Report to the European Commission, DG Regional and Urban Policy

ECOSYSTEMS and FUNCTIONING EDP for S3 2021-2027 in GREECE

Nicos KOMNINOS
in collaboration with A. Panori, C. Kakderi, A. Psaltoglou, A. Chatziparadeisis

URENIO Research &
INTELSPACE INNOVATION TECHNOLOGIES

Table of contents

Introduction: DG Regio assignment

This report presents the outcome of the DG Regio assignment on "Ecosystems and Functioning Entrepreneurial Discovery Process (EDP) for S3 2021-2027 in Greece". We describe and discuss the findings of a survey realised between November 2019 and March 2020 and the derived policy recommendations on how to achieve "functioning EDP" for smart specialisation strategies 2021-2027.

The objective of the DG Regio assignment is to advise the European Commission on business and/or innovation ecosystems and their role to RIS3 Entrepreneurial Discovery Processes (EDP). Following the inception report agreed in the DG Regio meeting on 26/9/2019, the following tasks are included in Section A of the assignment.

Task A1 - Identification of ecosystems: It will focus on the mapping of the Greek and Cypriot innovation ecosystems and the pre-selection of 10 ecosystems per region, which will be further elaborated on and investigated throughout the assignment. More specifically, Task A1 will focus on the identification of existing and emerging business ecosystems at the regional level. The initial detection of regional ecosystems will be achieved through the use of (1) employment data, and (2) the calculation of the location quotients (LQ) for each region. Hence, a mapping of the regional agglomerations will be outlined, which will lead to the identification of the ten (10) most important 3-digit NACE ecosystems. Moreover, a set of 4 interviews per region with companies and/or stakeholders will follow, targeting on collecting additional information regarding the identification of value chains or platforms corresponding to the 10 identified ecosystems. As the final activity of this task, we will determine the three (3) most important business ecosystems within each region, followed by the outline of corresponding value chains or common platforms (in the case of platform-based ecosystems).

Task A2 - Profiling of ecosystems: It will focus on further analysing the selected ecosystems of each region (Greece and Cyprus) by elaborating their profile and assessing relevant existing bottlenecks for innovation diffusion within the region. This will be achieved through the use of secondary data. The most important companies participating in each ecosystem will be identified alongside their demographic characteristics using data coming from official sources (ICAP database). Emphasis will be given on the identification of potential areas of ecosystem diversification, in order to better understand emerging trends and future areas of development.

Task A3 - Research and innovation intensity of ecosystems: It will focus on further exploration of the R&D and innovation intensity within the three most important ecosystems for each region that have been identified in Task A1. The main secondary sources of data that will be used include:

- EPANEK (GR), Competitiveness and Sustainable Development (CY) provides essential information for ecosystem companies having received or still receiving funding from IP1b. This will provide information regarding the main areas of R&D financing that the selected ecosystems received from ESPA.
- ICAP provides information regarding the internal R&D spending for each company. It will be essential for the analysis to identify companies that have a growing trend for R&D spending and identify their main areas of interest.
- CORDIS provides information referring to H2020 projects. Through CORDIS information, we will better understand the positioning of the ecosystem companies regarding their participation in EU projects and their collaboration status with other international companies.
- Available information from CIS and the National Documentation Centre (Metrics) and data on Universities and Research Institutes that might be parts of ecosystems (patents, publications, citations per research/technological area)

All above-mentioned sources of information are essential for better understanding the latent R&D potential within the selected regional ecosystems, in terms of emerging technologies and areas of interest that are significant for those ecosystems, and thus, could be potential areas for future investments.

Task A4 - Recommendations: Presentation of the findings in a meeting with DG Regio recommendations on R&I policy and RIS3 focusing on business ecosystems at a regional level for Greece and Cyprus, and procedures to improve (a) prioritisation of activities and (b) research and innovation actions in prioritised activities in the next round of RIS3.

The survey we present in this report was developed in two stages. At stage 1 we address the problem of *identification of ecosystems* (defining areas in the economy and society that have the greatest potential for future development) and the feasibility of an EDP approach without excluding major industrial activities (Task A1). This means that we don't define priority activities by a theoretical approach excluding some activities, but we assess all major activities considering that all have the potential of future diversification and growth. We assess the feasibility of this non-excluding EDP methodology. At stage 2 we address the *problem of profiling ecosystems* and assessment of their research and innovation potential (Task A2 and A3). These surveys conclude with *recommendations for EDP and policy actions* at the level of business ecosystems which may be beneficial for all members of an ecosystem (Task A4).

We have worked with secondary from Greece for the last four years (2016-2020) as well as primary data from interviews and field surveys on research and innovation. We should underline that our work *is not to perform EDP*, which is a collaborative engagement of stakeholders rather than an expert advice exercise. Our objective is to pave the way and *define a methodology for functioning ED*P in Greece for the period 2021-2027.

Greece is composed of 13 regions and smart specialisation strategies include a national strategy and 13 regional strategies. Given this typology of regions and S3, our recommendations for functional EDP may be useful for other EU member states having the same combination of national and regional S3.

Problem definition: The challenge of functioning EDP

This assignment of DG Regio is placed in the framework of enabling conditions of good governance of national and regional smart specialisation strategies 2021-2027, defined by Policy Objective 1 for 'Smarter Europe' through innovation, digitisation, economic transformation and support to small and medium-sized businesses. Good governance is assessed by seven (7) fulfilment criteria:
1. Analysis of challenges including bottlenecks for innovation diffusion
2. Existence of competent regional / national institution or body, responsible for the management of the smart specialisation strategy
3. Monitoring and evaluation tools to measure performance towards the objectives of the strategy
4. Functioning of stakeholder co-operation ("entrepreneurial discovery process")
5. Actions necessary to improve national or regional research and innovation systems, where relevant
6. Where relevant, Actions to manage support industrial transition
7. Measures for internationalisation

The present assignment *focuses on criterion 4*, a "functioning of stakeholder co-operation in entrepreneurial discovery process". Functioning EDP is working EDP. EDP doing what it's supposed to do, namely addressing two challenges (1) the prioritisation challenge and (2) the discovery challenge. EDP must *identify and prioritize* innovative business activities in a variety of technological areas and sectors, that have the potential for diversification and transformation towards higher added value activities. Moreover, EDP must *outline policy actions* and public support measures for the benefit of entire industry sectors or ecosystems than the benefit of specific organisations and enterprises.

Under Europe's 2020 strategy for smart, sustainable and inclusive growth, the research and innovation strategies for smart specialisation (RIS3) were introduced as a precondition for receiving financial support from European Structural and Investment Funds (ESIF). The

preparation for these strategies started in 2011 and in May 2012 the *Guide of RIS3* was published by Foray, Goddard, Beldarrain, Landabaso, McCann, Morgan, Nauwelaers, and Ortega-Argilés, as a "methodological guidance for policy-makers and implementing bodies on how to prepare for and how to design, draft and implement a national/regional research and innovation strategy for smart specialisation (RIS3)" (Foray et al., 2012).

The basic principle of smart specialisation is that European regions should aim to explore and exploit key capabilities for global niche markets, to create long term competitive advantages (Foray, 2014; Reid and Maroulis, 2017; Komninos et al., 2018)). Thus, the overall objective of RIS3 is to create innovative, but place-specific and evidence-based capabilities, which take advantage of available resources and competencies within a process of diversification and transformation. In particular, diversification and industrial transformational strategies should foster cross-sectoral links and/or cross-border cooperation (Gianelle et al., 2014; Landabaso, 2014). These capabilities have to be identified and revealed through an Entrepreneurial Discovery Process.

Thus, the Entrepreneurial Discovery Process (EDP) ***is the cornerstone of smart specialisation*** (Kyriakou et al., 2016) a feature that distinguishes the S3 from innovation strategies of the past (Rodriguez-Pose and Wilkie, 2017). During the EDP, different entrepreneurial actors are brought together in ***a government-led participatory process*** generating a collective debate, integrating the divided and dispersed knowledge belonging to different actors, and setting common priorities for intervention.

Guidance on Entrepreneurial Discovery Process (EDP) is provided by the RIS3 Guide (Foray et al., 2012) and other official documents on aims, contribution to prioritisation, and methods of implementation.

- EDP "aims to build a systematic understanding of the areas in the economy and society that have the greatest potential for future development" (p.20) & "mobilise talent by matching RTD + I capacities and business needs through an entrepreneurial discovery process" (p.17).
- "Smart Specialisation should address the difficult problem of prioritisation and resource allocation based on the involvement of all stakeholders in a process of entrepreneurial discovery, which should secure a regionally and business-driven, inclusive and open prioritisation process" (p.52).
- "There are different methodologies for organising such processes, e.g. surveys, seminars with participatory leadership methods, crowdsourcing, etc. Such an open, participatory process, together with reliance on robust evidence based on regional assets, are the best guarantees to avoid both the risk of capture by interest groups and the risk of lock-in into traditional activities" (p.52). "An effective appreciation of dynamic EDP can only be performed if entrepreneurial actors and management and governance bodies responsible of RIS3 engage in direct discussion" (p.20).

Despite the guidance provided, serious gaps and open questions remain in the theory and methodology for EDP.

The specifications of S3 make clear that the objective is diversification and industrial transformation toward higher added value activities. Diversification may be ***intra-industry***, when research and innovation change and improve products and processes of an industry or ***inter-industry***, when innovation leads to a branching of industry towards other sectors. Inter-industry diversification may be "***related***" to existing skills and know-how or "***unrelated***" towards new skills and know-how. Empirical evidence suggests that knowledge spillovers within a region, or smaller country, occur primarily among related sectors, and only to a limited extent among unrelated sectors. It is the related variety in a region that feeds branching out new activities from technologically related activities, not regional diversity nor regional specialisation per se (Boschma and Frenken 2011, p.67). The meaning of this finding

is that related variety can guide the selection of priority activities for inter-industry related diversification. Unfortunately, ***we don't dispose of any theoretical guidance about the diversification of industries in the other three trajectories,*** either in the case of an intra-industry change or inter-industry unrelated change.

This theory gap is accompanied by a methodology gap regarding the EDP granularity. The granularity allows defining the level of detail in modelling industries or decision-making processes. The greater the granulation, the deeper the level of detail and the better understanding of future trends.

Statistical data on industrial activities are given at four levels of granularity, classifying industries in 21 Sections, 88 Divisions, 272 Groups, and 615 Classes as below (see, NACE rev 2).

Section	Division	Group	Class	Description of the class
C	25	25.9	25.91	Manufacture of steel drums and similar containers
	28	28.1	28.11	Manufacture of engines and turbines, except aircraft, vehicle an
		28.2	28.24	Manufacture of power-driven hand tools
		28.9	28.93	Manufacture of machinery for food, beverages and tobacco pro
			28.95	Manufacture of machinery for paper and paperboard productic
G	46	46.1	46.14	Agents involved in the sale of machinery, industrial equipment
		46.6	46.61	Wholesale of agricultural machinery, equipment and supplies
M	71	71.1	71.12	Engineering activities and related technical consultancy

Figure 1: NACE industry classification in sections, divisions, groups, classes

We don't dispose of any methodological guidance about the best granularity level to perform EDP. For instance, is it better to perform EDP at the level of industry sections, industry divisions, industry groups, or industry classes? The JRC application *Eye@RIS3: Innovation Priorities in Europe* which depicts S3 priorities across Europe shows that most member-states and regions have selected priorities (thus performed EDP) at the level of industry section or division. This is rather a low granularity EDP, which obstructs a clear understanding of industrial diversification because sections and divisions include a mix of industrial activities with very different features and future trajectories.

These gaps in theory and methodology are reflected in the EDP process followed in Greece in the period 2014-2020 (see the report GOOD GOVERNANCE OF RIS3 GREECE, 2021-2027, pp. 26-29). At the national level, the process was undertaken by the GSRT and involved two basic steps. The first was an exploratory study and consultation, extensive bibliographic analysis, and elaboration of findings from recent strategy studies. This led to the identification of 8 domains where research and innovation might contribute to significant competitive advantage, considering the critical mass and excellence of the research potential. These domains are (1) Agrofood, (2) Life Sciences, Health - Medicines, (3) Information and Communication Technologies, (4) Energy, (5) Environment and sustainable development, (6) Transport and Supply Chain, (7) Materials – constructions, and (8) Culture - Tourism - Creative Industries.

The second step was related to the application of the Entrepreneurial Discovery Process in finding new business opportunities to exploit knowledge and integrate it into value chains. This process is aimed at further refining the above domains, highlighting the critical research priorities that should be included in the strategy, and highlighting synergies between the areas of specialisation, to achieve greater added value from the policy interventions. GSRT developed innovation platforms in the eight priority domains, which are the core of the EDP process at the national level, bringing together representatives from the sectors' businesses, research centres, universities, ministries and regions, and in general the stakeholders involved in the innovation system of each sector. For each Innovation Platform, a small Steering Group

has been set up consisting of experts with significant experience in the field with a mandate to identify the intervention areas and proposals for policy actions. The most important actions have been the National R&D Infrastructures Roadmap with 28 infrastructures (partly resulting from the EDP), and the Programme 'Erevno-Kainotomo' for research and innovation support towards companies and organisations in the above eight priority domains.

At the regional level, EDP has been performed by all Greek regions. Most advanced has been the EDP exercise realised in the region of East Macedonia and Thrace under the guidance of the JRC, which was organised at a 3-digit NACE group (wine, meat production, and dairy products). Informed EDPs were implemented in Central Macedonia, Western Greece, Epirus and Crete. All Greek regions have used methods of enquiry, analysis and discovery of opportunities, including mapping, foresight, workshops, focus groups, and others. In most of the cases the EDP process at the regional level was based on sectoral and thematic workshops thus being restricted to simple information collection without any use of more advanced tools. Concerning the participation and support of EDP by members of Regional Innovation Councils (PSEK) this has been limited in the majority of the regions.

Selectivity and exclusion are clearly reflected in the 8 priority domains selected at the national level. For instance, from the 24 manufacturing Divisions of NACE Section C (10-33) only 4 are included in the 8 priority domains (food, construction materials, pharmaceuticals, and electronics). However, it is difficult to find a good justification for this selection, especially regarding its narrow manufacturing focus.

Also, the industry granularity used is extremely fuzzy. Within the same domain (e.g. Life Sciences, Health – Medicines) and the respective innovation platform there are science fields (life sciences), services (health), and manufacturing activities (medicines). Some domains contain activities from many radically different industries, (e.g. culture, tourism, creative industries). Tourism is an amalgam of sectors that includes air transport, sea and coastal passenger water transport, real estate, accommodation, food and beverage services, rental and leasing activities, travel agencies and tour operators. It is not feasible to identify common challenges and emerging opportunities in such large and diverse domains. There are no common business, technology and innovation trends to be assessed under the same EDP process.

Having the above in mind, we address the problem of ***functioning EDP in Greece for the period 2021-2027,*** which includes: (1) the *prioritisation* and selection of activities for specialisation – diversification, and (2) the *discovery* of policy mix or design of policy actions, assuring consistency to priorities and wide impact to beneficiaries.
- Prioritisation refers to the identification of priority areas or activities that will be selected as the focus of S3 in which most public funding will be channelled.
- Discovery refers to the policy design and action plan of the S3 strategy. A key question is how EDP can best drive public funds to maximise a sustainable growth potential? Here an important concern is the policy mix derived from EDP, which must be public policy avoiding lock-in in private or specific interests. Bringing a significant amount of investment in a few actions has the risk to direct public funds to industries with only a few beneficiaries, which contradicts the principles of cohesion policy and inclusive growth.

Our survey on the ***prioritisation challenge*** is presented in section A1 of this report. We adopt a methodology based on data than theory. We start from the statement that all industries of a country or region have the potential for diversification and growth. We intend to test the feasibility of this approach in Greece. Instead of selecting a few industries and performing EDP in them, we examine the ***most important industries*** per region, in terms of size and specialisation. We test the feasibility of performing EDP at the level of NACE industry groups (272 groups) for all important industry groups per region of Greece. Our aim

is to assess whether the effort for this detailed EDP without initial exclusion of any important industry group is functional for Greece.

