. optimising multi-plant operation schedule based on availability and cost of energy).[121]

Despite its important contribution to the establishment of a Circular economy, IS is not currently the prevalent mode of operation for industrial companies. Therefore, many barriers have to be overcome to foster the adoption of this new paradigm successfully. The key (non-exhaustive list of) barriers towards the implementation of IS initiatives are presented below:

- Companies usually focus on their profitability and competitiveness. For this, procurement will seek out suppliers who make the best offers, often at the lowest cost. Therefore, in order to motivate waste owners (e.g. CO2 emitters) to make these streams available, the culture of shared benefits, which is the hallmark of industrial symbiosis, first needs to be established, even if at the beginning, it might be perceived as counterproductive for the welfare of a company. Even more, a culture of trust between independent industrial actors needs to be established.
- Establishing industrial symbiosis also requires significant investments in new technologies, new infrastructure, the operation itself and the time needed. These investments will often only be made when the benefits are certain, clear and short-term. In this context, if industrial symbiosis is to be

[119] CORDIS, 'Scaling European resources with industrial symbiosis' (https://cordis.europa.eu/project/id/768748).
[120] CORDIS, 'Enhanced energy and resource efficiency and performance in process industry operations via onsite and cross-sectorial symbiosis' (https://cordis.europa.eu/project/id/679386/reporting).
[121] CORDIS, 'Human-mimetic approach to the integrated monitoring, management and optimization of a symbiotic cluster of smart production units' (https://cordis.europa.eu/article/id/257676-applying-the-principles-of-industrial-symbiosis-for-more-sustainable-manufacturing).

promoted, there is certainly the need for broader involvement of local and national authorities, especially in major infrastructure investments (e.g. in pipelines and grids).

- Furthermore, antitrust, legal and IP-protection rules are significant barriers and extra effort needs to be made to meet the challenges. This pertains specifically to the exchange of data, be it technical or commercial. Not only is such an exchange potentially problematic because of antitrust rules, but also often not even wanted by the industrial partners. When data exchange is intended, proper confidentiality agreements need to be in place to avoid potential leaks and damage to the partners.
- A lack of awareness and understanding of industrial symbiosis, a lack of visibility of opportunities and a lack of relevant skills and successful business models can significantly slow down the adoption of industrial symbiosis.
- Clarity, stability, consistency and a long-term perspective on the regulations to utilise waste as a raw material are an important factor.
- For the identification of industrial symbiosis opportunities, relevant data on waste streams, their classification, composition and quantities need to be publicly available. This is not usually the case. The standardisation of the data is an important factor. Municipalities should find a way of making, for example, data on waste streams publicly available in an accepted way.

To address these barriers, governments shall focus their efforts on multiple areas to increase awareness, equip enterprises with the appropriate skills, introduce relevant innovation structures and platforms that will promote collaboration and trust building amongst industrial stakeholders, improve the Greek regulatory and standardization framework and introduce relevant financial schemes for industrial organizations. It shall be mentioned that the initiatives proposed in the next paragraph cannot and will not cover the whole spectrum of circular economy/ Industrial Symbiosis activities that the country should pursue to become more circular and greener. On the contrary, it is a set of non-exhaustive initiatives that aim at highlighting different ways that Industry 4.0 actions could contribute towards the materialization of Greece's circular economy and Industrial Symbiosis plan. These actions will focus on:

- How we can upskill the human workforce in Industry 4.0 technologies and applications that can contribute to Greek organizations' rotation to the circular economy and the adoption of IS business models?
- How we can enhance R&D and innovation structures for the development of circular economy solutions and the setup of an Industrial Symbiosis ecosystem?
- How organizations of different sizes can collaborate amongst them and with the academia and the research community to promote Industry 4.0 solutions that support the circular economy and increase trust between each other for setting up IS clusters?
- What are the activities regarding standardization and regulation that shall enhance the production of circular-oriented products and services using Industry 4.0 technologies?
- Which can be specialized funding schemes that will support the Greek Industrial enterprises to transform their production lines/ products and services into greener ones and embrace IS business models?

Finally, it should be mentioned that a key "enabler" that shall accelerate the adoption of new circular economy and IS business models is the design and implementation of a set of measures and initiatives to radically fight shadow economy in the circular economy area, with specific emphasis given to fight of corruption with regards to waste management, at all stages of production, treatment and disposal. This

consists a horizontal initiative that requires the active collaboration of multiple stakeholders across the Greek Government.

At the same time, the introduction of Smart Manufacturing technologies for the development of circular and IS applications and new business models can also significantly support for the first time monitoring in a modern and transparent way the course of the waste, until its final destination, protecting the environment, cessing uncontrolled discharges of industrial waste and ultimately eliminating the shadow economy. In addition, dedicated marketplaces of secondary materials (like the one presented in initiative 9.2) can further fight shadow economy, through the monitoring of the production of secondary raw materials that will result from the recovery of waste or their declassification, based on specific criteria.

As a next step the below mentioned initiatives shall be evaluated in the wider context of Greece's circular economy strategy, in order to become more detailed and to become aligned with Greece's strategic priorities and objectives with regards to circular economy.

8.2 Measures & Initiatives

8.2.1.1 Initiative 9.1: Develop an online reskilling & up-skilling programme on Circular Economy & Industry 4.0 enabling technologies

Title of the Initiative	**Develop an online reskilling & up-skilling programme on Circular Economy & Industry 4.0 enabling technologies**
Initiative's Coding	Initiative 9.1
Pillar	Pillar 1: Digital skills & human capital qualification
Area of focus	• Upskill and reskill the Industrial workforce
Link with strategic goals	• Increase the Greek Industry's overall digital maturity • Support the Greek Industry to transition into the zero-carbon and low environmental footprint economy • Digitally upskill and reskill the human workforce in the Greek industry
Description of the initiative	*Rationale behind the need for the initiative* Currently the Greek Industrial workforce demonstrates limited awareness not only on Industry 4.0 technologies but also on the notion of circular economy and Industrial Symbiosis and how this can be enabled by new digital solutions. For this reason, we propose the design of an online training programme that will aim to highlight and explain the different circular business models that organizations could adopt, introduce IS concepts and terminologies and demonstrate how Industry 4.0 and Smart Manufacturing technologies can support organizations' transition to IS and Circular Economy business models. *Details of the initiative* Design and launch a dedicated training programme on the Circular Economy/ IS new business models and the enabling Industry 4.0 technologies that support them, in collaboration with: 1) Academics & Research institutions specialized in Industry 4.0 technologies and circular economy 2) Circular Economy & Industry 4.0 Experts (from the private and public sector) that can provide real-life use cases regarding the implementation of Industry 4.0 technologies to adopt a circular business model and develop "green" innovative solutions and services. The training shall be provided online to participants and they will be constructed in modules so that they can complete these in their own free time. The programme shall be designed on two different streams: - The first stream shall introduce the concepts of Circular Economy and Industrial Symbiosis, will provide general information on the new circular/ IS business models (as these are presented in paragraph 8.1.2) and shall provide real-life examples on how these have been applied by different organizations across different industries. The

online modules could also include interviews with the executives from companies that have already implemented these models, who can discuss on their business objectives, key challenges they faced during the models' implementation and key success factors for deploying these.

The first stream of the training can also demonstrate and explain the key capabilities that Greek enterprises shall also adopt and develop for implementing these models. Without the right capabilities, companies may face unnecessarily high costs during their efforts for applying these new business models. Indicative capabilities are:

- The design of a corporate strategy that can manage complex and collaborative circular/ IS networks
- New innovation and product development capabilities for designing for many lifecycles and users
- New sourcing and manufacturing capabilities to accommodate circular supplies
- New sales capabilities to promote the continuous customer engagement
- Return chains & reverse logistics capabilities to find the optimal volume and quality mix of end-of-life products, components and materials that should be targeted for return from the markets

- Having set the business context, the second stream of the training shall focus on the Industry 4.0 technologies and solutions that enable organizations' rotation to circular/ IS business models and specific applications of these in the circular economy context. Indicative technologies that could be reviewed are:
  - Machine 2 Machine Communication: M2M Technology is especially relevant to the Sharing Platform and Product as a Service business models, as it allows companies to manage assets without using costly field service, which has historically been a barrier to circular models. M2M sends data from a product to the manufacturers' management system. This allows manufacturers to remotely manage their products and reduces the risks associated with offering performance-based products (which is fundamental to the Product as a Service business model).
  - Cloud Computing: Dematerialization (the process of replacing something physical with a digital alternative) can let consumers shop or use services from anywhere at any time by transferring data to them from the cloud. This can enable the implementation of Product as a Service business model.
  - AI & Big Data Analytics: In the circular economy and especially in IS models, many companies will generate their revenues from product use instead of sales, and growth will rely on how good they are at understanding and catering to product-use behaviour. This means companies need to monitor and analyse data in entirely new ways. Complex analytics and AI shall be especially important for the Circular Supply-Chain, the Sharing Platform and the Product as a Service business models.
  - Additive Manufacturing: Arguably one of the most-hyped technologies of the past years, additive manufacturing is one of the key drivers of circular business models for several reasons. For one, it facilitates repairing by making it possible to directly print suitable parts with the exact geometry. It also creates opportunities for circular inputs, inputs that are biodegradable or infinitely recyclable. The technology also spurs new production methods that can result in significantly more durable products.

	○ New Materials: New Materials play a key role in driving input substitution at a large scale. Ongoing innovation in this field will lead to new circular material input options. It will also bring on new ways to alter outputs so they can be used as inputs. The programme is primarily addressed to the human workforce of the Greek Industry and Manufacturing sectors. Differentiated content for each of the streams can be provided to different levels of experience across the Greek workforce (i.e. senior executives, mid-level management, low-level employees). In addition, it could be evaluated whether different content could be provided for the different sectors of economic activity within the Greek industry, including tailored examples and use cases for each sector. Government shall cover the expenses for the development of the training curriculum.
Stakeholders (Design & Implementation)	• Ministry of Environment & Energy • General Secretariat of Industry • Ministry of Education & religious affairs • Ministry of Labour • Ministry of Digital Governance • Industry federations
Key beneficiaries (Target group)	Employees from Greek Industrial enterprises (including SMEs & midcaps) that wish to further explore the circular economy/ IS field and the underlying Industry 4.0 technologies
Potential funding sources	• Current NSRF/ ESF (OP Human Resources Development, Education and Lifelong Learning)/ Future NSRF
Indicative Budget	€1.000.000 - €2.000.000 for the development of the curriculum
Dependencies with other initiatives	• Initiative 7.1: Design a training curriculum and an online digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies
Timeline of implementation	Midterm/ Long term
Feasibility and Necessity of initiative	Feasibility= 3 Necessity= 5

8.2.1.2 Initiative 9.2: Support the Setup of an Industrial Symbiosis Competence Center

Title of the Initiative	**Support the Setup of an Industrial Symbiosis Competence Center**
Initiative's Coding	Initiative 9.2
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	Design of new and/or enhance existing innovation structures to ensure the diffusion of expertise and best practices between all the players of the Industrial ecosystem
Link with strategic goals	- Enhance the Greek Industry's applied R&D and the innovation capabilities - Support the Greek Industry to transition into the zero-carbon and low environmental footprint economy - Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* The communication between different actors is essential in symbiotic and circular relationships, as it is understood that many of the symbiotic initiatives do not materialize due to lack of knowledge and other social barriers. In some cases, the relationships between universities/research centres (or other knowledge agent) and industrial actors can be a defining factor for the success of the initiatives, once these agents bring new knowledge and perspectives to practical cases. But it cannot be let that the networking depends absolutely on the proactivity of some actors. As previously mentioned, one of the most difficult barriers to overcome are the social ones, and these two actors generally have considerable social barriers to overcome before materializing some type of exchange (lack of environment trust, resistance to new concepts, lack of motivation). For this reason, it is considered that a differentiating element to facilitate networking and clustering between different actors could be the creation of a Competence Center that will support the implementation of IS and will enable the experimentation and development of new, innovative Industry 4.0 solutions that can promote the new circular and IS business models. This IS competence centre shall also set up and operate a national circular economy marketplace that can match the demand and supply for secondary raw materials in the Greek market and promote the Industrial Symbiosis model. *Details of the initiative* **Scope of the Center** Encourage the setup of a Competence Center that shall focus on the design, testing, experimentation and development of new innovative Industry 4.0 solutions that will enable organizations of all sizes and types (i.e. SMEs, startups, midcaps, large organizations) to experiment with new circular economy business models and realize their benefits. The focus of the Competence Center can be wide in order to cover the full spectrum of the circular economy domains, with a specific emphasis on Industrial Symbiosis. Indicatively the

	Competence Center could develop Industry 4.0 solutions that will have the potential to broaden the basis for useful material flows, should optimize inter-plant integration through integrated control systems and shall promote innovation in feedstock mobilisation, renewable energy process technology and sustainable integrated process technologies by targeting at the same time decarbonisation, energy security, raw material dependence and cost.
	
	Indicatively, the Competence Center could focus on different IS-related initiatives, i.e.:
	
	- The promotion of experimentation and innovation areas to test the use of by-products
	
	- The promotion of biotechnologies for extracting and reusing nutrients and compost, favouring the hierarchy of waste material use and the added value (economic and environmental) of the derived product, e.g. the bio-refining of industrial/domestic effluents to extract phosphorus/nitrogen, produce compost and/or produce organic fertilisers and bio-energy from livestock effluents
	
	- The applicability of breakthrough technologies to achieve resource efficiency, energy efficiency, carbon sequestration and reuse, product efficiency, sustainable construction
	
	- The development of solutions for eco-design and repair, short production and consumption loops, use of secondary raw materials, water resource regeneration, etc.
	
