Annex 3

Profiles of industry groups having potential for ecosystem development

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03.1 Fishing in North Aegean

1. Economic and production profile

This group includes capture fishery, i.e. the hunting, collecting and gathering activities directed at removing or collecting live wild aquatic organisms (predominantly fish, molluscs and crustaceans) including plants from the oceanic, coastal or inland waters for human consumption and other purposes by hand or more usually by various types of fishing gear such as nets, lines and stationary traps. Such activities may be conducted on the intertidal shoreline (e.g. collection of molluscs such as mussels and oysters) or shore-based netting, or from home-made dugouts or more commonly using commercially made boats in inshore, coastal waters or offshore waters. Such activities also include fishing in restocked water bodies. More specifically, this group includes the following codes:

> *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.

According to the Hellenic Statistical Authority, there are 599 companies dedicated to fishing located in the five regional units of North Aegean with 721 employees and EUR 7,49 turnover in 2017. Compared to Greece, the regional specialisation is 4,72 and 7,28 times higher based on the number of companies and the number of employees respectively. This group is first in the region in terms of number of companies, and second based on the number of employees, as well as on specialisation.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-based
03.1	Fishing	599	721	7.49	4.72	7.28
	Position among top 10 3-digit industries in **North Aegean**	1st	2nd	6th	2nd	2nd

Source: ELSTAT, 2017

The 03.1 group is one of the most frequent in Greece, as it is within the top 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

Source: ELSTAT, 2017

2. Relation to RIS3 North Aegean

Agrofood is a priority sector according to the RIS3 strategy for North Aegean[1]. The strategic objective of RIS3 in this sector is to re-produce old, traditional products with new, modern technological processes and promote them to the world market as new products. Especially fish and fish products are available in all islands of the region, but other products are also very important, such as olive oil, livestock products and mastic. The properties of such products in some cases have not been systematically studies despite their significant benefits for health. Therefore, promoting nutritional value is vital for the production and marketing of innovative food products.

For this reason, another crucial objective of the RIS3 strategy refers to the link between primary production and processing, since quality cannot be ensured adequately only at the stage of processing. On the contrary, interventions have to be done since the stage of production, which in this case is fishing. Finally, the strategy underlines the need for collaboration not only between companies of the same sector (horizontally), but also between companies of different sectors (vertically), since the product is a common resource for them. For example, the improvement of fish infrastructure directly affects fish processing companies but also restaurants and other services related to tourism.

3. 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[2], and the species with the largest catches were anchovy (15.5% of total) and sardine (14.6%). Compared to 2015, the average annual employment in the sector decreased by 9.8%.

The marine fisheries sector in Greece face the challenge to balance the sustainability of stocks and the income of fishermen[3]. 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. Finally, overfishing in combination with illegal fishing and trade pose a threat to certain species, especially sharks and skates, as at least 50-54% of their population

[1] RIS3 of the North Aegean Region, Source: https://www.espa.gr/elibrary/RIS3_BoreioAigaio_201502.pdf
[2] Athens News Agency - Macedonian Press Agency, Source: https://www.alfavita.gr/koinonia/257070_ereyna-alieia-kai-ydatokalliergeia-stin-ellada-kai-tin-ee
[3] https://ec.europa.eu/fisheries/sites/fisheries/files/docs/body/op-greece-fact-sheet_el.pdf

is at risk[4]. A recent study demonstrates that mislabeling of such species (named elasmobranch) in North Aegean reach 60% of the specimens found in Greek fish markets[5].

In this context, 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 achieve 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.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total
3.9.1	Invasive species. A possible new marine resource. Ways to exploit.	1	0	1
3.9.2	Development and utilization of new remote sensing and Geographic Information Systems technologies in the agri-food sector and for the evaluation and management of pastures.	0	0	0
3.9.3	Innovative applications of new biotechnological methods and microbial fermentation systems in the agri-food sector.	0	0	1
	Total	**1**	**0**	**1**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	0	0	0
Central Macedonia	0	1	1
Western Macedonia	0	0	0
Epirus	0	0	0
Thessaly	1	0	1
Ionian Islands	0	0	0
Western Greece	0	0	0
Central Greece	0	1	1
Attica	1	1	2
Peloponnese	0	0	0

[4] The Conservation Status of Sharks, Rays and Chimaeras in the Mediterranean Sea https://www.iucn.org/sites/dev/files/content/documents/brochure_medredlist_sharks.pdf
[5] Giovos, I., et al. (2020). Assessing multiple sources of data to detect illegal fishing, trade and mislabelling of elasmobranchs in Greek markets. *Marine Policy*, 112, p.103730.

North Aegean	**1**	**0**	**1**
South Aegean	0	0	0
Crete	1	0	1
Total	**4**	**3**	**7**

Overall, there is limited interest on developing research and innovation in the sector of fishing, despite its importance for the Greek economy. The research interest is mainly focused on aquaculture (described next) and it remains open to discussion whether regional and national policies should promote research and innovation in the fishing sector in Greece.

5. Potential platforms for ecosystems development

Compared to aquaculture, the industry of fish capture remains stagnant across the years[6]. According to a World Bank study[7], it was estimated that successfully restored and managed world fisheries would sustainably provide 10% more yield annually relative to the 2004 harvest level. Restoring and improving the productivity of stressed capture fisheries is possible if correct measures are taken by country governments, marine resource managers, and the fishing fleets and communities.

A **common branding** could support the establishment of the Greek identity for fish products coming from capture fishing, and not from aquaculture. Similar to the brand "*Fish from Greece*" supported by the Hellenic Aquaculture Producers Organization (HAPO), there should be collaboration between all actors involved in the sector in order to create a common identity and a common organization framework. This identity should act not only as a seal of confidence and trust for buyers and consumers through a certification protocol, but also as a common ground for promotional activities that could support all actors involved in the fishing ecosystem.

Another direction to support the fishing ecosystem could be investing on **value-added products**, such as fillet, pre-cooked, smoked and processed products in general, as opposed to the freshly produced fish. Facilitating development of new uses and ideas for fish products could significantly broaden the market share of the fishing sector, providing both retailers and consumers with more convenient yet healthy ways of eating fish. The development of new products by the fish catches could also open the way to new markets, such as China, Russia, USA and Canada, increasing the export rates of the Greek economy.

[6] Fish to 2030: Prospects for Fisheries and Aquaculture (2013)
Source:http://www.fao.org/3/i3640e/i3640e.pdf
[7] Arnason, R., K. Kelleher, and R. Willmann. 2009. The Sunken Billions: The Economic Justifi cation for Fisheries Reform. Washington, DC: World Bank.

03.2 Aquaculture in Western Greece

1. Economic and production profile

The Group 03.2 comprises the following 4-digit classes:

03.21 Marine aquaculture: fish farming in sea water including 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, culture of crustaceans, bivalves, other molluscs and other aquatic animals in sea water, as well as aquaculture activities in brackish waters, in salt water filled tanks and reservoirs but also operation of fish hatcheries (marine) and of marine worm farms.

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

According to the Hellenic Statistical Authority, there are 34 companies dedicated to Aquaculture located in the 3 prefectures of Western Greece with 766 employments and EUR 87,72 turnover in 2017 (Elstat, 2019). Compared to Greece, the regional specialisation is 1,95 and 4,74 times higher based on the number of companies and the number of employees respectively. Despite the relatively small number of companies, the sector of aquaculture is crucial for the sustainable development of the region, as it represents one of the most important regions in the field of fisheries, aquaculture, processing and trade in Greece[8].

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation -employment-based
03.2	Aquaculture	34	766	87.72	1.95	4.74
	Position among top 10 3-digit industries in **Western Greece**	7th	3rd	3rd	4th	2nd

Source: ELSTAT, 2017

The 03.2 group is quite frequent in Greece, as it is within the top 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

Source: ELSTAT, 2017

[8] Western Greece Five-Year Operational Program 2014-2019, Source: https://www.pde.gov.gr/gr/enimerosi/epixeirisiako-programma-2014-2019.html

2. Relation to RIS3 Western Greece

As stated in the RIS3 strategy of Western Greece[9], the sectoral ecosystem of agro-food, including agriculture, aquaculture and fishing, constitutes the most important value chain of its regional economy. More specifically, aquaculture is highlighted as the most dynamic industry of the region's primary production, especially in the regional unit of Aetolia-Acarnania, as it ranks top in value exports of agricultural products (RIS3 of Western Greece, p. 14). At a national level, 48% of the country's lagoons and 25% of lakes are located in the region of Western Greece, while the activity of aquaculture companies at the production level accounts for 25% of the domestic production.

Restructuring and modernization of aquaculture production, using modern production methods and the shift towards activities of higher added value, are considered significant opportunities for the region's specialization, and therefore, its future prosperity. The actions proposed in the RIS3 Action plan regard the protection and ecological restoration of water bodies that are important for aquaculture and fishing, as well as the adoption of quality assurance and control systems in the agro-food sector.

3. 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[10]. The growing market demand for certain species that are produced in Greece (such as sea bream and sea bass), combined with the favorable 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[11]. 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, they produce offspring, foods and fixed equipment.

In Greece, the aquaculture sector aims to meet the increasing demand and claim market shares from third Mediterranean countries that have much higher growth rates. 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. However, improving the productivity of existing plants, while expanding activity and productive innovation as well as establishing new plants, are among the main requirements for the development of the aquaculture sector in Western Greece.

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[9] RIS3 of the Western Greece Region, Source: http://dytikiellada.gr/wp-content/uploads/2016/01/RIS3_%CE%94%CE%95_2-2015.pdf
[10] Common Fisheries Policy (CFP), Source: https://ec.europa.eu/fisheries/cfp_en
[11] Annual report on Greek Aquaculture (2019), Federation of Greek Mariculture, Source: https://www.fgm.com.gr/uploads/file/FGM_19_GR_WEB_Spreads(4).pdf

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
3.1.5	Innovative processes for optimizing traditional products and producing new products with superior features	0	1	1	8.3%
3.3.3	Investigation of production of innovative livestock / industrial crops	1	0	1	8.3%
3.4.2	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	0	1	1	8.3%
3.9.1	Invasive species. A possible new marine resource. Ways to exploit	0	0	0	0.0%
3.9.4	Improving knowledge on the metabolism and nutritional requirements of farmed fish. Development of indicators and methods of early detection of ineffective nutrition	1	1	2	16.7%
3.9.5	Exploitation of processed animal protein by fish and other animal by-products, use of alternative animal feedstocks	0	0	0	0.0%
3.9.6	Use of alternative plant raw materials with emphasis on local plant varieties (linking to other legumes production and processing) or alternative methods of treatment of plant materials used	0	1	1	8.3%
3.9.7	New methods for the treatment of viral and bacterial infections	0	1	1	8.3%
3.9.9	New farming technologies for precision aquaculture	1	4	5	41.7%
3.9.12	Increase product life (new packaging, machining). Methods of transportation - storage - storage of products	0	0	0	0.0%
3.9.13	New ways of processing existing farmed fish (fillets, pre-cooked meals, etc.) and mussels (processing for added value eg decollated, pre-cooked, with storage and transport capabilities). Standardization and production of processed products from new species (farmed fish, shellfish)	0	0	0	0.0%
3.9.14	Diversification - Breeding new species of fish and shellfish with added value.	0	0	0	0.0%
3.9.15	Identification and cultivation of local species of phytoplankton or algae of economic interest	0	0	0	0.0%
	Total	**3**	**9**	**12**	**100.0 %**

Regions	Round B Erevno-Kainotomo		Special Action		Total
	Research	Company	Research	Company	
Eastern Macedonia and Thrace	3	3	3	1	**10**

Central Macedonia	4	8	12	1	**25**
Western Macedonia	0	1	0	0	**1**
Epirus	2	2	4	5	**13**
Thessaly	9	0	16	3	**28**
Ionian Islands	0	3	0	3	**6**
Western Greece	**3**	**9**	**13**	**7**	**32**
Central Greece	0	5	0	5	**10**
Attica	14	15	37	4	**70**
Peloponnese	0	2	0	2	**4**
North Aegean	4	0	2	0	**6**
South Aegean	0	0	0	0	**0**
Crete	9	1	19	0	**29**
Total	**48**	**49**	**106**	**31**	**234**

5. Potential platforms for ecosystems development

Aquaculture, and in particular fish farming, is today one of the most dynamically growing animal production industry. According to the Food and Agriculture Organization (FAO) and the World Bank, by 2030 more than 65% of fishery products will come from aquaculture[12]. The Hellenic Aquaculture Producers Organization (HAPO), officially recognized in 2018, aims to firmly establish the Greek identity and highlight the exceptional characteristics and competitive advantage of the fresh Greek fish branded under *"Fish from Greece"*. This brand certifies responsible aquaculture and supports the promotion of high-quality Greek fish, while at the same time it takes advantage of the common organisation of the markets in fishery and aquaculture products.

Given these circumstances, there is a good opportunity for the Greek aquaculture sector to open its recently branded products to **new markets**, including China, Russia, the US and Canada. **Collective promotional activities** orchestrated by HAPO should highlight the benefits of fish products branded under *"Fish from Greece"*, as a high-quality brand with a clear geographical reference and a special focus on responsible and sustainable ways of production.

At the same time, the collaboration with research and innovation institutions could support the shift of the industry to **new fish species**, which will boost the market, where prices are falling due to saturation and high competitiveness with other countries. As noted by Technavio[13], introducing new species in the market directly focuses on the development of the industry, providing core scientific and commercially useful information to support the growth in aquaculture production and in the advancement of new technological tools. Finally, another direction to support the ecosystem might be the focus on **value-added products**, such as fillet, pre-cooked, smoked and processed products in general, as opposed to the freshly produced fish. Facilitating development of new uses and ideas for fish products could significantly broaden the market share of the aquaculture sector, providing both retailers and consumers with more convenient yet healthy ways of eating fish.

[12] Fish to 2030: Prospects for Fisheries and Aquaculture (2013)
Source:http://www.fao.org/3/i3640e/i3640e.pdf
[13] Global Aquaculture Market 2018-2022, Source: https://www.seafoodsource.com/features/technavio-report-global-aquaculture-markets-growth-accelerating-through-2022

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

1. Economic and production profile

This group includes the processing and preserving of meat in general and the production of meat products. It comprises the following three 4-digit classes:

10.11 Processing and preserving of meat: which includes the operation of 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. This class also includes, among others, the production of hides and skins originating from slaughterhouses, including fellmongery; the rendering of lard and other edible fats of animal origin; and the processing of animal offal-production of pulled wool.

10.12 Processing and preserving of poultry meat, which includes the operation of 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, which includes the production of dried, salted or smoked meat and the production of meat products (sausages, salami etc.).

Processing and preserving of meat and producing meat products is the most significant sector in terms of employment and turnover in Epirus. It is also the fifth larger industry in Epirus in terms of number of companies (data for 2017). Compared to total Greece, the regional specialisation is 4.43 to 11.58 times higher, depending on whether it is computed on number of companies or in terms of employment.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation -companies-based	Specialisation -employment-based
10.1	Processing and preserving of meat and producing meat products in Epirus	43	2,260	613.75	4.43	11.58
	Position among top 10 3-digit industries in Epirus	5th	1st	1st	4th	1st

Source: ELSTAT, 2017

Apart from Epirus, the 10.1 group is within the 10 top industries in other three Greek regions with East Macedonia and Thrace, Thessaly and Crete having the highest specialisation among all Greek regions in terms of companies and Thessaly along with Epirus having a significant turnover ranging from 113,49 mil. Euros to 613,75 mil. Euros. The highest specialisation based on both the number of employees and the number of companies is in Epirus. East Macedonia and Thrace and Thessaly have also a significant specialisation index in terms of companies and employees, which is two to three times higher than the national average.

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

Source: ELSTAT, 2017

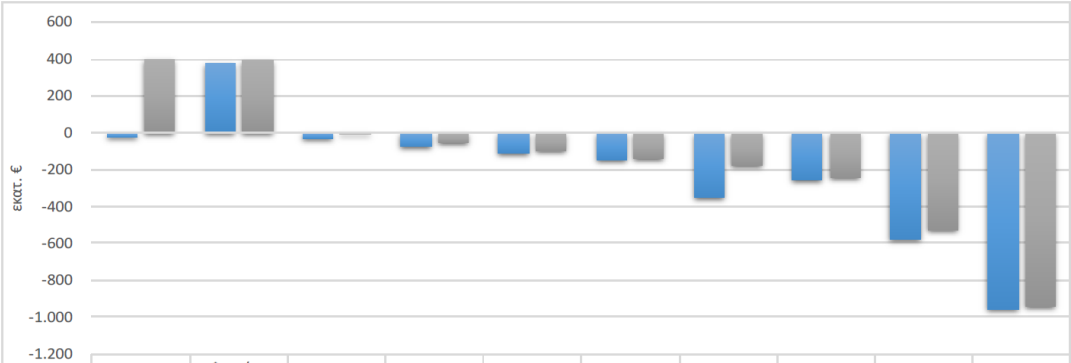
2. Relation to RIS3 Epirus

Processing and preserving of meat and the production of meat products is a priority sector for the RIS3 of Epirus through the wider agrofood industry. The region holds a significant tradition in meat production and processing. The strategic objective of RIS3 Epirus is to increase production and productivity of agrofood products, preserving at the same time the particular traditional characteristics of these products and to increase their volume of exports. Currently, the exporting activity for meat products is 4% which is much lower than the level of imports (RIS3, 2014).

The emphasis of the strategy is on i) improvements in the levels of competitiveness through better sanitation and food safety, ii) the standardisation and the broadening of processed meat types and iii) the use of technological innovations in meat processing aiming to advance the quality of the final products (taste, aesthetic, quality, safety etc.) and increase the added value of traditional meat products. A significant objective of the strategy is the development of cooperative schemes among local producers and the establishment of international sales networks in order to improve the promotion of local products -especially those with a small production scale-and increase exports. However, due to the small-scale production of most traditional meat products in Epirus, more emphasis should be given to the tourist market by introducing local brand name products to hotels, than on exports.

3. 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 bil. euros. Due to the negative balance between domestic production and demand, the sector is highly dependent on imports from other countries (e.g. Germany, France, The Netherlands, Poland, Spain). In fact, despite the increase in the exporting activity, the size of imports grows at a higher level (both in terms of size and of value). Apart from domestic consumption, large quantities of meat and meat-based products are absorbed in the food service industry (restaurants, hotels, catering services) as well as for cold cuts. In fact, processed meat and cold cuts are highly dependent on other EU countries for importing primary material. These products have a higher demand elasticity compared to meat, since they are not considered as basic necessity food products.



	Έλαια και λίπη	Φρούτα και λαχανικά	Αλευρώδη	Ποτά	Προϊόντα αμύλου	Ζωοτροφές	Γαλ/μικά	Ψάρια	Άλλα είδη διατροφής	Κρέας
2014	-21	380	-31	-74	-112	-144	-354	-259	-579	-958
2015	397	390	-8	-50	-99	-139	-178	-243	-529	-944

Figure 10.1.1. Trade balance of main food industry sub-sectors (imports-exports) for 2014-2015. Source: IOBE (2017)[14]

[14] IOBE (2017) Βιομηχανία Τροφίμων και Ποτών, Facts and Figures 2016, Ίδρυμα Οικονομικών και Βιομηχανικών Ερευνών.

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 stuffs. Small units on the other hand, have problems of complying with storage and distribution regulations in terms of quality control and the application of the existing institutional framework for the production and disposal of meat and the operation of standardisation/processing plants. In Epirus, all types of meat are produced (cows', pork, lamp, poultry) while the special climate conditions of the region enable the exploration of other possibilities for new products and breeds (turkey, rabbit).

Meat is mainly distributed through wholesalers while smaller quantities can also be sold directly to supermarkets. In areas which lack central meat markets, retailers are addressed directly to meat producers. Existing infrastructure in slaughterhouses and meat industries appear to be sufficient to cover the supply of the primary sector. In terms of research infrastructure, the Technological Research Centre (T.R.C.) of Epirus operates in the region with some of its research activities linked to the rescue of husbandry genetic material and the control and improvement of animals' productivity.

Both animal farming and meat processing and preservation face fierce competition from imported products. The increase in animal feeds and animal fattening feeds' price increase the production cost and leads to fluctuations in the level of meat production. 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. Such advancements can be easily used in the region's small scale meat production units but also in poultry farming which -compared to other animal production sectors- is characterised by quick reproduction, the ability to adapt to technical breeding conditions and can immediately adopt new technological innovations in the fields of genetics, nutrition and hygiene.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
3.1.4	Potential of using innovative medicinal / aromatic plants and exploring their use in the food, cosmetic and animal production industries.	3	3	6	26.1%

3.4.4	Development and application of innovative technologies in agri-food businesses to improve reproductive performance and ensure the hygiene and quality of the products produced.	1	1	2	8.7%
3.5.4	Development of products aimed at preventing pathological conditions and improving the quality of life.	3	2	5	21.7%
3.8.1	Reduction of environmental footprint at all stages of the agri-food chain.	1	2	3	13.0%
3.8.3	Innovative applications of genomics, proteomics, metabolomics, and new biotechnological methods in the agri-food sector.	2	1	3	13.0%
3.10.1	Other emerging technologies. Indicative: Circular bioeconomics and sustainable systems	1	3	4	17.4%
	Total	**11**	**12**	**23**	**100 %**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	6	9	15
Central Macedonia	44	33	77
Western Macedonia	1	6	7
Epirus	**11**	**12**	**23**
Thessaly	16	14	30
Ionian Islands	1	1	2
Western Greece	11	15	26
Central Greece	2	9	11
Attica	59	32	91
Peloponnese	1	5	6
North Aegean	2	2	4
South Aegean	0	0	0
Crete	5	4	9
Total	**159**	**142**	**301**

5. Potential platforms for ecosystems development

Processing and preserving of meat and meat production can benefit as an industry significantly from the creation of platform-based ecosystems. A first example can be the collaborative efforts of small producers for entering external markets. Regional meat producing enterprises can offer their production aggregated, conduct exporting business transactions through a common institution, or use common logistics networks in order to promote local brand name products to international markets. The unique climate conditions for animal breeding and the access to superior traditional raw materials that are used in the development of meat products guarantee high quality products which are linked to the benefits of the Mediterranean cuisine, a popular cuisine internationally. Such platforms could operate the other way around, providing market relevant information with regards to demand and customer specific needs.

Other potential ecosystems can be created around new technological solutions (e.g. using common research infrastructures in key production processes, ecosystems that allow the absorption of technological change by SMEs etc.). State-of-the-art research infrastructures can be used for testing the nutritional value of meat products, for novel packaging or meat by-products treatment, while other types of technology sharing schemes can reduce the cost of infrastructure or technology access by small enterprises.

10.3 Processing and preserving of fruit and vegetables in Central Macedonia

1. *Economic and production profile*

The Group 10.3 comprises the following 4-digit classes:

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, except ready-made dishes in frozen or canned form, preserving of fruit, nuts 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, roasting of nuts, manufacture of nut foods and pastes, and manufacture of perishable prepared foods of fruit and vegetables.

According to the Hellenic Statistical Authority, there are 177 companies located in the 7 prefectures of Central Macedonia with 5.464 employees and EUR 786,36 million turnover in 2017 (Elstat, 2019). Compared to Greece, the regional specialisation is 1,49 and 2,44 times higher based on the number of companies and the number of employees respectively. This industrial group has the highest turnover in the region, while it is the second largest group in terms of the number of employees.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation -companies-based	Specialisation -employment-based
10.3	Processing and preserving of fruit and vegetables	177	5,464	786.36	1.49	2.44
	Position among top 10 3-digit industries in Central Macedonia	4th	2nd	1st	9th	5th

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

Source: ELSTAT, 2017

2. *Relation to RIS3 Central Macedonia*

This group is part of the RIS3 priority sector of Central Macedonia under "**Agrofood Sector**", which is recognized as a regional specialization sector (primary sector and food manufacturing),

as it has critical mass of businesses, primary production of considerable range of high quality products, export orientation, significant employment rate, remarkable research production and developmental opportunities. The potential for innovation lies on the scientific expertise of the Region of Central Macedonia compared to the national level in the fields of Agriculture, Chemistry and Veterinary, and specialized scientific fields such as Agricultural Engineering.