A survey that deals with the ***discovery*** challenge is presented in sections A2 and A3. Having included all important industry groups in the EDP process, we intend to assess whether EDP can address common challenges and drive the industrial transformation, assuring the public and inclusive character of EDP-derived policy measures and actions. We use the concept of ***platform*** and ***platform-ecosystem*** (fig. 1) to identify actions for the benefit of an entire industry group or ecosystem than the benefit of some companies and organisations. Supporting platform-based ecosystems we assure that EDP shapes policies for public goods that bring companies and organisations under the same challenges and objectives for collaboration and growth.
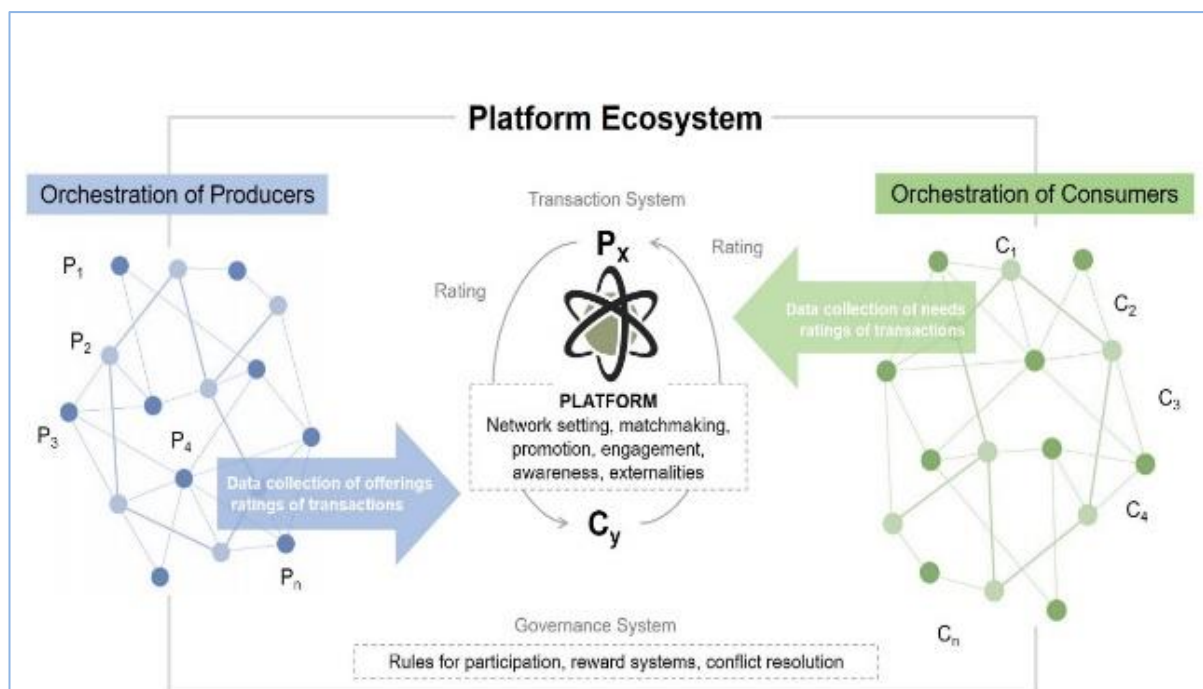
Figure 1: Platform-ecosystems and two-side orchestration

A1. Identification of most important industry groups and business ecosystems in Greece

Our aim at this stage of work is to assess whether it is functional to **perform EDP without excluding any important industry** in advance, even if theoretical knowledge allows for focusing the EDP investigation in some specific industries. Two reasons justify this orientation of work: (a) the widely accepted S3 principle for place-specific innovation strategy or "one-size-does-not-fit-all", which suggests that the most robust theoretical prediction should be assessed with place-specific data (Tödtling and Trippl, 2005), and (b) the probability of finding innovative solutions in less expected activities, a trend outlined by many aspects of innovation theory, such as the probabilistic and non-deterministic character of innovation, serendipity in innovation, and innovation outcomes by chaotic systemic combinations (Chenga and Van de Ven, 1996; Poutanen et al., 2016).

We assess the feasibility of EDP without exclusion at the NACE industry group level in five steps (a) starting with the regional distribution of industrial activity in Greece at the NACE group level, (b) defining the most important industry groups per region with respect to size

and specialisation, (c) defining the top-10 industry groups in the 13 regions of Greece, (d) assessing the diversity of industry groups in all regions of Greece and the total needs for EDP exercises, and (e) identifying industry groups with potential for ecosystem building.

1. Regional distribution of NACE industry groups

NACE rev 2 classifies industrial activities at 4 levels: in 21 Sections, 88 Divisions, 272 Groups, and 615 Classes. Regional data are available at the level of Sections, Divisions and Groups. Thus, the industry group level is the level of higher granularity and detail when it comes to regional data. If non-excluding EDP is functional at this level, then it is preferable to any other level of granularity.

Data on the regional distribution of NACE industry groups in Greece is provided by ELSTAT. The latest dataset is for 2016, and it is available at the address below
https://www.statistics.gr/el/statistics/-/publication/SBR01/-

The name of the dataset is "09. Αριθμός νομικών μονάδων, κύκλος εργασιών και απασχολούμενοι, σε τριψήφιο κλάδο οικονομικής δραστηριότητας και Περιφέρεια".
Three variables are given per region and NACE industry group, (1) number of legal entities (companies), (2) turnover, and (3) number of employees, under the following format.

ΠΕΡΙΦΕΡΕΙΑ	ΟΙΚΟΝΟΜΙΚΗ ΔΡΑΣΤΗΡΙΟΤΗΤΑ		ΑΡ. ΝΟΜΙΚΩΝ ΜΟΝΑΔΩΝ	ΚΥΚΛΟΣ ΕΡΓΑΣΙΩΝ (σε χιλιάδες €)	ΑΡ. ΑΠΑΣΧΟ-ΛΟΥΜΕΝΩΝ
	Κωδικός NACE Rev2	Περιγραφή			
ΑΝΑΤΟΛΙΚΗ ΜΑΚΕΔΟΝΙΑ ΚΑΙ ΘΡΑΚΗ	22.2	Κατασκευή πλαστικών προϊόντων	36	96,172.65	609

Table 1: ELSTAT dataset on the distribution of industry groups in regions of Greece

Based on this dataset, we calculated two more indicators per region and industry group (4) the Location Quotient based on a number of companies, and (5) the Location Quotient based on number of employees. The Location Quotient allows to evaluate the strength and size of a particular industry in a region. It quantifies how concentrated an industry is within an area compared to the country as a whole. Location Quotient is the most preferred index of specialisation. It is calculated as a proportion of an industry in a region compared to the proportion of the same industry in the country. Having those five variables, we created our **basic data matrix**, which comprises 7 columns and 3,536 lines (272 industry groups x 13 regions).

NACE	Name of industry group	Number of companies	Number of employees	Turnover (million €)	Specialisation computed on companies	Specialisation computed on employment
xxx Region of Greece						
xxx	XXXXXXX	Xx	Xx	xx	xx	xx
10.1	Processing and preserving of meat and production of meat products	49	863	130.45	3.87	3.2
yyy	YYYYYYY	Yy	yy	yy	yy	yy

Table 2: Basic data matrix: 272 industry groups in 13 regions of Greece

2. Ordering industry groups per region and index

For each one of the above indexes, we order the industry groups per region and select the first ten by size and specialisation. ***We produce four ordered lists of industry groups per region,*** by number of companies, number of employees, location quotient on companies, and location quotient on employment ***(top-40 industry groups)***. We did not use the turnover index, considering that the other two variables (number of companies and employment) represent better the size of industry groups.

We fine-tune these ordered lists of industry groups by removing industry groups having (a) limited entrepreneurial activity, such as forestry or mining, (b) small number of companies or public companies, such as mining or extraction of petroleum and gas, (c) utilities, such as electricity and water supply, (d) public services, such as public administration, defence, libraries and museum, etc., and (e) services in which self-employment dominate, such as legal and accounting, veterinary, etc. Industry groups that fall in the above categories of limited or no business activity are given below at section / division level.

NACE Sect./Div.	Name
A01	Agriculture
A02	Forestry
B05	Mining of coal and lignite
B06	Extraction of crude petroleum and natural gas
B07	Mining of metal ores
B09	Mining support service activities
D (D35)	Electricity, gas, steam and air conditioning supply
E (E36-E39)	Water supply; sewerage, waste management and remediation activities
F (F41-F43)	Construction
G (G45-G47)	Wholesale and retail trade; repair of motor vehicles and motorcycles
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
K65	Insurance, reinsurance and pension funding, except compulsory social security
K66	Activities auxiliary to financial services and insurance activities
L (L68)	Real estate activities
M69	Legal and accounting activities
M70	Activities of head offices; management consultancy activities
M73	Advertising and market research
M75	Veterinary activities
N77	Rental and leasing activities
N78	Employment activities
N80	Security and investigation activities
N81	Services to buildings and landscape activities
N82	Office administrative, office support and other business support activities
O84	Public administration and defence; compulsory social security
Q87	Residential care activities
Q88	Social work activities without accommodation
R91	Libraries, archives, museums and other cultural activities
R92	Gambling and betting activities
R93	Sports activities and amusement and recreation activities
S (S94-S96)	Other service activities

T (T97-T98)	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U (U99)	Activities of extraterritorial organisations and bodies

Table 3: Industry groups with low or null entrepreneurial activity

The fine-tuning of industry groups with respect to entrepreneurial activity shortens the full list of **NACE industry groups from 272 to 140,** capturing mainly activities of manufacturing and services provision. The number of industry groups that are not given attention is much lower because industry groups with limited business activity are not at the ten top positions in the ordered lists per size and specialisation.

Per region, the ordering and fine-tuning of industry groups by size (number of companies and employment) and specialisation (location quotient on number of companies and employment) produces a list of **top-40 groups,** in total 520 industry groups in the 13 regions of Greece. These industry groups are presented in **Annex 1,** ordered from larger to smaller by size and specialisation.

3. Top-10 industry groups per region

The Table of Annex 1 includes four ordered lists and shows the top-10 industry groups by (1) number of companies, (2) employment, (3) specialisation computed on companies and (4) specialisation on employment separately. This is not a combined ordering. A combined ordering includes industry groups that figure at the top-10 positions of all ordered lists. For a combined identification of industry groups per region we selected one after the other:
- Industry groups at the top-10 positions in all four lists
- Industry groups at the top-10 positions in three out of four lists
- Industry groups at the top-10 positions in one list related to size and one list related to specialisation
- If the above selection gives less than 10 industry groups, we fill the rest positions with industry groups that figure either in the two lists of size or the two lists of specialisation.

Table 4 shows this logic for defining top-10 industry groups per region. We start with the selection of groups that figure in all lists of size and specialisation and move down to industry groups with high specialisation only.

Top10 per # companies		Top10 per # employment		Top10 per specialisation on companies		Top10 per specialisation on			NACE	TOP10-Comp	TOP10-Empl	TO10 - LQ com	TOP10-LQ Empl
NACE	Index	NACE	Index	NACE	Index	NACE	Index						
55.1	1077	55.1	20284	10.4	8.12	10.4	6.39		55.1	1077	20284	2.51	2.97
10.7	591	10.7	3241	30.3	4.55	55.1	2.97		10.4	466	1237	8.12	6.39
72.1	499	79.1	2570	23.4	3.55	50.1	2.80		72.1	499	1323	1.98	1.69
10.4	466	50.1	1707	32.2	3.18	23.4	2.30		79.1	378	2570	2.14	2.04
79.1	378	72.1	1323	55.1	2.51	79.1	2.04		16.2	208		1.79	
62.0	351	10.4	1237	79.1	2.14	72.1	1.69		50.1	.	1707		2.80
90.0	269	10.1	791	72.1	1.98	32.2	1.65		10.1	.	791		1.14
31.0	235	31.0	699	25.2	1.88	13.9	1.51		10.5	95		1.87	
16.2	208	62.0	663	10.5	1.87	10.1	1.14		23.4	.		3.55	2.30
10.5	95	61.2	624	16.2	1.79	28.3	1.13		32.2			3.18	1.65

Table 4: Selection of top-10 industry groups per region

We consider these industry groups as the most important industry groups per region because they exhibit both significant size and specialisation. These top-10 industry groups per region or most important industry groups per region are presented in

Annex 2. Their share in the total of industry groups of Greece is between 34.04% and 42.22% (Table 5).

Industry groups	Number of companies	Number of employees	Turnover (million €)
Top-10 industry groups – all regions	32,670	211,320	29,464.93
All industry groups – all regions	95,989	547,869	69,814.48
Share of top-10 to all industry groups	34.04%	38.57%	42.20%

Table 5: Share of top-10 industry groups

4. Most important industry groups in Greece

Top-10 industry groups in the 13 regions of Greece (Annex 2) belong to 51 categories, of which 26 categories appear in more than one region and 25 in one region only. The 26 transregional industry groups hold 105 out of 130 (81%) top-10 positions in all regions of Greece. This finding indicates that with EDP in 51 industry groups we can cover all the most important industries of Greece, while with EDP in 26 industry groups we can cover 81% of most important industrial groups in Greece (Table 6).

NACE	Name	# Regions	NACE	Name	# Regions
55.1	Hotels and similar accommodation	8	63.9	Other information service activities	1
11.0	Manufacture of beverages	8	61.3	Satellite telecommunications activities	1
10.5	Manufacture of dairy products	7	61.1	Wired telecommunications activities	1
03.1	Fishing	7	50.2	Sea and coastal freight water transport	1
16.2	Manufacture of products of wood, cork, straw and plaiting materials	6	32.2	Manufacture of musical instruments	1
31.0	Manufacture of furniture	5	32.1	Manufacture of jewelry, bijouterie and related articles	1
03.2	Aquaculture	5	30.3	Manufacture of air and spacecraft and related machinery	1
25.1	Manufacture of structural metal products	4	29.1	Manufacture of motor vehicles	1
23.4	Manufacture of other porcelain and ceramic products	4	28.9	Manufacture of other special-purpose machinery	1
10.9	Manufacture of prepared animal feeds	4	26.7	Manufacture of optical instruments and photographic equipment	1
10.7	Manufacture of bakery and farinaceous products	4	26.2	Manufacture of computers and peripheral equipment	1
10.6	Manufacture of grain mill products, starches and starch products	4	26.1	Manufacture of electronic components and boards	1
10.3	Processing and preserving of fruit and vegetables	4	24.3	Manufacture of other products of first processing of steel	1
90.0	Creative, arts and entertainment activities	3	24.2	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	1
79.1	Travel agency and tour operator activities	3	23.6	Manufacture of articles of concrete, cement and plaster	1
72.1	Research and experimental development on natural sciences and engineering	3	23.3	Manufacture of clay building materials	1

50.1	Sea and coastal passenger water transport	3	22.2	Manufacture of plastic products	1
23.7	Cutting, shaping and finishing of stone	3	21.1	Manufacture of basic pharmaceutical products	1
16.1	Sawmilling and planning of wood	3	20.5	Manufacture of other chemical products	1
10.4	Manufacture of vegetable and animal oils and fats	3	18.2	Reproduction of recorded media	1
10.2	Processing and preserving of fish, crustaceans and molluscs	3	15.1	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness; etc	1
10.1	Processing and preserving of meat and production of meat products	3	14.2	Manufacture of articles of fur	1
62.0	Computer programming, consultancy and related activities	2	14.1	Manufacture of wearing apparel, except fur apparel	1
28.3	Manufacture of agricultural and forestry machinery	2	13.3	Finishing of textiles	1
22.1	Manufacture of rubber products	2	10.1	Processing and preserving of meat and production of meat products	1
10.8	Manufacture of other food products	2			

Table 6: Most important (Top-10) industry groups in regions of Greece
(Green: Manufacturing / Yellow: Services)

Having identified the most important industrial activities in Greece in 26 industry groups at the national level and 25 at the regional level, we now ***go deeper and look into those 51 industry groups*** that gather the most important industrial activities in the 13 regions of Greece. The main question is about the identification of industry groups that have the potential for ecosystem development and the business and innovation challenges a smart specialisation strategy should address.

5. Comparing most important industry groups and RIS3 2014-2020 sectoral priorities

In Annex 2 we have identified the top-10 industries per region of Greece with respect to size and specialisation and in Table 6 their overlap at the national and regional level. These most important industries of Greece should be given priority in S3 strategies. However, compared to RIS3 2014-2020 sectoral priorities, we find significant differences.

On the 13 tables of Annex 2, we give data that allow comparing the most important industry groups we found with RIS3 2014-2020 sectoral priorities. Per each of the 13 regions of Greece, we provide key KPIs (number of companies, number of employees, turnover, LQ computed on companies, and LQ computed on employment), and at the last two columns, the relation of each industry group to sectoral priorities in regional and national RIS3. However, conclusions don't come out easily and data can be interpreted in different ways.

First, the level of granularity of RIS3 priorities is much wider than the NACE industry groups we used to define the most important industries of Greek regions. This happens in all 13 regional RIS3 and the national RIS3 as well. RIS3 sectoral priorities are defined at the level of industry Sections and Divisions, or even wider classes (e.g. manufacturing in RIS3 Peloponnese).

Many sectoral priorities are expressed by an amalgam of industries (e.g. metal products and construction materials; agriculture and animal breeding) that don't correspond to existing industry sections or classes. These should be easily split into their components.

Most important, both in regional and the national RIS3, sectoral priorities are described by many "invented" categories that don't correspond to clear industry classes and for which the past and the future is unclear due to the absence of data. This is the case of classes used such as the "industry of experience" that includes tourism, local beverages, and cheese production; the "industry of well-being" at the interface between health, accommodation and tourism; "creative industries" that include marketing, architecture, arts, video games, photography, movie making, tv and radio broadcasting; "marine economy" that includes aquaculture, fisheries, sea tourism; "sustainable economy of social needs", and many other.

The lack of standardisation in the categories used to describe economic activities for prioritisation is an important barrier for forecasting trends or understanding the relationship and complementarity between regional and national RIS3. This fuzzy definition of priority activities should be addressed in 2021-2027.

Second, most industry groups that we found as important ones with respect to size and specialisation, are included in wider industry priority sectors defined in RIS3. However, inclusion happens because RIS3 priority sectors are extremely wide. For instance, the "agro-food" includes 8 industry groups that we found as most important ones, from aquaculture to dairy products, and the manufacture of beverages.