	The Competence Center can focus both on inter-sectoral Industry 4.0 solutions that will refer and be applied horizontally to the Greek Industry, as well as it can focus on specific sectors, for which specialized circular solutions can be developed. Indicatively:
	
	- Agriculture & Food: Develop solutions for:
	  ○ Reducing & reusing food waste across the value chain
	  ○ Anaerobic digestion to produce circular energy
	  ○ Soil & Water Management
	  ○ Reusability of fully recyclable packaging
	- Apparel: Develop solutions for:
	  ○ Fibre recycling
	  ○ Material innovation such as wood-based fibres
	  ○ Circular production practices to eliminate toxic chemicals
	  ○ Biodegradable products
	- Construction Industry: Develop solutions for:
	  ○ Recycling building materials such as asphalt, concrete and plasterboard
	  ○ Reusing waste from construction & demolition as well as from other industries to create new building materials
	  ○ Modular building designs
	- Consumer Electronics & IT: Develop solutions for:
	  ○ 3D printing of spare parts
	  ○ Modular designs and component marketplaces
	- Energy: Develop solutions for:
	  ○ Renewable energy
	  ○ Biofuel
	  ○ Product Service Systems for energy production
	- Industrial Equipment: Develop solutions for:
	  ○ Remanufacturing of end-of-life machinery
	  ○ Product Service Systems for asset lifecycle management

- Connected equipment for monitoring efficiency and predictive maintenance

Indicative Services Provided by the Circular Economy Competence Center

The Competence Center will enable its clients to innovate, build differentiated circular solutions and applications. In more detail, the Competence Center could provide the following services (non-exhaustively), to support its clients:

- Collaborative R&D: Provide support for the design and implementation of R&D projects on the circular economy
- Testing and validation: Provide technical and specialized services for design, testing & validation of new solutions including product demonstration & product qualification
- Technical support on scale up: Provide support for solutions' technology concept development, proof of concept, prototyping & small series production
- Community building: Support the creation of a collaborative, innovation-driven ecosystem, instigate awareness, act as the broker to bring in contact enterprises, etc.
- In addition, the Competence Center can also act as an ecosystem accelerator for start-ups, active in the "circular economy" field.

Finally, the Competence Center shall design and develop a circular economy marketplace for matching supply and demand of secondary raw materials and enable organizations across the Greek Industry to optimize their resources.

The marketplace will consist of a website that will enable the organizations in demand of second raw materials to easily search the market by location and particular type of material and identify potential buyers that can contact. At the same time, organizations with excess of raw materials, will be able to post on the marketplace these, as well as materials to be discarded and off-cuts for sale. This can promote the reuse of materials by reintegrating them into the distribution circuit. In addition, it can reduce the organizations' waste volume and associated costs and give to materials a second life with the marketplace.

Secondary materials that can be promoted on the marketplace can be metals & alloys, plastics and polymers, biotic resources, construction and demolition waste, textile and leather, paper & cardboards, wood, chemical, oil, fats & waxes, etc. Besides the general listing of markets and materials, the marketplace can feature case studies of other particularly successful marketplaces to showcase the potential of secondary raw material markets and to highlight good practices.

The marketplace can function under the auspices of the Competence Center and each participant shall pay a membership fee to use this. Similar initiatives have been implemented by the Marketplace Hub in Switzerland[122] and by Restado, a German company that has developed the marketplace to cover the needs of three different countries: Germany, Austria & Switzerland.[123]

The Competence Center and more specifically the introduction of this marketplace can significantly contribute in fighting shadow economy, through the monitoring of the production

[122] https://circulareconomy.europa.eu/platform/en/good-practices/offer-and-demand-secondary-raw-materials-make-perfect-match-marketplacehub
[123] https://restado.de/

	and distribution of secondary raw materials that will result from the recovery of waste or their declassification, based on specific criteria.
	
	Description of its structure
	
	The Competence Center shall consist a nation-wide initiative and shall run under the auspices of the Greek Government, in cooperation with industry federations and organizations of the Greek Industry and ICT sectors with an interest in investing in R&D and IS innovation, as well as with academic/ research institutions focusing on the respective area (i.e. Departments of Electrical/ Chemical Engineering, Departments of Mining & Metallurgical Engineering, Mechanical Engineering, Department of Environmental studies and agriculture infrastructure, etc.).
	
	The project can run as a PPP project with a co-investment both from the Greek Government and the Private Organizations/ Academic Research that will participate as founding members in this.
	
	Commercial Model/ Revenue Streams
	
	Although different commercial models can be used for the Competence Center, we recommend a mixed approach with regards to the center's commercial model. The key revenue streams for the Center will be:
	
	- Membership fees from participants
	- Research Grants from Academic/ Research Institutions
	- Government/ EU Funding
	- Partnerships & sponsorships from foundations (i.e. Onassis Foundation, Niarchos Foundation, etc.)
	
	Government and respective EU programmes' funding (i.e. Horizon 2020) could be used to cover the setup and first years of operation of the Competence Center. The programme could indicatively (and non-exhaustively) cover the following cost/expense types:
	
	- Costs for the setup of the Competence Center, i.e.:
	  • Infrastructure, Equipment purchasing & maintenance costs
	  • Intangible SW Costs (i.e. S/W Licenses, Application S/W, Patents & IPs)
	  • Personnel Costs for running the Competence Center
	- R&D Costs, i.e.:
	  • Feasibility Study Costs
	  • Contractual Costs to perform R&D engagements

Stakeholders (Design & Implementation)	• General Secretariat for Research and Technology • General Secretariat for Industry • Ministry of Environment & Energy • Ministry of Digital Governance • Academic & Research Institutions with a specialization on Industry 4.0 & Circular economy • Industry Federations (whose members wish to participate in the Competence Center) • Private Organizations that wish to experiment in the circular economy field

Key beneficiaries (Target group)	• Greek industrial enterprises (including SMEs, midcaps & start-ups), Greek enterprises from the Business Services & ICT Sector with an interest in Industry 4.0 & Circular economy • Academic & Research Institutions with a specialization on Industry 4.0 & Circular economy
Potential funding sources	• Horizon Program • Digital Europe Program
Indicative Budget	€ 2.500.000 – € 6.000.000 for the setup of the Competence Center and the marketplace
Dependencies with other initiatives	Initiative 9.4: Support the setup of an Industrial Symbiosis Eco-Industrial Park
Timeline of implementation	Mid-term/ Long-term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 5

8.2.1.3 *Initiative 9.3: Introduce a Green Innovation Challenge Fund to enhance innovation and collaboration for Green Economy & Industrial Symbiosis*

Title of the Initiative	**Introduce a Green Innovation Challenge Fund to enhance innovation and collaboration for Green Economy & Industrial Symbiosis**
Initiative's Coding	Initiative 9.3
Pillar	Pillar 2: Innovation & start-up supporting mechanisms in the Digital Age
Area of focus	• Enhance the applied R&D and Innovation
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities • Support the Greek Industry to transition into the zero-carbon and low environmental footprint economy • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps
Description of the initiative	*Rationale behind the need for the initiative* The identification of opportunities for concrete implementation of industrial symbiosis cases is not a trivial task. This is because, among other reasons, in some cases, the technologies which would allow partners to work symbiotically need to first be developed or adapted to the symbiotic interaction (e.g. pre-treatment of waste streams to be used as raw materials, removal of contaminants and adaptation of the processes to different composition raw materials). Many technologies are already available from non-networked applications and can be used to support industrial symbiosis concepts. Nevertheless, significant challenges arise from the current energy transition and the need for full circularity. As such, technologies– their availability or the need for their development– should be considered at the beginning of an industrial symbiosis initiative. In the future, design, development and optimisation of technologies should be oriented towards ensuring their usefulness in complex, cross-sectoral systems of industrial symbiosis. For this reason, we propose the introduction of a Green Innovation Fund, to promote the development of innovative Industry 4.0 solutions that will enable the implementation of IS initiatives. *Details of the initiative* The fund will provide assistance to Greek enterprises in the forms of grants for developing, testing and commercializing Industry 4.0 solutions and applications that addresses key challenges that Greece currently faces in the field of IS and circular economy. The challenges will be defined by a consortium of Greek academics & researchers, Greek Industry representatives, Circular Economy Experts and the Greek Government. The challenges shall evolve around all circular economy areas of focus, namely: - The Smarter Raw Material Use and Manufacture (i.e. increased energy and resource efficiency through optimal valorisation and smarter use and management of existing, alternative and renewable feedstock, etc.)

	- The extension of the lifespan of products and their parts - The useful application of materials (i.e. reuse of discarded products, incineration of materials with energy recovery, etc.) - Waste Management & Recycling (i.e. avoidance, valorisation and re-use of waste streams within and across sectors, including recycling of post-consumer waste streams and new business models for eco-innovation) Focusing further on Industrial Symbiosis, relevant research at a European level[124] indicates that the following technology areas should continue to be developed and supported in order to ensure their broad availability for partners willing to engage in industrial symbiosis: - CO2 capture, storage and reconditioning technologies. - Electrification of processes and optimisation of energy and resource utilisation at system level (e.g. electrochemical processes and utilisation of electrified technologies in processing, such as microwave, plasma and photocatalysis). - Large-scale electrolysers and non-conventional energy sources to enable processes for integration in a renewable energy grid. - Process technologies for the efficient production of flexible energy storage carriers (e.g. methanol and hydrogen). - Novel purification technologies to enable the utilisation of waste streams as secondary raw materials in industrial processes (e.g. purification, dismantling and recycling technologies) to upgrade process residues for reuse. Technologies to provide a more efficient utilisation of water in industry, aiming to reduce freshwater utilisation and achieve a closed loop. - More efficient heat-recovery technologies. - Technologies for the utilisation of renewable energy in industry (e.g. concentrated solar energy). - Biotechnological technologies, e.g. for CO2 conversion and use of biological substances like lignin for the production of value chemicals. - Lifecycle and holistic approach in product and process design (i.e. thinking about the end of life of a product and the waste stream of a process). **How this programme shall work** This initiative shall follow the same structure as the Industrial Strategy Challenge Fund. As such, it will follow similar guidelines and way of implementation. Each challenge (thematic area) will be broken down into more detailed fields of focus. For each of these a call for tender will be published. The participants in these calls can be: - individual private sector companies - consortiums of private sector companies - partnerships between private sector companies and academic/research institutions Up to 5 winners can get awarded per call for tender. The grants can range between 100,000 – 200,000 Euros and shall cover up to 50% of the costs of each project. Grantees can be: - individual private sector companies

[124] European Commission, „Study and portfolio review of the projects on industrial symbiosis in DG Research and Innovation: Findings and recommendations", March 2020.

	- consortiums of private sector companies - partnerships between private sector companies and academic/research institutions The consortiums/ partnerships must include at least one SME or start-up. The selected companies/ consortiums/ partnerships shall develop a challenge specific I4.0 solution (TRL>5) and shall testify that this can be industry applicable, in order to get the full fund awarded to them. This initiative shall also be aligned with the EU regulations on the Circular Economy (i.e. the EU Circular Economy Action Plan[125], the Green Deal[126], the EU Plastics Strategy[127].
Stakeholders (Design & Implementation)	General Secretariat of Industry/ Ministry of Development & Investments General Secretariat for Research and Technology/ Ministry of Development & Investments Ministry of Environment & Energy Ministry of Digital Governance
Key beneficiaries (Target group)	Greek enterprises (including SMEs, midcaps & start-ups) and Greek academic/ research institutions that will participate in the challenges for the development of circular solutions
Potential funding sources	• Current NSRF/ ESF (OP Competitiveness, Entrepreneurship and Innovation)/ Future NSRF
Indicative Budget	€ 500.000. – 1.000.000 per call for tender The Green challenge can incorporate 10 call for tenders € 5.000.000 – 10.000.000 costs in total
Dependencies with other initiatives	Initiative 2.6: Introduce an Industrial Strategy Challenge Fund to enhance innovation & collaboration across the Greek Industry
Timeline of implementation	Mid-term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 3

[125] European Commission, EU Circular Economy Action Plan, https://ec.europa.eu/environment/circular-economy/
[126] European Commission, EU Circular Economy Action Plan, https://ec.europa.eu/environment/circular-economy/
[127] European Commission, European strategy for plastics, https://ec.europa.eu/environment/waste/plastic_waste.htm