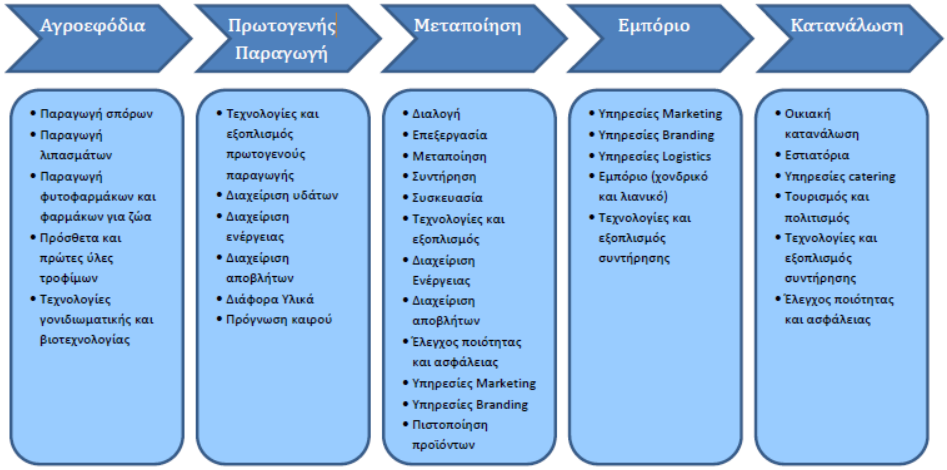


Figure 10.3.1. Value chain in Agrofood in Central Macedonia, Source: RIS3 Central Macedonia, p. 65.

3. Business challenges

The region of Central Macedonia is characterized by significant manufacturing activity in food products, represented by the wider food manufacturing sector (NACE 10). The existence of industrial areas in all regional units ensures the establishment of processing units. 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 (Interview, Emetris). 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 (Interview, CERTH). Overall, dynamic and productive manufacturing is a central pole for basic agricultural products. 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).

At a national level, processed fruits and vegetables show a surplus in all years from 2010 to 2017 and processed fruits and vegetables account for the largest share of exports (21% respectively in the three sectors), in terms of the share of each sector in the total trade flows of processed food and beverages[15]. At the same time, processed fruits and vegetables is the main exporting industry for the region of Central Macedonia[16] and among the top target countries are Poland, Italy, Germany, Bulgaria and France. [17]

[15] Τσακανίκας, Α., Βασιλειάδης Μ., Σταυράκη Σ.,Πέππας Κ., Μουστάκας, Α., και Βαλαβανιώτη Ε. (2018). Προκλήσεις και προοπτικές του τομέα μεταποίησης στην Ελλάδα: Στρατηγικές παρεμβάσεις για ανάπτυξη. ΙΟΒΕ

[16] Εξαγωγές Περιφέρειας Κεντρικής Μακεδονίας, Πηγή: ΕΛΣΤΑΤ, Επεξεργασία: Ινστιτούτο Εξαγωγικών Ερευνών και Σπουδών.

[17] Europages - https://www.europages.co.uk/

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
3.1.1	Improving, developing and evaluating new varieties Recognizing and evaluating the particular characteristics of indigenous plant species.	52	34	86	**15.8%**
3.1.5	Innovative processes for optimizing traditional products and producing new products with superior features.	16	14	30	**5.7%**
3.2.1	Reduce production and input costs in all agricultural and food production systems.	5	13	18	**3.5%**
3.2.2	Systems and technologies for rational water management and conservation.	9	26	35	**6.4%**
3.2.3	Energy saving / Increasing share of renewable energy use.	3	8	11	**2.0%**
3.3.2	Design, development and implementation of innovative technologies for holistic management of farms to meet the challenges of climate change.	18	41	59	**10.8%**
3.3.4	Innovative techniques for selective harvesting, processing, packaging, fruit and vegetables, soft management systems of vegetable products (ripening indices - storage conditions).	12	17	29	**5.3%**
3.4.1	Organic and integrated agricultural production with emphasis on the use of inputs from domestic sources.	5	5	10	**1.8%**
3.4.2	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.	51	80	131	**24.0%**
3.4.4	Development and implementation of innovative technologies in agri-food businesses to improve reproductive indicators and ensure the hygiene and quality of the products produced.	22	15	37	**6.8%**
3.6.2	Development of methods, mechanisms, tools for verifying food authenticity and protecting consumers from fraud or fraud in Greek traditional value-added products and foods.	2	5	7	**1.3%**
3.7.1	Modern technologies of packaging, processing, post-harvest maintenance of agricultural products and food.	32	44	76	**13.9%**
3.7.2	Development and application of new technologies in the standardization, labeling, traceability of products and foods from vegetable and animal production.	4	10	14	**2.6%**
	Total	**231**	**312**	**543**	**100.0%**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	26	46	72
Central Macedonia	**231**	**312**	**543**
Western Macedonia	5	23	28
Epirus	16	23	39
Thessaly	121	104	225
Ionian Islands	0	2	2
Western Greece	35	69	104
Central Greece	5	22	27
Attica	206	138	344
Peloponnese	4	49	53
North Aegean	6	14	20
South Aegean	0	11	11
Crete	100	58	158
Total	**755**	**871**	**1626**

5. Potential platforms for ecosystems development

There is no doubt that food manufacturing and processing is a crucial industrial sector not only for Central Macedonia and Greece, but also for Europe as a whole. Lately, the leading trends for the industry of fruit and vegetables' processing in Europe involve **sustainability**, especially environmental issues related to waste reduction and **energy efficiency**, changing consumer habits towards more personalised and **healthier diets**, food safety, transparency and convenience.

Based on these trends, an ecosystem building on **brands and packaging** might be the common ground connecting the companies in this sector. In terms of brands, the focus should be on creating either high quality local brands or a national identity, similar to that of *"Fish from Greece"*, which provides also some sort of certification of quality. These 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 vegetables processing might provide a competitive advantage for the region of Central Macedonia, and therefore, Greece.

To 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 **adoption of advanced technologies supported by competence centres** and the integration of applied research results in the processing of agricultural production may also play a crucial role on supporting the ecosystem of processing and preserving of fruit and vegetables in Central Macedonia. An interesting example is the case of Tetra Pak that has announced the launch of its connected packaging platform, which will use digital tools such as code reading to provide full information about the traceability of product throughout the supply chain.

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

1. Economic and production profile

This group includes the manufacture of crude and refined oils and fats from vegetable or animal materials, except rendering or refining of lard and other edible animal fats. It comprises the following 4-digit classes:

> *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. This class also includes the manufacture of non-
>
> *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.

In total, 96 companies are located in the prefectures of Northern Aegean with 285 employees and a 36.66 million turnover in 2017. This industrial group is between the third and fifth larger in Northern Aegean in terms of number of companies, employment, and turnover. What is remarkable is the very high degree of specialisation. Compared to total Greece, the regional specialisation is 4.86 to 10.08 times higher, depending on whether it is computed on number of companies or employment.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
10.4	Manufacture of vegetable and animal oils and fats in Northern Aegean	96	285	36.66	4.86	10.08
	Position among top 10 3-digit industries in N. Aegean	3rd	5th	4th	1st	1st

Source: ELSTAT, 2017

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

Source: ELSTAT, 2017

2. Relation to RIS3 Northern Aegean

Agrofood is a priority sector for Northern Aegean RIS3. The strategic objective of RIS3 in this field is to re-produce old products with the new, modern, technological processes and to promote them as 'new' products on the world market. Indicatively, such products are olive oil (in Lesvos, Samos, Chios, Ikaria and less in Lemnos), livestock products, mainly dairy products in all islands, wine

and ouzo (in Samos and Lemnos mainly, but also in the other islands)), mastic and mastic products (in Chios), citrus fruits and juices (in Chios), fish and fish products (in all islands). Many of these products have beneficial health features that have not been systematically studied to date, and are transferred to the finished food product, thereby providing them with pharmacological, or even functional, properties.

In this context, a particularly important RIS3 objective is the link between processing and primary production, as a focus on quality cannot be effectively implemented only by processing interventions, but crop-farming interventions, depending on the product, are also required. A 'platform' for development may be 'contract Agriculture' enhanced by the development of sustainability rules and methods of monitoring and verifying their implementation.

Indicative actions might be the integrated product management involving producers and processors, groups of producers for quality management systems from 'field to shelf', promotion of unique Mediterranean food and the unique raw materials of North Aegean produce to the world markets.

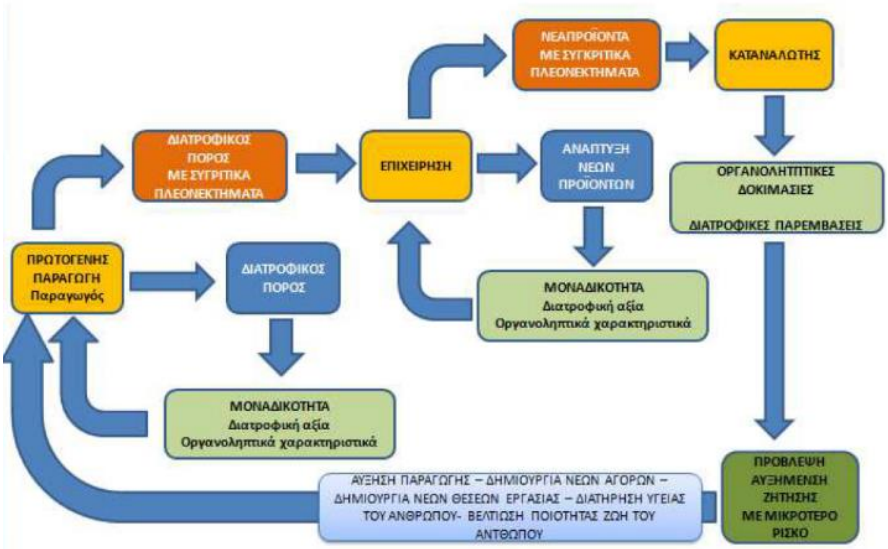


Figure 10.4.1. Production process for new nutritional products
Source: RIS3 Northern Aegean, p. 47

3. 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.

Olive Oil extraction is the process of separating the oil from the fruit's pit and pulp. It is possible to attain this separation by physical means alone (since oil and water don't mix), so they are relatively easy to separate. This contrasts with other oils that are extracted with chemical solvents. There are 3 basic methods of olive oil extraction: (1) the Traditional Olive Press, which is a better grinding of the olives, thereby reducing the release of oil oxidation enzymes, (2) the Decanter Centrifugation, which offers highest percentage of oil extraction and the olive oil contains a higher amount of phenolic compounds and tocopherols and more aroma, and the Sinolea Cold Dripping, which produces an oil of higher polyphenol content, lower acidity levels in the oil and a higher olive oil quality.

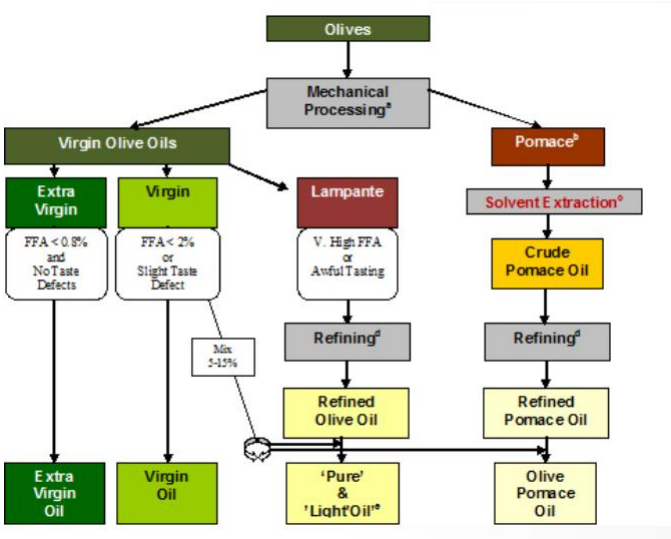


Figure 10.4.2. Measuring Oxidation in Extra Virgin Olive Oil
Source: Richard Gawel, 2016.

The mechanical processing includes methods that do not use solvents or excessive heat to extract the oil. These methods include centrifugation and (now, rarely) pressing. Pomace is the mix of skins and crushed olive seeds left over after most of the olive oil and water have been mechanically extracted from the olive paste. Usually hexane is the solvent used. Refining involves a number of steps which involve the addition of strong acids and bases, and the application of processes such as chilling, washing, centrifugation, filtration and deodorisation.[18]

Key challenges in the olive oil production of Northern Aegean and at the Lesvos island in particular are: [19]

- <u>High quality but low branding</u>: Greece is the third largest producer of olive oil in the world (11 per cent of total volume production), following Spain (40 per cent) and Italy (14 per cent). Indeed, Greek olive oil is of superior quality, since 80 per cent of production is extra virgin olive oil (compared with 65 per cent in Italy and 30 per cent in Spain). However, only 27 per cent of Greek production reaches the stage of labeling/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.

- <u>Backward production and high costs</u>: Structural problems are due to the small size and traditionality of firms, (1) the cost of olive production is relatively high in Greece (about €1/kg of olives, compared with €0.6/kg in Spain), (2) most olive mills in Greece are smaller and less advanced (in terms of technology) than those in Spain, leading to higher milling costs, (3) firms are not vertically integrated with the olive farming stage and the distribution stage, (4) existence of many olive oil cooperatives that does not facilitate the standardization of quality control, (5) the small size of bottling and labeling companies does not allow for the successful promotion of branded products. A more vertically integrated production structure would increase the efficiency of the sector, strengthen its marketing strategy, and consequently prove favorable for a successful branding of Greek olive oil.

[18] BIC of Attica (2012). Κλαδική μελέτη ελαιόλαδου - πυρηνελαιου.
[19] National Bank of Greece (2015). Olive oil: Establishing the Greek brand. Sectoral report.

The Greek olive oil is losing share in the world oil production. Greece's market share in the world market of branded olive oil decreased from 6 per cent during the 1990s to 4 per cent during the past 5 years.

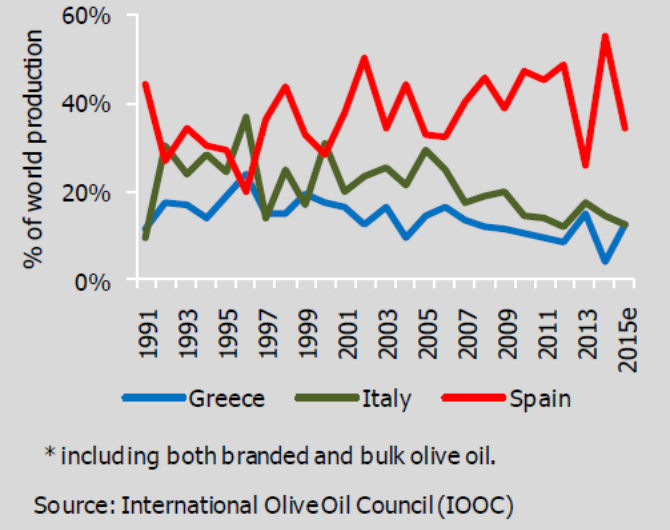


Figure 10.4.3. World production of olive oil. Main producers and market share

Exports absorb the 35 per cent of Greek production. Most of the exported quantity (about 70 per cent) is directed to Italy in bulk form, where it is mixed with olive oil of different origins and then re-exported as branded Italian olive oil (as mentioned above). This leads to two negative effects, the loss of value added from branding and the low familiarity of foreign consumers with the taste of Greek virgin olive oil, which is more intense than refined oils and blends.

Environmental pollution. 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 leaves transported with the olive tree, and a significant volume and organic amount of liquid waste (known as "Katsigaros"). This by product consists of the aqueous fraction of the olive oil juice and the water used in the various stages of oil production in the olive mill. Essentially it is an aqueous vegetable extract containing a range of substances such as sugars, nitrogen compounds, organic acids, polyalcohols, polyphenols and oil residues. The immediate impact of the cigarette on the environment is the aesthetic degradation it causes due to its strong odour and dark colour. The high organic load of the cigarette due to the presence of polyphenols does not allow it to be released directly into the environment but requires its prior treatment.

In terms of environmental regulation, 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 into the sea. The report of Environmental Inspectors (2014) point out that the majority of Lesvos mills have been operating at least since 2006 until today without definitive authorization in violation of the legislation. Inappropriate wastewater disposal was allowed to natural receptors (streams, sea). This practice served the owners of the mills, exempting them from complying with environmental protection provisions. It is estimated that only 24,500 to 81,500 cubic meters of waste resulted in Lesvos streams or at sea only from 2009 to 2013. And the threshold exceedances in the Inspector Samples are enormous (for example COD - chemically required oxygen for complete oxidation of organic matter, ranging from 62,000-104,000mg / l to 125 mg / l and BOD - biochemically required oxygen for the biochemical oxidation of organic matter, between 8,000 and 33,000 mg / l with a limit of 25 mg / l).

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
3.1.5	Innovative processes for optimizing traditional products and producing new products with superior features	2	4	6	33.3%
3.1.6	Utilization of underutilized and by-products of Greek raw materials for the production of new foods	2	2	4	22.2%
3.6.2	Development of methods, mechanisms, tools for verifying food authenticity and protecting consumers against fraud or fraud in Greek traditional value-added products and foods	3	3	6	33.3%
5.4.3	Clinical efficacy (necessary - required clinical trials) and product safety studies (In vitro and in vivo pharmacological studies of herbal substances)	0	2	2	11.1%
	Total	**7**	**11**	**18**	**100.0 %**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	15	22	37
Central Macedonia	127	124	251
Western Macedonia	7	17	24
Epirus	18	17	35
Thessaly	43	46	89
Ionian Islands	1	6	7
Western Greece	28	41	69
Central Greece	2	30	32
Attica	153	97	250
Peloponnese	4	22	26
North Aegean	**7**	**11**	**18**
South Aegean	1	4	5
Crete	31	31	62
Total	**437**	**468**	**905**

5. Potential platforms for ecosystems development

Many of the above challenges could be addressed by stronger collaboration, development of commons, and vertical integration of the olive oil production. Following the example of Chios mastixa, for instance, olive oil producers could create common assets of research, marketing and promotion which could contribute to address the challenges of quality, branding, market share and environmental pollution.

Something similar in Crete, the Agricultural Cooperatives of Crete are considering the creation of a single Cretan olive oil management body, which will (a) ensure quality by intervening in all matters of quality and certification of olive oil, and (b) create a common brand, that will offer economies of scale to get better access on the world market.[20]

The recommendation of the NBG sectoral report is for "higher concentration as well as vertical integration in the sector. In particular, relatively larger farms (or more efficient cooperatives) could operate at a lower production cost and attain the critical size in order to have coherent marketing and export strategies". **An ecosystem along the value chain of the olive oil production could include** (1) the cultivation of olives, (2) the processing of olives for olive oil production, (3) the processing of the high toxic waste, and (4) the marketing and distribution of olive oil. Better organisation along the value chain (including the stages of processing, branding and distribution) could internalize market volatility and lead to the distribution of branded products of standardized high quality.[21]

[20] https://www.neakriti.gr/article/kriti/1566291/kritiko-elaiolado-zitoun-onomateponumo-gia-ton-prasino-hruso/

[21] National Bank of Greece (2015). Olive oil: Establishing the Greek brand. Sectoral report, p. 25.

10.5 Manufacture of dairy products in Epirus

1. Economic and production profile

This group includes the operation of dairies and cheese making and the manufacture of ice cream. It comprises the following two 4-digit classes:

10.51 Operation of dairies and cheesemaking: which includes the manufacture of fresh liquid milk, pasteurised, sterilised, homogenised and/or ultra-heat treated; manufacture of milk-based drinks; manufacture of cream from fresh liquid milk, pasteurised, sterilised, homogenised; 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.

Manufacture of dairy products is the second most significant sector in terms of turnover production in Epirus. It is also between the fourth and the sixth larger industry in Epirus in terms of number of companies and employment having 37 companies located in the region with 616 employees (data for 2017). Compared to total Greece, the regional specialisation is 1.83 to 2.66 times higher, depending on whether it is computed on number of companies or employment.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
10.5	Manufacture of dairy products in Epirus	37	616	147,977	1.83	2.66
	Position among top 10 3-digit industries in Epirus	6th	4th	2nd	7th	7th

Source: ELSTAT, 2017

The 10.5 group is within the 10 top industries in seven Greek regions with North Aegean, West Macedonia and Thessaly having the highest specialisation among all Greek regions in terms of companies and Thessaly along with Epirus having the highest specialisation based on the number of employees. Apart from Epirus which shows a high ranking at the regional market, Thessaly also has a high turnover (almost half a million) and a significant specialisation index in terms of employees (4.79).

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

Source: ELSTAT, 2017

2. Relation to RIS3 Epirus

Manufacture of dairy products is a priority sector for the RIS3 of Epirus through the wider agrofood industry. The region holds a significant tradition, not only in the manufacture of dairy products but also in the production of vegetable oil, the as well as aquaculture. The strategic objective of RIS3 Epirus is to increase production and productivity of agrofood products, preserving at the same time the particular traditional characteristics of these products and to increase their volume of exports.

The emphasis is both on small scale improvements (standardisation, better packaging) as well as the modernisation of dairy products manufacturing process with the use of innovative technologies. The modernisation of traditional methods of dairy products production (e.g. cheese), which give unique taste characteristics to the products, can increase the scale of production and disseminate the particular identity of the region. Improved processing and standardisation accompanied with innovations that increase the scale of production and advance the quality of the final products (taste, aesthetic, quality, safety etc.) can accelerate the competitiveness of the food industry.

Finally, a significant objective of the strategy is the development of cooperative schemes among local producers and the establishment of international sales networks in order to improve the promotion of local products -especially those with a small production scale-and increase exports. In fact, it should be noted that dairy products account 15% of the regional exports.

3. Business challenges

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 (IOBE, 2019).

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. Large enteprises dispose modern mechanical equipement which they renew investing significant funds. Some of the most important dairy companies in Epirus are Dodoni, Epirus S.A., Karalis S.A.-Milk Industry of Epirus, Minerva and Tositsa.

Enterprises that belong to the 10.5 sector are mainly vertical with operations that start from the receipt of milk to the standardisation of the final products. Dairy products are extremely diverse as a result of the robust composition of milk and the types of microorganisms that can grow in milk. In Epirus, 90% of the enterprises process only sheep and goat milk and only 10% process cow's milk. In total, and on an annual basis, 140,000 tons of milk are processed by regional enterprises. The most significant dairy products of the region are yogurt and cheese. Three Greek Protected Designation of Origin (PDO) cheeses are produced in Epirus (feta, kefalograviera and galotiri) while Metsovone chesse which is also PDO is produced only in Epirus. Yogurt is another competitive product that shows significant exports (RIS3 Epirus, 2014).

In terms of research infrastructure the Dairy Research Institute (defined in 2001 as the "National Research Institute of Milk and Milk Products") and the Agricultural Experimental Station of the

National Agricultural Research Foundation (NAGREF) are located in Ioannina conducting considerable research and training-dissemination work on the Greek dairy sector and traditional cheese production. The scientific specialisation of Epirus partly corresponds to the regional productive specialisation although there is scope for improvements. For this, emphasis should be given to basic research and the advancement of technological services of the dairy industry. Some of the main business challenges that can be addressed through technological advancements are i) consistency in the quality of traditional dairy products such as cheese, ii) improved sanitation and at the same time reduction of wastewater, achieving both cost efficiency and environmental issues, iii) new packaging (packaging in different formats and sizes, e.g. enclosable, snack packs etc., product specific packaging etc.). Many of these operational improvements are expected to increase consistency and productivity of regional enterprises.

The law which released the life of milk has allowed domestic companies to limit the cost of returns. However, supermarkets and big suppliers have now the ability to import cheaper milk (from Germany, France and the Netherlands) and either sell it at relatively competitive prices or use it in the production of dairy products such as cheese and yogurt. Also, the competition between large enterprises is significant and they have to invest heavily on advertising and other promotion activities. In Epirus, due to the small scale of production of some traditional dairy products the sector may be benefited by the indication of nutritional information for the promotion of Mediterranean cuisine and the development of sales networks with emphasis on the touristic market.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
3.1.4	Potential of using innovative medicinal / aromatic plants and exploring their use in the food, cosmetic and animal production industries.	4	4	8	25.0%
3.1.5	Innovative processes for optimizing traditional products and producing new products with superior features.	3	4	7	21.9%
3.3.1	Development and implementation of precision systems in agricultural and livestock production.	1	1	2	6.3%
3.4.4	Development and implementation of innovative technologies in agri-food businesses to improve reproductive indicators and ensure the hygiene and quality of the products produced.	1	1	2	6.3%
3.4.5	Investigation of the use of alternative protein feeds in animal production.	1	0	1	3.1%
3.6.2	Development of methods, mechanisms, tools for verifying food authenticity and protecting consumers from fraud or fraud in Greek traditional value-added products and foods.	2	2	4	12.5%
3.7.1	Modern technologies of packaging, processing, post-harvest maintenance of agricultural products and food.	1	1	2	6.3%

3.8.3	Innovative applications of genomics, proteomics, metabolomics, and new biotechnological methods in the agri-food sector.	4	2	6	18.8%
	Total	**17**	**15**	**32**	**100.0 %**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	11	19	30
Central Macedonia	105	108	213
Western Macedonia	4	14	18
Epirus	**17**	**15**	**32**
Thessaly	57	50	107
Ionian Islands	1	2	3
Western Greece	25	40	65
Central Greece	2	19	21
Attica	130	67	197
Peloponnese	5	23	28
North Aegean	3	8	11
South Aegean	0	4	4
Crete	27	24	51
Total	**387**	**393**	**780**

5. Potential platforms for ecosystems development

As in the other packaged food industries in Greece, many of the above challenges could be addressed by stronger collaboration and development of commons. Platforms creating networks of producers with local brand name products or giving emphasis on biological products or nutritional characteristics of traditional dairy products in relation to Mediterranean cuisine can enhance reach to international markets. Also, broader agro-food technology platforms providing knowledge on vertical operations of the industry (e.g. innovative packaging, cost-effective and eco-friendly manufacturing processes) or the incorporation of digital technologies (analysis/monitoring tools for improving product quality, product development and process quality, traceability of products etc.) can also reinforce competitiveness of the products.