Third, the last two columns of the Tables in Annex 2 show a good correspondence of most important industry groups we found and RIS3 priority sectors. However, this is mainly due to regional RIS3 than the national S3 strategy. Apart from domains such as agrofood, ICT, transport, tourism-culture-spectacle, the other four national priorities (health, energy, environment, materials) have a limited interface with the important industry sectors we found.

Our analysis of industry groups and RIS3 priorities in Greece shows regional RIS3 match better to most important industry groups. Regional RIS3 than the national S3 capture better industry trends, especially in manufacturing, which is almost absent from national S3 priorities.

6. Identifying industry groups with potential for ecosystem development

In order to assess the potential for ecosystem development in the 51 industry groups identified (Table 6), we undertook a survey based on interviews with business stakeholders and experts in the 13 regions of Greece. Interviews were guided by open questionnaires, specific for each region, having the aim to identify potential business ecosystems into industry groups.

We defined ecosystems as groups of businesses that interact with each other and with their environment. Thus, we searched for industry groups in which companies work together, share common functional elements (physical resources, infrastructures, collaboration platforms, technologies, or share value chains) or other components that shape an interdependent growth.

The questionnaires driving interviews can be found at the addresses below:
1. East Macedonia and Thrace https://www.surveymonkey.com/r/7TTLQBW
2. Central Macedonia https://www.surveymonkey.com/r/7FKJVHF
3. West Macedonia https://www.surveymonkey.com/r/9SNCYKZ
4. Epirus https://www.surveymonkey.com/r/DXQJHHM
5. Thessaly https://www.surveymonkey.com/r/YRHW5NZ
6. Sterea Ellada https://www.surveymonkey.com/r/38WBLWG
7. Ionian Islands https://www.surveymonkey.com/r/3LW6DX6
8. Western Greece https://www.surveymonkey.com/r/3V9NN25
9. Peloponnese https://www.surveymonkey.com/r/3VPHC3V
10. Attica https://www.surveymonkey.com/r/37NDN2G

11. North Aegean https://www.surveymonkey.com/r/3DWDRG3
12. South Aegean https://www.surveymonkey.com/r/3YQ86V3
13. Crete https://www.surveymonkey.com/r/32VKZNH

We conducted 25 interviews. In each region, the top-10 industry groups were depicted, and we sought to identify among them those with ecosystem potential or common elements that provide ground for business operation and collaboration. Based on the interviews and the trans-regional presence of industry groups, **we selected 25 industry groups that have features of cluster-type ecosystems**. They have typical features of business clusters (geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field), such as (i) productive specialisation, (ii) geographical boundaries in a region, and (iii) high location quotients, higher than 2 in all cases and in some cases higher than 10. These industry groups/ecosystems are listed below.

East Macedonia and Thrace
22.2 Manufacture of plastic products
23.7 Cutting, shaping and finishing of stone
26.2 Manufacture of computers and peripheral equipment

Central Macedonia
10.3 Processing and preserving of fruit and vegetables
14.1 Manufacture of wearing apparel, except fur apparel
25.1 Manufacture of structural metal products

West Macedonia
16.2 Manufacture of products of wood, cork, straw and plaiting materials
14.2 Manufacture of articles of fur

Epirus
10.1 Processing and preserving of meat and production of meat products
10.5 Manufacture of dairy products

Thessaly
22.1 Manufacture of rubber products
31.0 Manufacture of furniture

Sterea Ellada
24.2 Manufacture of tubes, pipes, hollow profiles and related fittings, of steel

Ionian Islands
79.1 Travel agency and tour operator activities

Attica
90.0 Creative, arts and entertainment activities
62.0 Computer programming, consultancy and related activities
21.1 Manufacture of basic pharmaceutical products

Western Greece
03.2 Aquaculture
10.9. Manufacture of prepared animal feeds

Peloponnese
11.0 Manufacture of beverages

North Aegean
10.4 Manufacture of vegetable and animal oils and fats
03.1 Fishing

South Aegean
50.1 Sea and coastal passenger water transport

Crete
55.1 Hotels and similar accommodation
72.1 Research and experimental development on natural sciences and engineering

7. Some provisional conclusions and further questions

This analysis of industry distribution, size and specialisation documents the following:
- 51 NACE industry groups gather the most important activities of manufacturing and services in Greece.
- Thus, EDP at the level of important industry groups, without exclusion, requires 51 exercises, of which 26 should be trans-regional (or national) and 25 regional. This is the maximum of EDP exercises, given that we used the most detailed level of industry classification.
- EDP in 26 industry groups that figure in the top-10 positions in more than one region should be performed at the national level to assess trans-regional collaboration and common needs across the region.
- EDP in 25 industry groups that figure in the top-10 positions in one region only should be performed at the regional level as they reflect local context and conditions.

Now, a further question is whether we should perform EDP in all those 51 cases or some industries don't meet the conditions for a successful outcome? For instance:
- Can we state common challenges in each and every of the 51 industry groups?
- Is there critical innovation capacity and motivation for innovation in all 51 industry groups?
- Is there potential for ecosystem building for the benefit of all companies of an industry group?

To answer these questions, we undertook another survey on the 25 industry groups having potential for ecosystem building. We started with (a) desk study of business and challenges per industry group, examining the profile, structure, business and growth challenges, (b) continued with a survey on research and innovation demand per industry group/ ecosystem based on GSRT data from the 'Erevno-Kainotomo' programme, and (c) ended up identifying challenges and platforms that may orchestrate companies towards common goals and ecosystems. The latter is particularly important when it comes to maintaining EDP as a public policy that promotes collective rather than individual goals.

A2. Profiling industry groups and business ecosystems

In this section, we give a short profile of 25 industry groups (1 page per group) that have the potential for ecosystem development. Per industry group, we give data related to size and specialisation, regional distribution, and outline growth and innovation challenges.

More detailed descriptions per industry group are given in Annex 3. Each report comprises 5 sections: (1) industry group/ecosystem profile, (2) relationship to regional RIS3 priorities, (3) business and growth challenges, (4) research and innovation demand, (5) common challenges and potential areas for platform-based ecosystems. These brief reports, 4-6 pages, allow for an assessment of whether a platform ecosystem can be created in an industry group.

Various sources of data are used to this end: (1) sectoral studies published by the Foundation for Economic and Industrial Research (IOBE) or other organisations, (2) data from the ICAP database or financial performance indexes per industry published in the annual studies of ICAP, (3) other secondary data sources, such as company websites, news, and reports from related industry associations, and (4) data from the GSRT on research proposals submitted to Erevno-Kainotomo programme (A & B calls). The survey in each of the above 25 industry groups reveals main business challenges, growth trends and patterns, and allows defining platforms and commons on which policy actions for ecosystem building can be launched.

1. Profiles of industry groups with potential for ecosystem development

03.1 Fishing in North Aegean

This group includes:

03.11 Marine fishing: fishing on a commercial basis in ocean and coastal waters, taking of marine crustaceans and molluscs, whale catching, taking of marine aquatic animals: turtles, sea squirts, tunicates, sea urchins etc. It also includes activities of vessels engaged both in marine fishing and in processing and preserving of fish, gathering of other marine organisms and materials: natural pearls, sponges, coral and algae.

03.12 Freshwater fishing: fishing on a commercial basis in inland waters, taking of freshwater crustaceans and molluscs, taking of freshwater aquatic animals and gathering of freshwater materials.

It is one of the most frequent industry groups in Greece, as it is within the top-10 industries in seven regions:

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
North Aegean	599	721	7.49	4.72	7.28
Eastern Macedonia and Thrace	414	1.065	21.15	2.17	4.02
Western Greece	413	590	6.34	1.44	2.42
Ionian Islands	451	540	3.35	2.76	2.53
South Aegean	1,067	1,333	13.87	3.17	2.35
Peloponnese	533	604	5.61	2.03	2.46
Central Greece	741	1.192	13.32	3.14	5.06

Business challenges: Greece has a long tradition and history in fishing and shipping. Despite its limited contribution (below 3.1%) to gross domestic product (GDP), Greek fisheries are a primary sector of high socio-economic importance, especially in coastal areas and in areas traditionally dependent on fisheries, such as the islands. In 2016, the fishing areas from the Thermaic Gulf to the Thracian Sea accounted for 56% of Greece's catches, and the species with the largest catches were anchovy (15.5% of total) and sardine (14.6%). The marine fisheries face the challenge to balance the sustainability of stocks and the income of fishermen. Given that 94% of the Greek fishing fleet consists of small-scale coastal fishing vessels, with limited capacity and age, the industry is characterized by low levels of competitiveness and financial performance. In terms of human resources, most fisheries workers are elderly and under-trained. Overfishing in combination with illegal fishing and trade poses a threat to certain species, especially sharks and skates, as at least 50-54% of their population is at risk. A recent study demonstrates that mislabeling of such species (named elasmobranch) in North Aegean reach 60% of the specimens found in Greek fish markets. The challenge for the fishing sector in Greece is to become a sustainable fishing industry, with healthy stocks, sustainable marine and coastal ecosystems, while at the same time achieving environmental, economic and social stability for coastal communities. The modernization of fishing infrastructures (vessels, landing sites, ports and shelters) together with a strategy for protecting and restoring biodiversity of wetlands and aquatic ecosystems, should be the top priorities for the sector's development.

Research and innovation challenges: Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows that there is limited interest in developing research and innovation in the sector of fishing, despite its importance for the Greek economy. The research interest is mainly focused on aquaculture and it remains open to discussion whether regional and national policies should promote research and innovation in the fishing sector in Greece.

03.2 Aquaculture in Western Greece

The Group 03.2 comprises

03.21 Marine aquaculture: fish farming in seawater including the farming of marine ornamental fish, production of bivalve spat (oyster mussel etc.), lobsterlings, shrimp post-larvae, fish fry and fingerlings, growing of laver and other edible seaweeds, the culture of crustaceans, bivalves, other molluscs and other aquatic animals in seawater, as well as aquaculture activities in brackish waters, in salt water-filled tanks and reservoirs.

03.22 Freshwater aquaculture: fish farming in freshwater including the farming of freshwater ornamental fish, the culture of freshwater crustaceans, bivalves, other molluscs and other aquatic animals, operation of fish hatcheries (freshwater) and farming of frogs.

The group is within the top-10 industries in five regions:

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Western Greece	34	766	87.72	1.95	4.74
North Aegean	6	216	28.35	0.78	3.29
Epirus	74	387	37.68	8.36	3.04
Ionian Islands	4	178	34.12	0.41	1.26
Central Greece	33	647	91.85	2.31	4.14

Business challenges: Aquaculture is a vital economic sector of modern food industry and the promotion of sustainable development of European aquaculture is a key priority, as it is underlined in the Common Fisheries Policy (CFP) of the EU. The growing market demand for certain species that are produced in Greece (such as sea bream and sea bass), combined with the favourable climate conditions and the country's extensive coastline, constitute aquaculture one of the vital sectors for development for the region and thus the country. At a national level, 62% of domestic fishery production comes from aquaculture and 38% from fisheries. In addition, aquaculture is a strongly extroverted sector, as approximately 80% of its production is traded outside Greece and the main target countries are Italy, Spain and France, accounting for 60% of the Greek production. The ecosystem mostly comprises of family, small and medium-sized enterprises, while there are also larger groups with vertical companies that apart from feeding fish, produce offspring, foods and fixed equipment. The aquaculture sector aims to meet the increasing demand and claim market shares from third Mediterranean countries that have much higher growth rates.

Research and innovation challenges: It is noteworthy that the high level of know-how acquired, the intensive research, experimentation and development at the aquaculture infrastructure have led to an increase in the efficiency of the industry and a reduction in the production cost as well as the cost of capital per unit produced. Improving productivity of existing plants, while expanding activity and product innovation as well as establishing new plants, are among the main requirements for the development of the aquaculture sector in Western Greece. Analysis of GSRT data shows a mid-level demand for innovation and main areas of research and innovation related to

- Development and evaluation of new systems and technologies for the diagnosis and control of pests and diseases in all sectors of the agri-food chain.
- Improving knowledge on the metabolism and nutritional requirements of farmed fish. Development of indicators and methods of early detection of ineffective nutrition.
- New methods for the treatment of viral and bacterial infections.
- New farming technologies for precision aquaculture.

10.1 Processing and preserving of meat and production of meat products in Epirus

This group:

> *10.11 Processing and preserving of meat*: slaughterhouses engaged in killing, dressing or packing meat; the production of fresh, chilled or frozen meat, in carcasses; the production of fresh, chilled or frozen meat, in cuts, production of hides and skins originating from slaughterhouses, including fellmongery; the rendering of lard and other edible fats.
>
> *10.12 Processing and preserving of poultry meat*, slaughterhouses engaged in killing, dressing or packing poultry; the production of fresh, chilled or frozen meat in individual portions and the rendering of edible poultry fats.
>
> *10.13 Production of meat and poultry meat products*, production of dried, salted or smoked meat and the production of meat products (sausages, salami etc.).

Apart from Epirus, the group is within the 10-top industries in other three Greek regions.

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Epirus	43	2,260	613.75	4.43	11.58
East Macedonia and Thrace	49	863	130.45	3.87	3.2
Thessaly	52	688	123.94	2.59	1.88
Crete	19	791	11.,49	0.78	1.14

Business challenges: The meat processing industry belongs to the agrofood sector and is one of the strongest sectors in Greece with a turnover of about 10 bl. euros. The sector is highly dependent on imports from other countries (e.g. Germany, France, The Netherlands, Poland, Spain). In Epirus, all types of meat are produced (cows', pork, lamb, poultry) while the special climate conditions of the region enable the exploration of other possibilities for new products and breeds (turkey, rabbit). Both animal farming and meat processing and preservation face fierce competition from imported products. In Epirus, as in the rest of the country, the industry (in all meat categories) includes some vertical large-sized companies which dominate most of the domestic market (e.g. KREKA, GIOLDASIS, HITAS, NITSIAKOS etc.) and many small-sized family companies which produce traditional products. Large companies (mainly in the poultry and pork sector) with vertically integrated units have slaughterhouses in their premises and are able to deal with all stages of product development, from the rearing and slaughtering of animals to meat production, processing (de-boning and shredding), standardisation and the production of meat products. Few companies have extended this verticalisation also to feeding stuff. Small units, on the other hand, have problems complying with storage and distribution in terms of quality control and compliance to the institutional framework for the production of meat.

Research and innovation challenges: Local businesses have to differentiate and maintain their competitive advantage. First, the development of innovative products adapted to contemporary nutritional needs and preferences (e.g. readymade or pre-cooked meat-based meals, meat preparations, organic meat, the incorporation of meat in other types and categories of processed/packaged food etc.) can create an opportunity for companies of the meat processing sector. Second, the modernisation of operations in the processing of traditional products (automation, sanitation techniques, novel packaging which extends the product's shelf life), is expected to improve quality consistency as well as productivity of regional enterprises. Analysis of GSRT data on research proposals participation shows mid-level demand and main areas of research and innovation related to development and application of innovative technologies to improve reproductive performance and ensure the hygiene and quality of the products produced; development of products aimed at preventing pathological conditions and improving the quality of life; innovative applications of genomics, proteomics, metabolomics, and new biotechnological methods.

10.3 Processing and preserving of fruit and vegetables in Central Macedonia

Group 10.3 comprises

10.31 Processing and preserving of potatoes: manufacture of prepared frozen potatoes, dehydrated mashed potatoes, potato snacks, potato crisps, potato flour and meal and industrial peeling of potatoes.

10.32 Manufacture of fruit and vegetable juice: manufacture of fruit or vegetable juices and production of concentrates from fresh fruits and vegetables.

10.39 Other processing and preserving of fruit and vegetables: manufacture of food consisting chiefly of fruit or vegetables, freezing, drying, immersing in oil or in vinegar, canning etc., manufacture of fruit or vegetable food products, manufacture of jams, marmalades and table jellies, manufacture of nut foods and pastes, and manufacture of perishable prepared foods of fruit and vegetables.

The 10.3 group is in the top-10 industries in four regions:

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Central Macedonia	177	5,464	786.36	1.49	2.44
Western Greece	64	737	130.1	1.97	2.04
Thessaly	74	1,967	277.05	2.13	3.71
Peloponnese	68	1,433	188.78	2.29	3.94

Business challenges: Companies in this sector focus primarily on food processing in terms of sorting, standardization, processing and packaging. There are relatively large companies with good productivity per employee that have grown over the last decade. The raw materials come from a common group of producers and there are collaborations between industries in the value chain; often a company's products are used as raw materials for other companies in the industry. In Central Macedonia, there are significant specialized business ecosystems with certain criteria, such as export activity (peach processing cluster in Imathia), international competitiveness (olive processing plants in Thessaloniki, Pieria and Halkidiki), innovation (food canning industries, products, based mainly in the Industrial Area of Thessaloniki).

Research and innovation challenges: GSRT data show high demand for research and innovation, which is mainly in processing and packaging technologies, hygiene and quality of products, labelling of products, such as

- Improving, developing and evaluating new varieties. Recognizing and evaluating the particular characteristics of indigenous plant species.
- Innovative techniques for selective harvesting, processing, packaging, fruit and vegetables, soft management systems of vegetable products (ripening indices - storage conditions).
- Development and evaluation of new systems and technologies for the diagnosis and control of pests and diseases through all sectors of the agri-food chain.
- Development and implementation of innovative technologies in agri-food businesses to improve reproductive indicators and ensure the hygiene and quality of the products produced.
- Modern technologies of packaging, processing, post-harvest maintenance of agricultural products and food.
- Development and application of new technologies in the standardization, labeling, traceability of products and foods from vegetable and animal production.