8.2.1.4 Initiative 9.4: Support the setup of an Industrial Symbiosis Eco-Industrial Park

Title of the Initiative	**Support the setup of an Industrial Symbiosis Eco-Industrial Park**
Initiative's Coding	Initiative 9.4
Pillar	Pillar 3: Collaborations & synergies
Area of focus	• Set up industrial platforms on specific areas of economic activity to enable the creation of ecosystems and achieve the scaleup of the Greek SMEs and mid-caps
Link with strategic goals	• Enhance the Greek Industry's applied R&D and the innovation capabilities • Develop a collaborative industrial ecosystem to accelerate the digitization and scale up of the Greek SMEs and mid-caps • Enhance the internationalization and extroversion of the Greek Industry and strengthen its active participation in global, European and regional value chains
Description of the initiative	*Rationale behind the need for the initiative* Although Industrial Symbiosis can significantly benefit the Greek economy, a number of structural inhibitors may prevent the Greek Industry from reaping these benefits. In more detail, the low receptivity of this type of initiatives by the firms, due to lack of knowledge and resistance to new concepts, the uncertainty in the continuity of these programs due to the lack of support from the local authorities in this type of initiatives, the lack of trust between institutions (universities and research centres) and firms (since they are two sectors with different perspectives and approaches) and the lack of actors working as coordinators and facilitators prevent the coordination of Greek stakeholders in adopting IS solutions and lead to loss of momentum problems. To enable the transition to IS, collaborative partnerships should be reinforced to make circularity more accessible. To achieve this, we propose the setup of an Industrial Symbiosis eco-industrial park that will apply a circular approach to production. The eco-industrial park shall: - Renew and strengthen the partnership of local stakeholders and shall develop and anchor the local symbiotic mindset - Connect park's stakeholders and shall provide full resource common utilization (the water, energy and material flow from the partners are all included in the symbiosis) - Promote and share the symbiotic mindset and inspire additional stakeholders to become part of an industrial symbiosis network. Flagship example of Industrial Symbiosis eco-industrial parks is Kalundborg Symbiosis, the world's first functioning example of industrial symbiosis. Situated in Kalundborg, Denmark, the symbiosis is based on public-private partnerships, with exchanges of energy, water and materials in closed loops. The vision of Kalundborg Symbiosis is to be the world's leading industrial symbiosis with a circular approach to production. An industrial symbiosis constitutes a local partnership where, partners provide, share and reuse resources to create shared value. The purpose of industrial symbiosis is to create loops of technical or biological materials while minimising the leakage and waste in the loops - demonstrating some key parts of a circular economy, at a local scale. The initial creation of symbiotic relationships in

	the area is dated back to the 1960s, when the local refinery set up a project to start using the surface water from a nearby lake, and the cluster has evolved from there. Today, it includes several symbiotic exchanges between power stations, oil refineries, plasterboard producers, biotechnology companies, cement producers, soil remediation firms and the municipality of Kalundborg. In more detail, the Kalundborg symbiosis network links a 1500MW coal-fired power plant with the community and other companies. Surplus heat from this power plant is used to heat 3500 local homes in addition to a nearby fish farm, whose sludge is then sold as a fertilizer. Steam from the power plant is sold to Novo Nordisk, a pharmaceutical and enzyme manufacturer, in addition to a Statoil plant. This reuse of heat reduces the amount thermal pollution discharged to a nearby fjord. Additionally, a by-product from the power plant's sulfur dioxide scrubber contains gypsum, which is sold to a wallboard manufacturer. Almost all of the manufacturer's gypsum needs are met this way, which reduces the amount of open-pit mining needed. Furthermore, fly ash and clinker from the power plant is utilized for road building and cement production. [128] *Details of the initiative* Support the setup of an Industrial Symbiosis eco-industrial park that shall attract industrial & manufacturing organizations across various sectors as well as academic and research institutions and shall create an emerging Industrial Symbiosis ecosystem. In more detail, the park could attract and host enterprises across the entire Structural Materials value chain (as this is presented in High Priority Case 2), including indicatively: - Enterprises focusing on the production of structural materials (i.e. metals, non-metallic products, fabricated metal products, etc.) - Enterprises focusing on advanced materials (i.e. Advanced composite materials, Semiconductors, laser, microelectronics, etc.) - Enterprises working on construction materials (i.e. superalloys, building materials, materials for advanced manufacturing, etc.) - Enterprises focusing on nanotechnology (i.e. nanoelectronics, nanophotonics, etc.) - Enterprises focusing on chemicals and specialty polymers (i.e. polymers, biopolymers, plastics, etc.) - ICT enterprises which are Industry 4.0 innovator/ solution designers and academic/ research institutions, which are looking to understand the real-world challenges being faced by the Greek Industry & Manufacturing and how will their research be valid in a commercial setting. The eco-industrial park shall be a dedicated area for industrial use at a suitable site that will ensure sustainability through the integration of social, economic, and environmental quality aspects into its siting, planning, management and operations. The eco-industrial park shall bring direct and indirect, holistic benefits to the industrial sector in general, and resident enterprises in particular. Firms and industrial sectors in the park shall be able to improve capital efficiency, achieve utility cost savings, sustain business continuity, produce goods that are preferred by global buyers, attract foreign direct investment, increase exports and generate additional revenues. Companies located in the eco-industrial park shall:

[128] http://www.symbiosis.dk/en/

	- Effectively use and exchange materials, energy, water, and/or by-products. For instance, Organic waste from a company can be converted into animal feedstuff and synthetic fertilizer, which are used in agriculture. In another case, the by-products from a company that purifies flue-gases can be recycled and used by another neighbouring company as raw materials in its manufacture of plasterboard. - Efficiently share common resources & infrastructure (such as information, materials, water, energy, infrastructure, and natural resources). For instance, compressed air is used in many industries. Instead of having individual systems, the companies can join forces in a shared plant. It becomes more efficient and cheaper. Handling can be made safer and more reliable if several companies run a plant together. - Develop new services and "green" products. Building a functioning industrial symbiosis is not just about working together for the sake of each other and the environment, but a continual search for a better way of doing business. To that end, the eco-industrial park shall work well as a hotbed for innovative test and demonstration projects, as well as providing great opportunities for start-ups. To that end, the eco-industrial park can also host the Industrial Symbiosis Competence Center (please refer to initiative 9.2). **Description of the structure** The eco-industrial park shall run under the auspices of the Greek Government, in cooperation with the key partners (private organizations and academic/research institutions) that have established the park. The project can run as a PPP project with a co-investment both from the Greek Government and the Private Organizations that will participate as founding members in this. The Kalundborg eco-industrial park has implemented a similar Governance structure. The park is managed by a partnership that was formalised as a private association called 'Kalundborg Symbiosis' in 2011 and that is structured as a board of directors, where each partner has a member on the board. The association has regular meetings to drive further innovation as well as other matters involving the partners. For example, the association recently decided to map all internal resource flows of the partners and implement ten new symbiosis projects by 2025. **Participation in the Innovation District** Enterprises across different sectors and areas of focus as presented above, shall be eligible to participate and relocate in the eco-industrial park. Indicative sectors, in which organizations could belong to are chemicals, steel, cement, ceramics, engineering/ ICT, non-ferrous metals, minerals, water, electricity, etc. The Governance body could introduce a set of due diligence criteria, with regards to: - their innovation/technology/ know-how - the implementation of "green" and circular practices - strategy/ vision and business plan - development collaborations & strategic alliances - human resources, etc.
Stakeholders (Design & Implementation)	• General Secretariat for Research and Technology/ Ministry of Development & Investments • General Secretariat for Industry/ Ministry of Development & Investments • Ministry of Environment & Energy

	• Greek Academic Institutions • Research Centres • Industry Federations
Key beneficiaries (Target group)	Greek industrial/ manufacturing enterprises across various sectors (including SMEs, midcaps & start-ups)
Potential funding sources	• Horizon Program • Digital Europe Program
Indicative Budget	€ 2.000.000 – 5.000.000
Dependencies with other initiatives	• Initiative 8.3: Support the setup of a Structural Materials Test lab • Initiative 9.2: Support the Setup of an Industrial Symbiosis Competence Center This initiative is also directly linked with High Priority Case 2, since the eco-industrial park could be primarily populated by Structural Material organizations that would create IS relationships.
Timeline of implementation	Long-term
Feasibility and Necessity of initiative	Feasibility= 2 Necessity= 5

8.2.1.5 Initiative 9.5: Develop the national standards for the Circular Economy and Industry

Title of the Initiative	**Develop the national standards for the Circular Economy and Industry**
Initiative's Coding	Initiative 9.5
Pillar	Pillar 4: Standardisation & Norms
Area of focus	• Set key ICT standardisation priorities, in accordance to the European Commission's ICT Standards plan and communication
Link with strategic goals	• Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* The Greek industry needs to transition smoothly and efficiently, while at the same time keeping a fast pace, to the Circular economy. In that overall effort, industrial standardisation is expected to play a catalytic role. *Details of the initiative* Key stakeholders from the Greek industrial sector (Ministry of Environment and Energy, General Secretariat for Industry) as well as the Greek industrial landscape and wider ecosystem (such as the Hellenic Standardisation Organisation (ELOT)) will be called to join forces in order to define and help industrial enterprises implement standards and norms that will lead to the circularity and the "greening" of the Greek industry. More specifically, this group should focus at the field of solid, liquid or other waste industrial enterprises produce through their operation, seeking to monitor and minimise waste to the best possible extend by adopting European and international best practices and approaches on standards in that area, tailoring them to the case and needs of Greek industrial enterprises. At the same time the group should seek to assist industrial enterprises to utilise their waste as a valuable resource for the refuelling of their business operations and production process in the context of the circular economy and industrial symbiosis within the Greek ecosystem. At the same time, it is imperative that through standardisation industrial and other products are better monitored/ supervised minimising the production and utilisation of products containing hazardous materials and substances, setting strict raw material specifications. With regard to that, and for those enterprises that do not abide to the directions set out in the context of the circular industry, it is necessary to monitor and impose sanctions whenever the pursued standards and procedures are not followed.
Stakeholders (Design & Implementation)	• Greek Industrial Standardisation Committee • General Secretariat for Industry • Hellenic Standardisation Organisation
Key beneficiaries (Target group)	• Greek industrial enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	• New NSRF (2021-2027)

Indicative Budget	N/A
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 4
Timeline of implementation	Mid-term/ Long term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

8.2.1.6 Initiative 9.6: Regulatory reforms for a Circular Economy and Industry

Title of the Initiative	**Regulatory reforms for a Circular Economy and Industry**
Initiative's Coding	Initiative 9.6
Pillar	Pillar 5: Regulatory Environment
Area of focus	• Update of the regulatory environment towards being more "Industry-friendly"
Link with strategic goals	• Support the Greek Industry to transition into the zero-carbon and low environmental footprint economy • Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* The major goal the Circular Economy High priority case is while pursuing the growth and revitalisation of the Greek Industry through the lens of Industry 4.0, to simultaneously develop a Green Industrial sector that will abide to the principles and practices of the Circular economy. In order to achieve that goal, a set of regulatory changes and reforms have to be implemented within the Greek industrial ecosystem, in order to create the right conditions for industrial enterprises of all sizes to make that shift toward circularity. *Details of the initiative* In order to design and promote the initiatives that will be analysed in the following lines with regard to the shift of the industrial regulatory environment toward a circular one, the a set of indicative key stakeholders from the Greek industrial and public sector that will be called to cooperate is presented below: ○ Ministry of Environment and Energy ○ Ministry of Development and Investments (General Secretariat for Industry) ○ Ministry of Agriculture and Food ○ General Secretariat for Research and Technology ○ Ministry of Interior To formally pursue the circularity of the economy and Greek industry, all relevant stakeholders (including the ones analysed above as well as other key players that might be identified in the process) should form a central committee and further sub-committees in order to discuss, design and roll out the respective regulatory reforms. The Ministry of Environment and Energy as well as the General Secretariat for Industry are expected to play a crucial role in this effort, since they are the ones directly related both to the areas of Circular Economy and the Industrial sector. A series of actions are outlined below as part of this "Regulatory reforms" initiative, which have to be pursued simultaneously since they will all contribute significantly to achieve the desired result of this High priority case: **Action 1:** A careful revisit, amendment or enhancement of the current legislative framework around waste management for the Greek industry. This will effectively seek to minimise waste in all forms across the Greek industry, encouraging materials' and waste reusage as inputs and components of industrial products and services. **Action 2:** Focus on specific industrial sector products that are currently leading in terms of production output as well as waste generated from their production process, in order to pursue their "greening" and turn to cyclical economy. With regard to that, circular criteria

	have to be developed in order to define how enterprises will produce these products in a more sustainable and eco-friendly way. **Action 3:** Better define the concept of "waste" within the industrial regulatory framework, in order to promote the transitioning of enterprises to utilising waste as secondary raw materials for their production purposes. This action will seek to determine the definitions and classifications of industrial products and by-products, setting strict qualitative standards for the use of waste in the production process as secondary raw materials. **Action 4:** Revisiting of the legislative environment of re-usage of processed water from industrial waste for other purposes after purification (such as irrigation purposes) or for further use within the industrial ecosystem. On the same note, promote the usage of industrial waste as biofuel from other industrial stakeholders.
Stakeholders (Design & Implementation)	• Ministry of Environment and Energy • Ministry of Development and Investments (General Secretariat for Industry) • Ministry of Agriculture and Food • General Secretariat for Research and Technology • Ministry of Interior
Key beneficiaries (Target group)	• Greek Industry Enterprises (Established/SMEs/ midcaps/ startups)
Potential funding sources	N/A
Indicative Budget	N/A
Dependencies with other initiatives	Highly interconnected with all other initiatives of Pillar 5
Timeline of implementation	Mid-term/ long term
Feasibility and Necessity of initiative	Feasibility = 1 Necessity = 5

8.2.1.7 Initiative 9.7: Financial incentives to promote the Circular Economy and Industry

Title of the Initiative	**Financial incentives to promote the Circular Economy and Industry**
Initiative's Coding	Initiative 9.7
Pillar	Pillar 6: Acceleration of investment in digital technologies
Area of focus	• Introduce adjustments to allow for a more "investment friendly" environment
Link with strategic goals	• Increase the overall contribution of Greek industry to the Greek economy
Description of the initiative	*Rationale behind the need for the initiative* As pointed out previously, Greece significantly lags behind its EU counterparts in the area of Circular Economy, especially in the industrial sector, despite it holds a significant weighting within the European agenda. Industrial enterprises have to be incentivised by the Greek state in order to adopt Circular economy best practices, aiming at achieving a greener, more efficient and circular economy and industry. *Details of the initiative* This initiative will seek to provide the right financial mechanisms and funding incentives to those industrial enterprises of all sizes (especially SMEs and Midcaps) that seek to restructure and relaunch their production line and overall business model. They should aim at minimising their waste products and proceed to become more environmentally friendly and sustainable. This initiative shall place special emphasis on promoting the "cyclical transition" of smaller and medium sized enterprises within the Industrial ecosystem. This stems from the fact that these enterprises face severe difficulties to abide to regulations and rules, conforming into the required standards and practices of cyclical economy. Such difficulties often are: • the low production resources • limited access to financing • lack of targeted guidance. It is therefore crucial that through this initiative, the respective tools and supportive mechanisms are developed, as analysed below. On one hand, this support will come in the form of grants from the Greek state, aimed to be invested in incremental changes or improvements in their production line seeking to achieve sustainable and circular results with a small investment that would range from €30.000-50.000. This circular economy grant would essentially to achieve the maximum impact at the lowest cost, providing the best value for money approach. However, this will be granted to candidate industrial enterprises after providing an "Expected impact assessment" exercise performed by the enterprises and evaluated by the Greek state, seeking to achieve measurable and realistic circular results. This support can come in the form of financing as per below: • Financing loans with preferential interest rates (reduced up to a certain amount, based on the needs/ financials and profile of the enterprises that will apply for it), or

	• Financial loans with a significant grace period (from 3 to 4 years) in order to invest directly to their circular transformation. The evaluation for the enterprises that will be eligible to receive these loans will be based on a complete "Circular transformation vision" laying out the planned transformational changes (with regard to waste minimisation, utilisation of recyclable or secondary materials etc.), that target to roll out new entrepreneurial business models or products or to develop new products and services abiding to circular economy criteria. These loans could range from €100.000- €400.000 for complete transformational plans.
Stakeholders (Design & Implementation)	• Ministry of Development and Investments • Ministry of Environment and Energy • Ministry of Finance • Hellenic Development Bank
Key beneficiaries (Target group)	• Greek Industry SMEs, scaleups & mid-caps
Potential funding sources	• European Structural and Investment Funds (ESIF) (through the new NSRF) • European Investment Fund • Public Investments Programme • Horizon Europe • Private Funding
Indicative Budget	€150.000.000 – €320.000.000 (an indicative target would be to assist financially 400 enterprises within the industrial environment with regard to incremental circular improvements and approximately 800 enterprises with regard to "Circular transformation vision" plans).
Dependencies with other initiatives	Highly interconnected with all initiatives of Pillar 6
Priority of implementation	Short term / mid-term
Feasibility and Necessity of initiative	Feasibility = 2 Necessity = 5

8.3 Involved stakeholders for High Priority Case 3

In this paragraph we list the key authorities, as these are presented in the abovementioned initiatives that shall be the key responsible for operationalizing the High Priority Case 3. It should be mentioned that the Circular economy, being a much wider theme than the two previous high priority cases, shall involve potentially additional, adjacent Ministries, i.e. Ministry of Agriculture & Rural Development, Ministry of Maritime Affairs & Insular Policy, etc. that shall be identified as part of Greece's wider circular economy strategy. In the list below, we mention these stakeholders directly involved with the initiatives we develop as part of this High Priority Case.