10.9 Manufacture of prepared animal feeds in Western Greece & Epirus

1. Economic and production profile

This group comprises the following 4-digit classes:

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 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.

According to the Hellenic Statistical Authority, there are 13 companies dedicated to the manufacture of animal feeds in Western Greece with a total of 77 employees and a turnover of EUR 19,35 (Elstat, 2017). Compared to Greece, the regional specialisation is 1,6 and 1,74 times higher based on the number of companies and the number of employees respectively. In the region of Epirus, there are 20 companies dedicated to the manufacture of animal feeds with a total of 305 employees and an annual turnover of EUR 50,524. Finally, compared to Greece, the regional specialisation is 4,83 and 8,78 times higher based on the number of companies and the number of employees respectively. Despite the relative low number of companies and number of employees in Epirus, the sector has a significant turnover per year, and very high specialisation in terms of both employment and number of companies.

NACE	Region	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation -companies-based	Specialisation -employment-based
10.9	Western Greece	Manufacture of prepared animal feeds	13	77	19.36	1.6	1.74
		Position among top 10 3-digit industries	7th	8th	7th	9th	10th
	Epirus	Manufacture of prepared animal feeds	20	305	50.52	4.83	8.78
		Position among top 10 3-digit industries	8th	9th	4th	3rd	2nd

Source: ELSTAT, 2017

The 10.9 group is within the top 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

Source: ELSTAT, 2017

2. *Relation to RIS3 for Western Greece & Epirus*

For the neighbouring regions of Western Greece and Epirus, agriculture and manufacture of products coming from the primary sector are among the priorities for development in their RIS3 strategies[22]. The manufacture of animal feeds is considered a supporting activity for the agricultural production and, thus, are part of the value chains of both regions. Indeed, 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. The RIS3 Strategy for the region of Epirus clearly states that the manufacturing industry is the most important industry of the secondary sector, as it accounts for 66% of the region's total turnover. The majority of the manufacturing units in the region are mainly involved in the processing of products from the primary sector. In particular, there is a high concentration of manufacturing activity in sectors that are directly processing products of the primary sector, such as livestock and agriculture.

Similarly, the sectoral ecosystem of food and bio-food constitutes the most important value chain of the regional economy of Western Greece, as it involves the main areas of expertise: (1) agricultural production which is qualitative but may lack clear targeting and orientation; (2) processing of food and beverages that seems to have resisted the economic crisis; and (3) trade. However, the need for extroversion and innovation through the integration of ICTs is highlighted as potential direction for future development in the region.

3. *Business challenges*

Animal feed is 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[23]. Due to the increased demand for livestock products for domestic consumption, farmers and livestock producers have become aware of the fact that the animals should be fed with high-quality animal feed. Furthermore, the proportion of crossbred animals has also increased over the years, which has generated a higher demand for a better quality and more nutritious animal feed. Overall, the market for animal nutrition has been changing considerably and is becoming strongly competitive owing to its major share in the pet care industry, which is thereby driving the global feed industry.

According to the Global Feed Survey published by Alltech[24], in 2017 the feed industry crossed the threshold of 1 billion metric tons and is expected to maintain an upward trajectory as the population continues to grow and is increasing protein consumption. Globally, the feed industry grew by a strong 3 percent in 2018, to 1.103 billion metric tons. The consolidation and intensification of the feed industry has resulted in more tonnes produced from fewer feed mills. For instance, in the European Union between 2005 and 2010, the feed mill size has increased from approximately 10,000 tonnes to 50,000 tonnes per feed mill per year, with the number of

[22] RIS3 Western Greece & RIS3 Epirus, Source: https://www.espa.gr/el/pages/staticRIS3.aspx
[23] Future of the Global Feed Industry (2017). Source: http://benisonmedia.com/future-of-the-global-feed-industry/
[24] 2019 Global Feed Survey (2019). Source: https://www.alltech.com/sites/default/files/2019-01/GFS_Brochure_2019_English%20FINAL.pdf

feed mills shrinking from a level of 10,000 to 2,000[25]. Hence, the industrialisation of the feed industry has resulted in an increased specialisation and efficiency of manufacturers and suppliers. 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 the competition for natural resources and trade barriers. At the same time, there is growing concern 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 the European Union authorities[26].

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
3.1.4	Potential of using innovative medicinal / aromatic plants and exploring their use in the food, cosmetic and animal production industries.	8	8	16	66.7%
3.3.3	Investigation of production of innovative livestock crops / industrial crops.	2	1	3	12.5%
3.4.5	Investigation of the use of alternative protein feeds in animal production.	1	4	5	20.8%
	Total	**11**	**13**	**24**	**100.0 %**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	3	5	8
Central Macedonia	47	31	78
Western Macedonia	1	6	7
Epirus	9	8	17
Thessaly	19	18	37
Ionian Islands	0	0	0
Western Greece	**11**	**13**	**24**
Central Greece	2	12	14
Attica	29	13	42

[25] A view on the future of the feed industry (2013). Source: https://www.allaboutfeed.net/Home/General/2013/7/A-view-on-the-future-of-the-feed-industry-1227213W/

[26] den Hartog, L. and Sijtsma, S.R. (2013) Challenges and opportunities in animal feed and nutrition. Source: https://edepot.wur.nl/306279

Peloponnese	1	0	1
North Aegean	0	1	1
South Aegean	0	0	0
Crete	4	7	11
Total	**126**	**114**	**240**

5. Potential platforms for ecosystems development

The global food industry and, consequently, the global animal feed industry are mainly driven by consumer shift towards 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 for sustainability, as a result of their operations. In this context, any support for the development of the industry ecosystem could take into account these factors.

Strengthening the **link between industry and university** research can play a central role in supporting the development of the ecosystem. Scientific and technological advances offer many opportunities for innovation in different segments of the animal feed and nutrition industry. More specifically, technological advancements will help to increase the production efficiency by improving the accuracy of formulation and consistency. The adoption of advanced machinery will also enable feed manufacturers to change the feed consistency and formulation with each batch, while, innovation in raw materials could provide new types of feed stocks and, thus, alter feed formulation. Finally, biotechnology is also a trend in the feed industry, as through more scientific formulations and new molecule, the productivity could be increased to a large extent.

Another direction for the ecosystem development regards encouraging **the adoption of Information and Communication Technology (ICT)** in feed manufacturing. In the near future, it is expected that the animal feed industry will be increasingly connected through ICT. Creating flows of information between farms, feed mills and processing plants will allow matching availability of feed with demand, increasing the efficiency of the livestock industry, while reducing waste. Furthermore, the use of near infrared (NIR) probes together with feedback from farms and processing plants, will permit the real-time analysis of incoming raw materials and the reformulation of diets on a minute-by-minute basis. Briefly, real-time automated and verification systems, including the use of near infrared and in-vitro nutritional evaluations, could allow us to observe and define nutritional value, and detect contaminants, moving the industry towards new standards for **food safety**.

Overall, innovations are crucial for the future development of the animal feed ecosystem, as they have the potential to meet current challenges and result in resource efficiency, healthy livestock and people, responsible production systems and optimal profit throughout the value chain. The future of the feed industry will be more digitalized, and the complete supply chain is expected to be closed-linked, shaping a detailed flow of information from farms to consumers.

11.0 Manufacture of beverages in Peloponnese

1. Economic and production profile

This group includes the manufacture of beverages, such as non-alcoholic beverages and mineral water, manufacture of alcoholic beverages mainly through fermentation, beer and wine, and the manufacture of distilled alcoholic beverages (excluding the production of fruit and vegetable juices, the manufacture of milk-based drinks, and the manufacture of coffee, tea and mate products). It comprises the following seven 4-digit classes:

11.01 Distilling, rectifying and blending of spirits class: which includes the manufacture of distilled, potable, alcoholic beverages: whisky, brandy, gin, liqueurs etc.; the manufacture of drinks mixed with distilled alcoholic beverages; the blending of distilled spirits and the production of neutral spirits.
This class excludes the manufacture of non-distilled alcoholic beverages; the manufacture of synthetic ethyl alcohol; the manufacture of ethyl alcohol from fermented materials; as well as merely bottling and labelling
11.02 Manufacture of wine from grape, which includes the manufacture of wine, sparkling wine and wine from concentrated grape must. It also includes the blending, purification and bottling of wine and the manufacturing of low or non-alcoholic wine. The class excludes merely bottling and labelling.
11.03 Manufacture of cider and other fruit wines, which includes manufacture of fermented but not distilled alcoholic beverages (sake, cider, perry and other fruit wines) and the manufacture of mead and mixed beverages containing fruit wines. The class excludes merely bottling and labelling.
11.04 Manufacture of other non-distilled fermented beverages, which includes manufacture of vermouth and the like. The class excludes merely bottling and labelling.
11.05 Manufacture of beer, which includes the manufacture of malt liquors, such as beer, ale, porter and stout as well as the manufacture of low alcohol or non-alcoholic beer.
11.06 Manufacture of malt, which includes the manufacture of malt, and
11.07 Manufacture of soft drinks; production of mineral waters and other bottled waters, which includes the manufacture of non-alcoholic beverages (except non-alcoholic beer and wine); the production of natural mineral waters and other bottled waters, the manufacture of soft drinks and of non-alcoholic flavoured and/or sweetened waters such as lemonade, orangeade, cola, fruit drinks, tonic waters etc.
The class excludes the production of fruit and vegetable juice; the manufacture of milk-based drinks; the manufacture of coffee, tea and maté products; the manufacture of alcohol-based drinks; the manufacture of non-alcoholic wine and non-alcoholic beer; the manufacture of ice as well as merely bottling and labelling.

Manufacturing of beverages is the sector with the highest regional specialisation (4.02 higher compared to Greece) with regards to the number of companies. It is among the fourth and the sixth most significant sectors in Peloponnese in terms of number of companies, employment and turnover. The regional specialisation in terms of employment is 2.23 times higher, compared to total Greece (data for 2017).

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
11.0	Manufacture of beverages in Peloponnese	188	520	76,35	4.02	2.23

	Position among top 10 3-digit industries in Peloponnese	4th	5th	6th	1st	8th

Source: ELSTAT, 2017

Apart from Peloponnese, the 11.0 group is within the 10 top industries in other six Greek regions with Central Greece, Epirus, East Macedonia and Thrace as well as Western Greece having the largest numbers in terms of employment and turnover. Euros to 613,75 mil. Euros. The highest specialisation based on both the number of companies is in Peloponnese (4.02). However, the regional specialisation in terms of employment is Epirus and North Aegean, which is three times higher than the national average.

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

Source: ELSTAT, 2017

2. Relation to RIS3 Peloponnese

Manufacturing of beverages, and particularly the classes referred to wine production is of high priority in the RIS3 strategy of Peloponnese. Although the general strategic objective is the agrofood sector, a sector also of national priority, the strategy describes in detail the wine production activities that are concentrated in Peloponnese and includes actions for improving their competitive advantage. More specifically, in Peloponnese there are two recognised geographic indication zones of unique local grapevine varieties (Nemea and Mantineia). The wine production sector is well organised with companies having a high degree of verticalisation and significant exporting activities.

The strategy focuses on i) the exploitation of new technological knowledge and know-how in the agrofood sector for the upgrading of local products with the aim to develop highly recognisable and of good quality products, but also for differentiation and the promotion of local products for specific categories of consumer groups of markets with particular references; ii) the strengthening of human skills in the use of innovative practices throughout the production process but also on aspects of innovation management, marketing and international trade; iii) the enhancement of networking both in terms of business networks creation to achieve internationalisation and between businesses, institutional bodies and research institutions to support innovative entrepreneurship in the sector; iv) the encouragement of complete verticalisation of the primary production system towards processing, standardisation and marketing.

3. Business challenges

Manufacture of beverages is a highly dynamic sector in Greece with 253 companies in 2017 and more than 31.000 employees. The sector contributes to the Greek economy with 277 mil. euros taxation income from companies of the value chain (63% of the product's price), while the Gross

Domestic Value from all types of beverages reaches 1.5 bil. Euros. The sector is highly extroverted with 69% of the domestic production being 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) (IOBE, 2018). Apart from the traditional beverages such as ouzo, tsipouro and retsina, the country has a 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 value chain of the sector involves a wide set of activities than the narrow demarcation of beverages production which is reflects the first level of the chain. At a second level comes the intermediate distribution channels (wholesale), third, the retail endpoints (supermarkets and liquor stores) and fourth the endpoints of retail and onsite consumption (hotels, restaurants, bars etc.) (Figure 1).

Figure 11.0.1. The four levels of the beverages industry. Source: IOBE (2018).

In Peloponnese there are two out of the 27 Greek Protected Destination of Origin (PDO) wine zones (Nemea, Mantineia, Monemvasia-Malvazia). In Nemea and Mantineia, two of the four native varieties -'local ambassadors' of the Greek wine- are being cultivated, Agiorgitiko Nemeas and Moschofilero Mantineias. The region also holds a significant position in the production of certified organic grapes with 212 acres (about 25% of the country's total cultivated organic vineyards).

The wine sector in Peloponnese shows signs of extroversion and is characterised by bottom up collaborations. The Wine Producers' Association of the Peloponnese Vineyard (ENOAP), actively in the elaboration of the National strategic plan for the development of Greek wine. Collaborations with research centres is restricted to small scale studies given the limited entrepreneurial funds for long term primary research in the wine sector. Some of the business challenges of the sector are described below:

1) There is a need for **basic research** in the study of varieties and the development of a standard protocol for the clonal selection of grapevine varieties with the aim to rescue and promote local varieties of Peloponnese. The exploitation of such uniqueness can secure high value in niche markets. Activities that can be encouraged here include continuous testing and certification of genetic material for products/varieties PDO and PGI, analysis of their particular tasting characteristics and nutritional properties, and research on potential new uses of existing products or the development of new products based on local biodiversity (e.g. combining local grapevine varieties, production of organic wine, cultivation of grapevine varieties that are more resistant to climate change, use of phenolic compounds in other products such as cosmetics or food additives etc.).
2) The incorporation of **technological innovations in the 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). A significant issue in the wine production sector is

the utilisation of new technologies for the valorisation and management of waste and by-products as well as technologies for the minimisation of energy consumption.

3) 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 in Greece 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.
4) Dealing with factors that influence **the industry's sustainability** such as the relatively small scale of cultivations, the high cost of labour (especially the cost of insurance) during harvesting periods, low levels of private investment for the mechanisation of wine harvesting and the high rates of indirect taxation on wine products (RIS3, 2014).

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
3.1.1	Improving, developing and evaluating new varieties Highlighting and evaluating the particular characteristics of indigenous plant varieties.	0	7	7	20.0%
3.1.4	Potential of using innovative medicinal / aromatic plants and exploring their use in the food, cosmetic and animal production industries.	1	0	1	2.9%
3.3.1	Development and implementation of precision systems in agricultural and livestock production.	1	3	4	11.4%
3.3.2	Design, development and implementation of innovative technologies for holistic management of farms to meet the challenges of climate change.	0	2	2	5.7%
3.4.2	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.	0	6	6	17.1%
3.5.4	Development of products aimed at preventing pathological conditions and improving the quality of life.	0	2	2	5.7%
3.6.2	Development of methods, mechanisms, tools for verifying food authenticity and protecting consumers from fraud or fraud in Greek traditional value-added products and foods.	1	3	4	11.4%
3.6.3	Development of tools to identify and monitor emerging risks across the food chain.	0	2	2	5.7%
3.8.1	Reduction of environmental footprint at all stages of the agri-food chain.	0	1	1	2.9%
3.8.2	Development and utilization of new remote sensing and Geographic Information Systems technologies in the agri-food sector and for the evaluation and management of pastures.	0	3	3	8.6%

3.8.3	Innovative applications of genomics, proteomics, metabolomics, and new biotechnological methods in the agri-food sector.	0	3	3	8.6%
	Total	**3**	**32**	**35**	**100.0%**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	9	20	29
Central Macedonia	126	156	282
Western Macedonia	6	19	25
Epirus	14	16	30
Thessaly	62	46	108
Ionian Islands	1	1	2
Western Greece	30	37	67
Central Greece	2	16	18
Attica	126	73	199
Peloponnese	**3**	**32**	**35**
North Aegean	2	8	10
South Aegean	0	4	4
Crete	51	22	73
Total	**432**	**450**	**882**

5. Potential platforms for ecosystems development

Ecosystems finding common ground addressing some of the abovementioned challenges in a collaborative way could facilitate the sector while dealing with structural deficiencies (e.g. lack of funding, small scale of production etc.). Given the vertical -to a high degree- structure of the sector, ecosystems could include a wide variety of actors e.g. companies, research institutions, end users, collective bodies etc.

A first example could be the creation of an ecosystem connecting companies, research institutions, retailers etc. around the **study and preservation of local wine grape varieties**. Activities that can be developed around such ecosystem could include research on indigenous microdata of local wines and their oenological potential, collaboration among producers for data management on wine grape cultivation and on microflora to better understand the cultivation conditions, collaborations in exporting ventures, cultural events and hospitality services for the promotion of local vine grape varieties.

Another ecosystem could be created around the different potential **uses of by-products** from various stages of wine production process promoting a model of industrial symbiosis and circular economy. Research on potential exploitation in food supplements and cosmetics, technologies for the extraction of useful substances or use of other non-useful by-products as biomass for energy production or as organic fertilisers could expand the range of operations of local companies to other industries.

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

1. Economic and production profile

The Group 14.1 comprises the following 4-digit classes:

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

In total, 995 companies are located in the 7 prefectures of Central Macedonia with 4,552 employees and a 344.19 million turnover in 2017. Compared to Greece, the regional specialisation is 2.18 to 2.41 times higher, depending on whether it is computed on number of companies or employment. This industrial group is the third larger in Central Macedonia in terms of 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
	Position among top 10 3-digit industries in C. Macedonia	3rd	3rd	3rd	3rd	4th

Source: ELSTAT, 2017

2. Relation to RIS3 Central Macedonia

The Group 14.1 is part of the RIS3 priority sector of Central Macedonia 'Textiles and Clothing", a traditionally important employment sector in the region, third in export size, with interconnection to the primary production (cotton), technological capabilities (new materials) and non-technological innovation (design).

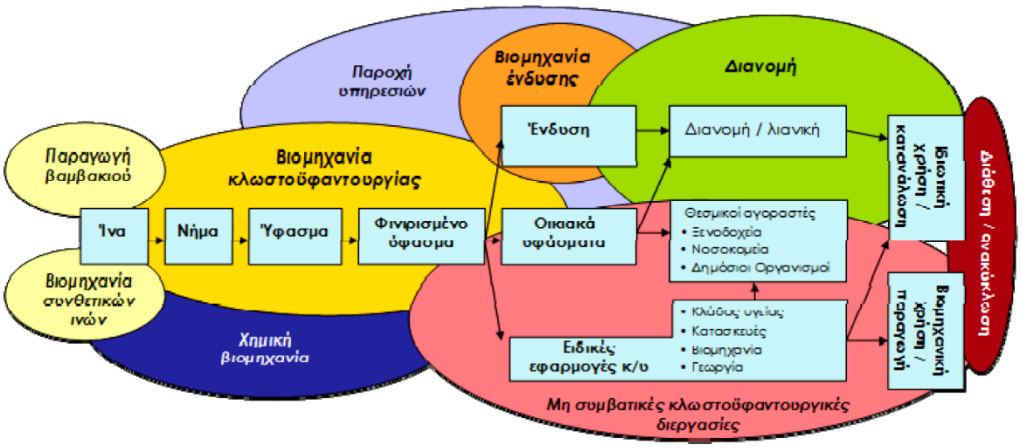


Figure 14.1.1. Value chain in textiles and clothing. Source: RIS3 Central Macedonia, p. 94.

The potential for innovation is to be found in the ability to utilise new materials and horizontal technologies, IT optimisation, energy and environmental efficiency, design, and organisational innovation, in particular in the supply chain management and just-in-time production (RIS3 Central Macedonia, p. 93). The two segments of the industry (textiles and clothing) differ substantially, textile is a capital-intensive industry with high barriers to entry and output, while clothing is labour-intensive.

3. 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 pre-40-year period of mass production of products does not exist, and the production activity of these plants is now focused on high value-added products (Interview, Federation of Industries of Greece). 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). Most export-intensive is the class 14.14-Manufacture of underwear. The Gross Profit Margin is among the highest of Greek manufacturing (29,6%). But gradually this leading position in exports and profitability is eroded[27]. 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, though more can be said when the official statistics are announced, towards the end of February. In the domestic market, on the other hand, wholesale and retail sales fell sharply (Hellenic Garment Enterprises Association).

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.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
1.5.1	Polymeric and organic materials (semiconductors and conductors), metal oxides and metals, dielectrics, nanomaterials (nanoparticles, nanowires), barrier materials, transparent electrodes for the manufacture of active and passive elements.	0	2	2	2%
1.11.1	Liquid deposition processes (mainly by solution deposition) and by steam (physical or chemical vapor deposition). Laminating processes. Chemical	0	1	1	1%

[27] Τσακανίκας, Α., Βασιλειάδης Μ., Σταυράκη Σ.,Πέππας Κ., Μουστάκας, Α., και Βαλαβανιώτη Ε. (2018). Προκλήσεις και προοπτικές του τομέα μεταποίησης στην Ελλάδα: Στρατηγικές παρεμβάσεις για ανάπτυξη. ΙΟΒΕ

	modification and microfabrication processes and surface modification and microfabrication surfaces.				
2.3.6	Development of innovative design, through the creation of value chains, for the development of products, applications, systems and services designed to support and enhance the primary and secondary production sectors, including craft production and crafts - Arts and Crafts	0	1	1	1%
2.4.2	Exploit and develop 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.	3	5	8	6%
3.1.1	Improving, developing and evaluating new varieties Recognizing and evaluating the particular characteristics of indigenous plant species.	17	11	28	21%
3.2.1	Reduce production and input costs in all agricultural and food production systems.	5	13	18	14%
3.2.2	Systems and technologies for rational water management and conservation.	2	5	7	5%
3.3.1	Development and implementation of precision systems in agricultural and livestock production.	5	12	17	13%
3.3.2	Design, development and implementation of innovative technologies for holistic management of farms to meet the challenges of climate change.	4	8	12	9%
3.4.2	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.	10	16	26	20%
3.4.5	Investigation of the use of alternative protein feeds in animal production.	1	1	2	2%
3.8.2	Development and utilization of new remote sensing and Geographic Information Systems technologies in the agri-food sector for the evaluation and management of pastures.	2	5	7	5%
3.10.1	Other emerging technologies. Indicative: Circular bio economics and sustainable food production systems, distributed ledger technology applications (e.g. Blockchain) in the agri-food sector.	1	1	2	2%
	Total	**50**	**81**	**131**	**100 %**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	4	11	15
Central Macedonia	**50**	**81**	**131**
Western Macedonia	3	6	9

Epirus	3	6	9
Thessaly	29	22	51
Ionian Islands	0	0	0
Western Greece	12	14	26
Central Greece	1	7	8
Attica	42	42	84
Peloponnese	2	11	13
North Aegean	3	4	7
South Aegean	0	6	6
Crete	25	13	38
Total	**174**	**223**	**397**

5. Potential platforms for ecosystems development

Given this trend, an ecosystem building on **brand and design** might be the common ground connecting the companies in this sector. Apart of traditional design-based, brands can be related to concepts of sustainability (e.g. how reducing water usage during garment production; use of sustainable cotton; eco-friendly fashion; alternative apparel that create eco-friendly, organic cotton in place of conventional cotton, and recycled polyester and plastic bottles to create soft eco-fabrics, and many other), or social responsibility as a core corporate value.

The ecosystem can be based on **non-competitive elements** of the industry group, such as awareness of global trends, strategy development, workforce education and skills, fashion events and Expos. Knowing the customers, anticipating their future needs, and exceeding their expectations results in solutions that serve rather than products to push. This leads to brand extension towards lifestyle branding.

Another option is for a few companies of the industry group **to create their own ecosystem**. In this case the players involved in the value chain can be put into the following categories:

- Brand Owner: Owns a recognized brand name easily identified by the masses; usually handles the marketing function of the end-product
- OEM: The manufacturer, who actually produces the product for the brand owner; can also be a brand owner
- Component Suppliers: Provide any number of components to the OEMs
- Resellers/Partners: Handle the distribution of the end-product in a specified geography; can also act as a go-between for the OEM and component suppliers

It may seem as though an ecosystem approach is only possible for huge companies operating in multiple industries, but even small businesses can make use of the model and connect with customers in a number of connected areas.