10.4 Manufacture of vegetable and animal oils and fats in Northern Aegean

This group includes

10.41 Manufacture of oils and fats: manufacture of crude vegetable oils, olive oil, soya-bean oil, palm oil, sunflower-seed oil, cotton-seed oil, rape, colza or mustard oil, linseed oil etc; manufacture of non-defatted flour or meal of oilseeds, oil nuts or oil kernels, manufacture of refined vegetable oils: olive oil, soya-bean oil etc, and the processing of vegetable oils, blowing, boiling, dehydration, hydrogenation etc.

10.42 Manufacture of margarine and similar edible fats, which includes the manufacture of margarine, melanges and similar spreads, and the manufacture of compound cooking fats.

The 10.4 group is in the top-10 industries in three Greek regions:

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
North Aegean	96	285	36,66	4,86	10,08
Crete	466	1.237	201,5	8,12	6,39
Central Greece	138	333	40,665	3,76	4,95

Business challenges: The production of vegetable olive oil is the main product in Northern Aegean in this industry group. Lesvos is one of the largest olive-growing areas. Lesvos's olive trees are estimated at 11 million and occupy about 450,000,000 sm or 6,2% of the total olive trees area of Greece. There are 82 mills on the island - of which 56 are operating - and 3 are olive grounding mills. Key challenges in the olive oil production of Northern Aegean and at the Lesvos island, in particular, are: (1) high quality but low branding, only 27 per cent of Greek production reaches the stage of labelling/branding, compared with 50 per cent in Spain and 80 per cent in Italy, with the remainder sold in bulk form, including 70 per cent of exports (mainly to Italy for re-export, (2) backward production and high costs, structural problems are due to the small size and traditionality of firms, firms are not vertically integrated with the olive farming stage and the distribution stage, existence of many olive oil cooperatives that does not facilitate the standardization of quality control, (3) the small size of bottling and labelling companies, (4) losing share in the world oil production, and (5) environmental pollution, as during processing of the olive fruit in the mills, a series of by-products are produced in addition to the olive oil. These are the olive kernel, which consists of ground solid components of the fruit (mainly the kernel), the olives leave transported with the olive tree, and a significant volume and organic amount of liquid waste (known as "Katsigaros").

Research and innovation challenges: the research and innovation demand is for
- Innovative processes for optimizing traditional products and producing new products with superior features
- Utilization of underutilized and by-products of Greek raw materials for the production of new foods
- Development of methods, mechanisms, tools for verifying food authenticity and protecting consumers against fraud or fraud in Greek traditional value-added products and foods.

There is high research and innovation demand for topics related to this industry as well as for technologies against environmental pollution, which are urgently needed. Most of the mills of Lesvos operate in an illegal regime. Only 4 of the 56 have a normal operating permit, while the rest receive small extensions as they dump their waste into streams or the sea.

10.5 Manufacture of dairy products in Epirus

This group includes the operation of dairies and cheese making and the manufacture of ice cream:

10.51 Operation of dairies and cheesemaking: manufacture of fresh liquid milk; manufacture of milk-based drinks; manufacture of cream from fresh liquid milk; manufacture of dried or concentrated milk whether or not sweetened; manufacture of milk or cream in solid form; manufacture of butter; manufacture of yoghurt; manufacture of cheese and curd; manufacture of whey; manufacture of casein or lactose.

10.52 Manufacture of ice cream, which includes the manufacture of ice cream and other edible ice such as sorbet.

The dairy industry is one of Greece's strongest in the packaged food sector. It accounts for the second largest turnover (14%), has the third-highest productivity rate (49.3 euros per employee per hour) and is the third-largest employer (with over 15,000 employees) among all other industries in the Greek packaged food sector. The 10.5 group is within the top-10 industries in seven Greek regions.

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Epirus	37	616	147,977	1.83	2.66
North Aegean	38	217	45,11	2.17	1.81
West Macedonia	43	149	22,248	2.21	0.9
Western Greece	74	549	130,92	1.86	1.86
Thessaly	84	2,077	593,64	2.01	4.79
Ionian Islands	29	65	11,695	1.29	0.25
Crete	95	389	67,77	1.87	0.47

Business challenges: In Epirus, as in the rest of Greece, the majority of enterprises producing traditional dairy products are of small size and production capacity and they mainly serve the local market (family dairies). The few large production units cover a significant part of the domestic market offering a wider range of products. In particular, through their organised and large distribution network they have managed to cover most of the Greek territory while a couple of companies have also developed significant exporting activity. In Epirus, 90% of the enterprises process only sheep and goat milk and only 10% process cow's milk. Three Greek Protected Designation of Origin (PDO) cheeses are produced in Epirus (feta, kefalograviera and galotiri) while Metsovone cheese which is also PDO is produced only in Epirus. Yogurt is another competitive product that shows significant exports.

Research and innovation challenges: Some of the main business challenges that can be addressed through technological advancements are (1) consistency in the quality of traditional dairy products such as cheese, (2) improved sanitation and at the same time reduction of wastewater, achieving both cost efficiency and environmental issues, (3) new packaging (packaging in different formats and sizes, e.g. enclosable, snack packs etc., product-specific packaging etc.). In these areas is the demand for research and innovation as recorded in GSRT data, which is high in areas such as

- Innovative processes for optimizing traditional products and producing new products with superior features.
- Development of methods, mechanisms, tools for verifying food authenticity and protecting consumers from fraud or fraud in Greek traditional value-added products and foods.
- Modern technologies of packaging, processing, post-harvest maintenance of agricultural products and food.

10.9 Manufacture of prepared animal feeds in Western Greece & Epirus

This group comprises
10.91 Manufacture of prepared feeds for farm animals: manufacture of prepared feeds for farm animals, including concentrated animal feed and feed supplements. It also includes the preparation of unmixed (single) feeds for farm animals, as well as treatment of slaughter waste to produce animal feeds.
10.92 Manufacture of prepared pet foods: manufacture of prepared feeds for pets, including dogs, cats, birds, fish etc., as well as treatment of slaughter waste to produce animal feeds.

The 10.9 group is within the top-10 industries in four regions:

Region	No of companies	Employment	Turnover (in million €)	Specialisation -companies- based	Specialisation -employment- based
Western Greece	13	77	19.36	1.6	1.74
Epirus	20	305	50.52	4.83	8.78
Peloponnese	27	256	107.71	3.64	5.75
North Aegean	8	37	6.29	2.23	2.06

Business challenges: The manufacture of animal feeds is considered a supporting activity for agricultural production and livestock, thus, are part of the food value chain. Animal feeding is an essential link in the livestock chain, i.e. between crop cultivation and animal protein production and processing. In Epirus, agricultural production is mainly complementary to animal production, as large-scale crops are used to cover feed requirements. Animal feed is also a crucial element of the global food industry, as it is one of the major constituents for ensuring safe and nutritious means of animal proteins. At the same time, it represents the largest input cost, of around 75% of the total cost for livestock producers, depending on the animal species and its specific requirements.

The feed industry faces diverse challenges, regarding both internal and external factors. Among the external factors is the supply of raw materials that results in competition for natural resources and trade barriers. At the same time, there are growing concerns about food and its impact on health, as well as about the environmental impacts of the production systems on animal welfare, including water, soil and air pollution, climate change, land and water use, and biodiversity. In particular, animal welfare together with the viability of rural areas have drawn much attention in Europe and are now part of the policies and regulations of public authorities.

Research and innovation challenges: The food industry and, consequently, the global animal feed industry is mainly driven by consumer shift towards a healthy diet, population growth, improved cold chain logistics, as well as the increasing adoption of automation systems. At the same time, there is an urgent need for companies to commit to sustainability and manage their entire cycle of operations.

Top research and innovation challenges recorded in GSRT data are related to
- Potential of using innovative medicinal/aromatic plants and exploring their use in the food, cosmetic and animal production industries.
- Investigation of production of innovative livestock crops / industrial crops.
- Investigation of the use of alternative protein feeds in animal production.

11.0 Manufacture of beverages in Peloponnese

This group includes the manufacture of a wide range of beverages, such as

11.01 Distilling, rectifying and blending of spirits
11.02 Manufacture of wine from grape
11.03 Manufacture of cider and other fruit wines
11.04 Manufacture of other non-distilled fermented beverages
11.05 Manufacture of beer
11.06 Manufacture of malt
11.07 Manufacture of soft drinks; production of mineral waters and other bottled waters,

Manufacturing of beverages in Peloponnese is the sector with the highest regional specialisation (4.02 higher compared to Greece) with regards to the number of companies. Apart from Peloponnese, this industry group is within the top-10 industries in other six Greek regions.

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
East Macedonia and Thrace	87	708	87.59	2.56	2.82
North Aegean	66	306	42.01	2.92	3.26
West Macedonia	53	147	11.27	2.11	1.14
Western Greece	84	425	81.81	1.64	1.84
Epirus	23	585	126.48	0.88	3.22
South Aegean	47	408	53.66	0.78	0.76
Peloponnese	188	520	76.35	4.02	2.23
Central Greece	98	658	152.57	2.33	2.95

Business challenges: Manufacture of beverages is a highly dynamic sector. The sector is highly extroverted with 69% of the domestic production is exported and a positive trend over the last years on trade balance (the trade deficit has been reduced significantly from 152 mil. euros in 2010 to 76 mil. euros in 2016). Apart from the traditional beverages such as ouzo, tsipouro and retsina, the country has significant activity in wine production and an emerging interest in beer production with the establishment of more than 30 microbreweries in different areas of Greece. The wine sector in Peloponnese shows signs of extroversion and is characterised by bottom-up collaborations. The exploitation of collective bodies and producers' openness to collaborative actions for the development of vertical and horizontal productive networks for the promotion of local wine that could stretch beyond the narrow value chain delineation of the product. Tourism, for example, is an advanced sector and, therefore, the establishment of synergies with the touristic sector should be further explored through the roads of wine in Peloponnese, oenological museums or other cultural initiatives, the development of collaboration agreements with tourist operators and businesses, the promotion of ecotourism etc.

Research and innovation challenges: GSRT data show high demand for research and innovation, which is focused on (1) the need for study of varieties and the development of a standard protocol for the clonal selection of grapevine varieties to rescue and promote local varieties of Peloponnese, (2) technological innovation in vertical operations of wine-producing, from the cultivation of vineyard (e.g. monitoring climate conditions and how they affect product properties and product quality, precision agriculture), to processing operations, distilling, bottling and labelling, as well as distribution and marketing (e.g. exploitation of traceability methods), (3) utilisation of new technologies for the valorisation and management of waste and by-products as well as technologies for the minimisation of energy consumption, and dealing with the industry's sustainability.

14.1. Manufacture of wearing apparel except for fur apparel in Central Macedonia

The Group comprises the following activities
14.11 Manufacture of leather clothes
14.12 Manufacture of workwear
14.13 Manufacture of other outerwear
14.14 Manufacture of underwear
14.19 Manufacture of other wearing apparel and accessories

The industry is within the top-10 industry groups in Central Macedonia only. It is the third larger in Central Macedonia in terms of the number of companies, employment, and turnover.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
14.1	Manufacture of wearing apparel, except fur apparel	995	4,552	344.19	2.18	2.41

Business challenges: The wider clothing sector (NACE 14) is made up of small, mainly industrial units, but with a high degree of expertise and flexibility. These plants produce products for demanding markets such as the United Kingdom, the United States of America, Germany, etc. in high value-added products. The industry belongs to high-export sectors of Greece with a share of 4,8% of total exports (5th position among all sectors in 2010), also the Gross Profit Margin is among the highest of Greek manufacturing (29,6%). But gradually this leading position in exports and profitability is eroded. In 2019, the sector has been characterised by two different trends, one concerning exports and another the domestic market. Across the border, in exports, the estimate is that the industry is heading for a record decade in 2019. In the domestic market, on the other hand, wholesale and retail sales fell sharply. Recent data shows a recovery of the industry based on "branded clothing", which is gaining ground, with high export sales of branded Greek clothing rather than "private label" clothing.

Until recently, "private label" clothing, which was sewn in Greece on behalf of foreign companies, had a significantly higher share of Greek exports than brand names, but in recent years the gap has been closing rapidly. This is not because "private label" exports are falling - on the contrary they are steadily increasing - but because sales of "branded Greek" clothing abroad are going faster.

Research and innovation challenges: GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows a mid-level demand for research and innovation in the area of design. Exploitation and development of innovative design methods and technologies (e.g. customization, optimization, mass customization, etc.), digital production tools and tools (e.g. CAM, 3D printing, CNC, robotic systems, innovative tools etc.) to improve design processes, prototyping and manufacturing in the areas of clothing/fashion, jewelry, optical communication, industrial design, product design, etc.

14.2 Manufacture of articles of fur in Western Macedonia

The group comprises the *manufacture of articles of fur*, including the manufacture of articles made of fur skins; fur-wearing apparel and clothing accessories; assemblies of fur skins such as "dropped" fur skins, plates, mats, strips etc.; and diverse articles of fur skins, such as rugs, unstuffed pouffes, industrial polishing cloths.

In total, 735 companies of this group are located in the prefecture of West Macedonia, with 2,631 employees and a 124.23 million turnover in 2017. This industrial group is the largest in West Macedonia in terms of the number of companies, employment, and turnover. Compared to total Greece, the regional specialisation is huge, 42.46 to 68.22 times higher, depending on whether it is computed on the number of companies or employment. The manufacture of articles of fur holds the 1st position among the sectors of economic activity in West Macedonia, in terms of the number of companies, employment, turnover, and specialisation.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
14.2	Manufacture of articles of fur	735	2,631	124.23	42.46	68.22

Business challenges: Exports are the most important challenge. Fur farming and manufacture of fur articles belong to sectors of the Greek economy that have lost market shares, probably due to traditional production and promotion models, and they were not modernised in time to maintain their strong position in international markets. The industry has experienced a sharp drop in demand from abroad over the past four years as events unfolding during the Russian-Ukrainian conflict have caused a devaluation of the ruble, thereby limiting the purchasing power of Russian consumers. Demand shrinkage has led most businesses to temporarily suspend their productive activities as they have stocks of ready-made goods that have difficulty shipping overseas. However, following a four-year downturn, the outlook for domestic fur trading is positive, as Russia's economy has begun to recover. Russia remains the most important market for Greek fur skins and apparel and accounts for 43.2% of Greek exports. The traditional Ukrainian market is growing significantly, as is the market in Hong Kong, Denmark, and the countries of the Balkan Peninsula. On the opposite side, the US market, as well as in the United Arab Emirates, declines sharply.

Research challenges: Research and innovation demand is very low. In the two rounds of Erevno-Kainotomo calls (A & B) only 2 proposals related to fur manufacturing have been submitted dealing with
- Development and implementation of innovative technologies in agri-food businesses to improve reproductive indicators and ensure the hygiene and quality of the products produced.
- Development of urban and industrial wastewater treatment systems.

There were no other proposals submitted from other regions, so this sector is closely related to the region of Western Macedonia and the overall interest on research and innovation appears quite limited.

16.2 Manufacture of products of wood, cork, straw and plaiting materials in Western Macedonia

This industry group comprises
  16.21 Manufacture of veneer sheets and wood-based panels
  16.22 Manufacture of assembled parquet floors
  16.23 Manufacture of other builders' carpentry and joinery
  16.24 Manufacture of wooden containers
  16.29 Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials

Veneer sheets, wood-based panels and assembled parquet floors are artificial timber, which is produced after strong and varied mechanical and / or chemical treatments of wood raw materials. Artificial timber does not retain any particular characteristics of the wood it came from, which is obtained by cutting and drying the tree trunks. It is made to deal with the serious defects that wood presents, namely the unevenness of strength, shrinkage, mud, fire resistance and more. The group is in the top-10 industries in six Greek regions.

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Western Macedonia	67	265	23.43	1.51	3.53
Epirus	168	376	8.45	3.64	3.57
Thessaly	186	598	45.48	1.95	3.03
Crete	208	386	9.08	1.79	1.03
North Aegean	152	401	11.23	1.43	1.29
Peloponnese	188	440	14.83	2.27	3.26

Business challenges: The artificial timber industry includes several product categories and is directly affected by the construction and furniture (kitchen, home, office) sectors. Since 2009, the sharp decline in demand for timber products caused by the financial crisis has gradually led to a shrinkage in domestic production, with most of today's consumption being covered by cheaper imports of either timber or imitation products. The production of timber products has declined in the year since the financial crisis, which negatively affected the industry, at about 68.6% of its capacity. This development was mainly the result of a sharp decline in the volume of orders for wood products used in construction and in general in the construction sector, given the severe decline in construction activity due to the economic crisis. It should be noted here that the total building activity has declined by 86% over the last decade. The overall downturn in the timber market was followed by furniture production, which fell by almost 72% compared to its level of production in 2008. However, reversal trends have been observed since 2016 and artificial timber products were up 5.3% over the previous year.