- **Ministry of Environment & Energy**: Accountable public authority for the design, development and implementation of all Circular Economy & Industrial Symbiosis initiatives shall be the Greek Ministry of Environment & Energy. With regards to initiatives presented in this high priority case (that combine Industry 4.0 technologies and the theme of the circular economy), the Ministry shall work closely with the Ministry of Development and specifically the General Secretariat of Industry and the General Secretariat for Research and Technology.
- **General Secretariat of Industry**: As also explained in the previous point, the General Secretariat of Industry (Ministry of Development) shall be responsible for the design and implementation of all the High Priority initiatives, in close collaboration with the Ministry of Environment & Energy. The General Secretariat of Industry shall have as a key goal through these initiatives the promotion of the circular economy in manufacturing through the 'circular economy' and 'industrial symbiosis" model.
- **General Secretariat for Research and Technology**: Responsible for design of initiatives 9.2, 9.3 and 9.5 that focus on the promotion of applied research and development and aim at guiding industrial entrepreneurship towards new productive operation models strongly characterised by innovation, environmental conservation and rational use of energy resources.
- **Ministry of Education & religious affairs**: Responsible for co-designing initiative 9.1 through the provision of expertise and guidance on the areas of lifelong learning.
- **Ministry of Labou**r: Responsible also for contributing to initiative 9.1 that refers to the development of an innovative training programme that will "marry" Industry 4.0 technologies and their applicability in the circular economy.
- **Ministry of Digital Governance**: As the "Chief Digital Officer" of the Public Sector, the Ministry shall be consulted and informed on all initiatives of High Priority Case 3. The Ministry is expected to have even heavier involvement across initiatives 9.1, 9.2, 9.3, 9.4, 9.5 and 9.7, as together with the Ministry of Development, it carries significant experience in the design and setup of digital innovation structures & support mechanisms for digital transformation and it is also extensively active across the digital skills area.
- **Academic & Research institutions with a specialization on Industry 4.0 & Circular economy**: The rotation to the circular economy cannot be achieved without the support and continuous efforts performed by the Greek academic and research institutions that focus either on STEM/ ICT areas and/or the field of circular economy. Academic & research organizations shall participate across initiatives 9.1, 9.2, 9.3, 9.5 and 9.6 to provide their expertise and guidance on the suggested reskilling/upskilling programme (initiative 9.1), the setup of the Circular Economy Competence Center (initiative 9.2), the definition of circular challenges to be addressed through initiative 9.3, the

participation in the new eco-industrial park (initiative 9.5) and the development of national standards for the circular economy (initiative 9.6).

- **Industry Federations**: Industry federations will have an important role to play in the design and the operationalisation of the High Priority Case 3, as they act as the interface between the Industry, the Public Authorities, the Greek academic institutions and research institutes. Industry federations can bring significant expertise and know how on different elements of the initiatives identified can be implemented and can help set up operations. At the same time, they can provide expert advisory on specific Industry 4.0 & circular economy topics and cross-sectoral related tasks. In addition, industry federations can raise awareness through the organisation of relevant initiatives, can support the up-skilling and reskilling of their sectors' human capital and can conduct selected reviews on progress and outcomes of implemented digital initiatives by their members.
- **Ministry of Finance**: The Ministry of Finance shall be the ultimate responsible for designing and implementing the case initiatives that refer to introduction of financial and tax incentives for promoting the circular economy and the Greek Industry (namely initiatives 9.8 and 9.9).
- **Hellenic Development Bank**: The Hellenic Development Bank shall also support the design and can undertake the implementation of the proposed financial incentives for promoting the circular economy and the Greek Industry (initiative 9.8).
- **Greek Industrial Standardisation Committee**: The Greek Industrial Standardization Committee, introduced as a separate measure in initiative 4.1 will be responsible to develop the national standards for the Circular Economy (initiative 9.6)
- **Greek Organisation for Standardisation (ELOT)**: The Greek Organization for Standardisation (ELOT) shall also be involved in the development of the national standards for the Circular Economy (initiative 9.6)
- **Ministry of Interior/ Ministry of Agriculture**: The Ministry of Interior/ Ministry of Agriculture shall be two of the public stakeholders that shall be involved in the proposed regulatory reforms for a circular economy under initiative 9.7. It should be mentioned that this is not expected to be the only Ministry (apart from the already mentioned) that will participate in this initiative. According to the regulatory reforms to be decided, all involved Ministry shall participate in this discussion.

As also suggested by Greece's National Circular Economy Strategy[129] we strongly recommend that a Circular Economy Committee is introduced with the participation of public authorities, economic and social agencies and the scientific community so as to create synergies and ensure transition to the circular model. Among others, the Committee shall focus on developing the dialogue with entrepreneurship, which plays a leading role for the substantial implementation of circular economy and on:

- improving the competitiveness of the Greek industry through using its comparative advantages and the entrepreneurial development of environmental potential
- digitally upskilling the Greek Industry's human capital and the expansion of the knowledge and technology reserves;
- increasing the generated added value of the economy and
- creating new markets and products with a high degree of penetration in international markets

The setup of the Circular Economy Committee will consist part of Deliverable 4 and will further analyzed there.

[129] https://www.circulareconomyclub.com/listings/greece-national-action-plan-on-circular-economy/

8.4 Implementation of high-level timeplan

An indicative implementation timeline of High Priority Case 3 initiatives is briefly presented below.

As it can be seen, we consider that initiative 9.1 that refers to the design of a reskilling and upskilling, online programme on Circular Economy & Industry 4.0 can start in the 1st year of the Operational Plan, in order to increase the Greek Industrial workforce's awareness and knowledge both on Industry 4.0 and the circular economy. During the 1st year of the operational plan, we suggest also that initiative 9.2 can also be initiated. There are several European funding schemes (i.e. Horizon 2020, Digital Europe Programme, etc.) that can support the funding and implementation of this initiative. In addition, during the 1st year the design of the financial incentives for promoting the Circular Economy & Industry should be initiated, as this will consist a key enabler for the Greek Industry's adoption of Industry 4.0 solution for the circular economy.

During the 2nd year of the Operational Plan we also consider initiative 9.5 (setup of eco-industrial park) to start being conceptualized and designed.

Finally, during the 3rd year of the Operational Plan, we position the design of the Green Innovation Challenge Fund and the development of the national standards for a circular economy (initiative 9.5).

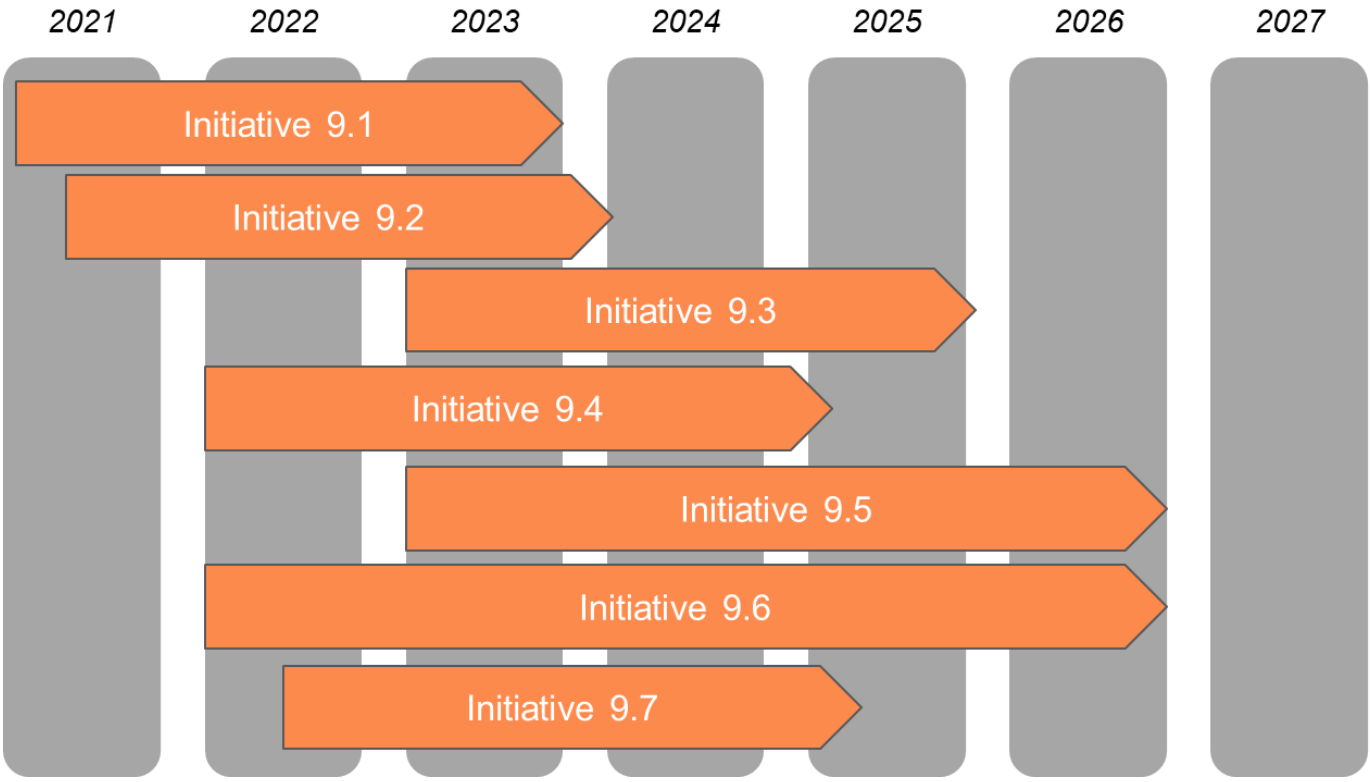


Figure 26: Figure 18: High level time plan for High Priority Case 3

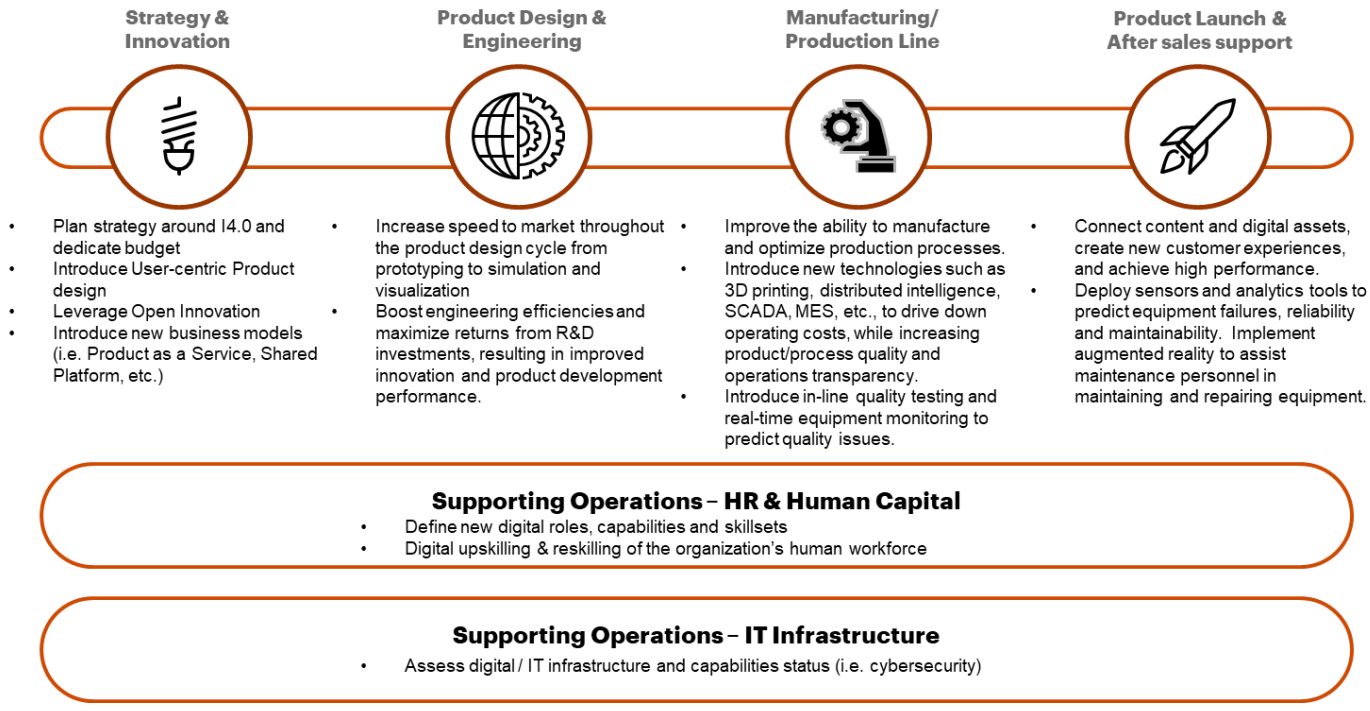
9 Annex D: Guide for High Priority Case 1 – Smart Manufacturing Technologies

9.1 Introduction

The last part of the High Priority Cases section consists of a practical guide that will deliver a "how to" guide for the target group of one of the three case studies. As per the General Secretariat's for Industry selection, the guide will be developed for High Priority Case 1: Smart Manufacturing Technologies. The guide shall provide step by step information to the specific target companies/group of High Priority Case 1, on how to benefit from the 4th industrial revolution.