14.2 Manufacture of articles of fur in Western Macedonia

1. Economic and production profile

The group comprises one class only:

14.20 Manufacture of articles of fur, including 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 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 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 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
	Position among top 10 3-digit industries in Western Macedonia	1st	1st	1st	1st	1st

Source: ELSTAT, 2017

2. Relation to RIS3 of Western Macedonia

The priority domains (sectors) in the RIS3 of Western Macedonia, selected after evaluation of qualitative and quantitative data are (1) energy and heating based on renewable energy sources (mainly in the Kozani and Florina), (2) integrated waste management (in all prefectures); traditional rural development and processing sectors, such as processing - standardization of agricultural products (in all prefectures), fur farming and leather products (in Kastoria and Kozani), foods, beverages, and metal products (in all prefectures) and tourism (also in all prefectures. These priorities form a mixture of sectors in four main groups as follows:

1. Agro-food (processing - standardization of agricultural products, food and beverages)
2. Environment (Energy / RES-Heating – metal structures - integrated waste management)
3. Breeding of fur animals and leather products
4. Tourism [28]

Thus, the activities of the industry group 14.2 are clearly within the scope and priorities of the regional RIs3. In particular, the objectives set by the RIS3 for the fur and leather products are to strengthen the production capacity and outward orientation with actions such as developing research, and in particular genetic material, to improve the quality of fur animals; development of the Greek Fur Certification System; enhancing environmental awareness and investment in

[28] Region of Western Macedonia (2015). RIS3 Strategy, https://www.espa.gr/el/pages/staticRIS3.aspx

waste management of animal breeding and residue; transfer of know-how transfer, mainly in breeding and processing, innovative approach to extroversion, and empowering employment in the Youth for fur chain. These sectoral priorities cover the entire value chain of fur production, fur farming, manufacturing of fur articles, extroversion towards new fur markets; and developing of skills and the human potential. [29]

3. Business challenges

At the beginning of 2017, active fur companies did not exceed 500, with the number of registered companies rising to 1,250. At the same time, fur farms decreased to 80, from 120 two years ago.

Exports are the most important challenge. The sector 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. Therefore, fur is a much more expensive product for the Russians than in the past. 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, after a four-year downturn, the outlook for domestic fur trading is positive, as Russia's economy has begun to recover. The improvement of the ruble's exchange rate against the dollar and the euro supports exports, while interest from Russian buyers is on the rise. In 2017, the productive performance of the industry is clearly improved, with several domestic fur-makers also undertaking subcontracting on behalf of foreign firms. [30]

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.

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.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation (see Table below).

Tech area	Research and Innovation priority	Number
2.1.3	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).	1
3.4.4	Development and implementation of innovative technologies in agri-food businesses to improve reproductive indicators and ensure the hygiene and quality of the products produced.	1

[29] Op. cit., p. 107-109
[30] Νικολαΐδης, Α. (2017). κλάδος της γουνοποιίας. Infobank Hellastat A.E

4.6.3	Development of urban and industrial wastewater treatment systems.	1
	Total	**3**

There were no other proposals participations 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.

5. Potential platform for ecosystem development

A digital platform for exports might be a driver for the growth of the fur industry in West Macedonia. It can be built as evolution of the KASTORIA International Fur Fair, which is the platform in South Europe that gathers and curates the very best of Greek and International Fur Fashion Brands and puts them in the hands of the most influential players in the fur fashion industry (https://www.furfairkastoria.com/). Changes should be toward the selling of fur articles and apparel instead of fur skins as luxury, high end products.

The platform could adopt the logic of sharing economy platforms, which follow a hub and spike architecture, with separate companies promoting and selling their own products over a common digital infrastructure. Moreover, it should take advantage of current digital promotion techniques for personalisation and recommended systems.

Digital promotion and commerce provide a number of advantages that can be shared by companies in the branch as external economies: personalization is a leading factor in ecommerce at large, purchases are influenced by personalized recommendations or promotions, consumers prefer brands to personalize messaging, offers, and experiences, and companies see personalization as critical to current and future success. By tracking user behavior, fashion sellers can build personalization into the onsite experience. Although this may start with recommended products, true personalisation extends to the very visuals that are used to present products themselves.

Selling high-end goods, services or experiences isn't the same thing as selling the low and mid-tier alternatives. The key learning here was that the techniques that work for mass-market products don't work for luxury goods or services. Images play an important role both emotionally and on an informational level in persuading visitors to buy.

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

1. Economic and production profile

The group comprises five product classes:

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 the common wood presents, namely the unevenness of strength, shrinkage, mud, fire resistance and more.

In total, 67 companies of this group are located in the prefecture of Western Macedonia, with 265 employees and a 23.43 million Euro turnover in 2017. This industrial group holds a middle position between the top 10 industries in terms of number of companies, employment, and turnover. Compared to total Greece, the regional specialisation 1.51 to 3.53 times higher, depending on whether it is computed on number of companies or employment.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
16.2	Manufacture of products of wood, cork, straw	67	265	23.43	1.51	3.53
	Position among top 10 3-digit industries in Western Macedonia	5th	5th	4th	7th	4th

Source: ELSTAT, 2017

The 16.2 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

Source: ELSTAT, 2017

2. Relation to RIS3 of Western Macedonia

The priority activities in the RIS3 of Western Macedonia are defined in terms of sectors and fall into four main groups:
1. Agro-food (processing - standardization of agricultural products, food and beverages)
2. Environment (Energy / RES-Heating – metal structures - integrated waste management)
3. Breeding of fur animals and leather products
4. Tourism [31]
Thus, the activities of the industry group 16.2 Manufacture of products of wood, cork, straw and plaiting materials are not within the scope and priorities of the regional RIs3.

3. Business challenges

The artificial timber industry includes several product categories and is directly affected by the construction and furniture (kitchen, home, office) sectors. Veneer, as a product, is used in coating manufactured surfaces of industrial timber (particleboard, plywood, fiberboard). Particle boards are the most widespread of artificial timber products and cover (in quantity) most of their total consumption. The types of chipboard produced are: bare chipboard, veneer or melamine chipboard. Most of the coated particle boards are covered by melamine coated boards (approximately 85% -90% of the total coated particle board market). Fiberboards are divided into three main categories: high density (hardboard), medium density (MDF) and low density (insulating board). The most consumed species is MDF, which due to its properties finds many applications in construction and furniture. Plywood is the first artificial timber product to appear on the market. In recent years, however, it has faced intense competition, notably from the MDF. In addition to the internal competition they face, as artificial timber products compete with each other, these products are threatened to some extent by the development of innovative counterfeit products. Specifically, in recent years they have come up with products made of imitation wood, which are used in various uses (eg frames).

Across Europe, employment trends in the wood industry are declining. The same trends are found in the production of wood-based panels in southern European countries. On the contrary in central and northern Europe, the production of wood-based is more or less stable over the last decade.[32]

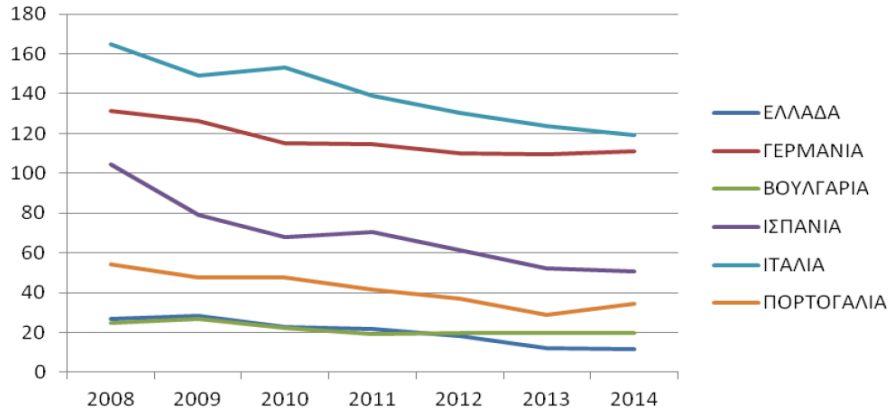


Fig. 16.2.1. Employment trends in the wood industry.

[31] Περιφέρεια Δυτικής Μακεδονίας (2015). Σχέδιο Στρατηγικής Έξυπνης Εξειδίκευσης Περιφέρειας Δυτικής Μακεδονίας, 98.
[32] Σέργης, Γ. Κατσουλάκης, Ι. & Νικολούδη, Κ. (2017). Διαχρονική εξέλιξη στον κλάδο της ξυλείας κατά την περίοδο 2000-2013. ΤΕΙ Κρήτης, Σχολή Διοίκησης και Οικονομίας, 38.

The gradual decline in timber raw materials makes it difficult to find suppliers gradually. This, coupled with the rise in international oil prices and transport cost, has led to an increase in the prices of raw materials and (consequently) artificial timber products. The course of the industry depends on the course of construction activity, both on new buildings and on improvements, repairs and remodelling, demand from furniture companies, supply of raw materials (logging wood), as well as competition created from other timber products and / or substitutes.

In Greece, since 2009, the sharp decline in demand for timber products caused by the financial crisis has gradually led to a shrinkage in the 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.[33]

However, reversal trends have been observed since 2016 and artificial timber products were up 5.3% over the previous year. According to ELSTAT data, the last three years it has been observed positive growth rates.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation (see Table below).

Tech area	Research and Innovation priority	Number
1.9.2	Development of multifunctional construction and protection materials, compatible with traditional structures and monuments, with increased durability and lifetime / efficiency, utilizing multiscale modeling models that allow for the controlled design and modification of their properties.	1
1.17.1	Development of building materials and / or systems for use in structures and infrastructures with improved energy, functional and / or environmental performance (indicative targeting of thermal insulation, seismicity, waterproofing, reduced energy consumption, fire resistance, improved environment / comfort, antibacterial, antibacterial, antibacterial) diversity, photo-catalysts, etc.).	1
1.17.2	Development or application of new building materials (cement, concrete, natural materials, metallic materials, composites, carbon fibers, etc.), processes and / or (nano-) additives to improve durability and extend the life of construction, while improving the overall environmental and energy footprint.	1
	Total	**3**

[33] Νικολαΐδης Α. (2017). Προϊόντα τεχνητής ξυλείας, InfoBank HellaStat – IBHS. https://worldenergynews.gr/index.php/2016-09-23-09-14-04/item/6205-enischysh-ths-paragwghs-proiontwn-xyloy-to-2016,-meta-th-ragdaia-ptwsh-twn-prohgoymenwn-etwn

The above participations were found with the keyword of “wood”, while no participations were found including the words of “cork” and “plaiting”. Furthermore, there were no other proposals submitted from other regions, a fact that reveals the limited interest on research and innovation both at a regional and at a national level.

5. Potential for ecosystem development

The above trends show that this is an intermediate industry group whose growth is driven by demand in the construction and furniture industries. Common actions and infrastructures that can help create ecosystems and improve the market share of wood products are in the value chain of construction and furniture, and especially in the Greek internal market. Competition on the European market is fierce in both central and northern Europe, and the high volume and weight per unit of product make it less competitive due to increased transport costs.

In the two value chains, wood and artificial timber products can be promoted under eco-quality labels and open markets for environmentally sensitive consumers. Artificial wood is one of the best examples of sustainable technology. It is a clean and green product that contributes to CO2 reduction goals. It satisfies the pollution prevention hierarchy and prevents environmental pollution caused by fly ash lying around. It also reuses and recycles industrial waste and converts it into products with economic value, introducing a radical new approach to sustainable construction. These properties can bring timber products into the spotlight, stimulating local economies and promoting forest health in a way that architects, conservation groups and timber companies can get behind.

A platform for the promotion of wood products should be set up on a national rather than a regional basis. The overall size of the group per region is small to support a collaborative effort for widening the Greek internal market of wood products. As the two tables in section 1 show, the six Greek regions have almost similar potential, with Western Macedonia and Thessaly leading the turnover. Industry leaders are also located in different regions, with Akritas SA. in Eastern Macedonia and Thrace and Alfa wood SA in Thessaly.

21.1 Manufacture of basic pharmaceutical products in Attica

1. Economic and production profile

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.

According to the Hellenic Statistical Authority, there are 19 companies with 1.215 employees dedicated to manufacture of basic pharmaceutical products in the region of Attica, with an annual turnover of EUR 646.22 (Elstat, 2017). Compared to Greece, the regional specialisation is 2,42 and 2,02 times higher based on the number of companies and the number of employees respectively. 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 manufacture of basic pharmaceutical products and the ratio of employees and number of companies indicate that the large size of 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
	Position among top 10 3-digit industries in Attica	7th	8th	5th	1st	1st

Source: ELSTAT, 2017

2. Relation to RIS3 Attica

The RIS3 Strategy for Attica[34] identifies the pharmaceutical industry as a sector with significant potential for growth, based on the volume of health businesses and the pharmaceutical companies located in the region. According to the European Cluster Observatory, Hellenic Bio Cluster (HBio)[35] is a coalition of Greek companies on Life Sciences, which includes partners in the fields of biotechnology, diagnostics, medical devices, pharmaceuticals and health services. It is the first cluster in Life Sciences and Biosciences established in Greece and it aims to promote the Greek business of Life Sciences and facilitate business and research collaborations between Greek and foreign businesses and research teams. Based on the metrics of the European Cluster Observatory's rating system, the pharmaceutical products are among the sectors with the highest scoring. Overall, the sector of pharmaceuticals is recognized as a dynamic cluster that could be further developed through appropriate mobilizations of potential actors.

In this context, the health sector and the pharmaceutical industry are under one of the priority

[34] RIS3 Strategy for Attica, Source: https://www.espa.gr/el/pages/staticRIS3.aspx
[35] http://hbio.gr/

fields defined by the strategy, the so-called 'Sustainable Economy of the Needs'. It refers to improving the quality of life in every aspect of the daily functioning of individual and social life. Among the main challenges identified are, on the one hand, enhancing the competitiveness and extroversion of Greek businesses and, on the other hand, the emergence of new business opportunities through the creation of networks of collaboration between academia and businesses as well as the subsequent exploitation of research results. A key comparative advantage of Attica in the health sector is the existence of significant research, innovation and entrepreneurial potential.

Finally, among the indicative priority sectors of the action plan is the development of internationally competitive pharmaceuticals, functional foods and cosmetics based on nutrition and domestic flora and fauna. Further support is also provided for medium- and large-scale testing of knowledge-intensive products and services in areas where the certification of relevant products such as medicine, nutrition, functional foods, educational tools, methods, etc. is required.

3. Business challenges

Societal challenges play a crucial role in the economic development of territories. In particular, 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%)[36].

In economic terms, the total funding for health spending fell 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 2018, the pharmaceuticals industry covered patients' needs through the mechanisms for pharmaceutical coverage (clawback and rebate) by providing free 1 in 3 outpatient and 1 in 2 inpatient medication.

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. On the other hand, in 2017 the production of pharmaceutical products in value (ex-factory) amounted to EUR 954 million and with added value of EUR 668 million (3.0% share in the manufacturing sector). Pharmaceuticals employed 14.4 thousand people in 2017, while 60.5% of pharmaceuticals are university educated, compared to 35.7% in the economy and 22% in the manufacturing sector. Furthermore, imports and exports of pharmaceuticals in 2018 amounted to EUR 2.8 billion and EUR 1.4 billion, respectively with pharmaceutical exports accounting for 4.3% of total Greek exports in 2018. Finally, the multiplier effects on tax revenues and economy in general are remarkable accounting for approximately EUR 1.7 billion in 2018[37].

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

[36] Foundation for Economic and Industrial Research (2019).*The Pharmaceutical Market in Greece: Fact and Figures 2018* (report), Source: http://iobe.gr/docs/research/RES_05_A_22042019_REP_GR.PDF
[37] Foundation for Economic and Industrial Research (2019).*The Pharmaceutical Market in Greece: Fact and Figures 2018* (presentation), Source: http://iobe.gr/docs/research/RES_05_A_22042019_PRE_GR.PDF

with the support of research laboratories could consolidate and extend their presence at the stage of pharmaceutical discovery, relocation and drug re-targeting.

Overall, the number of people having access to healthcare services has increased and several countries set healthcare as a priority area in their policies. Therefore, the pharmaceutical industry will continue to play a central role in economic development. However, 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.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
5.1.1	Alternative / new routes of drug administration	3	7	10	6.6%
5.1.2	New drug contents in active substances	0	3	3	2.0%
5.1.3	New formulations	0	6	6	3.9%
5.1.4	Controlled release rates of active substances	2	2	4	2.6%
5.1.5	Modification of formulation to improve the cooperation of patients receiving medication	1	2	3	2.0%
5.1.6	Improvement of bioavailability and pharmacokinetic characteristics	2	2	4	2.6%
5.1.7	Innovation in the production process of the drug	4	6	10	6.6%
5.1.8	Characterization and action improvement with 'minor' variations of active ingredients and / or modifications to the structure of the active substance	6	4	10	6.6%
5.1.9	Quality of medicine (use of different excipients, etc.)	1	7	8	5.3%
5.2.1	Prescription trends shaped by the chronic clinical treatment of various diseases with low patient compliance	0	3	3	2.0%
5.2.2	Prescription trends shaped by comorbidity	0	0	0	0.0%
5.2.3	Development of pharmaceutical forms and / or specialized devices in combination with the successful delivery / co-administration of known drugs (eg combination of drug with a drug pump, combination of drug with development or adaptation of specialized devices such as butterflies, pens, pens, pens, sprays of solids or liquids, inhalers, etc.)	5	9	14	9.2%
5.2.4	Better compliance due to a reduction in the total number of tablets used (eg multi-layer tablets) and greater safety when administering medication (eg avoiding overdose)	0	2	2	1.3%
5.2.5	Alternative routes of administration that have advantages over the established route of administration (e.g. transdermal drug-patch administration with the main advantages of avoiding	2	2	4	2.6%

	the first passage of the drug to the liver and reducing the likelihood of dose reductions by systems)				
5.3.1	Efficacy and safety (Phase I-III) clinical trials of re-targeted therapies in new therapeutic indications	10	14	24	15.8%
5.6.1	Development of more faithful human disease models, optimizing pre-existing systems and their integration processes on preclinical testing platforms	7	9	16	10.5%
5.6.2	Development and application of human disease models in preclinical testing procedures for drug activity and / or efficacy	7	10	17	11.2%
5.6.3	Development of methodologies and protocols related to the documentation of drug safety at a preclinical level and the use of animal models	10	4	14	9.2%
	Total	**60**	**92**	**152**	**100.0 %**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	6	5	11
Central Macedonia	44	13	57
Western Macedonia	0	3	3
Epirus	13	6	19
Thessaly	6	10	16
Ionian Islands	2	0	2
Western Greece	19	10	29
Central Greece	0	14	14
Attica	**60**	**92**	**152**
Peloponnese	0	0	0
North Aegean	0	0	0
South Aegean	0	0	0
Crete	29	5	34
Total	**179**	**158**	**337**

4. Potential for ecosystems development

In the near future, the pharmaceutical industry will change dramatically as the industry moves from a mass-market approach to a more target and customized approach. With the widespread adoption of electronic medical records, a growing number of healthcare payers are measuring the performance of different medicines which enables them to determine best medical practice and pay for treatments based on the outcomes they deliver.

At the same time, more and more people are using the Internet to find healthcare information, and numerous blogs and online forums have sprung up to cater for them. Next in the so-called Health 2.0 revolution is the proliferation of electronic personal health records[38]. Large IT

[38] https://www.pwc.com/gx/en/pharma-life-sciences/pdf/pharma2020_virtualrd_final2.pdf

companies, like Microsoft and Google, have already launched services for people to create and store their personal health records on the web, but there are also other smaller companies with similar services, including myPHR.com, medicalrecords247.org and ihealthrecord.org[39]. Furthermore, many governments start focusing on prevention rather than treatment and promote the increase in the use of generic drugs.

In this context and considering the characteristics of the Greek pharmaceutical industry**, widening the share of generic drugs** in the market could be a way to support the respective ecosystem. In this way, through the reduction of production costs of the generic drugs, companies could invest more money both in R&D activities and the modernization of their infrastructure. These investments are crucial in order to keep up with the rapid advances in promising fields like precision medicine, biotechnology and genetics. Another potential direction for consideration could be the **management of health data** and the development of services that could support disease prevention and treatment.

[39] https://www.pwc.com/gx/en/pharma-life-sciences/pdf/ph2020-marketing.pdf

22.1 Manufacture of rubber products in Thessaly

1. Economic and production profile

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 which 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 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
	Position among top 10 3-digit industries in Thessaly	10th	8th	7th	9th	1st

Source: ELSTAT, 2017

2. Relation to RIS3 of Thessaly

The rubber industry or the wider rubber and plastic products sector (22) is not within the priorities of RIS Thessaly, which focuses on two pillars. The first pillar of the regional research and innovation strategy for smart specialisation is the agro-food complex, which comprises the primary sector, the processing and industry of food and beverages as a single intervention area. The second pillar of the RIS3 is he metal industry and the building materials industry. Around those pillars other activities connected, such as management of the environment, energy saving, circular economy, creative tourism, and ICT. The recycling of rubber products used tires in particular, which fall under the rubber products group, is the closest relationship with the regional specialisation strategy.

3. Business challenges

Clearly, the rubber industry in Thessaly is an emerging branch. The small size and emerging features of this industry group does not allow for a literature-based approach. We would need a survey to identify the companies belonging to the group and the condition for a common growth trajectory.

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.). Probably, 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.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation (see Table below).

Tech area	Research and Innovation priority	Number
4.5.1	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. • Use of used tire treatment products in civil engineering works (concrete additives, earthworks, road construction, etc.)	2
	Total	**2**

There were few proposals submitted from other regions, a fact that reveals the limited interest on research and innovation both at a regional and at a national level.

5. Potential platforms for ecosystems development

The small size of this industry group and the presence of only a few major companies call into question the concept of public policy in EDP. The implementation of the EDP in planning actions in favour of a small industry group inevitably leads to the particular interests of the main industry players. Thus, EDP loses it general interest and public policy dimension, linking to promoting activities and infrastructure of some companies. This should be avoided, as long as EDP follow-up actions are funded by national public funds or ESIF.

22.2 Manufacture of plastic products in Eastern Macedonia and Thrace

1. Economic and production profile

The 22.2 group comprises four classes:

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 number of companies, employment, and turnover. Compared to total Greece, the regional specialisation is 1.54 to 2.64 times higher, depending on whether it is computed on number of companies or employment.

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
	Position among top 10 3-digit industries in Eastern Macedonia & Thrace	7th	5th	4th	9th	7th

Source: ELSTAT, 2017

2. Relation to RIS3 of EMT

The RIS3 of East Macedonia and Thrace clasifies the priotiry areas for intervention in horizontal and vertical ones. The vertical priority areas are assessed by four categories:

a. the areas at the core of the regional specialisatio, characterized by a high priority at national level and a significant concentration at regional level;
b. Promising or emerging areas of regional specialisation, characterized by a high national priority but a low concentration at the regional level;
c. Areas for transformation, having high concentration at regional level but of low national priority;
d. Areas of No prospects, namely low national priority and low concentration at regional level.

Based on the above classification, the EMT S3 distinguishes two main pillars for interventions in the regional productive system (1) the transformation of the agri-food complex and (2) the growth and consolidation of emerging regional sectors economy.

The manufacure of plastic products is placed into the 2nd pillar of S3 interventions. The objective is to support this industry, enhancing technologically driven product or process innovation with

the application of Key Enabling Technologies and providing incentives for the attraction of acitivities. Thus, the manufacture of plastic products is **clearly into the priority areas** of the regional Smart Specialisation Strategy, at the core of the regional specialisation.

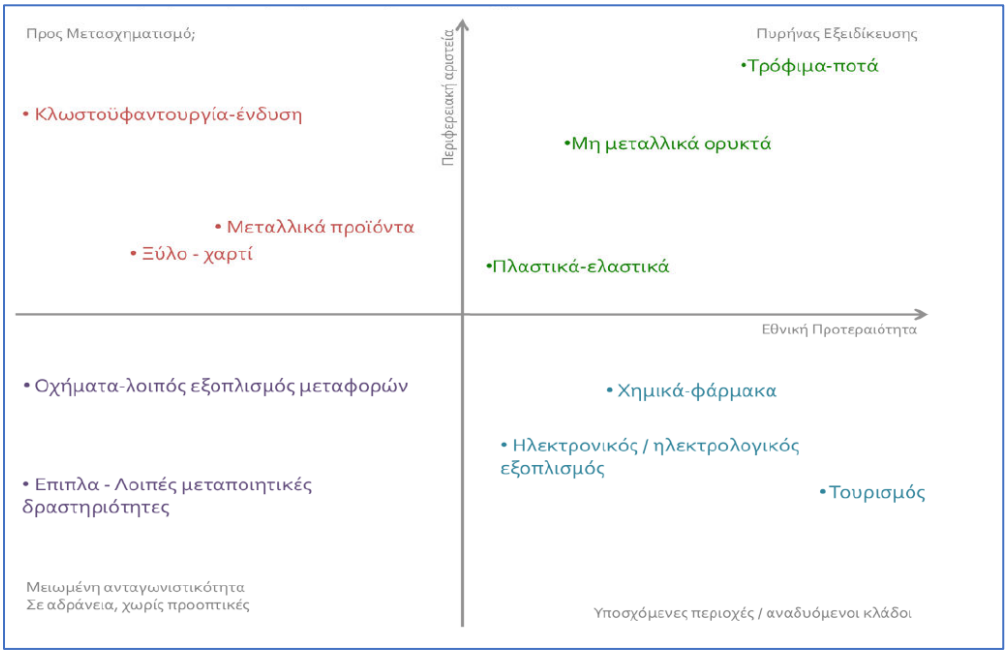


Figure 22.2.1: RIS3 EMT - Vertical prioriry areas for intervention. Source: RIS3 EMT, p. 72

3. Business challeges

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. As shown in the figure below, the industry group of plastic products (22.2) has the lion's share in the domestic production.