Research and innovation challenges: Search in GSRT data on research proposals with keywords "wood" sorted 3 proposals only, while no proposals were found including the words of "cork" and "plaiting". This reveals the limited interest in research and innovation both at a regional and at a national level. Technologies in focus are about
- Development of multifunctional construction and protection materials with increased durability and lifetime/efficiency
- Development of building materials with improved energy, functional and/or environmental performance
- Development or application of new building materials to improve durability and extend the life of construction, while improving the overall environmental and energy footprint.

21.1 Manufacture of basic pharmaceutical products in Attica

This group includes the following classes:
- *manufacture of medicinal active substances* to be used for their pharmacological properties in the manufacture of medicaments: antibiotics, basic vitamins, salicylic and O-acetylsalicylic acids etc.
- *processing of blood*
- *manufacture of chemically pure sugars*
- *processing of glands and manufacture of extracts of glands etc.*

In Attica, despite the small number of companies, the sector is first in terms of regional specialisation and fifth in terms of annual turnover. Indeed, Attica is the only Greek region with companies dedicated to the manufacture of basic pharmaceutical products and the ratio of employees and number of companies indicates mid-size companies in terms of employment.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-based
21.1	Manufacture of basic pharmaceutical products	19	1,215	646.22	2.42	2.02

Business challenges: The pharmaceutical industry is heavily affected by the demographic change reported during the last decade. In particular, population ageing directly affects population dependency ratio and, thus, health-care needs are higher. In 2018, Greece had an index of dependency at 53%, that is, for every 2 persons in the active population corresponds to 1 person inactive, which was close to the EU28 average (55%) and the average of the Southern countries (55%). The total spending for health has fallen by -30.9% in the period 2010-2017, with the largest decline in public funding which decreased by -38.2% for the same period. The significant reduction of public sector contribution to pharmaceutical spending has resulted in a shift to the private sector, particularly to the pharmaceutical industry. In addition to production of generic drugs, which is a main activity, businesses (currently a small number) are already active in producing small molecules for large pharmaceutical companies and with the support of research laboratories could consolidate and extend their presence at the stage of pharmaceutical discovery, relocation and drug re-targeting.

There are also several challenges lying ahead, including the increased competition from generic and biosimilar drugs, the transformative impact of disruptive technologies (like artificial intelligence, blockchain, wearable devices) in the health sector, the rise in chronic diseases and the overall slower growth rate in the market.

Research challenges: Despite the significant impact of the fiscal adjustment on public funding, the pharmaceutical industry is a driving force for investment with R&D spending accounting for 8% of total R&D spending in Greece in 2015. Research and innovation demand is mainly in the fields of (1) alternative / new routes of drug administration, (2) innovation in the production process of the drug, (3) characterization and action improvement with 'minor' variations of active ingredients and/or modifications to the structure of the active substance, (4) development of pharmaceutical forms and/or specialized devices in combination with the successful delivery / co-administration of known, (5) development of more faithful human disease models, optimizing pre-existing systems and their integration processes on preclinical testing platforms, (6) development of methodologies and protocols related to the documentation of drug safety at a preclinical level and the use of animal models.

22.1 Manufacture of rubber products in Thessaly

The 22.1 group comprises two product classes:

22.11 Manufacture of rubber tyres and tubes; retreading and rebuilding of rubber tyres
22.19 Manufacture of other rubber products

It is a small industry group comprising 9 companies only located in Thessaly that produce other rubber products (22.19). They are small and medium-sized companies with 237 employees and a 26.768 million turnover in 2017. This industrial group is among the smaller of the top-10 industry groups of Thessaly, measured in terms of the number of companies, employment, and turnover. Compared to total Greece, the regional specialisation is 1.89 to 10.66 times higher. The employment specialisation is the highest in Thessaly.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
22.1	Manufacture of rubber products	9	237	26.786	1.89	10.66

Business challenges: The rubber industry in Thessaly is an emerging branch. Some of the dynamic companies in the group are quite new. ELASTIKES ENOSIS SA, for instance, (http://elensa.gr/) diversified recently their activities and has become specialised in the production of steel cord and textile conveyor belts; belt splicing and repairing materials; vulcanizing devices, conveyor belt splicing and repairing services, and rubber lining services (pulley, pipings, etc.). It is the largest company in the group with 140 employees, good investments over the last five years, state-of-the-art mechanical equipment, specialized Quality Control laboratory, and large customers in Greece, Germany, and Spain.

The recycling of tires is another activity of this industry group. BIOTROCHOS SA (http://www.biotrohos.gr/) is a recycling company in Thessaly with state-of-the-art equipment for processing tires and producing quality products of specific specifications, such as black tire powder, rubber trim black of various dimensions, and rubber trim, green, security plates, vibration shutters, recycled rubber tiles, and other. Recycling of tires is supported by local authorities and is being implemented with the cooperation agreement signed by the Municipality of Larissa with the company ECOELASTIKA tire management.

Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows a very limited interest on research and innovation both at a regional and at a national level (2 only proposals in this thematic field).

The demand is for the development of alternatives for the absorption of tire recycling products, appropriate processing of end-of-life tires for the synthesis of new tires and similar tire-based products, and use of used tire treatment products in civil engineering works (concrete additives, earthworks, road construction, etc.).

22.2 Manufacture of plastic products in Eastern Macedonia and Thrace

The 22.2 group comprises
> *22.21 Manufacture of plastic plates, sheets, tubes and profiles (plastic plates, sheets, blocks, film, foil, strip etc)*
> *22.22 Manufacture of plastic packing goods (plastic articles for the packing of goods)*
> *22.23 Manufacture of builders' ware of plastic (builders' plastics ware, plastic doors, windows, frames, shutters, blinds, skirting boards)*
> *22.29 Manufacture of other plastic products (plastic tableware, kitchenware and toilet articles)*

In total, 36 companies of this group are located in the prefectures of East Macedonia and Thrace (EMT), mainly medium-sized companies with 609 employees and 96.172 million turnover in 2017. This industrial group is between the 4th and 7th larger in East Macedonia and Thrace in terms of the number of companies, employment, and turnover.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
22.2	Manufacture of plastics products	36	609	96.17	1.54	2.64

Business challenges: The gross added value of the Greek plastics industry stood at around € 1.7 billion in 2017 and it is slightly fluctuating in the period 2010-2017. The industry group of plastic products (22.2) has the lion's share in domestic production. The domestic industry of plastic products is located in four regions only (EMT, Epirus, Peloponnese, Attica) and the highest concentration is found in the region of East Macedonia and Thrace. The biggest challenge for the plastic products industry relates to legislation restricting the use of plastic products, as well as the shift of consumers to alternative products. Trying to move to a circular economy model poses significant challenges for the domestic plastics industry. The industry's prospects depend to a large extent on its ability to participate actively and constructively in the transition to a circular economy model. The goal is to use recycled PET in plastic bottles at 25% in 2025 and 30% in 2030. Measures to increase the share of reusable plastic packaging are being promoted, such as return systems guarantee, while the Member States are required to set national annual targets for the percentage of reusable packaging. A ban is introduced on use of certain disposable plastic products, such as plastic cutlery and expanded polystyrene dishes, straws, and food and drink containers. Other disposable plastic products, such as cups and food containers from others plastics, are subject to restrictions.

4. Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows very limited research and innovation demand with only 5 participations in proposals submitted.

The research topics are related to (1) polymeric and organic materials and integration of the above into various applications (consumer goods such as screens, clothes, packaging materials), but also into lighting systems, greenhouses, means of transport, robotic applications, artificial leather, bio-diagnostic leather electronics (2) development of advanced composite materials, organic, elastomers, for uses e.g. in transport, construction, energy, packaging or even for specialized applications, (3) technologies of plastics, bioplastics, biodegradable, special polymers for industrial and consumer products as well as specialized applications, and (4) food and agricultural packaging and preserving materials.

23.7 Cutting, shaping and finishing of stone in Eastern Macedonia and Thrace

This group includes cutting, shaping and finishing of stone for use in construction, in cemeteries, on roads, as roofing etc. The manufacture of stone furniture is also included in this group. On the contrary, this class excludes activities carried out by operators of quarries, e.g. production of rough cut stone, and production of millstones, abrasive stones and similar products.

There are 106 companies dedicated to cutting, shaping and finishing stone located in the six regional units of Eastern Macedonia and Thrace, with 1.431 employees and turnover of EUR 158,345 million in 2017. This group is fourth in the number of companies located in the region, while it comes first in terms of employment, turnover and specialisation. The group is also among the top-10 industries in three regions:

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Eastern Macedonia and Thrace	106	1,431	158.35	3.97	11.66
Western Macedonia	47	133	2.61	2.38	2.1
Peloponnese	75	283	12.7	2.05	2.48

Business challenges: The marble mining and trading sector in Greece has not been severely affected by the financial crisis of the last decade, at least as far as export activities are concerned. On the contrary, exports continued growing, accounting for almost 1,2 million tones a year, a fact that sets Greece as the third exporting leader in the industry after Italy and Turkey. However, there are crucial challenges that need to be tackled. First of all, in contrast to export activities, the domestic marble market has declined over time since 2008 with a cumulative decrease of 30%. At the same time, the need for high capital investment to meet international competition and modern technology requirements, as well as mandatory safety and certification requirements under the European framework for health and safety at work have to be addressed. There are also issues related to the state and the licensing of marble quarries, environmental remediation and sterile management in an activity with a useful mineral life of up to 10-15%.

Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows a mid-level demand for research and innovation. Three research and innovation areas can be identified (1) *related to materials*: Coatings with physicochemical functionality. Coating materials that adsorb or prevent the adsorption of chemicals, which allow or prevent the diffusion of substances through the coatings, or which influence chemicals in contact with the coating, such as photocatalytic coatings. (2) *Related to waste and reuse of materials*: Recycling & reuse of building materials, secondary materials & waste from extractive processes, used refractory materials from various furnaces and processes, metallurgical processes, industrial and/or secondary waste production. Development of waste treatment systems (inbound quality control, cutting, sorting, solidification, stabilization, mixing etc. and quality control of produced materials) before being promoted for subsequent recovery (such as recycling, energy recovery, conversion to high value-added products). (3) *Related to robotics and automation*: New-generation robots and support technologies applied to industry and service delivery. Operating in dynamic real-world environments, with enhanced capabilities for autonomy, adaptability and secure interaction with humans. Multi-scale modelling/simulation of complex production processes to optimize them, using advanced analytical methods (eg neural networks, artificial intelligence systems, molecular dynamics, hybrid methods, finite elements).

24.2.   Manufacture of tubes, pipes, hollow profiles and related fittings, of steel in Central Greece

This group includes the manufacture of seamless tubes and pipes of circular or non-circular cross-section and blanks of circular, precision and non-precision seamless tubes and pipes, welded tubes and pipes, flat flanges and flanges with forged collars, butt-welding fittings, and threaded and other tube or pipe fittings of steel.

Five (5) only companies of this industry are located in the Region of Central Greece with 129 employees and a 27.07 million turnover in 2017. This industrial group is the small of the top-10 in the Region in terms of the number of companies, employment, and turnover, but with a high degree of regional specialisation, which is 3.18 higher compared to Greece for the number of companies and 10.52 for employment. In none other Greek regions, this industry group is among the top-10 groups.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies -based	Specialisation - employment-base
24.2	Manufacture of tubes, pipes, hollow profiles and related fittings of steel in Central Greece	5	129	27.08	3.18	10.52

Business challenges: The size of the domestic market for steel pipes (tonnes) decreased by 60% in the period 2008-2018, due to the steep decline in the construction sector. It is noteworthy that some businesses have changed their business to cope with the increasing competition and the negative economic climate.

However, in recent years the market has experienced slight annual fluctuations (+ 1.3% in 2018/2017). In particular, the overall size of production has more than doubled in 2018 compared to 2017. The production rise however is due to exports than domestic market expansion. Construction and building activities as well as the implementation of large public works are among the main factors affecting the demand for steel pipes. Domestic production of steel pipes is characterized by a high concentration and covers only seam pipes, while demand for seamless steel pipes is entirely covered by imports. The fierce competition in the industry has deteriorated significantly in recent years due to the sharp decline in domestic demand following the economic downturn of the country that has hit investment strongly, with most companies in the sector turning to international markets to maintain their market position.

Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows extremely limited demand for research and innovation. Only two proposals have been identified related to this industry group. They concern (1) the development of production plants for secondary materials applying the principles of circular economy, and (2) the optimization of production processes.

25.1 Manufacture of structural metal products in Central Macedonia

This group includes the manufacture of structural metal products (such as metal frameworks or parts for construction). It comprises
    25.11 Manufacture of metal structures and parts of structures
    25.12 Manufacture of doors and windows of metal

This industrial group is the fourth larger in Central Macedonia in terms of the number of companies, employment, and turnover, with relatively a high degree of regional specialisation.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-based
10.4	Manufacture of structural metal products in RCM	867	3,664	280.96	1.72	2.14

Business challenges: In Central Macedonia manufacture of structural metal products is a highly dispersed industry with companies that vary significantly in size range and complexity of their products. The sector has a significant exporting activity towards EU countries and the Balkans, Turkey, countries of Northern Africa, and in some cases to more competitive markets such as the USA. During the last five years the sector has invested in product certification and standardisation of materials, complying with European legislation. This refers to the setting of requirements for design, fabrication and erection of steel and alloys of aluminium, together with materials, structural components and connections as applied in building, civil engineering and related structures. The main challenges of the sector are (1) *Automation (cost reduction) and energy efficiency*: The industry can optimise process technologies with the main purpose to reduce energy consumption and overall production cost, as well as to increase productivity. Also, despite the fact that steel is an infinitely recycled material, the industry has a significant environmental impact as it releases large amounts of carbon dioxide (CO_2) into the atmosphere. The adoption of cleaner production processes can increase energy efficiency and reduce the industry's carbon footprint. (2) *Improvement of logistics management*: The industry faces significant transportation costs due to the size and weight of the metal products. Improvements in logistics management together with the exploitation of key transport infrastructures can create significant added value to the industry and the value chain and improve its competitiveness.

Main research challenge is R&D in new materials: Understanding the real functional advantages and properties of products is crucial. The industry uses different steel varieties (most commonly high-strength low-alloy steels) for enhanced mechanical properties which are also corrosion-resistant. Innovations in alternative materials can disrupt the metal industry, while the use of key enabling technologies (KETs) can also address key problems that refer to product design, forming, joining of dissimilar materials, tailoring of surface properties etc.

Demand for research and innovation in the fields is at mid-level in areas such as (1) reinforcing and filling materials of load-bearing structural components in structures, with improved rheological, physic-chemical and mechanical properties, (2) development of coatings, films e.g. nanocomposite superhydrophobic materials, for the protection of visible metal elements, structures and cultural heritage works, (3) recovery of metals from industrial waste from metallurgical activities (e.g. steel slag) as well as critical for technological applications of metals from corresponding waste streams, and (4) zero error technologies and strategies in smart factories and integrated rapid configuration technologies for flexible manufacturing systems.

26.2 Manufacture of computers and peripheral equipment in Eastern Macedonia and Thrace

This group includes the manufacture and/or assembly of electronic computers, such as mainframes, desktop computers, laptops and computer servers; and computer peripheral equipment, such as storage devices and input/output devices (printers, monitors, keyboards).

In East Macedonia and Thrace there are 8 companies with 69 employees dedicated to the manufacture of computers and peripheral equipment. Companies in the industry group design, develop, and manufacture a wide array of IT, smart-grid and wireless-based systems, and integrated electronic components. Despite the small number of companies and employees, the sector appears to have high specialisation in this region, ranking 3rd and 2nd in companies-based and employment-based specialisation.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation -companies- based	Specialisation -employment- based
26.2	Manufacture of computers and peripheral equipment	8	69	3.66	3.85	11.47

Business challenges: Most electronic products contain many intermediate components that are purchased from other manufacturers. Companies producing intermediate components and finished goods often choose to locate near each other so that companies can receive new products more quickly and lower their inventory costs. This facilitates, as well, joint research and development projects that benefit both companies. While some of the companies in this sector are very large, most of them are relatively small. Some companies are involved in design or R&D, whereas others may simply manufacture components, such as computer chips, under contract for others. Although electronic products can be quite sophisticated, production methods are often similar, making it possible for a single company to manufacture many different electronic products or components with a relatively small investment.

Research and innovation challenges: The rapid pace of innovation in electronics technology generates a constant demand for newer and faster products and applications. In this context, a greater emphasis on R&D than in most manufacturing operations is needed. Product innovation is the main challenge. The product design process includes not only the initial design but also development work, which ensures that the product functions properly and can be manufactured as inexpensively as possible. Overall, globalization has become a major factor in the electronics manufacturing industry, often making it difficult to distinguish the exact origin of a product. Many products are being designed in one country, manufactured in another, and assembled in a third. The main demand for research and innovation is related to (1) diagnostic devices: development of micro-nano technology devices, as well as hybrid and multifunctional biomedical devices, diagnostics and/or therapy. (i) Biosensors and smart integrated wearable devices (ii) Bioreactors, (iii) Lab on Chip, (iv) Advanced imaging devices for diagnosis and treatment, (v) Biochips for diagnostics, integrated systems for personal diagnostic testing and bioanalysis, as well as primary organoids for personalized treatment selection (2) Internet of Things and Platforms - interconnected applications of "smart" objects. (3) Artificial intelligence and machine learning technologies and systems with the ability to adapt to different areas and applications. (4) New-generation robots and support technologies applied to industry and service delivery. The research and innovation demand recorded in GSRT calls for research and innovation is very high.