In order to provide practical guidance to the audience of "Smart Manufacturing Technologies", the guide shall follow the below structure:

- Step 1: We shall identify the group of enterprises that each initiative refers to (i.e. SMEs, large enterprises, start-ups, etc.). This group of enterprises shall be also in line with the group of enterprises identified as the major stakeholders to be support by the Industry 4.0 strategy (please refer to "Chapter 3: Key points of the proposed Industry 4.0 Strategy – Link between the proposed i4.0 Strategy and the Operational Plan" for more information).
- Step 2: We shall briefly explain what the target group of enterprises should do to access/ implement this initiative (i.e. liaise with the Ministry/ bid for a proposal/ submit request for participation in financing scheme, etc.).
- Step 3: We shall demonstrate the benefits that each initiative can provide to the target group of enterprises. Benefits shall be viewed across two different dimensions:
    - **Dimension 1:** The area(s) across the companies' value chain where the initiative will have the most impact. The high-level value chain areas are presented below:



- **Dimension 2:** The outcome that each initiative can have on organizations' high-level strategic objectives. The key strategic objectives are presented below:

Organisations' high-level strategic objectives							
Revenue & Growth			Customer Satisfaction		Operational Efficiencies & Cost Optimisation		
Enter in New Markets	Produce new, innovative Products & Services	Sell through new Channels	Increase Customer Satisfaction	Increase Customer Penetration	Reduce of labour costs	Increase workforce productivity	Improve tech capital efficiencies

- Step 4: After the presentation of Steps 1 to 3 for the detailed initiatives captured under High Priority Case 1, we will also present some general guidelines and key initiatives that Greek Industrial and Manufacturing organizations could design and implement on their own in order to prepare, implement Smart Manufacturing Technologies and reap the maximum extent their benefits. This part will in fact indicate initiatives that the Industrial organizations could undertake themselves, and that go beyond the initiatives designed and introduced by the Greek Government. It is evident that not all initiatives may be applicable for all organizations across the Greek Industry; indeed, Industry 4.0 initiatives are recommended to be selected in accordance to the different strategy, business model, size, available budget and most importantly, each company's own Industry 4.0 aspirations and vision.

9.2 Guide for the High Priority Case 1 Measures & Initiatives

9.2.1 Initiative 7.1: Design an online digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies

- **Short description:** Establish a modern digital delivery platform that will provide scalable, relevant, timely, and easily 'digestible' content for upskilling and reskilling on Smart Manufacturing technologies. This would enable all companies, but particularly SMEs, to play their part in the Fourth Industrial Revolution, with incentives and networks in place to drive adoption. The platform can adopt the guiding principles of the Digital Academy platform (developed by the Ministry of Digital Governance) or can be adopted and incorporated within the actual Digital Academy platform.
- **Key audience:** This initiative is targeted to Greek Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge and low maturity regarding Industry 4.0 and are yet to realize the benefits from adopting relevant Industry 4.0 solutions. In addition, this initiative could also apply to Industrial/ Manufacturing organizations of all sizes that demonstrate a moderate maturity regarding Industry 4.0, that nevertheless would like their workforce to get better training and gain more digital skills around Smart Manufacturing technologies.

  The design, set up and delivery of these training modules could be performed by Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0 that could provide experienced personnel for this, by ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps or by academic/ research institutions focused on Smart Manufacturing Technologies (i.e. Departments of Electrical/ Chemical Engineering, Departments of Mechanical Engineering, etc.).

  Below we present the matching to the key group of stakeholders for Industry 4.0 strategy, as this is presented in Chapter 3.

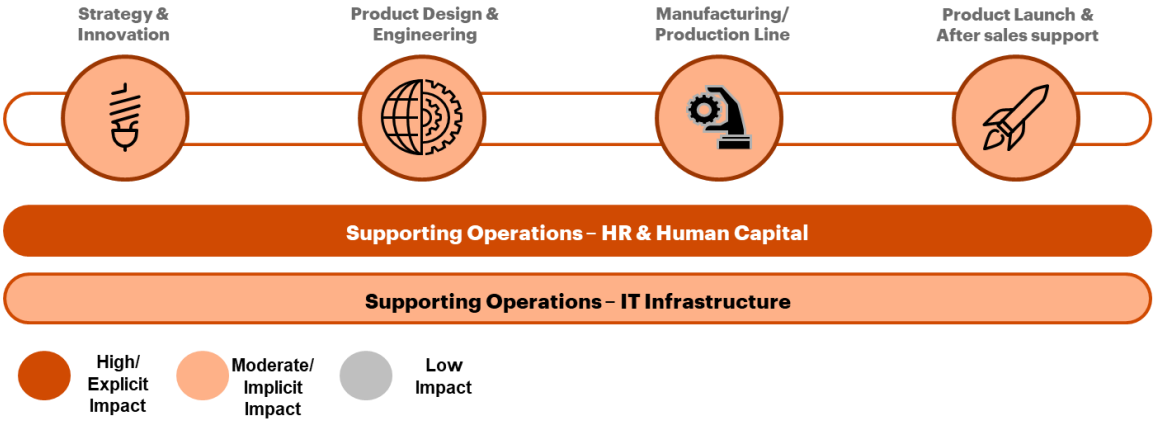
	Key Stakeholders	Initiative 7.1: Design an online digital platform for the reskilling & up-skilling of the Greek Manufacturing SMEs and midcaps on Smart Manufacturing Technologies
Industry 4.0 "Demand" – Increase the I4.0 adoption	• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0	☑
	• Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0	☑
	• Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0	☑ (as trainers)
I 4.0 "Supply" – Accelerate the commercialization of I4.0 innovation	• ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps	☑ (as trainers)
	• Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.)	
	• Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing	☑ (as trainers)

- **How to access/ use this initiative:** The potential "trainers" of Smart Manufacturing technologies modules shall be invited by the Greek Government and more specifically by the Ministry of Development & Investments and the relevant body who will be responsible for designing and implementing this initiative. A list of these "trainers" could be established and a data base could be created with topics (i.e. Smart Manufacturing technologies) and the relevant material to be provided by each group of these trainers. "Trainer" groups could also financially support the design of new training material, where this is not available, and be mentioned as sponsors of the new digital platform. Finally, an ICT Services Organization could also undertake the actual design and set up of the online digital platform that will host all Smart Manufacturing training modules. This could be done via issuing a relevant RfS.

  The group of organizations that consist the actual audience of this initiative shall be able to directly access this platform once this is ready and in production. Key for achieving a high rate of participation is to increase awareness of the new digital platform for reskilling and upskilling on Smart Manufacturing Technologies and explain the benefits from using this. This could be achieved through a dedicated campaign launched by the Ministry of Development and Investments, as well as through a platform demonstration and active guidance provided by Industrial Federations.

  Finally, a prerequisite could be introduced by new/ existing Competence Centres and Industrial Parks, that all Industrial SMEs and midcaps participating in these, should have first completed a certain number of Smart Manufacturing training modules, that would indicate their knowledge on specific I4.0 topics.

- **Key Benefits achieved:** As Smart Manufacturing Technologies overhaul and "reimagine" traditional job roles and re-write job descriptions, the need for the Greek Industrial Workforce's continuous reskilling and life-long learning becomes a prerequisite for their career progression and development, as well as for Greek corporations' survival. At the same time, a digitally upskilled human workforce will in turn nurture an agile culture within the organizations (starting with the leadership) to help the organizations digitally transform on both the inside (operations, culture, practices and workforce) and the outside (company image and appeal to prospective employees). Therefore, the entire value chain of the Industrial organizations is expected to significantly benefit from this initiative.



Companies that invest in the digital upskilling and reskilling of their workforce and/or which invest in new ways of working will **primarily** benefit across the following areas:

Organisations' high-level strategic objectives							
Revenue & Growth			**Customer Satisfaction**		**Operational Efficiencies & Cost Optimisation**		
Enter in New Markets	**Produce new, innovative Products & Services**	**Sell through new Channels**	**Increase Customer Satisfaction**	**Increase Customer Penetration**	**Reduce of labour costs**	**Increase workforce productivity**	**Improve tech capital efficiencies**
					√	√	

9.2.2 Initiative 7.2: Support the Setup of a Smart Manufacturing Competence Center

- **Short description:** Encourage the setup of a Smart Manufacturing Competence Center that shall focus on Smart Manufacturing technologies and their implementation in the Greek manufacturing and industrial enterprises. The Smart Manufacturing Competence Center shall aim to create a platform for applied research, development and innovation in Greek manufacturing enterprises (including SMEs, midcaps & start-ups) focusing on the development of innovative world-class manufacturing solutions.
- **Key audience:** The Greek Smart Manufacturing Competence Center shall act as the bridge between manufacturing and industrial SMEs and midcaps with large enterprises of the ICT and Manufacturing sectors as well as with academic and research institutions. The Competence Center will provide the resources, space and facilities to SMEs and midcaps to experiment with the development of Smart Manufacturing solutions, as well as with the associated digital processes and new business models under realistic conditions. It is therefore evident that this initiative, as well as initiative 7.4, is targeted to all groups of stakeholders introduced in Chapter 3 and presented below. Each of these groups could be significantly benefited in different ways through participating in the Competence Center:
  - Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited and moderate knowledge on Industry 4.0, could visit the Competence Center to:
    - Get support to assess their current Industry 4.0 maturity and design their Industry 4.0 strategy
    - Get access to resources, facilities and expertise for the design and implementation of new smart manufacturing concepts, solutions and services
    - Receive digital upskilling & reskilling training (i.e. workshops, seminars, courses, etc.), tailored to their digital maturity level & their business area
  - Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0 could either become one of the founding members of this Competence Center (through responding to the relevant call for tender) and provide their infrastructure, facilities and expertise, or could visit as guests this Competence Center in order to collaborate with academic/ research institutions, ICT organizations and Industry 4.0 producers to resolve a specific challenge that may face and for which a tailored Smart Manufacturing solution could be developed.
  - ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps, as well as academic and research institutions could also become founding members of this Competence Center (through responding to the relevant call for tender) that will provide their expertise and skills across the following dimensions:
    - Visioning & strategy development: Support new startups/ SMEs to assess their current I4.0 maturity and design their I4.0 strategy
    - Collaborative R&D: Provide support for the design and implementation of R&D projects on smart manufacturing; develop new smart manufacturing concepts, design and develop proof of concepts
    - Testing and validation: Provide technical and specialized services for design, testing & validation of new solutions including product demonstration & product qualification

- Technical support on scale up: Provide support for solutions' technology concept development, proof of concept, prototyping & small series production
- Skills & education: provide digital upskilling & reskilling training (i.e. workshops, seminars, courses, etc.) to the center's customers, tailored to their digital maturity level & their business area; offer technological infrastructure for educational purposes

- Finally, producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.) could also significantly benefit from their participation in the Smart Manufacturing Competence Center. This will allow them to come in contact and form close collaboration relationships with Industrial and Manufacturing organizations as well as with academic/ research institutions, in order to utilize each other's expertise and resolve challenges they face through innovative Industry 4.0 solutions.

Below we present the matching to the key group of stakeholders for Industry 4.0 strategy, as this is presented in Chapter 3.

Key Stakeholders		Initiative 7.2: Support the Setup of a Smart Manufacturing Competence Center
Industry 4.0 "Demand" – Increase the I4.0 adoption	• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0	☑ (primarily as clients of the Competence Center)
	• Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0	☑ (primarily as clients of the Competence Center)
	• Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0	☑ (as clients or founders of the Competence Center)
I 4.0 "Supply" – Accelerate the commercialization of I4.0 innovation	• ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps	☑ (primarily as founders of the Competence Center)
	• Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.)	☑ (as clients or founders of the Competence Center)
	• Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing	☑ (primarily as founders of the Competence Center)

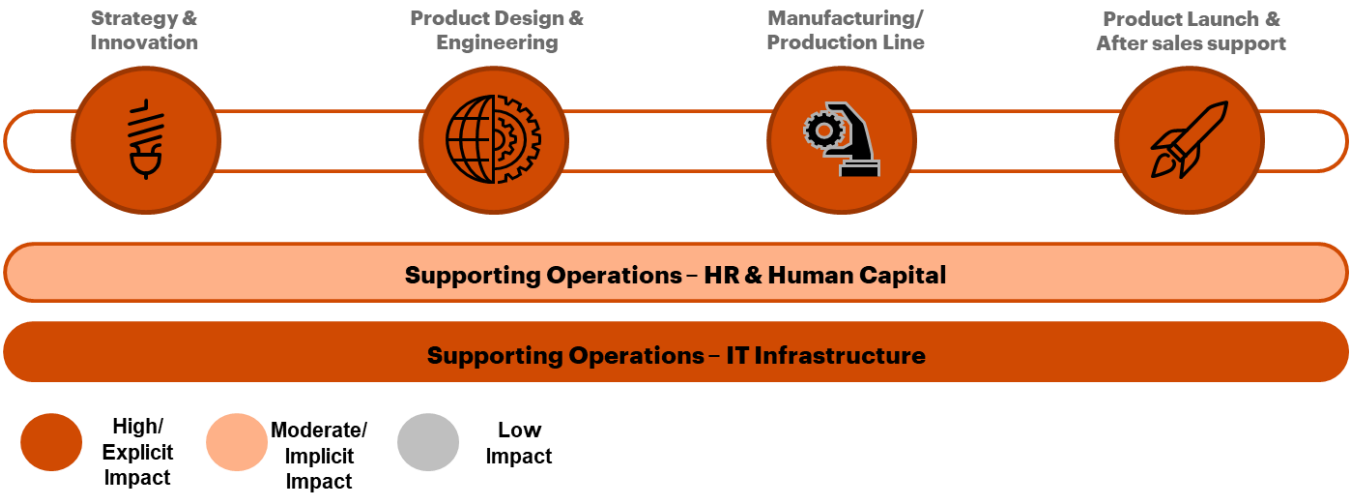
- **How to access/ use this initiative:** As explained in the description of the initiative, the Government shall issue a call for tender for the setup and operation of the Competence Center. The call for tender shall specifically prescribe the minimum criteria that the participants shall fulfill in order to participate in this call. These could refer to the type and the composition of the consortiums (i.e. at least one of their members shall be a Greek Manufacturing SME/ midcap), the legal structure of the consortium, the business activity of its members, etc. Therefore, potential founders of the Smart Manufacturing Competence Centre (i.e. ICT Services Organizations, Industrial/ Manufacturing organizations with increased maturity in Industry 4.0, producers of Industry 4.0 solutions and/or academic/research institutions shall form respective collaborative schemes to participate in the respective call for tender.