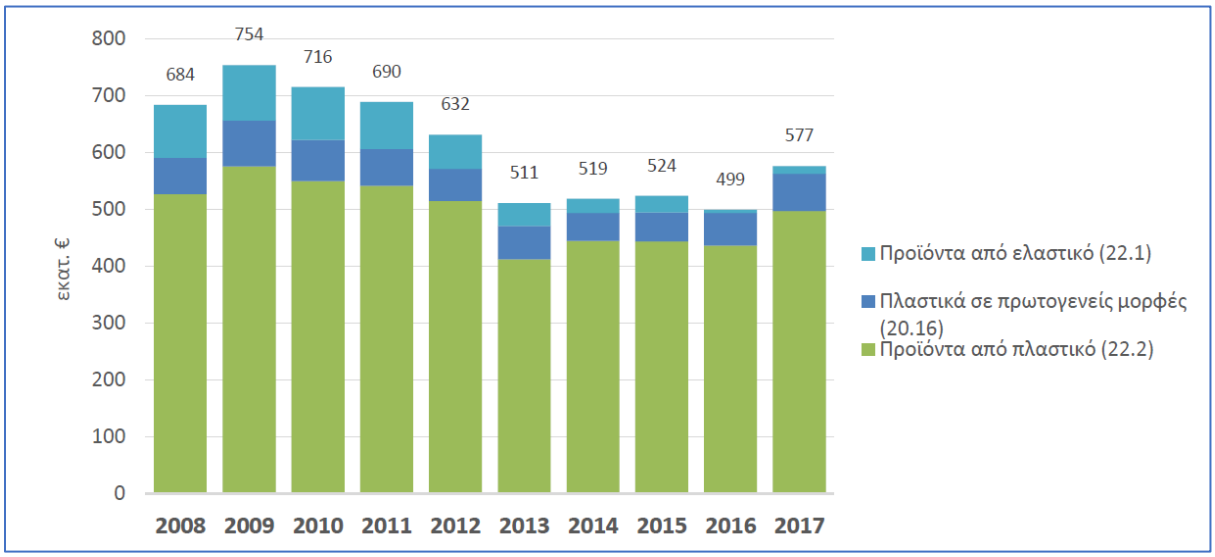


Figure 22.2.2: Domestic plastic industry. Gross added value. Source: IOBE, 2019

The domestic industry of plastic products is located in four regions only, and the highest concentration is found in the region of East Macedonia and Thrace.
Table 22.2.1: Location quotients of domestic plastic products manufacture

EMT	CEN MAC	WES MAC	EPIR US	THES SALY	CON GRE	IONI A	WES GRE	PELO PON	ATTI CA	N. AEGE AN	S . AEGE AN	CRET E
2,64	1,75	0,00	1,66	0,00	0,00	0,08	0,00	1,32	1,08	0,22	0,20	0,00

Source: ELSTAT, 2017

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 EU policy on waste and the circular economy has set itself ambitious targets for the recycling of plastics and the use of recycled plastics. In particular, it is foreseen that recycling of plastic packaging should amount to 55% by 2030. 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 Member States are required to set national annual targets for the percentage of reusable packaging. A ban is introduced in 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.[40]

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of reseach and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Rese arch	Busi ness	Total	%
1.3.4	Materials for transparent integrated opto-electronic applications (oxides, 2-dimensional, nanomaterials, etc.) in telecommunications, energy, transport, diagnostic medicine, etc.	0	0	0	**0.0 %**
1.5.1	Polymeric and organic materials (semiconductors and conductors), metal oxides and metals, dielectrics, nanostructured metals (nanoparticles, nanomaterials) or two-dimensional sheet materials, barrier materials, transparent electrodes for the manufacture of active and passive elements. Integration of the above into various applications (consumer goods such as screens, clothes, packaging materials), but also into lighting systems,	0	1	1	**20. 0%**

[40] ΙΟΒΕ (2019). Ο κλάδος πλαστικών στην Ελλάδα. Συμβολή στην ελληνική οικονομία, προκλήσεις και προοπτικές ανάπτυξης. Ιδρυμα Οικονομικών και Βιομηχανικών Ερευνών (10-14)

	greenhouses, means of transport, robotic applications, artificial leather, bio-diagnostic leather electronics.				
1.16.3	Development of advanced composite materials, organic, elastomers, for uses e.g. in transport, construction, energy, packaging or even for specialized applications.	0	1	1	**20.0%**
1.18.3	Technologies of plastics, bioplastics, biodegradable, special polymers for industrial and consumer products as well as specialized applications.	0	2	2	**40.0%**
1.18.4	Food and agricultural packaging and preserving materials.	0	1	1	**20.0%**
1.19.5	Product life cycle tracking and monitoring systems and processes	0	0	0	**0.0%**
	Total	**0**	**5**	**5**	**100.0%**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	**0**	**5**	**5**
Central Macedonia	4	6	**10**
Western Macedonia	0	1	**1**
Epirus	3	1	**4**
Thessaly	1	1	**2**
Ionian Islands	0	0	**0**
Western Greece	1	3	**4**
Central Greece	0	1	**1**
Attica	9	5	**14**
Peloponnese	0	0	**0**
North Aegean	0	0	**0**
South Aegean	0	0	**0**
Crete	2	2	**4**
Total	**20**	**25**	**45**

5. Potential platform for ecosystems development

The transition towards more sustainable plastics products is the ground for a plastic ecosystem development in East Macedonia and Thrace. A platform addressed to plastic products producers may offer significant research and technology services facilitating the transition to eco-friendly products. There are many opportunties from the shifting towards a holistic approach to tacking plastic waste, such as incentives and penalties to consumers, manufacturers and companies alike, through a plastics tax, recycling reforms, bottle deposit schemes and movements to chemical recycling and bioplastics.

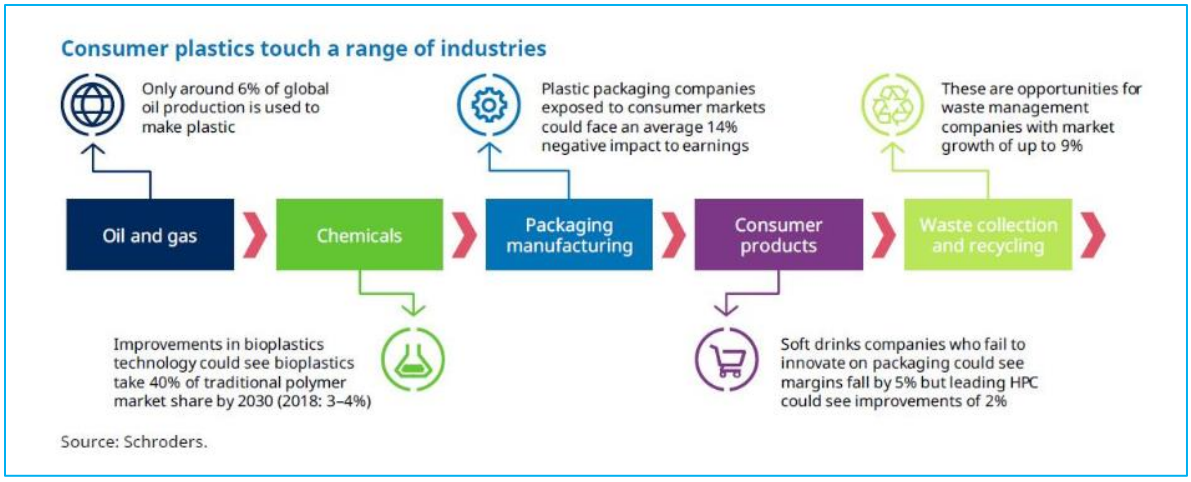


Figure 22.2.3. Challenges and opportunities in the plastics value chain
Source: http://news.bostoncommonasset.com/earth-day-plastics-challenge/

As shown on the figure 22.2.3, the plastics value chain extends over many industry groups and serious negative effect should be expected from failure to innovate and adapt to the new plastic product regulation framework. The New Plastics Economy Global Commitment envisions a circular economy where plastics never become waste. Signatories commit to a set of ambitious 2025 targets, such as eliminate problematic plastics; innovate for safer reuseable, recycled, or composted packaging; circulate 25% of plastic produced by reusing or recycling (current global average: 2%).

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

1. *Economic and production profile*

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.

According to the Hellenic Statistical Authority, there are 106 companies dedicated to cutting, shaping and finishing of 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 (Elstat, 2017). Compared to Greece, the regional specialisation is 3,97 and 11,66 times higher based on the number of companies and the number of employees respectively. Compared to other industrial sectors, this group is fourth in the number of companies located in the region, while it comes first in terms of employment, turnover and specialisation.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-based
23.7	Cutting, shaping and finishing of stone	106	1,431	158.35	3.97	11.66
	Position among top 10 3-digit industries in **Eastern Macedonia and Thrace**	4th	1st	1st	1st	1st

Source: ELSTAT, 2017

The 23.7 group is within the top 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

Source: ELSTAT, 2017

2. *Relation to RIS3 Eastern Macedonia and Thrace*

According to the RIS3 strategy for the region of Eastern Macedonia and Thrace, stone cutting and shaping is among the strongest manufacturing sectors together with food, textiles and plastic processing[41]. There is a significant concentration of companies in these sectors, as the region has

[41] RIS3 Eastern Macedonia and Thrace: https://www.espa.gr/elibrary/RIS3_AnatMakedonia-Thraki_201504.pdf

a large variety of raw materials (minerals, energy sources, agricultural products) and a long tradition on their production and processing.

Based on the insights of the fieldwork on certain manufacturing companies for the region, sectors with low impact of RTD have better export performance than those of a higher impact. This is probably due to the high extroversion of the marble industry. As for 2012, the contribution of the exporting activity in the region accounted for 3% of total Greek exports, and among the top three sectors is also the group of non-metallic minerals. While major manufacturing sectors had a negative performance compared to 2011, the marble industry showed an increase of 2.41% and 21.87% compared to 2008.

Finally, the fourth Entrepreneurial Discovery Process (EDP) focus group on marble in the region of Eastern Macedonia and Thrace took place on the 5th of May 2015[42]. The participation and engagement were moderately high, with more than 50 stakeholders from within the region and beyond. Among the ideas generated in the parallel sessions were the following:

- Geological and geophysical research & machinery or equipment for underground grounding
- Energy audit and integrated interventions for energy savings in quarries
- Development and dissemination of know-how for the exploitation of mining & marble by-products
- Creation of a cluster in the marble value chain
- Production of magnesium (too little interest)
- Quarry rehabilitation

Overall, the RIS3 strategy underlined the need for developing promotional activities that strengthen the marble branding and for expanding markets.

3. Business challenges

Marble is the cutting-edge product of the Greek mining industry, as its brand has been built since ancient years. 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 exporting 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[43]. Around seven out of ten tones of marble are exported to China, while considerable parts of the total production go to USA and United Arab Emirates. Based on the statistical results of the International Trade Centre, the UN Comtrade and the National Statistical Institutes, in 2017, Turkey, China, Italy, Greece and Spain exported almost 78% of the global value and quantity of marble exports (marble blocks and finished marble products in total)[44]. In particular, Greece increased its exports by 35,58% compared to the previous year and the upward trend continued for 2018[45]. Overall, Greece

[42] Fourth Entrepreneurial Discovery Process (EDP) focus group on marble in the region of Eastern Macedonia and Thrace, Source: https://s3platform.jrc.ec.europa.eu/-/fourth-entrepreneurial-discovery-process-edp-focus-group-on-marble-in-the-region-of-eastern-macedonia-and-thrace
[43] https://www.newmoney.gr/roh/palmos-oikonomias/business-stories/to-elliniko-marmaro-kiriarchi-se-olo-ton-kosmo/
[44] The countries with the largest marble exports in 2017 (2018). Source: https://stonenews.eu/countries-largest-marble-exports-2017/
[45] http://www.oryktosploutos.net/2018/05/blog-post_20.html

has systematically increased the value and quantity of marble exports over the last few years while maintaining the price per tonne at high levels.

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%[46].

Finally, the export activities of the sector have to be expanded, as focusing on one key recipient (in this case China) cannot survive over time. In a nutshell, the existence of a fossil raw material with high demand in the international market should be accounted as a comparative advantage over other sectors but also over other regions and countries. However, it needs to be combined with appropriate actions at institutional level (financing tools, licensing, etc.) and at entrepreneurial level (promotion of innovation, extroversion and reduction of environmental footprint), so that the sector can contribute to the sustainability and prosperity of the region and the country.

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of reseach and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
1.10.2	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.	1	1	2	9.5%
1.14.4	Multi-scale modeling / simulation of complex production processes / processes to optimize them, using advanced analytical methods (eg neural networks, artificial intelligence systems, molecular dynamics, hybrid methods, finite elements).	0	0	0	0.0%
1.19.1	Circular Economy: 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	1	2	3	14.3 %

[46] SWOT Analysis for the marble industry, Source: https://www.capital.gr/me-apopsi/3211531/i-simeiologia-tou-tomea-exoruxis-marmarou-mesa-stin-krisi

1.19.3	Eco-innovative approaches to the processes of metal recovery and processing of critical raw materials. Sustainable disassembly and recycling technologies for metal and other end-of-life structures.	0	0	0	0.0%
4.1.1	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).	1	2	3	14.3 %
8.4.1	New-generation robots and support technologies applied to industry and service delivery.	1	3	4	19.0 %
8.4.2	Operating in dynamic real-world environments, with enhanced capabilities for autonomy, adaptability and secure interaction with humans	4	3	7	33.3 %
8.6.3	Digital electronics	1	1	2	9.5%
	Total	**9**	**12**	**21**	**100 %**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	**9**	**12**	**21**
Central Macedonia	15	19	34
Western Macedonia	2	4	6
Epirus	2	2	4
Thessaly	1	3	4
Ionian Islands	0	1	1
Western Greece	7	4	11
Central Greece	1	7	8
Attica	32	37	69
Peloponnese	1	2	3
North Aegean	0	0	0
South Aegean	1	1	2
Crete	9	6	15
Total	**80**	**98**	**178**

5. Potential platform for ecosystems development

The region of Eastern Macedonia and Thrace is the most important area of development in the group 23.7. Based on the above data, the sector has proven that despite adversities, it can successfully meet difficult requirements and circumstances. At the same time, it is clear that there are crucial challenges that need to be addressed in order to fully exploit the comparative advantage of this sector in the region and thus support the development of an ecosystem around marble.

To this end, the international promotion and the official recognition of the **brand identity** "Greek Marble" should be among the first steps for supporting the ecosystem development. As

stated by the Association of Marble Companies of Macedonia-Thrace[47], there is a need for substantial and effective support to the Greek Marble and its historical, cultural and qualitative identity. Towards this direction, the participation of most Greek companies in Marmomacc 2019 International Trade Fair, in Verona, Italy in September focused on the Greek origin of their materials and products[48]. Collective promotional activities orchestrated by the Association should underline the benefits of the Greek marble as a high quality brand with a clear geographical reference and a special focus on responsible and sustainable ways of production and processing.

Furthermore, the **utilization of by-products** is another way to support the ecosystem development of the marble industry. This has a dual purpose, as apart from the exploitation of by-products, it also contributes to the environmental dimension regarding the rational and profitable management of extractive waste. For example, there are experimentations on using waste material resulting from marble processing in 3D printing[49]. It should be noted that although the marble deposits are low and the numbers of steriles are significant, the environmental impacts of marble exploitation are limited, as there are no problems with hazardous waste, vibrations from the explosions, dust during extraction, etc. Therefore, utilizing in a profitable way the by-products of the marble will contribute to the reduction of extractive waste, while at the same time will create new collaborations with other industries.

[47]Association of Marble Companies of Macedonia-Thrace, Source: http://www.semmth.gr/

[48] Association of Marble Companies of Macedonia-Thrace*, Greece: Strengthened and active participation in 2019 Marmomac International Trade Fair*. Source:https://stonenews.eu/association-marble-companies-macedonia-thrace-greece-strengthened-active-participation-2019-marmomac-international-trade-fair/

[49] Marble Ecodesign: Marble waste to 3D printing gold. Source: https://3dprintingindustry.com/news/marble-ecodesign-marble-waste-3d-printing-gold-19765/

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

1. Economic and production profile

This group includes one class only:

24.20 of manufacture of seamless tubes and pipes of circular or non-circular cross section and of 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 number of companies, employment, and turnover, but with 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 region, 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
	Position among top 10 3-digit industries in Central Greece	10th	9th	8th	3rd	1st

Source: ELSTAT, 2017

2. Relation to RIS3 Central Greece

Central Greece is among the Regions with the largest concentration of manufacturing activity with a prominent metal value chain that accounts for 41.4% of its processing capacity. The metal industry is among the priorities of the Smart Specialisation Strategy of Central Greece.

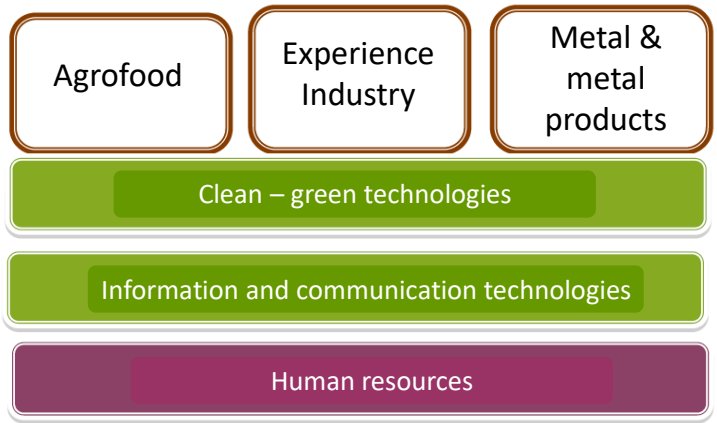


Figure 24.2.1. S3 priorities of region of Central Greece
Source: RIS3 Central Greece, p. 84

RIS3 views the significant industrial concentration of metal industries observed in the Region of Central Greece should be considered as an important asset and opportunity to enhance the region's economy and business development. There are opportunities for developing partnerships between businesses in the region's most important industrial activity, namely the metal and metal products production, and complementary businesses in the Region of Thessaly. In addition, participation in GSRT and Horizon 2020 projects (e.g. advanced materials and nanotechnology, or advanced industrial processes) can help improve quality and innovation in this sector.

RIS3 actions in the metal products industry include the establishment of an industrial area and creation of basic infrastructure, the support for a metal cluster, and the development of laboratory equipment for testing and certification of metal products. [50]

3. Business challenges

The latest changes and prospects for the industry are presented in the sectoral study of ICAP.[51] 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 in order 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 in order to maintain their market position.

The financial analysis on the basis of a sample of companies for the period 2016-2017 shows that total assets decreased by 4.3% in 2017 due to the decrease mainly in inventories and net assets. In contrast, own capital increased by 4.1% in 2017. Total sales of the sample companies recorded an annual growth of 45.2% in 2017. This significant increase is due to exports. Due to higher cost of sales (62.6%) gross profit decreased by 35.3%.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation (see Table below).

Tech area	Research and Innovation priority	Number

[50] Περιφέρεια Στερεάς Ελλάδας (2015). Στρατηγική Έξυπνης Εξειδίκευσης για την Περιφέρεια της Στερεάς Ελλάδας. Ειδική Υπηρεσία Διαχείρισης ΕΠ Περιφέρειας Στερεάς Ελλάδας.
[51] ICAP (2019). Χαλυβδοσωλήνες. Κλαδική μελέτη ICAP

4.2.4	Development of production plants for secondary materials applying the principles of circular economy (mainly plastics)	1
8.5.1	Optimization of production processes	1
	Total	**2**

There were few proposals submitted from other regions, a fact that reveals the limited interest on research and innovation both at a regional and at a national level.

5. Potential platforms for ecosystems development

The transformation of the production of metal tubes and pipes is a major challenge in this industry group. Both the RIS3 Central Greece and the ICAP sectoral study have identified areas where this effort should be directed, such as the creation of new products that are in demand but not locally produced (e.g. seamless steel pipes which are completely covered by imports), producers collaboration and operation of a cluster of metal products, the acquisition of laboratory equipment for the development and certification of new products.

These issues can form the basis of a two-sided platform enabling for the collaboration and orchestration of producers and consumers and setting of an ecosystem. The small number of tubes and pipes companies in the Region of Central Greece can be seen as an advantage of facilitating cooperation initially but should be extended to other companies in other regions of Greece in order to gain critical mass and market presence.

25.1 Manufacture of structural metal products in Central Macedonia

1. Economic and production profile

This group includes the manufacture of structural metal products (such as metal frameworks or parts for construction). It comprises the following 4-digit classes:

- *25.11 Manufacture of metal structures and parts of structures*, which includes the manufacture of metal frameworks or skeletons for construction and parts thereof (columns, beams, towers, masts, trusses, bridges etc.), the manufacture of industrial frameworks in metal (frameworks for blast furnaces, lifting and handling equipment etc.) and the manufacture of prefabricated buildings mainly of metal (site huts, modular exhibition elements etc.)
- *25.12 Manufacture of doors and windows of metal*, which includes the manufacture of metal doors, windows and their frames, shutters and gates as well as manufacture of metal room partitions for floor attachment.

In total, 867 companies are located in the prefecture of Central Macedonia with 3,664 employees and a 280.96 million turnover in 2017. This industrial group is the fourth larger in Central Macedonia in terms of number of companies, employment, and turnover, with relatively a high degree of regional specialisation, which is 2.14 higher compared to total Greece in terms of employment and 1.72 respectively in terms of companies.

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 Central Macedonia	867	3,664	280.96	1.72	2.14
	Position among top 10 3-digit industries in Central Macedonia	4rd	4th	4th	7st	7st

Source: ELSTAT, 2017

2. Relation to RIS3 Central Macedonia

Structural metal products are part of the vertical RIS3 priority of Central Macedonia 'Building materials" due to the high level of regional specialisation, the critical mass of enterprises as well as their export orientation. Building materials is a priority sector also for the national economy, as it contributes to 11% of the total GVA in Greece and accounts for 8.1% of total employment. Once a highly dynamic sector for the Greek economy it was affected by the economic crisis in 2008 and the subsequent slowdown in the construction, the stalling of large public works along and the decrease of private sector investments. The sector was shrunk to about one third during the period 2009-2017 (IOBE, 2019, p.9-10).

The industry links to emerging technological challenges in relation to energy and the environment and, thus, can be supported by all four RIS3 horizontal priority sectors of Central Macedonia (ICT,

energy, environment, transportation and logistics). The potential for innovation is especially in relation to the use new materials (complex castings) and/or of ICT in production, its connection to carbon footprint and energy efficiency in smart buildings but also the incorporation of organisational innovations (RIS3 Central Macedonia, p.83).