31.0 Manufacture of furniture in Thessaly

This industry group comprises

> *31.01 Manufacture of office and shop furniture*
> *31.02 Manufacture of kitchen furniture*
> *31.03 Manufacture of mattresses*
> *31.09 Manufacture of other furniture (or home furniture)*

In the region of Thessaly, the industry group comprises 314 companies. These are small and medium-sized companies with 856 employees and a 25.56 million turnover in 2017. This industrial group is the largest in the region in terms of the number of companies, but the smaller of the top-10 industry groups of Thessaly in terms of turnover and specialisation. The manufacture of furniture is in the top-10 industries in five Greek regions:

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Central Macedonia	1027	3,377	158.278	1.65	1.79
Thessaly	314	856	25.56	1.75	1.92
East Macedonia and Thrace	240	745	126.13	2.21	2.26
West Macedonia	107	215	3.116	1,28	1.27
Central Greece	104	437	21.86	0.74	1.49

Business challenges: The industry includes a significant number of businesses that differ in size, organization and products. Most companies are very small without automated production. Large companies combine production with trade and usually have showrooms and a distribution network for their products, which includes corporate stores, franchising shops, and local agents. Across the country, the economic crisis over the last decade has had a major impact on the furniture industry. The steep decline in private building activity and the shrinking disposable income of households has resulted in a significant decline in overall sales in the sector over time. In the period 2008-2015, the average rate of change was -11.7%. The annual rate of decline has been decelerating since 2013 and after that, however, in the period 2016 -2018 the market has been steadily increasing, with 2018 recording a +4.8% annual change. The crisis of the construction industry, the limited purchasing power and low levels of consumer confidence remain the key problems in the industry. On the other hand, furniture exports (in value) have been rising over the last five years, but they are low compared to the level of imports. The main destination countries are Cyprus and Bulgaria. Imports are on the rise, reaching 63.5% in 2018. Most of the furniture imported in recent years comes from Italy and China, accounting for 28% and 25% of their total value, respectively. Competition is particularly fierce, given the plethora of outlets and has intensified in recent years. There is a large presence of multinational furniture chains with a significant number of stores operating throughout the country

Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows very limited demand for research and innovation with one only proposal related to this industry on innovative design methods and technologies (eg customization, optimization, mass customization, etc.), digital production tools and tools (eg CAM, 3D printing, CNC, robotic systems, innovative tools etc.) to improve design processes, prototyping and manufacturing in the areas of clothing/fashion, jewellery, optical communication, industrial design, product design, etc.

50.1 Sea and coastal passenger water transport in South Aegean

This group includes the transport of passengers on vessels designed for operating on sea or coastal waters, as well as the transport of passengers on great lakes etc. when similar types of vessels are used. More specifically, it includes transport of passengers overseas and coastal waters, whether scheduled or not: Operation of excursion, cruise or sightseeing boats; and Operation of ferries, water taxis etc. It also covers renting pleasure boats with a crew for sea and coastal water transport (e.g. for fishing cruises). Restaurant and bar activities on board ships, as well as renting of pleasure or commercial boats without crew are not included in this class.

In South Aegean, there are 308 companies dedicated to passenger water transport located in the two island groups (Cyclades and Dodecanese) with 670 employees and EUR 52,51 turnover in 2017. This group has the highest specialisation index based on the total number of companies, while it is fourth in terms of the number of companies, employment and turnover. The group is in the top-10 industries in three regions of Greece.

Region	No of companies	Employment	Turnover (in million €)	Specialisation -companies- based	Specialisation -employment- based
South Aegean	308	670	52.51	4.15	1.32
Ionian Islands	223	642	65.85	6.2	3.35
Crete	91	1,707	330.23	1.12	2.8

Business challenges: The contribution of the shipping industry to the Greek economy is substantial, especially for the economies of the islands, and is considered among the largest in Europe. This is mainly due to the vast number of interconnections among the mainland and the island regions. The sector has been negatively affected since 2009 both by higher oil prices and by a vertical drop in passenger traffic, due to the economic crisis that affected primarily the Greek economy, and to a lesser extent, the European economy. In particular, the demand for coastal services has declined by 24% for passengers and 31% for vehicles respectively over the period 2009-2012, with an indication of stability in 2013 coming from the data for the first nine months of the year. Industry activity has shrunk in recent years. In 2013, 57 ships were launched, a retreat of about 40% compared to the previous decade. This development reflects the withdrawal of older ships and their replacement by new ones, the larger capacity, shipping/sale of ships to foreign companies, and retreat of passenger traffic. At the same time, the fuel cost comprised more than half of the total turnover in the sector. The effort to adjust to these exogenous shocks was further hindered by the limitations of the regulatory framework. The sustainability of some shipping firms is under threat, and the likelihood of shipping company closures due to the adverse economic environment in the sector will have damaging consequences for the Greek economy. Given these circumstances, the rationalization of the sector's capacity as well as of the coastal transport network is necessary.

Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows very limited demand for research and innovation. The focus is on the development of value-added and networking tourism services applications targeted at businesses to provide personalized information, recommendations and content to travellers (eg advanced holiday package and/or personalized advanced engines, route selection, activities, points of interest), tourist accommodation, events/events, public transit routes).

55.1 Hotels and similar accommodation in Crete

Hotels and similar accommodation include the provision of accommodation, typically on a daily or weekly basis, principally for short stays by visitors. This includes the provision of furnished accommodation by hotels, resort hotels, suite/apartment hotels in guest rooms and suites. Services include daily cleaning and bed-making. A range of additional services may be provided such as food and beverage services, parking, laundry services, swimming pools and exercise rooms, recreational facilities as well as conference and convention facilities.

Hotels and similar accommodation is the most significant sector in Crete with a considerably higher number of enterprises (more than double from the second-highest sector), at least ten times higher number of employees and three times higher turnover than the second most important sector in the region. Apart from Crete, the sector is within the top-10 industries in other six Greek regions. South Aegean and the Ionian Islands are more than 3.5 times more specialised and North Aegean and Crete are about two times more specialised in the sector compared to total Greece.

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
North Aegean	307	1,537	57.99	2.08	1.54
Epirus	313	1,567	48.602	1.84	0.81
Ionian Islands	689	7,566	376.15	3.62	3.53
Central Macedonia	928	10,690	454.36	0.76	0.7
Crete	1,077	20,284	1,069.68	2.51	2.97
South Aegean	1,505	22,991	1.196,12	3.84	4.04
Peloponnese	461	2,471	85.15	1.51	1

Business challenges: Tourism is a driving force of the national economy, with a 35 billion euros total contribution (both direct and indirect) to GDP (19.7% of national GDP). It is also a sector of high significance in almost all Greek regions. Within three years, 350 investment plans for -4* and above- hotels were submitted for licencing. The trends in these numbers continue to rise despite the economic crisis. Hotel infrastructure in the country is significant and is continuously upgrading. Tourism is the most dynamic economic sector also in Crete, an established tourist destination with a position that is strengthened over time. The region offers tourist accommodation infrastructure that can meet the needs of tourists from different income classes and thus, it is appealing both to mass tourism but also visitors with higher accommodation requirements. Crete has hotels and accommodation facilities of a wide range and high quality; it has the highest number of 1 and 2 stars hotels in the country (38.4%) and a high percentage of 4 and 5-star hotels and accommodation facilities, reaching 54.8% of 4 and 5* hotel rooms in Greece.

Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows very dynamic research and innovation industry. Main research topics are about ICT and digital services to accommodation and tourism, such as (1) the development of value-added and networking tourism services applications targeted at businesses to provide personalized information, recommendations and content to travellers, (2) development of methods and applications to provide new advanced services or to optimize existing services, (3) development and utilization of ICT applications for the analysis, documentation, modelling and management of cultural reserves, as well as areas of environmental and tourist interest, (4) developing innovative applications for guided tours of natural and/or virtual cultural environments, (5) development of innovative applications for the revival, representation and dissemination of intangible cultural heritage.

62.0 Computer programming, consultancy and related activities in Attica

This group includes

62.01 Computer programming activities, such as systems software, software applications, databases, web pages
62.02 Computer consultancy activities, planning and designing of computer systems
62.03 Computer facilities management activities, on-site management and operation of clients' computer systems
62.09 Other information technology and computer service activities, such as installation, disaster recovery other.

The industry is among the big top-10 industry groups in Attica with 4,868 companies, 17,312 employees in the field of computer and consulting services and an annual turnover of EUR 1,358.73 million. It includes a usual combination of IT skills, know-how in programming and data storage and consulting. ICT and consulting services in Attica have the lion share of the country with the region's employment reaching 72% of the total employment. The group is in the top-10 industries in two Greek regions.

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
East Macedonia and Thrace	178	1,379	86.19	0.74	2.03
Attica	4,868	17,312	1358.73	1.52	1.45

Business challenges: The domestic software market has been declining in the period 2010-2014, but since 2014 there has seen slight annual growth of 1.0-1.5%. The market for IT services shows similar trends. The dominant category in the software market is Application Software having about 64% of the market, while the remaining 36% belongs to the systems software category. Consulting services have also grown significantly after 2012 with an average annual growth rate of 6.7%. Strategy services have the largest share of consulting sales, accounting for 15-20%. Project management is also significantly similar in size, and IT services account for 15%. The industry group of computer services and consultancy are is composed of a large number of smart companies. The average employment is 3.56 person per company, while the larger companies are subsidiaries of multinationals (IMB, ORACLE, SAP, MICROSOFT). Growth opportunities are at enhancing outsourcing services, adapting to international regulations and standards that will boost demand for software, and expanding high-speed internet which also contributes to software applications growth.

Research and innovation challenges: The growth of the industry depend on the capability of small software houses to follow technological changes in AI, cloud, and Internet services and offer innovative services based on advanced technologies. The Business & Technology Information Network has mapped the technological landscape in the ICT sector identifying 9 cutting-edge technologies that are promising for Greek research and business organisations: mobile networks, advanced wireless & wired networks; sensor networks within the Internet of Things; cloud networks and services; services and applications for mobile computing systems; semantic web technologies; intelligent data analysis technologies; robotic systems; and distributed intelligence technologies. Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows a very high demand for research and innovation with 564 participations in proposals by companies and research organisations. The topics cover the entire ICT landscape, with the most participation in smart networks and new Internet architectures; tools & methods for software development, advanced 5G network infrastructures for the Internet of the future, Internet of Things and platforms - interconnected applications of "smart" objects, and ICT-supported modelling, simulation, analysis and forecasting technologies.

72.1 Research and experimental development in natural sciences and engineering in Crete

Scientific research and development include the activities of three types of research and development: 1) basic research: experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without particular application or use in view, 2) applied research: original investigation undertaken to acquire new knowledge, directed primarily towards a specific practical aim or objective and 3) experimental development: systematic work, drawing on existing knowledge gained from research and/or practical experience, directed to producing new materials, products and devices, to installing new processes, systems and services.

In total, 499 companies of this group are located in Crete, mainly small companies. This industrial group is between the second and seventh larger in Crete in terms of the number of companies, employment, and turnover. The group comprises also most companies of the Technology Park of Crete at the outskirts of Heraclio, companies in the field of medical technology and informatics.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies -based	Specialisation - employment-based
72.1	Research and experimental development in natural sciences and engineering	499	1,323	15.29	1.98	1.69

Business challenges: Companies in this industry group are mainly SMEs in the field of informatics and telecommunications. They have specialised staff and several companies in the industry collaborate with academic / research institutes. The main challenge is the capacity of companies to advance their technology know-how and provide related services. The most relevant technologies for this industry group are those of (1) mobile telephony networks, (2) advanced wireless & wired networks, (3) sensor networks, (4) cloud computing, (5) services and applications for mobile computing systems, (6) customizable online services, (7) semantic Internet technologies, (8) intelligent data analysis and forecasting, (9) robotic systems, and (10) diffuse intelligence environments. The major challenge for research-driven companies, and ICT SMEs in particular which develop solutions with high TRL is to transform research results into marketable products and services. Greek companies have fully exploited and specialized in several fields of the above-mentioned top technology fields and the degree of penetration in the Greek market can be characterized quite satisfactory. However, the barriers to the diffusion and commercialization of technologies are mainly market-related, due to their small size and limited financial strengths.

Research and innovation challenges: SMEs in the ICT sector is one of the most intensive research areas. The Greek researchers have a significant output of work, which is reflected in the number of publications and the overall ranking of the country in terms of research project production. Top research areas were those of IT applications, information systems and information processing, media, telecommunications, electronics and microelectronics. Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows a good demand for technology in the ICTs. It is important to consider also some macro-indicators to get a better picture of this sector in the region of Crete. The index Number of Participants per researcher gives Crete the 8th position among the other Greek regions, with 64.4% participation from research organizations and 36.6% from enterprises (the national average was 46.3% and 53.7%).

79.1 Travel agency and tour operator activities in Ionian Islands

This group includes the activities of agencies, primarily engaged in selling travel, tour, transportation and accommodation services to the general public and commercial clients and the activity of arranging and assembling tours that are sold through travel agencies or directly by agents such as tour operators. The group comprises

79.11 Travel agency activities, primarily engaged in selling travel, tour, transportation and accommodation services

79.12 Tour operator activities: through travel agencies or directly by tour operators for transportation, accommodation, food, visits to museums, historical or cultural sites, etc.

This group is among the top five sectors in the region. It is also among the top-10 industry groups in three Greek regions:

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Ionian Islands	211	897	55,69	2,7	2,27
Crete	378	2.570	459,84	2,14	2,04
South Aegean	394	1.906	136,24	2,45	1,82

Business challenges: Over time, the overall employment in the tourism sector has been declining, considering the main job position of a person, with the total number of employees having dropped by 11% (or 40.5 thousand employees) over the period 2007-2010. This trend is even more pronounced in Travel Agencies where the decline in employment has reduced the number of people employed in 2011 by half compared to 2006. The decline of employment in the sector of travel agencies and tour operators is mainly attributed to the wide use of Information and Communication Technologies (smartphones, apps, online platforms etc.). More specifically, the penetration of new technologies and the Internet into the purchase and sale of tourist services has significantly replaced the services previously offered by travel agents. At the same time, the rise of the sharing economy has left many travel agencies in the lurch, as the global trends for travelling deliberately leave them out of the equation. Travelling is no anymore, a difficult task and people can get information online about destinations, accommodation, transport and any other travel service. Therefore, there is an urgent need for the sector to adapt to these trends and offer services beyond the typical processes of booking flight tickets and accommodation.

Research and innovation challenges: Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows a good demand for research and innovation with 33 participations in proposals from the Ionian Islands and 1075 overall. Main topics for research and innovation are in the field of digital and Internet services, such as (1) the development of value-added and networking tourism services applications targeted at businesses for the purpose of providing personalized information, recommendations and content to travelers (eg advanced holiday package and / or personalized advanced engines, route selection, activities, points of interest) , tourist accommodation, events / events, public transit routes), (2) the development and utilization of innovative tools, products, services and processes to support specific forms of tourism (e.g. cruise, religious, diving and maritime tourism, rural tourism, science tourism, urban tourism, gastronomic tourism, sports tourism), (3) the development methods and applications to provide new advanced services or to optimize existing services (in terms of efficiency, cost reduction, human resources upgrades, user experience, personalization, audiovisual revenue generation, cost management, cost estimation). data management, analysis and/or visualization techniques, (4) the development of innovative platforms for collecting tourism and cultural content and making it available to application and service creators.

90.0 Creative, arts and entertainment activities in Attica

This group includes activities in the creative and performing arts and related activities and comprises the following 4-digit classes:

90.01 Performing arts: production of live theatrical presentations, concerts and opera or dance productions and other stage productions:

90.02 Support activities to performing arts: support activities to performing arts for production of live theatrical presentations, concerts and opera or dance

90.03 Artistic creation: activities of individual artists such as sculptors, painters, cartoonists, engravers, etchers etc., activities of individual writers, for all subjects including fictional writing, technical writing etc., activities of independent journalists, restoring of works of art

90.04 Operation of art facilities: operation of concert and theatre halls and arts facilities.

In the region of Attica, there are 5.443 companies dedicated to creative, arts and entertainment activities with 12.799 employees and EUR 186,21 turnover in 2017. The creative industry is first in terms of the number of companies and second in terms of employment. However, it comes sixth in annual turnover and has relatively low specialisation indexes. The 90.0 group is in the top-10 industries in three regions of Greece

Regions	No comp	Empl.	Turnover	Spec com	Spec emp
Attica	5,443	12,799	186.21	1.67	1.4
Ionian Islands	132	259	1.62	0.63	0.62
South Aegean	213	492	5.16	0.49	0.45

Business challenges: The financial crisis had a strong impact on the creative industry in general. From 2008 up to 2014, added value decreased by 55.1%, the number of employees was reduced by 29.5% and enterprises decreased by 27.9%. For the same period, a huge increase in the number of enterprises has been observed in EU-28 (36.5%), which triggered an upsurge of added value (28.6%). There are several challenges for the sector. Based on the economic profile of this group in Attica, we see that there seems to be a large number of small creative enterprises, which form a network of the small-scale freelance creator. The production of knowledge and new ideas usually thrives in small-scale structures like this; however, at the same time, the small size of the enterprises and the development of communication channels between many, small and different parties make it difficult to exploit economies of scale, to access funding, to protect intellectual property, as well as to penetrate in foreign markets. Financial institutions are not familiar and may be reluctant to evaluate companies based on intangible capital, thus they cannot rate the credit risks involved and this results in difficulty or even lack of access to the credit market.