  In terms of participants/ clients of the Competence Center, these could be attracted to the Competence Center through a mix of different initiatives. To increase awareness, Industrial Federations can join forces with the Ministry of Development & Investments and launch dedicated awareness campaigns

on the benefits of visiting this Competence Center and on the services that this can provide to organizations, as well as matchmaking events for the Greek Industry to meet the Competence Center stakeholders. Industrial organizations that will become the first visitors of the Competence Center could also then be used as the "evangelists" for the Center, explain first-hand how these have been benefited and attract further organizations of their network to join the centre.

Specific initiatives could also benefit organizations that use the Center, i.e. tax credits for I4.0 solutions developed and tested by the Competence Centres, favourable prices for training sessions organized by the Center, etc.

- **Key Benefits achieved:** Participation of organizations in the Competence Center can significantly benefit their entire value chain, with specific emphasis on:
  - **Strategy & Innovation:** Participation in the Center shall enable organizations to become part of a wider ecosystem, embrace open innovation and adopt a Product Innovation Strategy.
  - **Product Design & Engineering:** Organizations will be benefited during the design and implementation of R&D projects on smart manufacturing. They will be able to develop new smart manufacturing concepts, design and develop proof of concepts and they shall access modern facilities and resources for the design, testing & validation of new solutions including product demonstration & product qualification.
  - **Manufacturing/ Production Line:** Organizations shall also be able to experiment with new solutions and services that will significantly improve their manufacturing and production lines and improve product quality and traceability, i.e. solutions for remote monitoring & operations, connected workforce, digital factory, etc.
  - **Product Launch – After Sales Support:** Organizations shall be able to experiment with product enhancements through the implementation of Smart Manufacturing technologies (i.e. data analytics tools) to predict equipment failures, reliability and maintainability and assist maintenance personnel in maintaining and repairing equipment.
  - **Supporting Operations – IT Infrastructure:** The Competence Center shall in general enable the modernization of the organizations' IT infrastructure through the development of OT-IT solutions.



Companies that shall participate in the Smart Manufacturing Competence Center will **primarily** benefit across the following areas:

Organisations' high-level strategic objectives							
Revenue & Growth			**Customer Satisfaction**		**Operational Efficiencies & Cost Optimisation**		
Enter in New Markets	**Produce new, innovative Products & Services**	**Sell through new Channels**	**Increase Customer Satisfaction**	**Increase Customer Penetration**	**Reduce of labour costs**	**Increase workforce productivity**	**Improve tech capital efficiencies**
√	√		√	√			√

9.2.3 Initiative 7.3: Introduce a Smart Manufacturing Challenge Programme to develop innovative solutions for a modern, more productive, environmentally sustainable Greek Manufacturing

- **Short description:** Introduce a "Smart Manufacturing" challenge (that will be part of the Industrial Strategy Challenge Fund) that will aim to support the transformation of Greek manufacturing capabilities through the adoption of Smart Manufacturing technologies. The challenge shall be analysed across specific fields of focus, for which respective programmes will be issued. These specific fields of focus could indicatively be:
    - **Smart connected factory** - Harness Smart Manufacturing technologies to optimise the design and operations of current and future factories, including:
        - Manufacturing process and operations (use of robotics or additive manufacturing to accelerate processes, dynamic, real time production planning and scheduling, digital twins of facilities & processes to optimise future designs or current state, etc.)
        - Asset management optimisation
        - Use of robotics and autonomous systems to improve productivity or worker safety
        - Connected worker – augmented & virtual solutions for task assistance, training or safety
    - **Connected and versatile supply chain - Harness Smart Manufacturing technologies to optimise the design and execution of current and future supply chains.**
        - Interoperability and understandability of data across value chains
        - Supply chain design (i.e. end to end supply chain visibility and effective risk management, sustainable supply chains for increased flexibility, warehouse and logistic optimisation, etc.)
        - Supply chain execution (i.e. demand management, sensing and shaping, improved decision-making through analytics and artificial intelligence (AI), production planning or scenario modelling, track-and-trace technologies, traceability and provenance)
    - **Adaptable, flexible manufacturing operations**
        - Enabling customisation: adapting processes to smaller batch size production, rapidly configurable processes with reduction of design and production time.
        - Flexible /distributed manufacturing using a flexible network of supply and skills to manage volatility/disruption effectively.
        - Simulation and understanding of real work using data from people and industrial systems, efficient transfer of trial results to the workplace.
- **Key audience:** The "Smart Manufacturing" Challenge shall primarily address to the I4.0 "supply" stakeholders, namely ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps, academic and research institutions and/or innovation hubs as well as producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.). These stakeholders could individually or as consortiums take part in this Challenge.

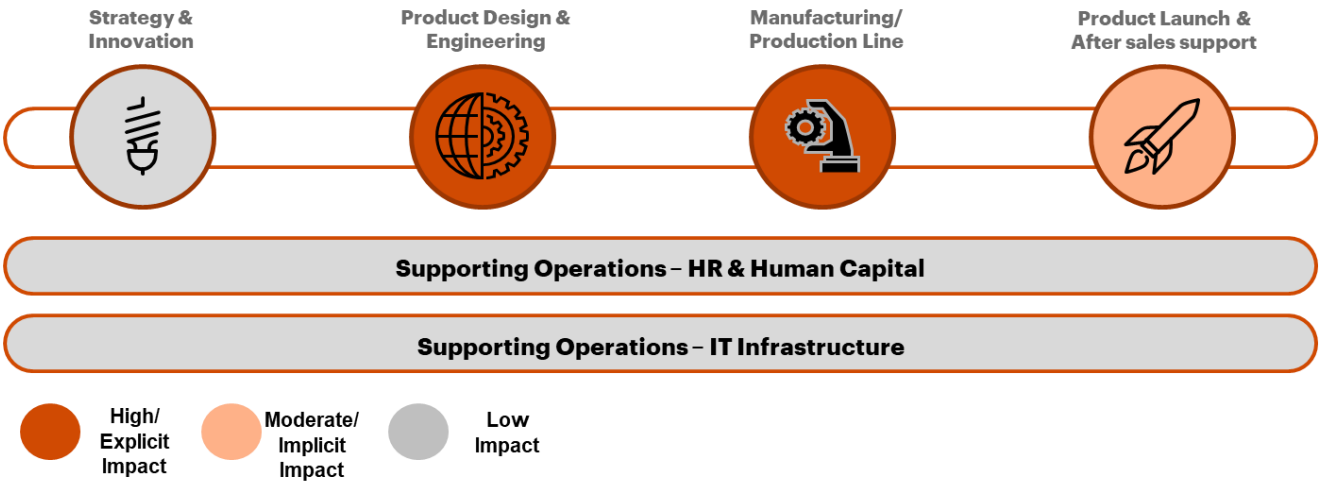
Below we present the matching to the key group of stakeholders for Industry 4.0 strategy, as this is presented in Chapter 3.

Key Stakeholders		Initiative 7.3: Introduce a Smart Manufacturing Challenge Programme to develop innovative solutions for a modern, more productive, environmentally sustainable Greek Manufacturing
Industry 4.0 "Demand" – Increase the I4.0 adoption	• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0	
	• Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0	
	• Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0	
I 4.0 "Supply" – Accelerate the commercialization of I4.0 innovation	• ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps	☑
	• Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.)	☑
	• Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing	☑

- **How to access/ use this initiative:** The Government shall publish a call for tenders for each thematic area under the "Smart Manufacturing" Challenge, i.e. smart connected factory, connected and versatile supply chain, etc. Participants shall submit their proposals for engagements that will aim to develop Industry 4.0 solutions and services to contribute to the field of focus.

  Upon the submission of the proposals, a selected panel of assessors will review all proposals. A portfolio selection approach will be applied to the top scoring proposals, with a certain number of proposals being invited to an interview and a presentation with an expert panel. This panel could consist of academics and researchers specialized in Industry 4.0 topics, as well as Public Sector employees certified in Industry 4.0 technologies. The selected companies/ consortiums/ partnerships shall develop a challenge specific I4.0 solution (TRL>5) and shall testify that this can be industry applicable within a predefined period of time (i.e. 6 to 8 months). It should be mentioned that for each of the challenges the Greek Government could closely work with industry and partners to find co-investment alongside the money that Government is prepared to make available and to work up the detailed business case with direct input from industry. In this context, a senior industry leader for each challenge could help the Greek Government secure investment from industry and refine the vision for the challenge.

- **Key Benefits achieved:** Participation of organizations in the "Smart Manufacturing" challenge could significantly benefit the Greek Industry's product design & engineering and manufacturing and production capabilities, since the challenge will prompt organization to develop relevant solutions that will harness Smart Manufacturing technologies to optimise the design and operations of current and future factories, optimise the design and execution of current and future supply chains and introduce adaptable, flexible manufacturing operations.



Companies that shall participate in the Smart Manufacturing Challenge will **primarily** benefit across the following areas:

Organisations' high-level strategic objectives							
Revenue & Growth			Customer Satisfaction		Operational Efficiencies & Cost Optimisation		
Enter in New Markets	Produce new, innovative Products & Services	Sell through new Channels	Increase Customer Satisfaction	Increase Customer Penetration	Reduce of labour costs	Increase workforce productivity	Improve tech capital efficiencies
√	√	√	√	√			

9.2.4 Initiative 7.4: Set up a Smart Manufacturing Industrial Park

- **Short description:** Set up a Smart Manufacturing Industrial park that shall aim to create an emerging Industry 4.0 ecosystem and a flexible production network around the design and production of Smart Manufacturing solutions and applications. The Smart Manufacturing Industrial park can be located in a remote industrial land that could be transformed and equipped with modern working spaces and manufacturing facilities, where leading-edge anchor institutions and manufacturing companies shall cluster and connect with Industry 4.0 start-ups, business incubators, and accelerators. The industrial park shall also be physically compact, transit-accessible, and technically wired and offer mixed use housing, office, and retail. The Industrial park could attract and host enterprises and academic institutions that are active/ involved in the Smart Manufacturing domain.
- **Key audience:** Similarly to the Greek Smart Manufacturing Competence Center (initiative 7.2), the industrial park shall provide a space where manufacturing and industrial SMEs and midcaps, large enterprises of the ICT and Manufacturing sectors as well as with academic and research institutions could co-exist, collaborate and prosper together. The industrial park will aim to develop a collaborative industrial ecosystem where the park's stakeholders shall cooperate and utilise each other's expertise in order to achieve greater goals. This is expected to accelerate the digitisation of the Greek SMEs and mid-caps, as well as to increase their thus far limited awareness on digital and Industry 4.0. Ultimately it is expected to assist the Greek industry to advance "as one" to the Industry 4.0 era and cumulatively reap the benefits that it has to offer, instead of having a few i4.0-advanced groups of firms and many i4.0-laggards operating in two different speeds. It is therefore evident that this initiative, as well as initiative 7.2, is targeted to all groups of stakeholders introduced in Chapter 3 and presented below. All groups that are relocated to the industrial park shall:
    - Have access to office spaces/ working locations/ accommodation in favourable prices
    - Develop close collaboration with other park's organization, building a strong network that can share resources and potentially human capital and expertise.
    - Undertake collaborative R&D and applied research for the design and implementation of Smart Manufacturing projects
    - Host of events & conferences to increase wider awareness on Smart Manufacturing technologies and attract more organizations to relocate in the park.
    - Organize and run digital upskilling and reskilling workshops for organizations located in the park
    - Host incubators and accelerators and organize relevant incubation sessions to support the for the development of new Smart Manufacturing start-ups, etc.

  Below we present the matching to the key group of stakeholders for Industry 4.0 strategy, as this is presented in Chapter 3.