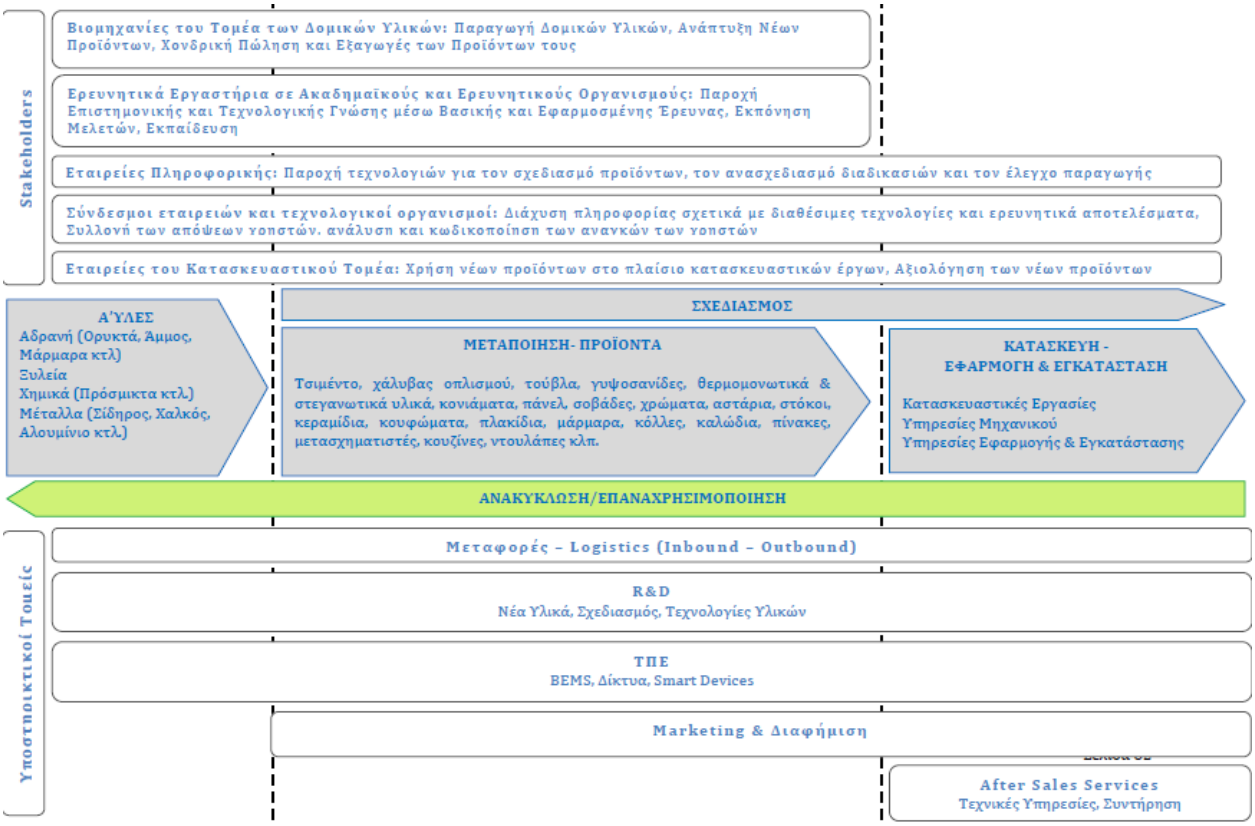


Figure 25.1.1. Value chain of Building Materials. Source: RIS3 Central Macedonia, p. 82

3. Business challenges

Manufacture of structural metal products belongs to the construction sector. It is linked vertically to mining activities as well as to services e.g. architectural/civil engineering services and management of real estate. Due to its dependence on raw materials and the high operational expenses, the market is price sensitive. Other factors that affect the business environment and level of competitiveness are technical know-how and operational efficiency, the public investment program, linkages to strategic contractors, labor, environmental and energy laws etc.

Figure 25.1.2. Value chain of the construction sector. Source: IOBE, 2019, p. 22

In Central Macedonia manufacture of structural metal products is a highly dispersed industry with companies that vary significantly in size and 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 to the 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.

Some of the main challenges of the sector are the following:

- 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[52][53], 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.
- 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 (CO2) into the atmosphere. The adoption of cleaner production processes can increase energy efficiency and reduce the industry's carbon footprint.
- Improvement of logistics management: The industry faces significant transportation costs due to the size and weight of the metal products. Improvements in logistics management

[52] IOBE (2019) Development perspectives of Construction in Greece, Foundation for Economic and Industrial Research (IOBE) (in Greek)

53 Conner, B., Essel, S., Paul, S. et al. JOM (2019) Technological Innovations in Metal Engineering 71: 651. https://doi.org/10.1007/s11837-018-3224-2

together with the exploitation of key transport infrastructures (e.g. the port of Thessaloniki) can create significant added value to the industry and the value chain and improve its competitiveness.

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
1.2.2	Diagnostic devices: development of micro-nano technology devices, as well as hybrid and multifunctional biomedical devices for diagnostics and / or therapy.	5	6	11	18.03%
1.9.1	Modified nanocomposite materials to enhance and protect natural and artificial stone building and decorative elements.	0	0	0	0.00%
1.9.2	Fastening, reinforcing and filling materials of load-bearing structural components in structures, with improved rheological, physic-chemical and mechanical properties.	1	1	2	3.28%
1.9.3	Development of coatings, films e.g. nanocomposite superhydrophobic materials, for the protection of visible metal elements, structures and cultural heritage works.	2	1	3	4.92%
1.10.2	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	2	4	6.56%
1.13.1	Integration and integration of non-conventional technologies (e.g. photon-based material processing technologies, spray technologies, ultrasound or sub-sonic processes, digital technologies, dissimilar material coupling methods, laser welding, friction stir welding) to develop new multifunctional or hybrid operations.	0	0	0	0.00%
1.13.4	Development / design of production process of high demand advanced metal products such as melting, casting, thermo-machining and industrial metal forming technologies. Optimizing existing - introducing new methods.	0	0	0	0.00%
1.16.1	New alloys for use in transport, construction, energy and packaging or even for specialized applications (eg automotive, aeronautics, architectural and special uses in construction, food packaging and / or agricultural products).	1	2	3	4.92%
1.19.1	Circular Economy: 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	4	4	8	13.11%

4.4.6	Recovery of metals from industrial waste from metallurgical activities (eg steel slag) as well as critical for technological applications of metals from corresponding waste streams (eg electronic equipment).	1	1	2	3.28%
4.4.8	Promoting industrial coexistence.	2	2	4	6.56%
6.1.6	Development and use of new systems and technologies to optimize fleet management (road, marine, air) and available resources on the one hand optimum routing and optimal scheduling of freight services.	3	3	6	9.84%
6.6.1	Other Emerging Technologies (Indicative: Development of research, technologies, applications and systems in emerging areas, for example and not exclusively with direct application to all media transportation and supply chain: 3D printing, artificial intelligence, machine learning, cloud computing, IoT etc)	2	3	5	8.20%
8.4.3	"Intelligent production" systems with robotic systems	0	1	1	1.64%
8.5.1	Optimization of production processes	2	1	3	4.92%
8.5.5	Zero error technologies and strategies in smart factories (Zero Defect Manufacturing)	3	4	7	11.48%
8.5.6	Integrated Rapid Configuration Technologies to Support Flexible Manufacturing Systems (Reconfigurable Manufacturing Systems / Industry 4.0)	1	1	2	3.28%
	Total	**29**	**32**	**61**	**100.00 %**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	5	8	13
Central Macedonia	**29**	**32**	**61**
Western Macedonia	1	3	4
Epirus	6	4	10
Thessaly	6	9	15
Ionian Islands	1	0	1
Western Greece	12	6	18
Central Greece	3	12	15
Attica	36	59	95
Peloponnese	0	2	2
North Aegean	1	0	1
South Aegean	0	0	0
Crete	8	4	12
Total	**108**	**139**	**247**

5. Potential platform for ecosystems development

The abovementioned challenges can be addressed by stronger collaboration in the vertical market of the construction sector, around key thematic fields. Ecosystems for example focusing on **smart materials** could well serve the highly growing market of **smart buildings** which is expected to

reach $59 billion by 2025[54]. Such collaborations could deal among others with (1) quality requirements of the product for improved structural performance, (2) possibilities for tailored shapes and forms, (3) towards achieving environmental objectives.

Other options for ecosystem creation include the **adoption of ICT technologies** and **new business models** that better respond to market changes. Digital technology is helping by connecting customer information, assets, products and processes and can accelerate innovations in the business culture of traditional industries. For example, flexible schemes for customer-producer relationships (or between producers' collaborations) may arise through the offering of rental steel as an alternative to purchase and the creation and monitoring of new business architectures for reusing, collecting and recycling of metal products. Online portals/platforms that link the whole supply chain and serve circular economy operations may develop an integrated (and disruptive) framework for operations management.

[54] https://www.marketwatch.com/press-release/smart-building-market-expected-to-grow-at-cagr-316-and-forecast-to-2025-2019-09-18

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

1. Economic and production profile

This class 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). Computers can be analog, digital, or hybrid. Digital computers, the most common type, are devices that do all of the following:

(1) store the processing program or programs and the data immediately necessary for the execution of the program,

(2) can be freely programmed in accordance with the requirements of the user,

(3) perform arithmetical computations specified by the user and

(4) execute, without human intervention, a processing program that requires the computer to modify its execution by logical decision during the processing run. Analog computers are capable of simulating mathematical models and comprise at least analog control and programming elements.

This class includes manufacture of:

- desktop, laptop, main frame, hand-held (e.g. PDA) computers
- magnetic disk drives, flash drives and other storage devices, optical (e.g. CD-RW, CD-ROM, DVD-ROM, DVD-RW) disk drives
- printers, monitors, keyboards, all types of mice, joysticks, and trackball accessories
- dedicated computer servers and computer terminals, like automatic teller machines (ATM's), point-of-sale (POS) terminals
- scanners, including bar code scanners, as well as office equipment performing two or more of following functions: printing, scanning, copying, faxing
- smart card readers, virtual reality helmets, computer projectors

According to the Hellenic Statistical Authority, there are 8 companies with 69 employees dedicated to manufacture of computers and peripheral equipment, with a turnover of EUR 3,66 in 2017 (Elstat, 2017). Compared to Greece, the regional specialisation is 3,85 and 11,47 times higher based on the number of companies and the number of employees respectively. 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
	Position among top 10 3-digit industries in Eastern Macedonia and Thrace	10th	10th	10th	3rd	2nd

Source: ELSTAT, 2017

2. *Relation to RIS3 Eastern Macedonia and Thrace*

One of the two intervention pillars defined by RIS3 strategy for the Region of Eastern Macedonia and Thrace (REMTh)[55] refers to the "*Strengthening and consolidation of emerging sectors of the regional economy*". Among these sectors is also the group of electronic computers and peripheral equipment. One of the priorities for this pillar and, in particular, for the group of electronics is the enhancement of the technologically driven product or process innovation, through the implementation of Key Enabling Technologies (KETs). However, the development of KETs goes beyond the resources that could be leveraged at the level of REMTh, since KETs require a high level of knowledge and are associated with intensive research efforts, significant investment in capital equipment and highly skilled human resources. For this reason, the RIS3 strategy suggests that the development of these technologies can be better achieved at national or European level. At the same time, it is underlined that it is important at the regional level for these technologies to penetrate into the local economy through technology transfer and application development that can be integrated into products and local production capacity.

The action plan defines a series of actions to support this intervention pillar. Among them is the support to technology-intensive start-ups, the creation of incubators for new intensive research and technology enterprises, as well as the creation of clusters between either similar companies or companies that form a complete value chain. Other actions focus on strengthening the extroversion of companies and on supporting the introduction of organizational innovation and of renewable energy sources. The call for proposals for funding research and innovation on Electronics, Electrical Equipment Manufacturing Sectors was published on May 2018[56]. The value chain of the industry is illustrated in Figure showing major players at the different steps.

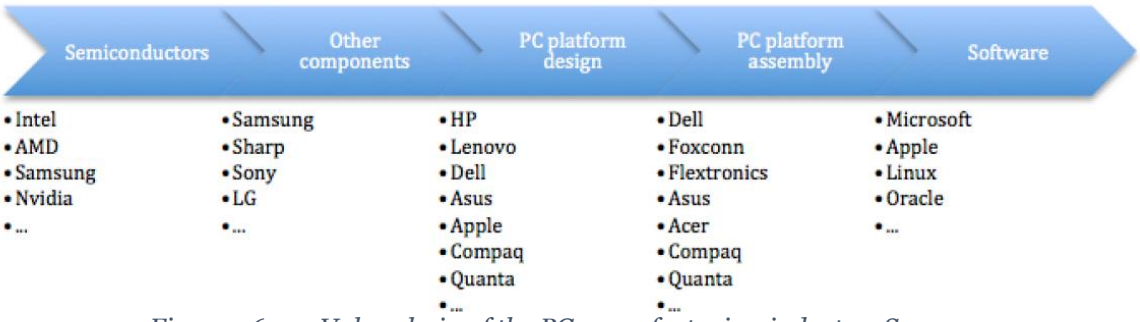


Figure 26.2.1. Value chain of the PC manufacturing industry. Source: https://ec.europa.eu/docsroom/documents/15347/attachments/1/translations/en/renditions/pdf

3. *Business challenges*

Today, the global computer manufacturing industry is concentrated in Asia; companies in Japan have traditionally dominated the computer printer market, and China, Singapore, and Taiwan host large numbers of both computer peripheral OEMs and contract manufacturers that serve the industry[57]. This industry is different from other manufacturing industries in that production

[55] RIS3 Eastern Macedonia and Thrace: https://www.espa.gr/elibrary/RIS3_AnatMakedonia-Thraki_201504.pdf

[56] https://www.eydamth.gr/index.php/component/k2/362-prosklisi-yp-arithm-2846-amth48

[57] Computer Peripheral Equipment Manufacturing Industry Profile, Source:

workers make up a relatively small proportion of the workforce[58]. Technological innovation characterizes this industry more than most others and, in fact, drives much of the industry's production. This fast pace of innovation and technological advancement requires a high proportion of engineers, technicians, and other technical workers who carry out extensive research and development (R&D). Similarly, the importance of promoting and selling the products manufactured by the various segments of the industry requires knowledge on marketing and sales.

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. The tradition of innovation in the industry explains the origins of many small firms. 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.

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. For this reason, many employees in the sector are research scientists, engineers, and technicians and their tasks are to continuously develop and improve products. 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.

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
1.2.1	New diagnostic biomaterials: development of innovative functional biomaterials for diagnosis and / or treatment. (i) Nanotechnology materials for concomitant diagnosis and treatment (ii) Molecular diagnostic-therapeutic bio-materials (iii) Biomolecular-based diagnostic vesicles.	0	1	1	**2.1%**

https://www.firstresearch.com/Industry-Research/Computer-Peripheral-Equipment-Manufacturing.html

[58] Computer and Electronic Product Manufacturing Industries, Source: https://collegegrad.com/industries/computer-and-electronic-product-manufacturing

1.2.2	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	2	4	**8.3%**
5.5.2	Services and systems to support personalized chronic patient self-management approaches	3	3	6	**12.5%**
5.5.3	Services and systems for the evaluation and support of healthy, active and independent living for the elderly	1	2	3	**6.3%**
8.3.1	Internet of Things and Platforms - interconnected applications of "smart" objects.	1	4	5	**10.4%**
8.3.2	Artificial intelligence and machine learning technologies and systems with the ability to adapt to different areas and applications	2	4	6	**12.5%**
8.4.1	New-generation robots and support technologies applied to industry and service delivery	3	7	10	**20.8%**
8.4.2	Operating in dynamic real-world environments, with enhanced capabilities for autonomy, adaptability and secure interaction with humans	8	5	13	**27.1%**
8.4.3	"Intelligent production" systems with robotic systems	0	0	0	**0.0%**
	Total	**20**	**28**	**48**	**100.0 %**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	**20**	**28**	**48**
Central Macedonia	69	84	153
Western Macedonia	10	7	17
Epirus	23	22	45
Thessaly	6	11	17
Ionian Islands	3	3	6
Western Greece	35	32	67
Central Greece	6	8	14
Attica	101	164	265
Peloponnese	4	5	9
North Aegean	3	1	4
South Aegean	3	1	4
Crete	30	12	42
Total	**313**	**378**	**691**

5. Potential for ecosystems development

The manufacturing industry is undergoing a massive collective shift: physical production, consumer demands, economics of production and distribution are all constantly evolving. According to a recent report from Deloitte University Press[59], the manufacture of consumer electronics presents a high ranking in the speed of fragmentation due to their small size and their decreasing life cycle. At the same time, the increasing demand for personalization and customization is poised to increase market fragmentation, while making it increasingly difficult for any single company to sustainably meet all of the consumer's needs.

Based on the same report, there are two potentially promising business models emerging in the manufacturing landscape: the shift **from products to platforms** and **from ownership to access**. Regarding the first one, as digital and physical products become platforms, they enable a wide variety of participants to join, collaborate, and innovate. Due to their remarkable network effect, platforms grow in importance as more participants join and thus extend their functionality. They are a cheaper, more flexible, and less risky way for participants to enter a space and once they achieve a critical mass of participants, they become hard to replace. Regarding the second one, the shift from ownership to access allows manufacturers to transform their focus from making products to developing deep, long-term customer relationships through a platform that aggregates resources and enables consumer access according to their needs. In this way, manufacturers can use data collection and product use feedback to continually grow and improve, while access providers gain a deeper knowledge of customers and their needs.

Finally, the development of the ecosystem could be further supported through new and existing networks of relevant actors. As an example, the Nano/Microelectronics-based Systems and Applications Cluster (mi-Cluster)[60] is the first innovation cluster in Greece, operating since 2006, aims to create the ideal environment that will enable sustainable growth for the Hellenic Semiconductor Industry and as a world class cluster, to be recognized as an accountable player in the global market.

[59] The future of manufacturing Making things in a changing world https://www2.deloitte.com/tr/en/pages/manufacturing/articles/future-of-manufacturing-industry.html
[60] http://www.mi-cluster.gr/

31.0 Manufacture of furniture in Thessaly

1. Economic and production profile

This industry group comprises four product classes of different types of furniture

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 terms of number of companies but the smaller of the top-10 industry groups of Thessaly in terms of turnover and specialisation. Compared to total Greece, the regional specialisation is 1,75 to 1.92 times higher. The industrial structure shows an industry with many small companies (on average 2,72 employees per company) and low productivity also.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation -companies-based	Specialisation -employment-based
31.0	Manufacture of furniture	314	856	25.56	1.75	1.92
	Position among top 10 3-digit industries in Thessaly	1st	3rd	8th	10th	8th

Source: ELSTAT, 2017

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

Source: ELSTAT, 2017

2. Relation to RIS3 of Thessaly

Manufacture of furniture is not within the priorities of RIS Thessaly. Sectoral priorities in the latter are on two pillars. The first pillar of the regional research and innovation strategy for smart specialisation is the agro-food complex, which comprises the primary sector, the processing and industry of food and beverages as a single intervention area. The second pillar of the RIS3 is he metal industry and the building materials industry. Around those pillars other activities connected, such as management of the environment, energy saving, circular economy, creative tourism, and ICT. The recycling of rubber products used tires in particular, which fall under the rubber products group, is the closest relationship with the regional specialisation strategy.

3. 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 have 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.

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

For the whole country, according to ICAP data for the period 2017-2018, total corporate assets stood at 2018/2017, with marginally lower total equity (-1.3%). Total sales increased by 7.1%, which led to an improvement in gross profit (7.7%) in the same period. Operating expenses are high and have resulted in a negative operating result of 2 years. Both EBITDA earnings and the final (net) result of this group of companies deteriorated. [61]

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Number
2.4.2	Exploit and develop 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, jewelry, optical communication, industrial design, product design, etc.	1
	Total	**1**

There was only one more proposal submitted from another region, a fact that reveals the limited interest on research and innovation both at a regional and at a national level.

[61] ICAP (2019). Επιπλα Οικιακής Χρήσης 2019. Κλαδική Μελέτη ICAP

5. Potential platforms for ecosystems development

The trends and dynamics of the furniture industry, the 2009 crisis in the construction, housing and office sector that has been driving the furniture market, the declining population purchasing capacity, and the strong competition from large furniture manufacturing and marketing chains (IKEA et al.), shows that the share of the furniture industry in the internal market remains the most significant challenge. Especially given the large number of small businesses (in Thessaly average employment per business of less than 3 people) and their limited export capacity.

A common platform for small furniture companies could be to promote the market by developing services, showrooms and a trade network. Small furniture cooperatives are common and are already operating (120 Furniture Manufacturers, http://www.120.gr/, ENOSSI-45, https://enosi45.gr/) as market access mechanisms. On this basis, a common commercial infrastructure could be designed and developed with presence in the major urban centers of Thessaly. In combination with furniture producers in other Greek regions (see section table 1), such a distribution and promotion network can cover the whole country.

50.1 Sea and coastal passenger water transport in South Aegean

1. Economic and production profile

This group has no subgroups under this code. 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
- Operation of ferries, water taxis etc.

Finally, it also covers renting of pleasure boats with 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.

According to the Hellenic Statistical Authority, there are 308 companies dedicated to passenger water transport located in the two island groups (Cyclades and Dodecanese) of South Aegean with 670 employees and EUR 52,51 turnover in 2017 (Elstat, 2017). Compared to Greece, the regional specialisation is 4,15 and 1,32 times higher based on the number of companies and the number of employees respectively. This group has the highest specialisation index based on the total number of companies, while it is fourth in terms of number of companies, employment and turnover.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation -employment-based
50.1	Sea and coastal passenger water transport	308	670	52.51	4.15	1.32
	Position among top 10 3-digit industries in **South Aegean**	4th	4th	4th	1st	5th

Source: ELSTAT, 2017

The 50.1 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

Source: ELSTAT, 2017

2. Relation to RIS3 South Aegean

According to the RIS3 for South Aegean[62], sea and coastal passenger water transport is considered a satellite sector for Tourism, which is the most important sector for the economic development

[62] Smart Specialization Strategy (RIS3) of South Aegean 2014-2020 Source: https://www.espa.gr/el/Pages/elibraryFS.aspx?item=2200

of the region. For this reason, tourism together with agriculture and fishing is among the priority sectors of the specialization strategy, while water transport is defined as second priority activities.

More specifically, the relatively small size of the local market and the prolonged economic crisis in Greece have contributed to the shrinkage of the local economy. The RIS3 strategy focused on the formulation of priorities that contribute to the extroversion of the economy and the development of export potential. In this context, non-export activities such as trade, construction and maritime transport are considered as second priority activities which will be indirectly supported through the development of the local economy. Especially water transport is part of the value chain of both agrofood and tourism (see Figure).

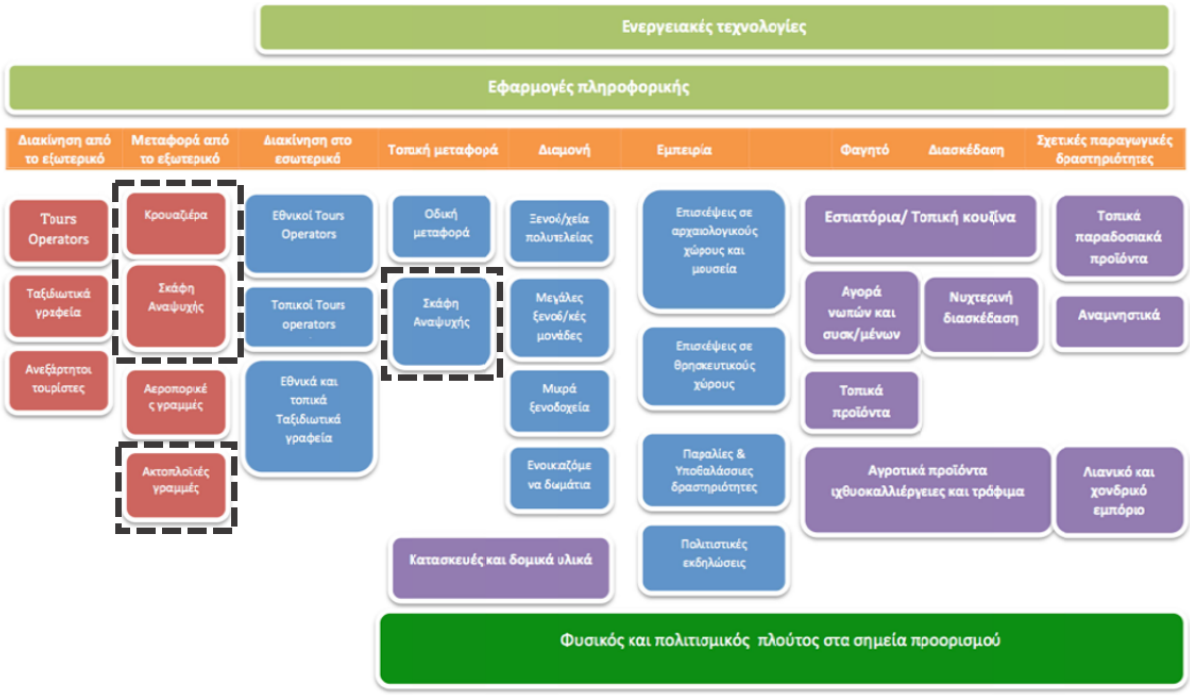


Figure 50.1.1. Sea and water transport (selected with black dashed line) as a part of the value chain in Tourism in South Aegean, Source: RIS3 South Aegean, p. 70.

3. 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[63]. 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. 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 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

[63] *The contribution of coastal shipping to the Greek economy: Performance and outlook* (2014). Foundation for Economic & Industrial Research http://iobe.gr/research_dtl_en.asp?RID=100

for the Greek economy. Given these circumstances, the rationalization of the sector's capacity as well as of the coastal transport network is necessary. At the same time, to maintain and extend the sector's contribution to the Greek economy, structural and sectoral policy measures have to be implemented. These measures should aim to reorganize and modernize the coastal maritime system in order to minimize costs for shipping services, so as to ensure the viability of the industry, without sacrificing the quality of service.