Research and innovation challenges: The cultural and creative economy is an area increasingly attracting research attention in the last ten years. Analysis of GSRT data from Erevno-Kainotomo calls (A & B) shows a strong demand with 162 participations in proposals from Attica and 387 overall. Main topics are related to ICT solutions, such as (1) innovative applications for guided tours of natural and/or virtual cultural environments (e.g. museums, virtual museums, archaeological sites, festivals, exhibitions, collections, cultural events and routes, as well as other poles and cultural events, high places traffic and concentration/displacement, etc.), (2) for the revival, representation and dissemination of intangible cultural heritage and related, as well as contemporary culture (modern culture) visual arts etc., and (3) digital gaming and gamification techniques for PCs, mobile devices and gaming machines, utilizing cultural and tourism content (arts, history, sciences, etc.) for entertainment, education, design thinking, culture promotion and promotion tourism.

A3. Innovation challenges and platforms for ecosystems development

The 25 ecosystems we described in the previous section A2 have main characteristics of cluster-based ecosystems, such as productive specialisation, geographical boundaries, and high location quotients. They were also identified as potential platform-ecosystems by the interviews to experts and stakeholders.

In this section, we go into further exploration of the research and innovation challenges within these ecosystems. The aim is to better understand their innovation potential and areas of interest that are significant for platform-based development of ecosystems.

1. Typology of ecosystems, innovation challenges and maturity

We can build a typology of the 25 ecosystems combining size, business challenges, and innovation demand. To this aim, three sources of information are used: (1) Statistical data from ELSTAT regarding the number of companies per ecosystem. This data is reliable and exact. (2) Data from sectoral studies and the ICAP performance indicators describing business and growth challenges. This data is also reliable and exact. (3) Data on research and innovation demand and intensity and from the General Secretariat for Research and Technology (GSRT) programme "Erevno-Kainotomo", which is the most important research and innovation support programme of the Smart Specialisation Strategy for Greece 2014-2020. This data is approximate as it stands on our estimations about participation in research proposals submitted per industry group.

In the two rounds of "Erevno-Kainotomo" were submitted 5,338 proposals (2,426 in the first round and 2,912 in the second). The participants (companies and research organisations) in these proposals were 17,481, and the data we provide is based on this population. The programme is aimed at linking research and innovation to entrepreneurship, enhancing business competitiveness, productivity and extroversion to international markets, sustaining innovative entrepreneurship and increasing domestic added value. The breakdown of 17,481 research and innovation participations per region is given below in Table 7.

	EMT	CM	WM	EP	TH	II	WG	SE	AT	PE	NA	SA	CR
N	721	4292	333	691	1139	99	1318	402	6630	305	187	82	1282
%	4.12	24.55	1.90	3.95	6.52	0.57	7.54	2.30	37.93	1.74	1.07	0.47	7.33

Table 7: GSRT Erevno-Kainotomo programme (A + B) proposals per region

Data mining into the details of submissions allowed identifying (1) the regional interest and participation of research and business actors per industry group and (2) the corresponding research and innovation demand per area of science and technology.

Matching NACE industry groups and GSRT technology and innovation areas was a very demanding task analysis. The dataset given to us by the GSRT does not have this matching. The industry group of companies that submitted proposals is being collected but it is not included within the dataset we received. Thus, we worked with matches between the GSRT technology and innovation areas and NACE industry groups. This approach gives a first look at the objectives of the projects submitted in each industry group and the technologies they intend to develop. It is a proxy of technology and innovation demand and should be carefully considered given a large number of categories for technology and innovation areas used (overall 401, argofood 56, energy 25, transport 58, environment 63, tourism- culture 37, ICT 41, health 41, materials 80). When matching between technology and innovation areas and NACE industry groups was not feasible, we search the full data of proposals with keywords to identify projects into a thematic domain.

Classification of the profiles of industry groups / ecosystems presented in the section A2 with respect to size, challenges, and innovation demand leads to four types of ecosystems, clustered around challenges of (1) product design and development, (2) production and supply chain optimisation, (3) branding and promotion, and (4) export market access and demand crisis (Fig. 7).
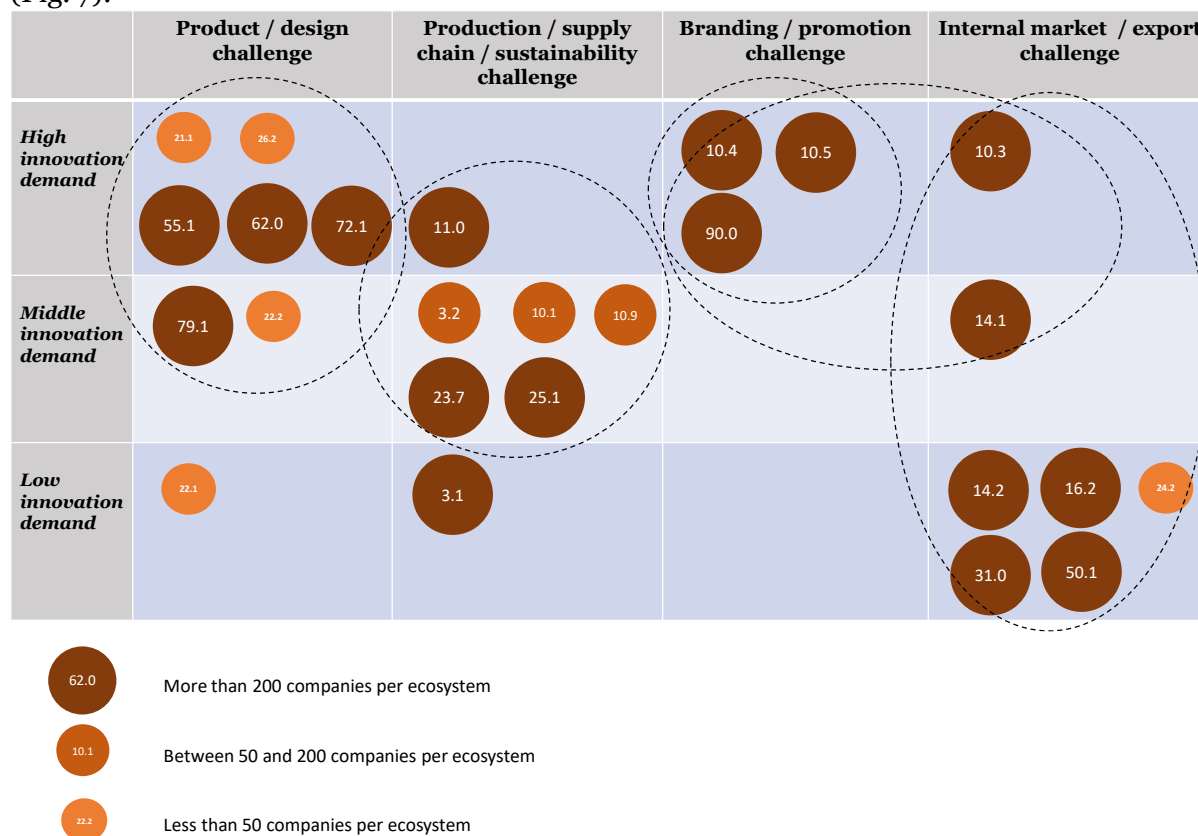

Figure 2: Typology and clustering of business ecosystems

New product design and development is the dominant innovation challenge in ecosystems such as 21.1-manufacture of basic pharmaceutical products (new medicines and molecules, pharmaceutical discovery, relocation and drug re-targeting), 22.2-manufacture of plastic products (new degradable plastics, transition to a circular economy model), 55.1-hotels and similar accommodation (services to specific population targets, applications to provide new advanced services or optimize existing services), 62.0-computer programming and consultancy (smart applications and new e-services), 79.1-travel agency and tour operator activities (replacement of services previously offered, need for new services). This challenge is pertinent for large and small ecosystems, emerging such as pharmaceuticals or mature ecosystems such as hotels and accommodation.

Production modernisation, supply chain optimisation and environmental sustainability is the dominant innovation challenge in ecosystems such as 03.2-aquaculture (improving the productivity, diagnosis and control of diseases, expansion of activities), 10.1-processing and preserving of meat and production of meat products (verticalization, standardisation and processing, storage and distribution), 10.9.-manufacture of prepared animal feeds (increased specialisation, supply of raw material, lowering production costs), 11.0-manufacture of beverages (protocols for the clonal selection of grapevine, vertical coordination, high labour costs), 23.7-cutting, shaping and finishing of stone (automation, exploitation of mining and marble by-products, environmental remediation, quarry rehabilitation). These innovation challenges are pertinent for large and medium size ecosystems, characterised by mid-level

demand for research and innovation and needs for technology transfer than radical process innovations.

Branding and promotion are the dominant innovation challenges in ecosystems such as 10.4-manufacture of vegetable and animal oils and fats (high quality of products but low branding, standardization of quality, trade in bulk form), 10.5-manufacture of dairy products (local brands, better packaging, international sales networks), 90.0-creative, arts and entertainment activities (access to media, innovative platforms for promotion, dissemination of intangible cultural heritage).

Market innovation and access to global markets and exports are the dominant innovation challenge in ecosystems such as 4.2-manufacture of articles of fur (sharp drop in demand from abroad, lost market shares due to traditional promotion models). On the internal market side, *the collapse of demand due to crisis of construction is pressing for access to new markets* in industries such as 16.2-manufacture of products of wood, cork, straw and plaiting materials, 24.2-manufacture of tubes, pipes, hollow profiles and related fittings, 31.0-manufacture of furniture, and 50.1-sea and coastal passenger water transport. All these ecosystems are mature and with a few exceptions characterised by low-level innovation capabilities and demand. This is an additional barrier to their industrial transformation.

2. Platforms and transition to platform-based ecosystems

Collaboration in cluster-based ecosystems is emerging, due to spatial proximity and interdependencies by knowledge spillovers. However, it is rarely orchestrated effectively by policy interventions. This emerging collaboration is extremely difficult to be replicated by policy measures, and cluster policies – though very popular - in many cases failed both in high-tech and low-tech clusters to overcome 'inertia' or 'path dependency', and the tendency to stick to existing patterns rather than to pace up with innovation (Hospers, 2005). Existing research finds also clear reasons to be pessimistic about the ultimate welfare implications of cluster policy interventions (Ketels, 2013), as not every cluster is also a case of successful collaboration and community (Kasabov, 2010).

A novel solution to this problem of orchestration of producers and markets comes from the recent literature on platforms and platform-based ecosystems. Research in this field shows that "industry platforms are technological building blocks (that can be technologies, products, or services) that act as a foundation on top of which an array of firms, organized in a set of interdependent firms (sometimes called an industry "ecosystem"), develop a set of inter-related products, technologies and services" Gawer (2010; 287). Equally, platforms can be understood as collaborative business models based on technology that engender ecosystems. A platform is "a plug-and-play business model that allows multiple participants (producers and consumers) to connect to it, interact with each other and create and exchange value" (Castellani, n.a.).

Platform-based ecosystems are created when an organisation launches a platform that becomes the foundation for products and services of other companies. Gawer and Cusumano (2002) call this relationship "platform leadership", a strategy that enables companies to exert influence over the direction of innovation in an industry, by engaging other firms in a joint effort for complementary products. Industry-wide platforms offer resources that third party organisations can use to develop their complementary products, technologies, or services. They enable the creation of business ecosystems and has a disruptive network effect in many industries. They are foundations for setting up ecosystems of organisations that share resources, knowledge or access to markets (Gawer and Cusumano, 2014). Working with an industry-wide platform typically results in a two-part structure: on the one side, there is the specific solution that is hosted on the platform, and on the other side, there is the platform

with its infrastructure, hardware, software and data which communicate with the hosted solutions and organise collaboration according to established procedures.

A typology proposed by Srnicek (2017) classifies platforms according to their purpose: *advertising platforms* (e.g. Google, Facebook) which offer an advertisement space; *cloud platforms* (e.g. Salesforce) that offer hardware and software as a service; *industrial platforms* (e.g. GE, Siemens) which offer infrastructures for the digital transformation of manufacturing; *product platforms* which generate revenue by using other platforms to offer goods as a service; and *lean platforms* (e.g. Uber, Airbnb) that provide a business model of minimal asset ownership.

In platform-based ecosystems, the orchestration at the producer and consumer sides is achieved by the platform, its services and infrastructures, and the business model for viability. Platforms offer services or infrastructure and have income from these services, which secure their sustainability.

A good working example in Greece is MEDITERRA S.A, the research and innovation centre of Mastiha producers in Chios. It was founded in 2002 by Chios Mastiha Growers Association, with objectives to establish a marketing tool for mastiha, promotion and sale of mastiha products worldwide. To date, the company has developed a retail outlet network under the brand "mastihashop" which comprises stores in Greece and abroad, has established a food production unit in Chios island where over 100 different products are produced, has developed a wide distribution network for brands such as natural mastiha, mastiha chewing gum, cosmetic products, parapharmaceutical products (selling line mastiha therapy), and Greek food products (selling line cultura mediterra). The Centre performs R&D on the antibacterial activity of mastiha, non-oxidative action, mastiha in oral hygiene, dermatological and healing properties of mastiha, and new product development using mastiha as natural supplement to functional foods.

Own facilities have a covered surface of approximately 10,000 m2 and house the total range of activities, including two production units for mastiha processing & packaging, ELMA products and distillation of mastiha oil.

In the present survey on the 25 business ecosystems, based on respective industry groups, we described a series of potential platforms in each ecosystem (see Annex 3). Those platforms address the challenges above described in the typology of ecosystems, namely (1) product development and design, (2) production modernisation and supply chain optimisation, (3) branding and promotion, and (4) market and export support.

They can be used to connect companies towards orchestrated innovation and growth:
- *Market-driven platforms*, with emphasis on dealing with demand, market access, branding, product promotion.
- *Product-driven platforms*, with emphasis on dealing with product design, new product development, smart products, quality, and certification.
- *Production-driven platforms*, with emphasis on production processes, automation, supply chain integration and optimisation, vertical coordination.

- *Materials-driven platforms*, with emphasis on dealing with new materials, raw material, waste, and materials recycling.
- *Infrastructure-driven,* with emphasis on physical space and equipment.

The platforms we propose are **regional** when the respective industry group is located into one region or **national** (trans-regional) when the industry group is present in many regions. In all cases, we propose **one platform per industry group** that brings together companies of the group wherever located.

An example might be the platform for the industry group **10.3-Processing and preserving of fruit and vegetables**, which bring together companies from Central Macedonia (177), Western Greece (64), Thessaly (74) and Peloponnese (78) with 9,601 employees and 1.382 billion turnover (2017). The platform focuses on **brands and packaging,** which is a common challenge among the companies in this industry. In terms of brands, the aim will be on creating either high-quality local brands or a national brand identity, similar to that of *"Fish from Greece"*, which provides also some sort of quality certification. The products may be branded under the concepts of sustainability and quality, and alternatives to plastic packaging should be promoted. Indeed, the introduction of new legislation for plastic packaging is among the future plans of the EU. Demand for sustainable packaging is likely to increase during the next years, and the early adoption of non-plastic alternatives for fruit and vegetable processing might provide a competitive advantage for the fruit producers in Central Macedonia and other regions of Greece. In this direction, the promotion of rural entrepreneurship through human resource education and training is of major importance, so that high-quality products are provided in the global market. At the same time, the platform will work as a **competence centre** promoting the **adoption of advanced production technologies** and the integration of applied research results in the processing of agricultural products. This may also support the extroversion of the transregional ecosystem of processing and preserving of fruits and vegetables. An interesting example in this direction is the case of Tetra Pak (https://tetrapak.com/) which has announced the launch of its connected packaging platform, which uses digital tools such as code reading to provide full information about the traceability of product throughout the supply chain. Public-private partnerships are good practice for platform setting as it secures sustainability in the long term.

The majority of platforms we propose are for large and mature ecosystems in traditional business activities, but there is also a small number of emerging ecosystems (20%) in ICT, pharmaceutical, and research services. However, these are brainstorming examples than actual agreements among producers in the respective industry groups. Each platform should stand **on agreement of producers** or **agreement for public-private-partnership** set out by an Entrepreneurial Discovery Process.

3. EDP exercises, platforms and ecosystems

In platform-ecosystems, the creation of the ecosystem goes together with the development and deployment of the respective platform. However, platforms and commons should be designed and developed from scratch.