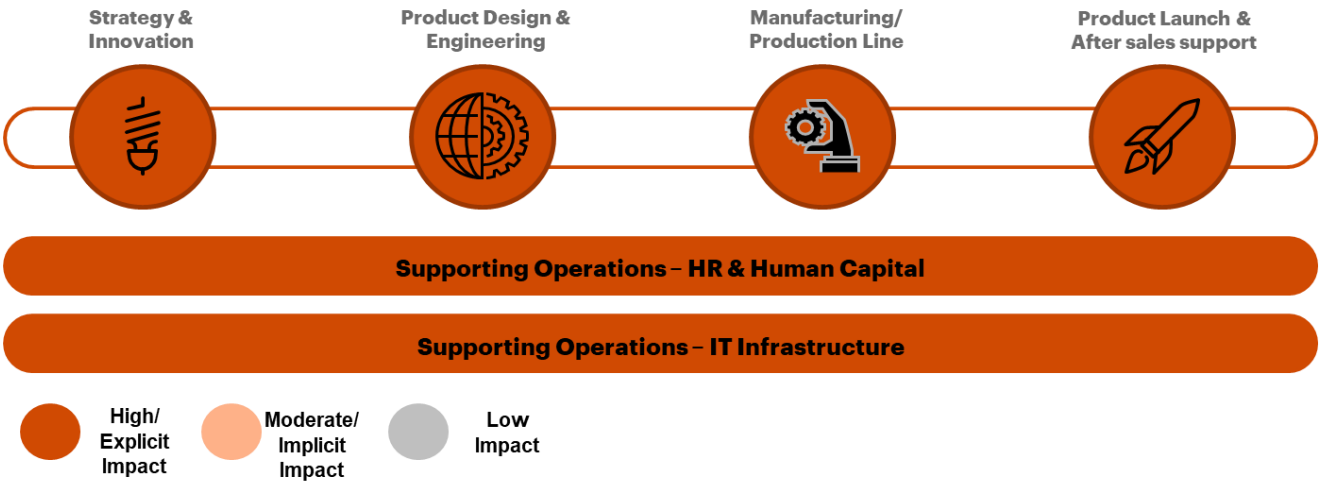
Key Stakeholders		Initiative 7.4: Set up a Smart Manufacturing Industrial Park
Industry 4.0 "Demand" – Increase the I4.0 adoption	• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0	☑
	• Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0	☑
	• Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0	☑
I 4.0 "Supply" – Accelerate the commercialization of I4.0 innovation	• ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps	☑
	• Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.)	☑
	• Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing	☑

- **How to access/ use this initiative:** As explained also in paragraph 6.2.1.4, the Smart Manufacturing Industrial Park can run as a PPP project with a co-investment both from the Greek Government and the Private Organizations that will participate as founding members in this. As such, the founders of this industrial park that could be large industrial/ manufacturing organizations (with advanced I4.0 maturity) and/or ICT Services Organizations focused on Industry 4.0 solutions and/or academic/research institutions or innovation hubs active on Smart Manufacturing technologies could co-operate with the Greek Government for the setup of this park.
  In order to attract more industrial organizations both from the Industry 4.0 "supply" and "demand" sides, the Greek Government should provide a set of incentives to encourage their relocation to the park. Indicatively, these could be:
  - Attractive rates for renting/ buying land and building new facilities within the innovation districts
  - Attractive pricing rates to access modern, high-end digital infrastructure
  - Tax credits and/or favorable loan interest rates for relocating into the park
  - Tax incentives for net new capital investment and job creation
  - Easier access to funding and higher amount of funding for setting up and operating innovation structures (i.e. testbeds/ test labs) within the park
  - Specific tax allowances for researchers working for academic/ research institutions located in the park, etc.
  - Provision of free tech zones with a flexible legislative framework, where enterprises will be able to experiment and test new Smart Manufacturing products/ solutions.
- **Key Benefits achieved:** Participation of organizations in the Industrial park can significantly benefit their entire value chain. In more detail the Industrial park:
  - Will increase the productivity and growth of the Industrial/ ICT companies based within the park through leveraging the network multiplier effect. Park members will digitally tap into the park's networks and leverage them to gain better and faster access to employees and suppliers and to exploit accumulated expertise that will drive sustainable growth in faster and economically smarter ways.

- Second, the Smart Manufacturing Industrial park will act as an innovation sandbox. It will drive the direction and pace of disruptive innovation that will subsequently enhance the Greek Industry's digital maturity and will uplift industrial productivity growth through its transition to Industry 4.0 products and solutions.
- Third, it will stimulate the formation of new businesses, which is expected to expand and strengthen the industrial park itself and will create a value add ecosystem.
- Fourth, it will incubate and build the critical "digital mass" and diffuse this both within the Greek Industry and across the Greek market and society.
- Fifth, it will act as an accelerator and multiplier for the Greek Industry's rotation to digital, through the provision of technology expertise and the formulation of partnerships with organizations across the Greek Industry and Manufacturing.

With regards to benefits of organizations across their value chain, the Industrial park shall primarily benefit the following value chain areas:

- **Strategy & Innovation:** Participation in the park shall enable organizations to become part of a wider industrial ecosystem, embrace open innovation and reinvent their business models.
- **Product Design & Engineering:** Organizations will be benefited during the design and implementation of R&D projects on smart manufacturing. Through their collaboration with park "neighbors" they will be able to undertake collaborative R&D and applied research for the design and implementation of Smart Manufacturing projects.
- **Manufacturing/ Production Line:** Organizations shall also be able to experiment with new solutions and services that will significantly improve their manufacturing and production lines and improve product quality and traceability.
- **Product Launch – After Sales Support:** The introduction of an open innovation ecosystem shall enable organizations located in the park to continuously share ideas and collaborate on experimenting Industry 4.0 solutions to improve products' features and characteristics, create new customer experiences and achieve high performance.
- **Supporting Operations – HR & Human Capital:** As indicated also above, the industrial park shall incubate and build critical "digital mass" that will lead to the digital upskilling and reskiling of the entire ecosystem located in the park.
- **Supporting Operations – IT Infrastructure: The i**ndustrial park shall offer all urban amenities that businesses desire and benefit from these data like Telecommunications, postal facilities, filling stations, banks etc. These facilities are available for all enterprises to use and benefit from.



Companies that shall participate in the Smart Manufacturing Competence Center will **primarily** benefit across the following areas:

Organisations' high-level strategic objectives							
Revenue & Growth			Customer Satisfaction		Operational Efficiencies & Cost Optimisation		
Enter in New Markets	Produce new, innovative Products & Services	Sell through new Channels	Increase Customer Satisfaction	Increase Customer Penetration	Reduce of labour costs	Increase workforce productivity	Improve tech capital efficiencies
√	√		√	√		√	√

9.2.5 Initiative 7.5: Smart Manufacturing Technologies within the Greek Industry 4.0 Standardisation Framework

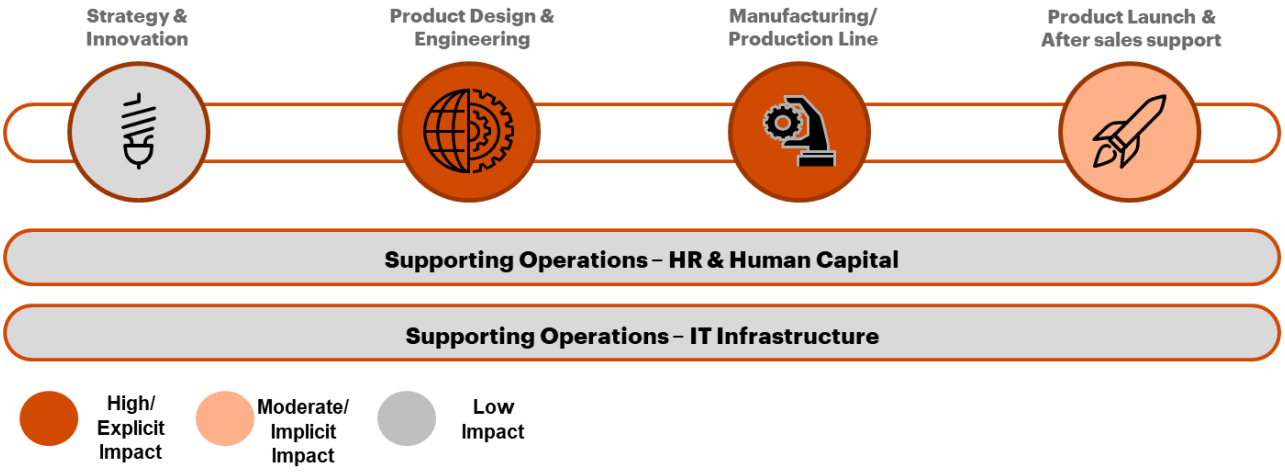
- **Short description:** Further to the development of the Greek Industry 4.0 standardisation framework (as described within Pillar 4 and more specifically Initiative 4.2) , the Greek Standardisation Committee should place a special emphasis on the Smart Manufacturing Technologies as they have been identified for High Priority Case 1. This initiative will seek to surface and design the industrial standards and norms that are related to the key Smart Manufacturing technologies, tailored to the needs and capabilities of the enterprises within the Greek industrial ecosystem.
- **Key audience:** This initiative is specifically targeted to all those enterprises that are part of the "Supply" side of the Greek industry, as identified and analysed within Chapter 3. More specifically, the purpose of the Greek Standardisation Committee will be to carefully map out the level of "standards' readiness" players of different sizes have within the industrial ecosystem and proceed, always based on the developments of the EU industrial landscape, to design the respective standards for Greece. It is important to note that these Smart Manufacturing technologies' standards will not be applicable to a niche of the industrial ecosystem, but rather should be developed with a broader outlook in order to be implemented by a large number of enterprises and stakeholders. These are mostly, the following (also presented in the Graph below):
    - **ICT Services' organisations**, which are focused on producing i4.0 solutions for industrial and manufacturing SMEs and mid-caps
    - **Producers of Industry 4.0 solutions**
    - **Academic and research institutions as well as industrial innovation hubs**, which are focused on applied research and R&D within the industrial ecosystem

Key Stakeholders		Initiative 7.5: Smart Manufacturing Technologies within the Greek Industry 4.0 Standardisation Framework
Industry 4.0 "Demand" – Increase the I4.0 adoption	• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0	
	• Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0	
	• Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0	
I 4.0 "Supply" – Accelerate the commercialization of I4.0 innovation	• ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps	☑
	• Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.)	☑
	• Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing	☑

- **How to access/ use this initiative:** In order to take advantage of this initiative, the groups of industrial stakeholders that fall within the "Supply side" (as analysed above) will have to closely monitor the developments of the standardisation committee and pursue to adopt the new standardisation norms within their operational model as soon as they have been issued.

  On another note, and in order to act "proactively" and in a preparatory manner, these stakeholders should pursue to understand what standards their main collaborators are already utilising (if any), as well as what industrial standards might be applicable to their business or activity and are already being pursued and applied in an EU level. This kind of preparatory work together with receiving guidance from the Standardisation Committee on what standards and norms (when the standardisation framework on smart manufacturing technologies has developed and ready to be applied across the ecosystem) are relevant for their core business and how they should be applied specifically to them will ensure a smooth and synchronous adoption of those across the industrial landscape, upgrading its players holistically and all at once.

- **Key Benefits achieved:** Upon the catholic adoption of the designed Smart manufacturing technologies' standards for the Greek industrial ecosystem, its stakeholders will be able to co-operate smoothly and effectively, beginning from industrial research and new innovative products up to production. This stems from the fact that by abiding to the same standards, norms, industrial processes etc. industrial stakeholders will essentially "speak the same language", allowing for better and more synergies to be born throughout the ecosystem, especially for new products' design and engineering as well as the better communication and interrelation of production lines of enterprises in general.



Companies that apply these standards and norms will **primarily** benefit across the following areas:

Organisations' high-level strategic objectives							
Revenue & Growth			Customer Satisfaction		Operational Efficiencies & Cost Optimisation		
Enter in New Markets	Produce new, innovative Products & Services	Sell through new Channels	Increase Customer Satisfaction	Increase Customer Penetration	Reduce of labour costs	Increase workforce productivity	Improve tech capital efficiencies
	√						√

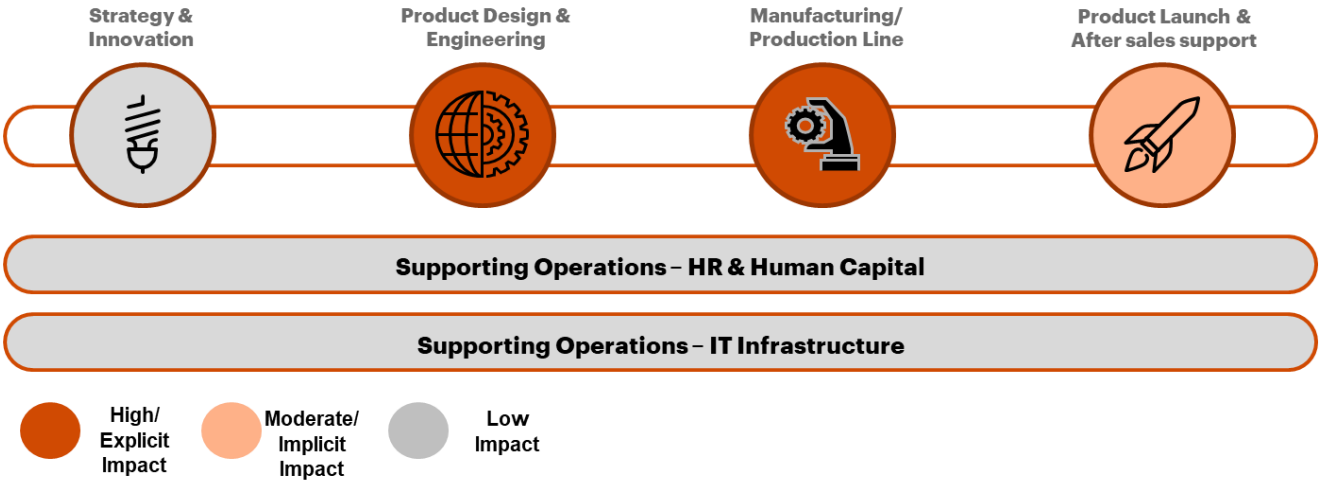
9.2.6 Initiative 7.6: Enhancement of the Patents' Framework with regard to Smart Manufacturing Technologies