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Number
2.1.1	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).	1
6.5.1	Development of innovative solutions and services to address the problems faced in arid zones	1
	Total	**2**

Despite the small number of proposals both at regional and national level, water transport for passengers for the sector of tourism, and therefore, potential for EDP and ecosystem development should be considered.

5. Potential platforms for ecosystems development

In order for the sector to adapt to the current economic conditions but also further develop and prosper, there are several policies and measures that need to be taken. The following indicative suggestions could support towards this direction.

- **Re-organisation of the coastal maritime network**: The maritime transport network should be reorganised in order to better serve the existing needs. This means that an assessment of the existing coastal routes should take into consideration whether the coastal transportation needs are covered by the existing commercial routes, and whether there are alternative connection means (e.g, roads between the ports of the same island). Further issues about the fleet's capacity, the route frequency as well as the cost per passenger should also be taken into account.
- **Modernisation of the ticketing system:** With the adoption of new technologies by the users, the upgrade of the IT systems of the shipping firms and adjustment of the regulatory framework, the use of e-tickets in the maritime sector could be facilitated. In this way, the services provided to passengers could improve further, while the shipping firms would be able to make savings and at the same time extend the implementation of dynamic pricing systems (as in the case of airlines), allowing them to manage their revenue streams more efficiently.
- Along with the re-design of the coastal network the potential of establishing **regional transit hubs** that enable the fast correspondence with smaller islands, combined with other means of transportation (such as buses, airlines, trains) could also be considered.

55.1 Hotels and similar accommodation in Crete

1. Economic and production profile

Hotels and similar accommodation group is comprised by a single 4-digit class:

> *55.10 Hotels and similar accommodation*: which includes 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. It excludes the provision of homes and furnished or unfurnished flats or apartments for more permanent use, typically on a monthly or annual basis.

Hotels and similar accommodation is the most significant sector in Crete with 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. In terms of specialisation, the regional specialisation compared to total Greece is 2.51 to 2.97 times higher depending on whether it is computed with respect to the number of companies of the number of employees. It has the fourth most important -compared to the other sectors in the region- specialisation in terms of companies and the second in terms of employees (data for 2017).

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation - employment-base
55.1	Hotels and similar accommodation in Crete	1.077	20.284	1.069,68	2.51	2.97
	Position among top 10 3-digit industries in Crete	1st	1st	1st	4th	2nd

Source: ELSTAT, 2017

Apart from Crete, the 55.1 sector is within the 10 top industries in other six Greek regions with South Aegean, Central Macedonia and Ionian Islands having the largest numbers in terms of companies, employment and turnover. The islands (South Aegean, Ionian Islands and Crete) seem to have a higher specialisation in the sector compared to total Greece based on both the number of companies and the number of employees. South Aegean and Ionian Islands are more than 3.5 times more specialised and North Aegean and Crete 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

Source: ELSTAT, 2017

2. Relation to RIS3 Crete

Hotels and accommodation is a priority sector in RIS3 of Crete since it belongs to the wider culture-tourism industry. Due to this connection it is also a priority in the national RIS3 strategy.

Crete is first among all Greek regions in overnight stays with a share of 27.5%. The region has a significant stock of high-quality hotels and other accommodations with a large number of 2* hotels but also the presence of well-known group hotels and other 5* accommodation facilities (it accounts for 30% of the country's stays in 5* hotels). The sector is highly extroverted since Crete attracts 3.3 mil international visitors on an annual basis (2013 data) (RIS3 Crete).

According to the RIS3 strategy of Crete the innovation potential of this sector is based on the integration of ICT, multimedia, mobile applications and interactive software solutions. As a wider objective linking the ICT with the culture-tourism cluster, the strategy aims to exploit scientific knowledge, innovation and ICT technologies to enhance international competitiveness by upgrading the services provided, diversifying the touristic product and interconnecting it with the local community. Focusing more specifically on hotels and accommodation, the strategy aims to develop and implement technological solutions with the exploitation of ICT, mobile applications and the internet a) to create new 'smart room' services, b) to document a stricter accreditation system as well as c) to reduce the environmental footprint of hotels and other accommodation facilities.

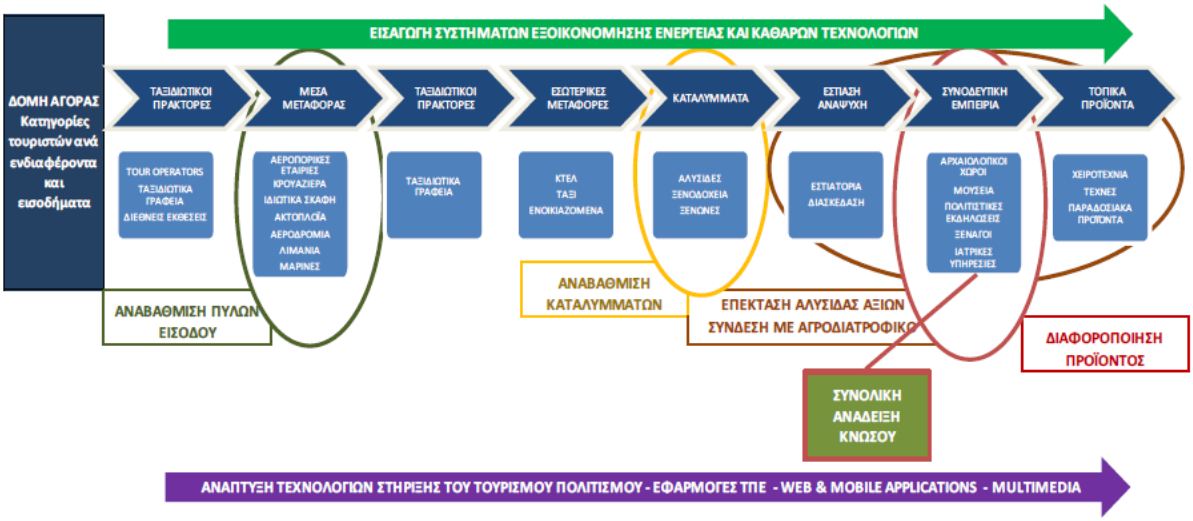


Figure 55.1.1. Smart Specialisation Strategy in Tourism

3. 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. Tourism creates synergies between all economic sectors, acts as a means of development for local communities and creates new jobs and business opportunities. In 2017 only, Greece recorded 30.2 million of international arrivals and attracted 3 bil. euros of investments in tourism. Within three years, 350 investment plans for -4* and above- hotels were submitted for licencing[64]. The trends in these numbers continue to rise despite the economic crisis. Hotel infrastructure in the country is significant and is continuously upgrading. Greece has a higher than its competitor countries number of all-star categories hotels while the tourist satisfaction from services in Greek hotels is significantly higher than in other internationally competitive destinations (e.g. Spain, Italy, Portugal, Croatia, Cyprus) (Figure 55.1.2) (SETE, 2016)[65].

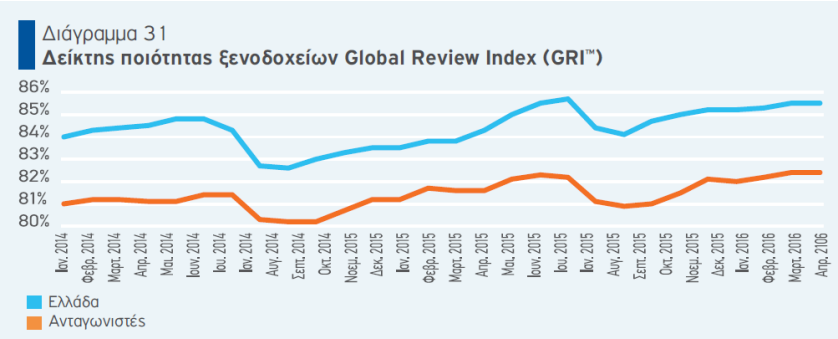


Figure 55.1.2. Quality indicator between hotels in Greece and in competitive countries

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 to visitors with higher accommodation requirement. 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 of, reaching 54.8% of 4 and 5* hotel rooms in Greece (2012 data).

The hotels and similar accommodation industry is characterised as a high entrepreneurial sector with a great extroversion. The main challenges can be found in the generally small size of the companies (despite some exceptions) and the subsequent difficulties in creating economies of scale and introducing innovations. In fact, substantive relationships and formal collaborations among entrepreneurs and researchers are absent, despite the presence of significant academic and research institutions in the region, such as the Foundation of Research and Technology-Hellas (FORTH), one of the largest research centres in Greece, the Polytechnic School of Crete and the Technological Foundation of Crete with academic and research activities in ICT, telecommunications, robotics, materials, energy and environment protection etc.

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[64] Υπουργείο Οικονομίας και Ανάπτυξης (2019) Ελλάδα: Εθνική Στρατηγική για τη Βιώσιμη και Δίκαιη Ανάπτυξη 2030, http://www.mindev.gov.gr/wp-content/uploads/2019/05/%CE%91%CE%BD%CE%B1%CF%80%CF%84%CF%85%CE%BE%CE%B9%CE%B1%CE%BA%CE%AE-%CE%A3%CF%84%CF%81%CE%B1%CF%84%CE%B7%CE%B3%CE%B9%CE%BA%CE%AE-2030.pdf

[65] SETE (2016) Ελληνικός Τουρισμός: Εξελίξεις - Προοπτικές

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
2.1.1	Development of value-added and networking tourism services applications targeted at businesses for the purpose of providing personalized information, recommendations and content to travelers (e.g. advanced holiday package and / or personalized advanced engines, route selection, activities, points of interest), tourist accommodation, events / events, public transit routes).	2	11	13	14.4 %
2.1.3	Development and utilization of innovative tools, products, services and processes to support specific forms of tourism (eg cruise, religious, diving and maritime tourism, rural tourism, science tourism, urban tourism, gastronomic tourism, sports tourism).	1	1	2	2.2%
2.1.4	Development of products and services to support businesses and organizations targeting specific population groups (eg people with disabilities, children, the elderly, chronically ill).	5	2	7	7.8%
2.1.5	Develop 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.	3	4	7	7.8%
2.1.6	Development and utilization of ICT applications for the analysis, documentation, modeling and management of cultural reserves, as well as areas of environmental and tourist interest, with the aim of upgrading tourism resources and their products.	2	0	2	2.2%
2.1.9	Development of marketing, marketing and supportive applications for stimulating competitiveness through the use of high-volume data techniques.	1	1	2	2.2%
2.1.11	Development of innovative digital content protection applications (existing audiovisual content, new producers, amateur films, promotional material, etc.), e.g. applications for exploitation, clearing, copyright management-Digital Rights Management, watermarking.	1	0	1	1.1%
2.1.15	Development of innovative tools, applications for promoting and upgrading tourism resources and products of areas of cultural, tourist and environmental interest.	1	2	3	3.3%
2.2.1	Developing innovative applications: (a) for guided tours of natural and / or virtual cultural environments (eg 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 / population displacement, etc.), and / or (b) highlighting and touring areas of tourist and	6	5	11	12.2 %

	environmental interest (eg areas of natural beauty, traditional settlements, chimneys, geoparks, wrecks, underwater attractions, aquariums, etc.) and / or (c) to promote specific forms of tourism (experiential, educational, alternative, medical, etc.).				
2.2.2	Development of innovative applications for the revival, representation and dissemination of intangible cultural heritage and related evidence (eg folk tradition, Greek mythology, cultural events, customs, artistic events, events, activities etc.), as well as contemporary culture (modern culture) visual arts etc.) through technologies / techniques of speech, sound, imaging, augmented reality, etc.	3	3	6	6.7%
2.2.3	Design of storytelling techniques and systems for innovative / interactive presentation of exhibits / events in places of cultural and tourist interest.	2	1	3	3.3%
2.2.4	Development of advanced applications for advertising and marketing of the country's cultural and tourism product (eg interactive applications, immersion environments, etc.)	1	2	3	3.3%
2.2.5	Development of 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.	2	2	4	4.4%
2.2.8	Development of advanced applications to enhance foreign language access to cultural and tourist content.	0	1	1	1.1%
2.3.1	Development of applications for improving, forecasting and managing the energy and environmental footprint of tourism infrastructure.	3	3	6	6.7%
2.3.2	Development of platforms and applications to provide advanced security and protection services to tourists.	2	2	4	4.4%
2.3.5	Development of technological applications for the promotion of Greek gastronomy, sports activities and events for the benefit of tourism.	1	0	1	1.1%
2.5.1	Targeted research, implementation and testing of new technologies and / or development of methods, products, services, prototypes related to documentation, diagnosis, rehabilitation, maintenance, authentication and demonstration / demonstration of documents / works of our cultural heritage , as well as modern and modern culture (including the emergence of demonstration facilities	1	1	2	2.2%
2.6.1	Other Emerging Technologies: Indicative: IoT - Internet of Things, Artificial Intelligence	1	2	3	3.3%
7.1.2	Increasing the potential for energy efficiency measures to be implemented in the industry and services industry and infrastructures OTAs / public infrastructures etc. Creating the necessary financial and technical tools to enable decision-making and enhancing corporate policy towards energy efficiency.	0	0	0	0.0%
7.1.4	Reduce the cost of converting existing buildings to near zero energy footprint. Development of advanced computing techniques to increase the energy efficiency of	1	0	1	1.1%

	buildings. Application of RES and energy storage technologies.				
8.3.1	Internet of Things and Platforms - interconnected applications of "smart" objects.	3	1	4	4.4%
8.4.2	Operating in dynamic real-world environments, with enhanced capabilities for autonomy, adaptability and secure interaction with humans.	2	2	4	4.4%
	Total	**44**	**46**	**90**	**100.0%**

Regions	Research	Company	Total
Eastern Macedonia and Thrace	23	28	51
Central Macedonia	74	95	169
Western Macedonia	8	8	16
Epirus	15	26	41
Thessaly	14	28	42
Ionian Islands	8	11	19
Western Greece	34	34	68
Central Greece	6	7	13
Attica	109	219	328
Peloponnese	9	9	18
North Aegean	16	5	21
South Aegean	5	7	12
Crete	**44**	**46**	**90**
Total	**365**	**523**	**888**

5. Potential platforms for ecosystems development

Potential ecosystems in the hotel and similar accommodation industry could be created a) around hospitality technology reaping the benefits of digitisation and the evolution of new technologies (new reality technologies such as augmented or virtual reality, artificial intelligence, data analytics) towards the exploration of potential new personalised services and improvements in service automation; b) around environmental targets/criteria and eco-friendly practices from construction (sustainable materials), operation (use of technologies for energy and water management, practices for zero carbon footprint etc.) but also promotion and services development (eco-labelling, promotion of locally sourced materials and food). Such ecosystems could include actors from the whole tourism value chain but also from other local sectors with common interests (e.g. enterprises from the agrofood sector, local service providers etc.).

62.0 Computer programming, consultancy and related activities in Attica

1. Economic and production profile

This group includes the following classes:

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.

According to the Hellenic Statistical Authority, this is among the big top-10 industry groups in Attica with 4868 companies, 17312 employees in the field of computer and consulting services and an annual turnover of EUR 1358.73 million (Elstat, 2017). Compared to Greece, the regional specialisation is 1.52 and 1.45 times higher based on the number of companies and the number of employees respectively. 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.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation -companies-based	Specialisation - employment -based
62.0	Computer programming, consultancy and related activities	4,868	17,312	1,358.73	1.52	1.45
	Position among top 10 3-digit industries in Attica	2nd	2nd	2nd	8th	8th

Source: ELSTAT, 2017

The 62.0 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

Source: ELSTAT, 2017

2. Relation to RIS3 Attica

The S3 of Attica aims to foster innovative activities in three areas of specialisation, which have regional comparatives and offer significant windows of development opportunity for Attica: (1) the creative economy, culture-tourism and ICT interaction, (2) the blue economy, maritime industries, fisheries, port and logistics, and (3) the sustainable needs economy and quality of life, including solid and liquid waste management.

The sectors involved in the Creative Economy are culture (theaters, arts, cultural heritage, archaeological sites, cultural centers etc.), crafts (traditional and new, ceramics, jewelry, etc.), software and ICT applications in the areas of entertainment, learning of culture, etc. (e.g.

development of gaming applications and technologies, creation of services and content - mobile apps, e-learning, etc.), film production, video and multimedia digital content and broadcasting of emissions. Also, creativity and culture relate to activities such as gastronomy, clothing and footwear, industrial design. Finally, the tourism and leisure industries belong to the broader field of design and production - providing experiences in various forms such as recreational tourism, gastronomic and wine, cultural, religious, sports, environmental tourism and so on.

Thus, clearly computer programming, software applications, databases, web design are within the scope and one pillar of the regional S3. ICT-related activities are at the center of the three priority areas (see figure below). In the ICT industry, developing startups that are knowledge-intensive, creative and innovative is expected to enrich the business ecosystems with innovative activity and improve the capacity to absorb technologies and innovation. [66]

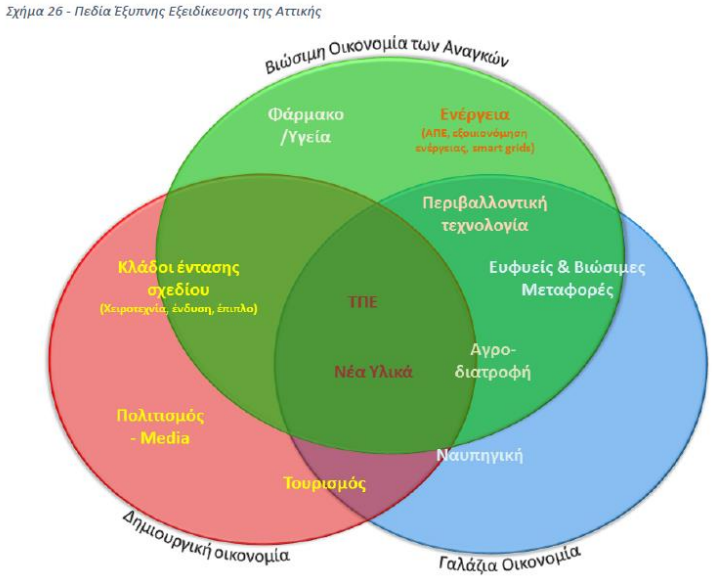

Figure 62.0.1: Smart Specialisation areas for Attica
Source: RIS3 Attica

RIS3 actions are targeting to develop infrastructures and mechanisms corresponding to the S3 pillars. Supporting R&D and fostering innovative and creative culture, incubators, accelerators, business grants to encourage start-ups, innovation vouchers ranging from hatching to business development and co-operation enhancing innovative activities and supporting the extroversion of the region.

3. Business challenges

The domestic software market has been declining in the period 2010-2014, but since 2014 there has seen a 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. [67]

[66] Περιφέρεια Αττικής (2015). Στρατηγική Έξυπνης Εξειδίκευσης για την Περιφέρεια Αττικής. Ενδιάμεση Διαχειριστική Αρχή Αττικής.
[67] ICAP (2018). Κορυφαίοι κλάδοι της ελληνικής οικονομίας. ICAP group.

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 accounting for 15%.[68]

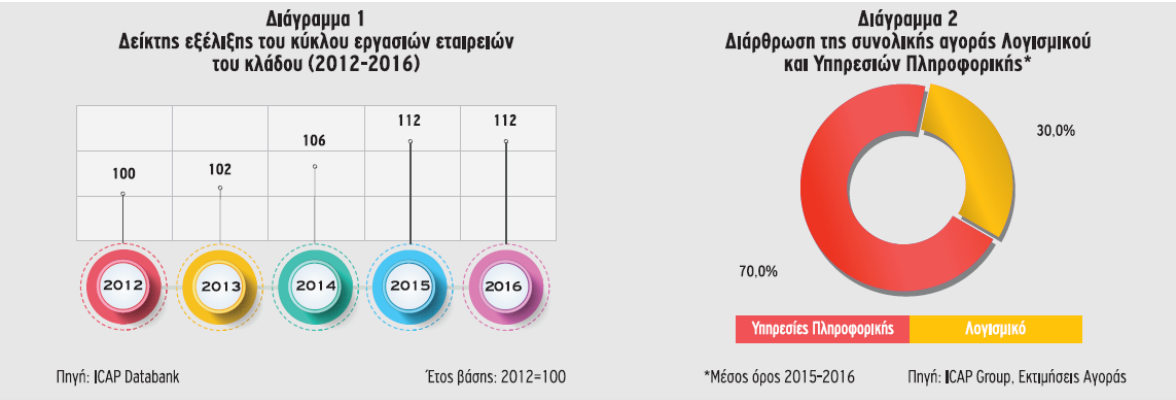

Figure 62.0.2: Software and informatic services turnover, 2012-2016
Source: ICAP, 2019

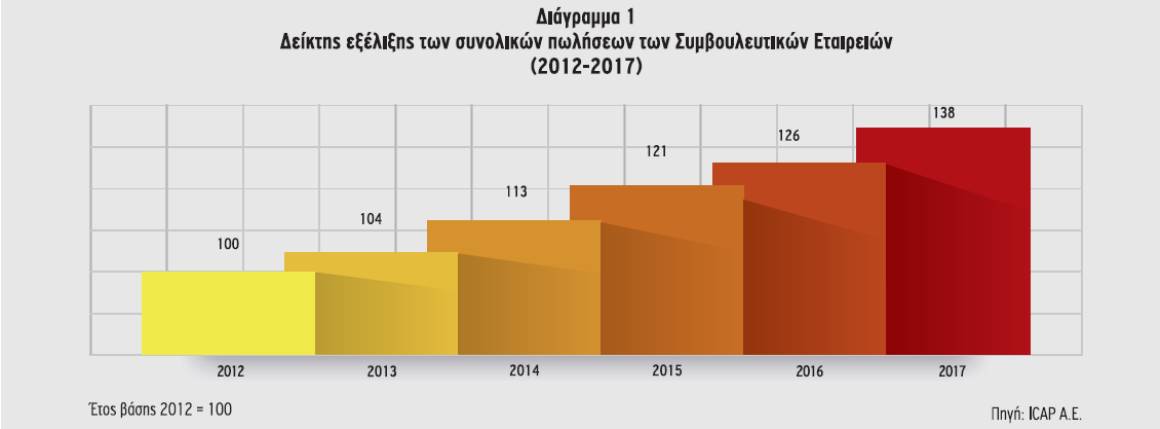

Figure 62.0.2: Consulting services sales, 2012-2017
Source: ICAP, 2019

The industry group of computer services and consultancy are is composed by 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.

Much will 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 Communications, 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

[68] ICAP (2019). Κορυφαίοι κλάδοι της ελληνικής οικονομίας. ICAP group.

applications for mobile computing systems; semantic web technologies; intelligent data analysis technologies; robotic systems; and distributed intelligence technologies.[69]

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Rese arch	Busine ss	Total	%
8.1.2	Advanced technologies of 3D modeling, preservation, restoration of materials and intangibles of particular interest using semantic web technologies	6	9	15	2.7%
8.1.4	Development of advanced entertainment software and innovative game technologies and gamification techniques	8	20	28	5.0%
8.1.5	Multimodal and physical interaction with computer, phonetic and non-phonetic	8	16	24	4.3%
8.2.1	Smart networks and new Internet architectures	16	29	45	8.0%
8.2.2	Smart technologies for optical & wireless networks	5	10	15	2.7%
8.2.3	Advanced cloud infrastructure & services	12	29	41	7.3%
8.2.4	Tools & methods for software development	12	39	51	9.0%
8.2.5	Collective Awareness Platforms for Sustainability and Social Innovation	12	29	41	7.3%
8.2.6	Advanced 5G network infrastructures for the Internet of the future	13	19	32	5.7%
8.2.7	Satellite Internet and IoT Satellite	1	3	4	0.7%
8.3.1	Internet of Things and Platforms - interconnected applications of "smart" objects.	26	49	75	13.3%
8.4.1	New-generation robots and support technologies applied to industry and service delivery	6	11	17	3.0%
8.4.2	Operating in dynamic real-world environments, with enhanced capabilities for autonomy, adaptability and secure interaction with human	4	7	11	2.0%
8.5.1	Optimization of production processes	3	8	11	2.0%
8.5.2	ICT-supported modeling, simulation, analysis and forecasting technologies	6	15	21	3.7%
8.5.3	3D Printing	6	10	16	2.8%
8.5.4	Smart technologies and strategies to extend the operational life of production systems	4	8	12	2.1%
8.5.5	Zero Defect Manufacturing Technologies and Zero Error Strategies (Zero Defect Manufacturing)	2	4	6	1.1%

[69] ITE (2013). Δίκτυο Επιχειρηματικής & Τεχνολογικής Πληροφόρησης, «Τεχνολογίες Πληροφορικής και Επικοινωνιών» 2012.ΣΕΒ, Στέγη της Ελληνικής Βιομηχανίας

8.5.6	Integrated Rapid Configuration Technologies to Support Flexible Manufacturing Systems (Reconfigurable Manufacturing Systems / Industry 4.0)	1	2	3	0.5%
8.6.1	Nano-Microelectronics and embedded systems	1	2	3	0.5%
8.6.2	Sensors (MEMS - Microelectromechanical systems)	5	4	9	1.6%
8.6.3	Digital electronics	16	14	30	5.3%
8.6.4	Electronic and integrated audio, video and image management systems	3	6	9	1.6%
8.6.9	Microelectronic device design and simulation tools	2	3	5	0.9%
8.6.10	Production processes for microelectronics and electronic devices	1	1	2	0.4%
8.6.11	Low power electronics	1	2	3	0.5%
8.7.1	Privacy and security of personal data	2	3	5	0.9%
8.7.2	Reliability and quality of information and web profiles	2	4	6	1.1%
8.7.3	Internet security and illegal content detection technologies	2	4	6	1.1%
8.7.4	Electronic identification of persons (eID), objects and electronic information	3	5	8	1.4%
8.7.5	Distributed security for digital data	2	8	10	1.8%
	Total	**191**	**373**	**564**	**100.0 %**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	19	30	49
Central Macedonia	93	130	223
Western Macedonia	16	13	29
Epirus	12	20	32
Thessaly	12	20	32
Ionian Islands	5	3	8
Western Greece	60	43	103
Central Greece	10	15	25
Attica	**191**	**373**	**564**
Peloponnese	5	10	15
North Aegean	8	2	10
South Aegean	2	2	4
Crete	36	22	58
Total	**469**	**683**	**1152**

5. Potential platforms for ecosystems development

With the large number of businesses and jobs in this industry group, more business ecosystems can be set up, either on the basis of organisational / institutional agreements, common infrastructure, or thematic technologies. A case is the ecosystem of software, computer and Internet services that has been developed at the premised of Democritus Research Center in Athens.