Figure 3 illustrates a succession of four steps towards platform-based ecosystems, from setting the framework for the platform, creation of the platform, formation of an ecosystem of organisations, and growth of a self-sustaining ecosystem. The platform is the enabler and the ecosystem the maker of externalities. An externality is a value from an economic activity freely received by unrelated organisations. It is a value external to market transactions. In paltform ecosystems externalities derive from network effect and the large number of complementors on the platform.
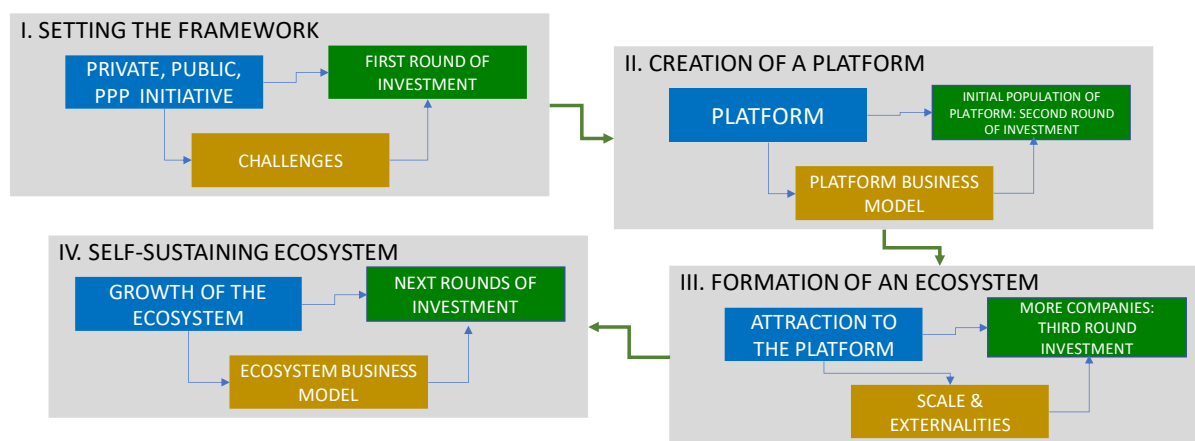
Figure 3: Platforms and the creation of industry ecosystems

The discovery and description of platforms for industry ecosystems may be a main task of the **EDP exercise**. EDP as part of step I (setting the framework) is the investigation of common challenges into an ecosystem, potential platforms for the orchestration of producers and consumers, and organisations to take the initiative for setting and operating the platform. Thus, EDP can be justified as a collective search for actions to the benefit of all actors belonging to an ecosystem.

Should we perform EDP in all important industry groups and ecosystems?
In principle yes as the cost of an EDP exercise is small compared to the added value in case of successful discovery and description of a platform. However, there are some conditions for setting a platform, which should be taken into consideration:
   a) capacity to describe the platform and mainly the services to be provided
   b) sufficient number of companies and organisations to populate the platform
   c) capacity to define a business model for the operation and viability of the platform.

Table 8 shows some key features of the initial investigation we have done on potential platforms per industry group. These features are based on respective sectoral studies. Marked in red are areas of low demand for platform services (due to the small size of industry groups or low demand for innovation services) or difficulty in identifying common ground for platform design and development. In these cases, EDP for platform design should be avoided. However, this concerns three cases out of the 25 cases examined.

In 21/25 cases (85%), the industry groups studied are included in the respective RIS3 2014-2020 priority domains. However, this is due to low RIS3 granularity, defining priorities at the level of NACE Sections and Divisions, rather than detailed targeting of industry groups.

How many EDP exercises would be needed for all ecosystems in Greece?
In 22/25 (88%) of cases, this preliminary investigation documents that EDP should be attempted to reveal features of platforms or other commons for ecosystem building. In these 22 cases, there is substantial evidence that EDP may drive actions proper to public policy, promoting collective rather than individual interests. All national ecosystems should be included for EDP, while 3 out of 10 regional cases do not meet the conditions for EDP, due to low innovation demand, the small number of companies in the group, or difficulty to identify common ground for platform building.

Given the number of industry groups we have studied (25 out of 51), we estimate that a full coverage of the most important industry groups in Greece would require 26 national-level EDP and 17 regional-level EDP, and **overall, 43 EDP exercises**. This is a figure quite feasible if it is well allocated in the 13 regional and the national strategy for smart specialisation.

REGION	Industry group / ecosystem	Included in RIS3 2014-2020 priorities	Size of ecosystem	Mature or emerging ecosystem	Research and innovation demand	Initial identification of innovation platform	National / regional ecosystem	EDP for platform design
EST MACEDONIA THRACE	22.2 Manufacture of plastics	Yes	Small	Mature	Medium	New product/ materials	Regional	YES
	23.7 Cutting, shaping of stone	Yes	Large	Mature	Medium	Brand/ Byproducts	National	YES
	26.2 Manufacture of computers	Yes	Small	Emerging	High	No	Regional	NO
CENTRAL MACEDONIA	10.3 Processing fruit and vegetables	Yes	Large	Mature	High	Brand / Packaging	National	YES
	14.1 Manufacture of wearing apparel	Yes	Large	Mature	Medium	Brand / Design	Regional	YES
	25.1 Manufacture of structural metal products	Yes	Large	Mature	Medium	Materials	Regional	YES
WEST MACEDONIA	16.2 Manufacture of products of wood	No	Large	Mature	Low	Brand / Eco-quality	National	YES
	14.2 Manufacture of fur	Yes	Large	Mature	Low	Export	Regional	YES
EPIRUS	10.1 Processing of meat	Yes	Medium	Mature	Medium	Brand / Packaging	National	YES
	10.5 Manufacture of dairy products	Yes	Large	Mature	High	Brand / Packaging	National	YES
THESSALY	22.1 Manufacture of rubber products	No	Small	Emerging	Low	No	Regional	NO
	31.0 Manufacture of furniture	No	Large	Mature	Low	Commercial infrastr.	National	YES
ST ELLADA	24.2 Manufacture of tubes of steel	Yes	Small	Mature	Low	New product	Regional	NO
IONIAN ISLANDS	79.1 Travel and tour operator activities	Yes	Large	Mature	High	New products	National	YES
ATTICA	90.0 Creative, arts activities	Yes	Large	Mature	High	Digital infrastr.	National	YES
	62.0 Computer programming	Yes	Large	Emerging	High	Market / infrastr.	Regional	YES
	21.1 Manufacture of pharmaceutical products	Yes	Small	Emerging	High	New products	Regional	YES
WESTERN GREECE	03.2 Aquaculture	Yes	Medium	Mature	Medium	Brand/ Product	National	YES
	10.9. Manufacture of prepared animal feeds	No	Medium	Mature	Medium	Production / Chain	National	YES
PELO-PONNESE	11.0 Manufacture of beverages	Yes	Large	Mature	High	Production /Byproducts	National	YES
NORT. AEGEAN	10.4 Manufacture of vegetable oils and fats	Yes	Large	Mature	High	Brand/ Quality	National	YES
	03.1 Fishing	Yes	Large	Mature	Low	Brand/ Infrastruct	National	YES
SOUTH AEGEAN	50.1 Sea passenger water transport	Yes	Large	Mature	Low	Infrastructure	National	YES
CRETE	55.1 Hotels and similar accommodation	Yes	Large	Mature	High	Market access	National	YES
	72.1 Research in natural sciences & engineering	Yes	Large	Emerging	Medium	Infrastructure	National	YES

Table 8: Industry groups and ecosystems key features

A4. Policy recommendations

The final section (A4) of the report outlines a series for recommendations to the European Commission DG Regio, as well as to national and regional authorities of Greece about the management of EDP for 2021-2027.

1. EDP should be performed at the level of NACE industry groups

Statistical data that are necessary to assess areas in the economy and society that have the greatest potential for future development (which is the aim of EDP) are provided at the level of industry sections (21 categories), divisions (88 categories), and groups (272 categories). Industry sections and divisions are very heterogeneous, including diverse economic activities with very different growth potential and trajectories. Industry groups on the contrary are the only category with sufficient homogeneity to assess future development. This level of industry granularity is the best possible to reveal the detailed challenges and prospects of an industry. The only barrier to performing EDP at the level of industry groups is the large number of EDP exercises. However, we have seen that the most important industrial activities in Greece, in terms of size and specialisation, are gathered in 51 industry groups (Table 6). Prioritisation and EDP should be defined with standard industry categories than "invented" ones.

2. EDP in Greece is feasible at the NACE industry group level

EDP in Greece can be implemented at the NACE industry group level. It is within the potential of 14 (13+1) smart specialisation strategies in Greece to implement EDP in the most important industry groups of the Greek regions. We have identified 51 groups such groups that figure in the top-10 positions with respect to size and specialisation. Among them, 26 groups figure in more than one region and 25 in one region. Industry groups that include only a few companies (e.g. less than 50) in mature industrial activities with low innovation demand should be excluded. Thus, full coverage of all major industry groups in Greece would require approximately 43 EDP exercises. This is quite feasible given the number of regional and national S3 strategies with approximately 3 EDP exercises per RIS3.

3. Priority domains for RIS3 support should be determined after EDP

At the end of EDP at the level of most important industry groups, the priority domains for RIS3 support should be defined. All 51 (or 43) industry groups will not be selected as priority domains, but only those having potential for future development and assessed successfully by EDP. This is in contrast to what happened in EDP at RIS3 2014-2020, both at national and regional RIS3, where first was the selection of priority domains and then followed the EDP.

Authorities should perform EDP without excluding any important industry in advance. Two reasons justify this orientation of work: (a) the widely accepted S3 principle for place-specific innovation strategy or "one-size-does-not-fit-all", which suggests that the most robust theoretical prediction should be assessed with place-specific data, and (b) the probability of finding innovative solutions in less expected activities, a trend outlined in many aspects of the innovation theory, such as the probabilistic and non-deterministic character of innovation, serendipity in innovation, and innovation outcomes by chaotic systemic combinations.

4. EDP at the level of industry groups requires coordination between national and regional S3 authorities

Applying the above-mentioned number of EDP exercises requires the good allocation of industry groups among regions. Thus, the main task of the national S3 authorities will be to organize the distribution of EDP exercises among the 13 regions of Greece

and engage the regions in interregional EDP exercises. EDP in industry groups that are important for most regions must be conducted nationally and bring together companies that are spread across multiple geographical areas over the same industry platform.

EDP exercises may be national or regional depending on whether the respective industry group or ecosystem is present in one or more regions. We have observed common challenges and solutions per industry group across regions and localities. For instance, olive oil production is a leading industry group in three regions (Northern Aegean, Crete, and Sterea Ellada) and many other localities. Beyond Lesvos, high olive oil production is found in Fthiotida, Laconia, Messinia, Heraklion, Lasithi and Chania. An EDP exercise designed and implemented at the national level should cover the needs in the Northern Aegean for Lesvos as well as the other six high oil producer localities.

5. The design of platforms that support innovation is the main objective of EDP

Industry platforms address common challenges of companies belonging to an industry group and create favourable conditions for setting up business and innovation ecosystems. In every top-10 industry groups, we have identified production, trade, technology and environmental challenges. With respect to these challenges, EDP should focus on the design of platforms that drive the formation of business ecosystems. Platforms may be physical, institutional, infrastructure or digital. They can be *market-driven*, providing access to markets, branding, and promotion; *product-driven* for new product design and development, smart products, product quality and certification; *technology-driven* to facilitate research, processing technologies, and supply chain integration/optimisation; *infrastructure-drive*n to provide physical, institutional, and digital infrastructure; and *materials-driven* to better manage new materials, raw materials, waste and recycling.

Platforms must be designed as service providers. Their detailed design must define the model of service provision, the providers, services, and users, as well as the business model, the service operation model, and the quality model of provided services assessment. Failure of defining a sustainable service model is equal to EDP failure and no further policy support to the respective industry group should be provided.

International cooperation should be sought in the design and definition of platforms. Since each platform is a service provider, it is possible to attract the interest of international organizations and companies from other EU regions who have experience in the relevant field and wish to participate in a PPP to organise and run the platform.

6. Towards platform-ecosystems: EDP as public cohesion policy

Platforms providing services for market making (access, branding, promotion), product development (innovation, quality, certification, standardisation) and technology development (materials, processing, value chain optimisation) are mostly needed to address the growth and innovation challenges of business ecosystems. They give birth to business ecosystems created around common challenges. Platforms and ecosystems guarantee the public character of policy mix and actions deriving from EDP as they serve the common needs of an industry group than individual trajectories and interests of companies.

We have identified 22 industry groups in which business and innovation ecosystems can be created under the guidance and orchestration of well-designed platforms (Table 8). These ecosystems do not exist before a platform, which acts as an anchor

orchestrating complementors. Ecosystems can be created in each and every industry group around a challenge and common assets that deal with the challenge. The starting point is to recognise some form of externalities (conditions outside the market and inter-firm competition) and how a platform can engage the companies of the industry group and offer advantages in dealing with the challenges they face. It may be an e-commerce platform, a common quality control laboratory, a common treatment of production waste. It may be also a service developed by a group of companies, which is needed, without being a field of competition.

We consider these 22 cases as mature for starting an EDP exercise aiming at the discovery of all key features of respective platforms. A national programme similar to "Research Infrastructures" could be designed to provide support in setting platform-based ecosystems based on successful EDP exercises that conclude to the definition of services, infrastructures and business models of respective platforms.

References

Boschma, R. and Frenken, K. (2011) "Technological relatedness and regional branching', in Bathelt, H., Feldman, M. P. and Kogler,D. F. (eds), *Beyond Territory: Dynamic Geographies of Knowledge Creation, Diffusion, and Innovation*, Routledge, London and New York, pp. 64-81.

Castellani, S. (n.a.). Everything you need to know about Digital Platforms. Online http://stephane-castellani.com/everything-you-need-to-know-about-digital-platforms/

Cheng, Y. T., & Van de Ven, A. H. (1996). Learning the innovation journey: order out of chaos?. *Organization science*, *7*(6), 593-614.

Foray, D., (2014). From smart specialisation to smart specialisation policy. *European Journal of Innovation Management* 17(4), 492–507. DOI:10.1108/EJIM-09-2014-0096

Foray, D., Goddard, J., & Beldarrain, X. G. (2012). *Guide to research and innovation strategies for smart specialisation (RIS 3)*. EU.

Foray, D., Goddard, J., Beldarrain, X. G., Landabaso, M., McCann, P., Morgan, K., Nauwelaers, C., and Ortega-Argilés, R. (2012). *Guide to Research and Innovation Strategies for Smart Specialisation (RIS3)*. Luxembourg, Publications Office of the European Union.

Gawer, A. (2010). The organization of technological platforms, in Nelson Phillips, Graham Sewell, Dorothy Griffiths (ed.) Technology and Organization: Essays in Honour of Joan Woodward. *Research in the Sociology of Organizations*, Vol. 29, Emerald Group Publishing Limited, pp.287 - 296

Gawer, A., and Cusumano, M. A. (2002). *Platform leadership: How Intel, Microsoft, and Cisco drive industry innovation* (Vol. 5, pp. 29-30). Boston, MA: Harvard Business School Press.

Gawer, A., and Cusumano, M. A. (2014). Industry platforms and ecosystem innovation. *Journal of Product Innovation Management*, *31*(3), 417-433.

Gianelle, C., Goenaga, X., Vázquez, I.G., Thissen, M. (2014). Smart specialisation in the tangled web of European inter-regional trade. *European Journal of Innovation Management* 17, 472–491. DOI:10.1108/EJIM-10-2013-0113

Hospers, G. J. (2005). Best practices and the dilemma of regional cluster policy in Europe. Tijdschrift voor economische en sociale geografie, 96(4), 452-457.

Jacobides, M. G., Cennamo, C., and Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal.*

Kasabov, E. (2010). Why every cluster cannot be a successful community?. *European Planning Studies*, *18*(9), 1445-1468.

Ketels, C. (2013). Cluster policy: A guide to the state of the debate. In Knowledge and the Economy (pp. 249-269). Springer, Dordrecht.

Kirzner, I. M. (1997). Entrepreneurial discovery and the competitive market process: An austrian approach. *Journal of economic Literature* , 35(1), 60–85.

N. Komninos, C. Kakderi, A. Panori, E. Garcia, K. Fellnhofer, A. Reid, V. Cvijanović, M. Roman, M. Deakin, L. Mora, A. Reid. (2018). Intelligence and co-creation in Smart Specialisation Strategies: Towards the next stage of RIS3. Online S3 White Paper

Kyriakou, D., Martínez, M. P., Periáñez-Forte, I., & Rainoldi, A. (2016). Institutions and the entrepreneurial discovery process for smart specialization. In: *Governing Smart Specialisation (pp. 58-72). Routledge.*

Landabaso, M. (2014). Guest editorial on research and innovation strategies for smart specialisation in Europe: Theory and practice of new innovation policy approaches. *European Journal of Innovation Management* 17(4), 378–389. DOI:10.1108/EJIM-08-2014-0093

Poutanen, P., Soliman, W., & Ståhle, P. (2016). The complexity of innovation: an assessment and review of the complexity perspective. *European Journal of Innovation Management.*

Reid, A., Maroulis, N., (2017). From Strategy to Implementation: The Real Challenge for Smart Specialisation Policy. In Advances in the *Theory and Practice of Smart Specialisation*. Academic Press, pp. 293–318.

Rodríguez-Pose, A., & Wilkie, C. (2017). Institutions and the entrepreneurial discovery process for smart specialization. In: *Governing Smart Specialisation*, (pp. 34-48), Routledge.

Srnicek, N. (2017). *Platform Capitalism*. John Wiley and Sons.

Tödtling, F., & Trippl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research policy*, *34*(8), 1203-1219.