- **Short description:** Through this initiative will seek to explore how to improve and simplify the regulatory environment through the creation of an innovation friendly setting with regard to the patents framework around Smart manufacturing technologies. This is rather critical within the Industrial regulatory environment since it will allow for closer and better collaborations among enterprises and research institutions that wish to cooperate in order to develop new innovative industrial products.
- **Key audience:** The enhancement of the patent's framework is targeted on all those enterprises that are part of the "Supply" side of the Greek industry, as identified and analysed within Chapter 3. More specifically, the upgrade of the patents' framework will lay the ground for innovation and remove as much "red tape" as possible with regard to industrial patentable products and new and innovative industrial solutions, two elements that are significantly missing from the industrial landscape as of today. These stakeholders are the following (also presented in the Graph below):
  - ICT Services' organisations, which are focused on producing i4.0 solutions for industrial and manufacturing SMEs and mid-caps
  - Producers of Industry 4.0 solutions
  - Academic and research institutions as well as industrial innovation hubs, which are focused on applied research and R&D within the industrial ecosystem

Key Stakeholders		Initiative 7.6: Enhancement of the Patents' Framework regarding Smart Manufacturing Technologies
Industry 4.0 "Demand" – Increase the I4.0 adoption	• Industrial/ Manufacturing organizations (mainly SMEs and midcaps) that demonstrate limited knowledge/ low maturity regarding Industry 4.0	
	• Industrial/ Manufacturing organizations with some knowledge/ moderate maturity regarding Industry 4.0	
	• Industrial/ Manufacturing organizations with increased knowledge/ high maturity regarding Industry 4.0	
I 4.0 "Supply" – Accelerate the commercialization of I4.0 innovation	• ICT Services Organizations, focused on Industry 4.0 solutions for industrial/manufacturing SMEs/ mid-caps	☑
	• Producers of Industry 4.0 solutions (i.e. hardware, software, sensors, meters, new materials, etc.)	☑
	• Academic/ research institutions and innovation hubs focused at applied research for the Greek Industry & Manufacturing	☑

- **How to access/ use this initiative:** The above stakeholders will essentially have to get informed with regard to the latest developments around the Smart Manufacturing Technologies' new patents framework, capitalising on the prosphorous ground and conditions that it shall provide. Once they have been fully informed on that, understanding the "new rules" of the industrial innovation game and landscape, they will be able to initiate new collaborations within the industrial ecosystem with the goal to innovate with regard to new products and services and seek to grow exponentially together with their business and research partners.

- **Key Benefits achieved:** As mentioned before, this initiative will motivate industrial enterprises from the "Supply side" to pursue and capitalise upon innovative new products and services, either through closer collaborations with research stakeholders from the industrial landscape or through pursuing internal innovation. This will benefit them deeply with regard to new product design and engineering, allowing them to benefit from newly developed and patented products and offerings. Moreover, it is expected to highly impact their manufacturing and production line, incorporating these patented products/ offerings in order to overcome competition both at a national as well as an international level, allowing them to pursue targets that would not seem realistic or applicable to them beforehand.



Stakeholders that will utilise this initiative will **primarily** benefit across the following areas:

Organisations' high-level strategic objectives							
Revenue & Growth			Customer Satisfaction		Operational Efficiencies & Cost Optimisation		
Enter in New Markets	Produce new, innovative Products & Services	Sell through new Channels	Increase Customer Satisfaction	Increase Customer Penetration	Reduce of labour costs	Increase workforce productivity	Improve tech capital efficiencies
	√						√

9.3 "No regret" moves for Greek Industrial Organizations to rotate to Industry 4.0

While each Industrial Sector is disrupted by Industry 4.0 and Smart Manufacturing technologies across different areas of its value chain, there is a set of fundamental, "no regret" digital initiatives that apply across all industrial sectors and are considered to be the common denominator for all organizations' rotation to Industry 4.0. A truly "Smart Manufacturing" enterprise stands for more than just using new technologies. Rather, what truly distinguishes and gives a "Smart Manufacturing" enterprise its competitive advantage is its culture, strategy and way of operating. "Smart Manufacturing" enterprises strive continuously to enable new and leaner operating models underpinned by agile business processes, connected platforms, analytics and collaboration capabilities that enhance productivity.

A "Smart Manufacturing" enterprise relentlessly explores, identifies and develops new I4.0 business models, always ensuring that customers and employees are at the centre of whatever it does. With global best practices as our reference point, we propose a set of "no regret" I4.0 initiatives for digital transformation. The initiatives that follow, are categorized according to the value chain area they refer to.

9.3.1 Strategy & Innovation

Companies need to fundamentally change the way they sense and interpret I4.0 disruption. For this reason, they should evaluate the way they incorporate digital into their corporate strategy and their objectives. To achieve this, the introduction of an I4.0 Strategy Office is proposed. At the same time, organizations need to ensure the creation of a supporting culture that will enable their I4.0 transformation, starting with the CEO, who should be the ultimate driver of their organization's rotation to I4.0. Finally, organizations shall understand and leverage their data to provide valuable insights and transform themselves into Data Powered Enterprises. The following "no regret" moves are proposed:

- **Design the organization's Industry 4.0 roadmap and introduce a dedicated role to undertake its implementation:** Design and implement a digital roadmap that will incorporate all digital initiatives to be undertaken by the organization. Set up the Digital Strategy Office that will be responsible for the effective operationalization of the digital roadmap and decide on the priorities and coordination of the digitalization initiatives undertaken by the respective business units.
- **Ensure a supportive culture for Industry 4.0 transformation, starting with the CEO:** Digital transformation of an organization can be a huge challenge. Therefore, this needs to be supported by a receptive corporate culture. Responsibility for this resides with the CEO. The CEO will be the ultimate driver of the organization's digital transformation program and shall play a key role in providing direction, securing key resources, and ensuring stakeholders buy-in.
- **Understand and leverage Data:** Data is the new digital capital. Organizations shall innovate, build differentiated data insight solutions and transform into Data Powered Enterprises. In more detail, companies shall:
    - Design their Data Strategies, Operating Models and perform data diagnostics to assess their dataset quality and quantity. Dataset may include: (User Data, Transaction Data, Field Data, Inventory Data, Performance Data, etc.)
    - Introduce structured data governance models and establish regulations, policies and standards to ensure data cybersecurity and ePrivacy
    - Design new or optimize the existing data engineering tools and mechanisms

- Build data management platforms (either on cloud or on premise) to enable data consolidation, management and seamless sharing

9.3.2 Product Design & Engineering

The introduction of Smart Manufacturing technologies radically transforms the product design and engineering process. In fact, Industry 4.0 Engineering requires rethinking of each step of the process. Start with the ideation process, which needs to rely more on crowd-sourcing and open innovation and co-innovation techniques with a larger, more open ecosystem of partners. The product and system architectures need to be fully redesigned in a more modular model to enable a platform engineering approach and easier integration of components from any source. The prototyping and development process must be agile and led by design thinking. The product design needs to take into account the lifecycle usage models and data required, particularly for as-a-service models. In short, this is a major transformation of engineering culture and processes. The following "no regret" moves are proposed for this value chain area:

- **Provide experiences instead of products/services:** Focus on delivering experiences tailored to the needs of the individual. Measure customer voice and sentiment, catalogue the outcomes your customers strive to achieve, identify partners and develop unique combinations that deliver relevant customer experiences.
- **Embark on an iterative product development approach:** Out goes the old-style programmed linear development process with a firm sequence of steps for a product project – from ideation to product launch. Organizations shall transform their design and engineering processes into a revolving and circularly revisiting but forward-looking design practice for which "design thinking" methods are the most efficient frameworks. With its roots in product design, design thinking is a perfect methodology for finding and developing services around products that customers really want. The guiding focus throughout is the end user, so this needs to become an integral part of design and development from day one, with things like interviews, observations in the field and techniques such as "customer journeys" forming the basis for new offerings.
- **Adopt open innovation for new product design:** In the new I4.0 era, multidisciplinary teamwork on design and development involve not just individuals from within one organization, but also from ecosystem partners. Developing, enabling and nurturing an ecosystem with the right partners becomes a critical success factor. With the necessary internal processes and approaches in place, companies will have a base from which to effectively collaborate with universities, other start-ups and third parties that complement them and supplement capability gaps.
- **Implement an agile engineering process:** Agile product engineering means that teams swiftly gather feedback, test and upgrade the architecture for products, software components and crucially the user experience. Connected to that is the idea of a minimum viable product (MVP), a development procedure in which a new product is developed with sufficient features, functionalities and services to get to market as quickly as possible and then iterate quickly based on real-world usage insights. Supported by digital manufacturing tools, such as laser cutters, 3D printers or digital twins, hardware engineers can now develop ideas while concurrently testing them with users.
- **Optimize composition of products:** Leverage big data analytics and integrate end-to-end the supply chain processes to quickly respond to customer requirements and produce products (i.e. alloys) tailor made to the specific customer needs.

9.3.3 Manufacturing/ Production Line

Companies will need to reassess every aspect of their manufacturing and production lines, to ensure they are fit for purpose in an Industry 4.0 world. Production greatly differs across the different sectors but also amongst different companies within the same sector. Nevertheless, companies shall evaluate digitally enabled hardware tools and Industry 4.0 technologies, i.e. Big Data Analytics, Artificial Intelligence, the Industrial Internet of Things, etc., in order to monitor and automate their assets, connect dispersed, diverse and remote operations and empower and protect their workforce. The following "no regret" moves are proposed:

- **Perform Asset Predictive Maintenance:** Deploy smart sensors, IoT and telematics on assets and equipment and design a predictive maintenance/service solution. The solution shall harness and analyse data from the organization's assets, transmit the resulting insights to the organization and enable it to anticipate problems, proactively schedule maintenance and help manage its assets.
- **Integrate the supply chain processes:** Design a platform that will integrate all supply chain processes, (i.e. order capture, payment processing, shipping, tracking, customer relationship management systems). The introduction of a cloud-based web app could allow for easy access between mobile devices and computers.
- **Setup a Remote Operations Center (ROC):** Setup a Remote Operations Center (ROC) that will integrate the supply chain processes and tools across silos. Continuously monitor the execution of operations' activities and provide visibility to performance metrics. Perform 'what if' analysis, and dynamically respond to changes. The Remote Operations Center (ROC) brings together capabilities such as Events & KPI Management, Analytics and Execution to enhance outcomes such as Operational Excellence and Overall Equipment Effectiveness.
- **Automate plant operations:** Implement automation techniques (i.e. robotics) to control systems for operating equipment such as compressors, heat exchanges, boilers and furnaces, switching power grids and other applications with minimum human intervention.
- **Enable the Field Workforce & Design Safety Solutions:** Leverage wearable solutions and analytics solutions to capture, analyse, communicate critical manufacturing information to and from workers, and improve operational performance by supporting fact-based decisions in near real-time. Remotely monitor and manage safety across sites, where the field workforce operates.

9.3.4 Product Launch and After sales support

As the rate and scale of digital disruption accelerates, and customer expectations evolve, companies face an increasingly important need to change the way they track and respond to customer expectations. Offering just products is no longer enough for businesses to succeed. Companies that rise to the challenge shall focus on using Smart Manufacturing technologies to better understand their customers, improve their omni-channel presence and ultimately offer hyper-personalized products and services. The following "no regret" moves are proposed for this value chain area:

- **Obtain a single, in-depth view of your customers:** Integrate on/offline and back-end systems to obtain a single view of customer, including customer's activities across all channels. Use big data analysis, in order to obtain an in-depth understanding of your customers. Based on various channel

customer information (including social), anticipate customer needs and suggest products aligned with customer preferences.

- **Improve the Omni-Channel Customer Interaction and add self-service tools:** Introduce and rollout customer journeys to track, integrate and analyze the way that customers use a combination of available channels to interact with an organization and improve the customer experience across channels in the context of the personalized treatment.
- **Introduce Smart Manufacturing technologies on products to improve their maintainability and reliability:** Implement deep data analytics tools to predict equipment failures, reliability and maintainability. Implement augmented reality to assist maintenance personnel in maintaining and repairing equipment. Implement sensors on equipment to drive predictive and cognitive maintenance analysis.

9.3.5 Supporting Operations

The deployment of Smart Manufacturing & Industry 4.0 technologies across the organizations' supporting operations and workforce, enable the organizations to "become digital", improve their operational efficiencies, and upskill their workforce. In fact, experience indicates that supporting operations are one of the value chain areas that is greatly impacted by I4.0, as well as an area that is often used as the instigation point for an organization's rotation to I4.0. The digitalization of an organization's internal operations is a multi-faceted activity that shall cover amongst others the digitalization of back-office processes, the transformation of IT operations, the prioritization of digital security and the digital upskilling and reskilling of the organization's workforce. The following "no regret" moves are proposed for this value chain area:

- **Automate and digitalize end-to-end back-office processes:** Digitalize and automate end-to-end internal processes powered by artificial intelligence (robotics) and big data analytics to increase their operating resilience while giving the opportunity to the workforce to participate in more engaging and creative type of jobs.
- **Transition the IT infrastructure to the cloud:** Move the IT infrastructure to the cloud to improve efficiencies, enable the seamless integration of business processes and provide immediate, on-demand access to the latest solutions and approaches and ready-to-deploy environments for creating and delivering the innovative business strategies and products.
- **Increase the security of the internal systems:** Strengthen internal systems and incorporate increased security measures such as multi-layered authentication and internal control processes to strengthen security and comply with increased regulations.
- **Manage the Digital Talent Cycle:** Define the new digital roles, capabilities and skillsets, assess the active workforce and design digital training sessions to digitally upskill and reskill the organizations' personnel according to their personal development needs.
- **Nurture an agile culture:** Nurture an agile culture within the organization (starting with the leadership) to help the organization digitally transform on both the inside (operations, culture, practices and workforce) and the outside (company image and appeal to prospective employees).

Only by actively pursuing all of the above and to the best of their capabilities, will Greek industrial enterprises be able to harness the true power of Industry 4.0 Smart Manufacturing technologies and evolve in the highly competitive yet promising industrial and digital world.

The current version of the document represents the Final Draft of Deliverable 3. This has been prepared in the context of the project “Digital transformation of the Greek Industry”, for the purposes of the Deliverable 3 in accordance with the signed contract.

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