Demokritos operates in its campus the "Lefkippos" Technology Park of Attica. The Park serves as a pole for approximately forty international high-technology companies and innovation-driven start-ups and SMEs, which are in a continuous, dynamic interaction with the Research Community of the Centre, and can readily access the Centre's Research Infrastructures. The companies can use the facilities of the Congress Center as well as the services of the Demokritos' Innovation Office concerning partnerships for research proposals, issues on technology transfer and intellectual property, access to VCs and other funding schemes.

Companies in this ecosystem may tap on the Institute of Informatics and Telecommunications (IIT) which focuses on research and development in the areas of telecommunications, networks, web technologies and intelligent systems. Both the IIT and Lefkippos may offer the platform for technological advancement of the hosted ecosystem, giving advantages and access to research results, technology prototypes, international collaboration, and exploitation of research results. The specific form under which this technology platform may operate is the challenge to be addressed at the Entrepreneurial Discovery Process.

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

1. Economic and production profile

Scientific research and development includes 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 in order 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. The 72.1 group comprises two classes:

72.11 *Research and experimental development on biotechnology*: DNA/RNA research, genomics, pharmacogenomics, gene probes, genetic engineering, DNA/RNA sequencing/synthesis; proteins and other molecules sequencing/synthesis/engineering of proteins and peptides; cell and tissue culture and engineering: cell/tissue culture, tissue engineering; process biotechnology techniques; bioinformatics; nanobiotechnology.

72.19 *Other research and experimental development on natural sciences and engineering* other than biotechnological; research and development on natural sciences; research and development on engineering and technology; research and development on medical sciences; research and development on agricultural sciences; interdisciplinary research and development, predominantly on natural sciences and engineering.

In total, 499 companies of this group are located in the prefectures of Crete, mainly small companies with 1,323 employees and a 15.29 million turnover in 2017. This industrial group is between the second and seventh larger in Crete in terms of number of companies, employment, and turnover. Compared to total Greece, the regional specialisation is 1.98 to 1.69 times higher, depending on whether it is computed on number of companies or employment. The group comprise also most companies of the Technology Park of Crete at the outskirts of Heraclio, companies in the field of medical technology and informatics that dispose specialised staff and collaborate with academic / research institutes. There is no formal networking between them but occasional partnerships.

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
	Position among top 10 3-digit industries in Crete	2nd	4th	7th	5th	6th

Source: ELSTAT, 2017

2. Relation to RIS3 of Crete

Research, technology development and innovation are a priority of RIS3 of Crete. Priorities are organised in 4 nexuses, among which is the knowledge – innovation nexus. Emphasis is placed on promising cutting edge research (biomedical, nanotech, computing, materials), which can

support the expansion of the productive activities towards new competitive knowledge-intensive production, the launching of start-ups springing from this high quality RTD, the attraction of relevant investment, and researchers, from around the world, and building human capital, focusing on the interaction of local research and local advantages.

RIS3 CRETE PRIORITIES THE KNOWLEDGE AND INNOVATION NEXUS	Professional, scientific and technical activities Scientific research and development Other professional, scientific and technical activities	Education General advancement of knowledge: biological sciences, chemical, earth and environment, engineering, mathematics, computer and information, medical sciences	Digital transformation High performance computing KETs: advanced materials, industrial biotechnology, micro/nano-electronics, nanotechnology, photonics

Source: Eye@RIS3: Innovation Priorities in Europe

The **platform logic is dominant in the RIS3 of Crete**. Following the consultation with stakeholders 4 innovation platforms have been set up corresponding to RIS3 Crete priority areas (agri-food, culture-tourism, environment, knowledge). Each platform should act as a coordinating body of the corresponding cluster with a high degree of specialization in the field. Participation of entrepreneurs with a leading role would take place over each platform. The four innovation platforms guide the regional EDP, an iterative interactive consultation process during which interested parties analyse, design, and adapt investments and technology strategies according to the evolving competitive environment and market trends.[70]

3. Business challenges

As stated by the interviews, 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. However, there is no formal networking between them but occasional partnerships.

SMEs in the ICT sector is one of the most intensive research areas. The Greek researchers have 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 (6th place in project coordination, 9th place to participate in ICT projects in the 7th Framework Program for research and technological development. In 18167 European FP7 projects, Greek partners participated in 450 (25% of European projects). Top research areas were those of IT applications, information systems and information processing, media, telecommunications, electronics and microelectronics. 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.[71]

[70] RIS3 Crete (2015). S3 Strategy for the Region of Crete. Special Managing Authority of Crete.
[71] ΙΤΕ (2013). Ετήσια έκθεση για τον τομέα "Τεχνολογίες Πληροφορικής και Επικοινωνιών". ΣΕΒ, Στέγη της Ελληνικής Βιομηχανίας, σελ 21.

The major challenge for research-driven companies, and ICT SMEs in particular which develop solutions with high TRL[72] , is to transform research results in marketable products and services. Greek companies have fully exploited and specialized in several field of the above-mentioned top technology fields and the degree of penetration in the Greek market can be characterized quite satisfactory. However, the barriers they face for the diffusion and commercialization of technologies are mainly market related, due to their small size and limited financial strength.

4. Research and innovation challenges

Analysis of GSRT data on research proposals participations submitted to Erevno-Kainotomo calls (A & B) shows a high demand for ICT technologies. It is important to consider also some macro-indicators to get a better picture about 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%). Based on relevant GSRT data, in 2015 Crete was:

- 1st in GDP research intensity: R&D expenditure of GDP stood at 1.53% versus 0.97% on average;
- 1st in GDP growth in public sector: R&D expenditure by research centers and higher education institutions was at 1.41% versus 0.64% on average;
- 5th in GDP growth in business: R&D expenditure in GDP was 0.11% versus 0.32% of Greece's average;
- 2nd in R&D Per Capita with € 213 versus € 157;
- 1st in employment of research staff in total employment 1.95% versus 1.40% in Greece
- 1st in participations in the 7th Framework Program with 73.7 Participations per 1000 researchers versus 47.9 on average;
- 1st in the absorption of funds from 7th Framework Program per Researcher with € 25.6 thousand versus € 14.5 thousand on average;
- 2nd in the number of publications with 2.8 pp / researcher (1st Epirus with 3.5)
- 5th place in number of publications per Million Euro R&D Expenditure (1st Epirus)
- 1st in Publications with International Collaboration with 58.1% versus 46.3% on average
- 1st in the percentage of Innovative Business with 58.4% versus 51% of the country
- 4th in product innovations;
- 1st in organizational and / or marketing innovations;
- 6th on expenditure on innovation with 0.32% of GDP versus 0.91% of the country
- 1st in business partnerships with other entities for Innovation Development with 21.1% versus 15.5% on average.

The above data reveal the significance of further promoting research on science and technology in Crete, as it has a great potential to contribute to the regional economy.

5. Potential platforms for ecosystems development

An important hub of research-driven companies is the Science and Technology Park of Crete (STEP-C), which was created in 1993 as an initiative of the Foundation for Research and Technology-Hellas (FORTH), one of the largest Research Organizations in the country. STEP-C offers incubating facilities and services to start-up companies, specialized professional services geared to assisting and guiding them to unleash their potential through innovation, assess and secure their intellectual capital, support better their business interests and needs, and transfer their technological advancements into the manufacturing of innovative products and services. Currently, STEP-C hosts a cluster of about 30 companies, mainly IT and telecom, such as *Cytech*

[72] Technological Readiness Level, 8-system development or 9-system test launch and operation.

(mobile solutions), *Enartia* (domain registration, hosting and cloud services), *Neurolingo* (natural language processing), *Neurocom* (software and IT services), *Phaistos* (digital marketing), *European Publishing*, *Hellenic telecommunications*, *Easysms* (communication), *Orama* (virtual learning), *QCELL* (spectral imaging), *Gnosis* (data analysis) and other.

STEP-C can be the focal point for the growth of ecosystems of research driven companies, **launching series of platforms** that will gather companies and creating specialised business ecosystems around thematic fields of technology. A discovery process in this domain is to define fields for platforms and motivation for companies to join and work as platform complementors.

79.1 Travel agency and tour operator activities in Ionian Islands

1. Economic and production profile

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. More specifically, this group comprises the following 4-digit classes:

> *79.11 Travel agency activities:* This class includes activities of agencies, primarily engaged in selling travel, tour, transportation and accommodation services on a wholesale or retail basis to the general public and commercial clients
>
> *79.12 Tour operator activities:* This class includes arranging and assembling tours that are sold through travel agencies or directly by tour operators. The tours may include any or all of the following: (1) transportation, (2) accommodation, (3) food, (4) visits to museums, historical or cultural sites, theatrical, musical or sporting events.

According to the Hellenic Statistical Authority, there are 211 companies dedicates to travel agency and tour operator activities located in the five regional units of Ionian Islands with 897 employees and EUR 55,69 turnover in 2017 (Elstat, 2017). Compared to Greece, the regional specialisation is 2,7 and 2,27 times higher based on the number of companies and the number of employees respectively. This group is among the top five sectors in all the economic numbers with noteworthy performance in terms of employment and annual turnover.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation - companies-based	Specialisation -employment-based
79.1	Travel agency and tour operator activities	211	897	55,69	2,7	2,27
	Position among top 10 3-digit industries in **Ionian Islands**	5th	2nd	3rd	4th	4th

Source: ELSTAT, 2017

The 79.1 group is within the top industries 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

Source: ELSTAT, 2017

2. Relation to RIS3 Ionian Islands

According to the RIS3 strategy for the Region of Ionian Islands[73], tourism is among the priority sectors for regional specialisation, as a subfield of both the priority on '*blue economy*' and the

[73] RIS3 Ionian Islands, Source: https://www.espa.gr/el/pages/staticRIS3.aspx

priority on '*experience industry*'. On the one hand, blue economy focuses on maritime transport, fisheries, aquaculture, marine biotechnology, marine archaeology and marine tourism. On the other hand, experience industry focuses on culture, ICTs and media, creative economy and thematic tourism. In both cases, the sector of travel agency and tour operator activities is considered a substantial part of the global value chain for tourism, as in the case of 'Experience' industry presented in Figure 1.

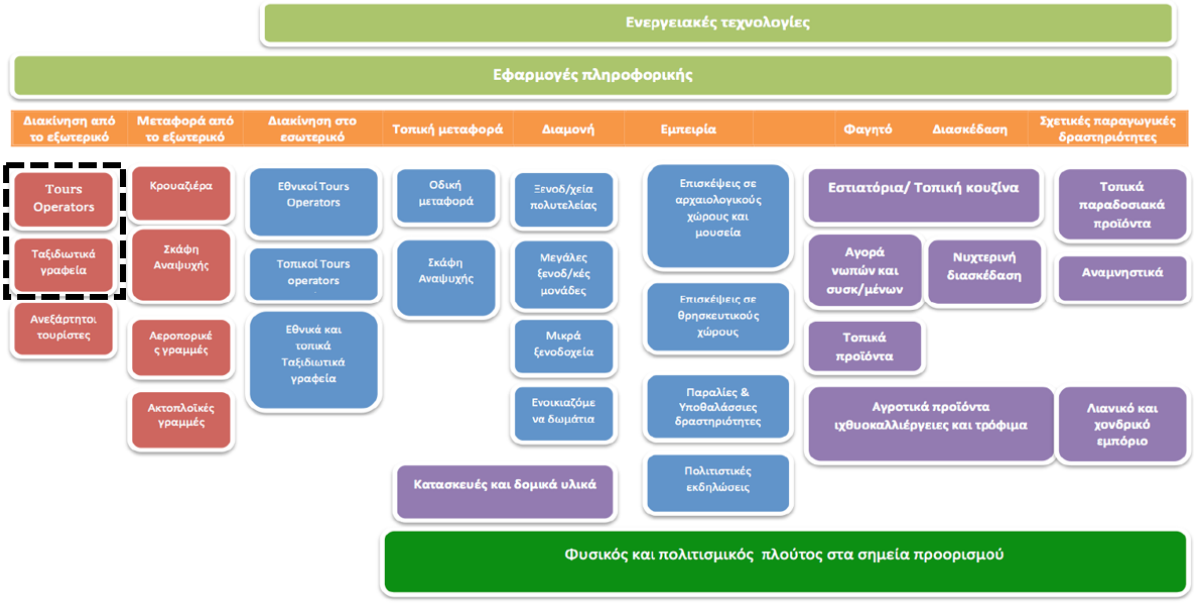

Figure 79.1.1. Travel agency and tour operator activities (selected with black dashed line) as a part of the value chain in 'Experience' Industry in Ionian Islands, Source: RIS3 Ionian Islands, p. 46.

More specifically, the main objectives of the strategy for specialisation for the 'Experience' industry include:

- Expanding the value chain, attracting more activities in the value chain by developing interconnections between tourism and the rural economy, manufacturing and culture.
- Diversification of the touristic product, exploiting the opportunities offered by the natural and cultural wealth of the region to develop forms of tourism beyond the "sun and sea" model.
- Use of ICTs and clean technologies for faster promotion of services, increased autonomy, reduced costs and reduced ecological footprint.

The action plan suggested for the implementation of the RIS3 strategy comprises a set of actions that aim at upgrading the quality of entrepreneurship, as well as the quality of the offered products and services, as well as at creating an appealing research environment for attracting partnerships. Overall, the combined benefits of these policies and actions definitely affect also the group of travel agency and tour operation activities.

3. Business challenges

According to a research on the tourism sector[74], in 2011 tourism accounted for 8% of total employees in the country. In particular, 12.000 employees were in the group of travel agency and tour operator activities, accounting for almost 4% of the total employees in the sector. Over time,

[74] Foundation for Economic and Industrial Research (2011), *Employment in the Tourism Sector,* Source: http://iobe.gr/docs/research/RES_05_E_07012013REP_GR.pdf

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 impact of tourism on direct employment is also reflected in 2011, as the decline recorded is milder than that of total domestic employment (-6.8%). Although incoming tourism in Greece recovered in 2011, on the basis of arrivals and revenues, the significant Greek recession economy has a negative impact on domestic tourism, the contribution of which has been instrumental in the development of domestic tourism activity in the latter decade.

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 leaves them out of the equation[75]. Travelling is not 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.

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
2.1.1	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).	4	8	12	36.4%
2.1.3	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).	6	4	10	30.3%
2.1.4	Development of products and services to support businesses and organizations targeting specific population groups (e.g. people with disabilities, children, the elderly, chronically ill).	0	1	1	3.0%
2.1.5	Develop methods and applications to provide new advanced services or to optimize existing services (in	1	1	2	6.1%

[75] Top Challenges Facing Travel Agencies (2015), Source: https://travelshift.com/blog/challenges-facing-travel-agencies/

	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.				
2.1.7	Development of innovative platforms for collecting tourism and cultural content and making it available to application and service creators. This includes the use and utilization of open data, social networks and crowd sourcing.	1	1	2	6.1%
2.1.9	Development of marketing, marketing and supportive applications for stimulating competitiveness through the use of high-volume data techniques.	0	0	0	0.0%
2.1.10	Development of innovative tools or platforms, such as Media Asset Management platforms offered as a product or cloud service (SaaS), for the unified management and processing of audiovisual content. e.g. a platform for the digital preservation, editing and promotion of Greek cinema and other audiovisual works, including amateur material.	0	0	0	0.0%
2.2.4	Development of advanced applications for advertising and marketing of the country's cultural and tourism product (eg interactive applications, immersion environments, etc.)	0	1	1	3.0%
2.2.5	Development of 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.	2	1	3	9.1%
2.3.2	Development of platforms and applications to provide advanced security and protection services to tourists.	0	1	1	3.0%
2.3.4	Developing digital games and generally innovative ICT applications that leverage creative content to promote wellness, fitness and health.	1	0	1	3.0%
2.3.5	Development of technological applications for the promotion of Greek gastronomy, sports activities and events for the benefit of tourism.	0	0	0	0.0%
	Total	**15**	**18**	**33**	**100.0 %**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	30	41	71
Central Macedonia	83	135	218
Western Macedonia	3	8	11
Epirus	15	28	43
Thessaly	34	47	81
Ionian Islands	**15**	**18**	**33**
Western Greece	31	40	71
Central Greece	5	7	12
Attica	121	272	393

Peloponnese	8	8	16
North Aegean	21	6	27
South Aegean	4	5	9
Crete	44	46	90
Total	**414**	**661**	**1075**

5. *Potential platforms for ecosystems development*

In an increasingly digital world, the way that people organize trips, book tickets and services and travel is constantly changing, while tourism continues to grow at an international level[76]. Travel agencies and tour operators have to adapt to these new conditions so that they are not left behind and become obsolete. However, the dominance of a handful of e-tourism huge companies (Booking, Trip Advisor, Yelp, etc.) makes it difficult for startups to emerge and thus prosper. Hence, it is important to find ways to support the development of the ecosystem as a whole and promote sustainable tourism, as highlighted in the 2030 Agenda for Sustainable Development[77].

One possible direction for the companies of this sector could be focusing on a **niche market** and promote the concept of **thematic tourism**. Instead of providing generic services in the form of travel packages in mass scale, travel agencies and tour operators should target a specific audience and provide a high-quality product for this audience. Providing customized experiences for travelers combining information that cannot be found online could be a key priority for the future of travel agencies. Especially in the region of the Ionian Islands, trips could be tailored to meet different interests such as focus on history and cultural identity or focus on natural landscapes and sports.

Another direction for development regards the **digital infrastructure** behind these services. More and more people use the Internet for their bookings and transactions, and the use of mobile devices for these activities is expected to rise over the next few years. In this context, it is fundamental for these companies to offer a seamless online experience, providing people with comprehensive and curated search results in order to retain their attention. A common platform for travel agencies and tour operators that gives the ability to modify product availability in real-time and offers an optimized booking management system, could further support the ecosystem in the region.

[76] Worldwide Travel Trends (2020), Source: https://www.itb-berlin.com/media/itb/itb_dl_all/itb_presse_all/ITB_World_Travel_Trends_Report_2020.pdf
[77] Sustainable Tourism, Source: https://sustainabledevelopment.un.org/topics/sustainabletourism

90.0 Creative, arts and entertainment activities in Attica

1. Economic and production profile

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:

- Activities of groups, circuses or companies, orchestras or bands
- Activities of individual artists such as actors, dancers, musicians, lecturers or speakers

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

- Activities of directors, producers, stage-set designers and builders, scene shifters, lighting engineers etc.
- Activities of producers or entrepreneurs of arts live events, with or without facilities

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, as well as restoring of works of art such as paintings etc.

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

According to the Hellenic Statistical Authority, there are 5.443 companies dedicated to creative, arts and entertainment activities in Attica with 12.799 employees and EUR 186,21 turnover in 2017 (Elstat, 2017). Compared to Greece, the regional specialisation is 1,67 and 1,4 times higher based on the number of companies and the number of employees respectively. The creative industry is first in terms of number of companies and second in terms of employment. However, it comes sixth in annual turnover, and has relatively low specialisation indexes.

NACE	Name of group	No of companies	Employment	Turnover (in million €)	Specialisation -companies-based	Specialisation -employment-based
90.0	Creative, arts and entertainment activities	5,443	12,799	186.21	1.67	1.4
	Position among top 10 3-digit industries in **Attica**	1st	2nd	6th	8th	9th

Source: ELSTAT, 2017

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

Source: ELSTAT, 2017

2. Relation to RIS3 Attica

According to the RIS3 Strategy for the region of Attica[78], the Creative Economy is one of the three priority fields for specialisation. The term 'creative economy' refers to the socioeconomic outlook of creativity- and knowledge-intensive activities, as they transform creativity into value for use that improve citizens' life. Among the sectors involved are culture (theatre, arts, cultural heritage, archaeological sites etc.), crafts, software and ICT applications in the areas of entertainment, film production and multimedia content. In the case of the Attica region, the sectors of the creative economy that are most important are:

- Information, communication, media and gaming technologies (including applications for education, culture and tourism)
- Design-intensive sectors, including clothing, furniture, crafts and jewellery.
- Culture & media
- Tourism, as a wider sector for the design and promotion of experiences.

Attica has a strong tradition and reputation in the creative economy. In this context, the RIS3 strategy aimed at strengthening this tradition and expand its potential through the combination of cultural and creative activities with innovative technologies. In other words, the strategy endeavors to renew and expand the economic and social activities of the creative industries, in order to fully exploit the potential not only of technological advances but also of human capital. According to a recent study for mapping the cultural and creative industries in Greece[79], in the period 2008-2014, there was an increase of 23.7% to employees that were higher education graduates; this indicates the increased professionalisation of the wider field of creative, which probably implies that the field is viewed as an attractive field of work for a highly educated workforce. Finally, among the actions suggested in the RIS3 Action plan is the development of technological platforms and learning networks for the creative economy, as well as the creation of innovative products and services related to the creative economy.

3. Business challenges

According to the study for mapping the cultural and creative industries in Greece[2], the cultural and creative sector in Greece in 2014 had 110,688 employees in 46,370 enterprises. It sold symbolic goods and services of about EUR 5.3 billion, with about EUR 2.1 billion added value for the Greek economy, and 1.4% contribution to the GDP. 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%).

The cultural and creative economy is an area increasingly attracting research attention in the last ten years. Overall, the Greek creative economy was strongly affected by the financial crisis, much more strongly than the Greek economy as a whole. However, the outlook of the cultural and creative industries in Greece shows that despite the enormous downfall they experienced since 2008, in 2014 they record signs of recovery for the first time after six years. The Region of Attica produces 75.5% of the Gross Value Added (GVA) of the cultural and creative industries in Greece, with 57.3% of creative enterprises, which employ 60.8% of employees as a whole. Therefore, the cultural and creative industries play an important role in the regional economy of Attica, as they

[78] RIS3 Attica, Source: https://www.espa.gr/el/pages/staticRIS3.aspx
[79] Ministry of Culture and Sports (2017), *Mapping the Creative and Cultural Industries in Greece*. Source:
http://ep.culture.gr/Lists/Custom_Announcements/Attachments/198/Xartografisi.Short.ENG.pdf

employ 2.1% of employees in the region and contribute a 5% to the regional GDP, while in the other regions of Greece employment fluctuates between 1.4% and 2.3% and the contribution to the regional GDP varies between 0.4% and 1%.

Regions with a high degree of specialization and employment in cultural and creative activities are among the most prosper regions in terms of per capita income, without necessarily including the most populous urban centers[80]. The importance of developing this sector is crucial for Attica and, thus, the Greek economy as a whole, as Greece could have a comparative advantage in the sector. The uniqueness of the language, the high number of university graduates, its historical and cultural heritage are among the characteristics that could contribute to providing a comparative advantage in Greek companies focuses on the field of culture and creativity.

There are several challenges for the sector as well. 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 forms a network of 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. Finally, financial institutions are not familiar and maybe reluctant to evaluate companies based on intangible capital and thus they cannot rate the credit risks involved and this results in difficult or even lack of access in the credit market, and therefore full dependence on state subsidy.

4. Research and innovation challenges

Analysis of GSRT data on research proposals submitted to Erevno-Kainotomo calls (A & B) shows the demand for technology in various areas of research and innovation and the distribution of participations across the 13 regions of Greece (see Tables below).

Tech area	Research and Innovation priority	Research	Business	Total	%
2.1.7	Development of innovative platforms for collecting tourism and cultural content and making it available to application and service creators. This includes the use and utilization of open data, social networks and crowd sourcing.	4	6	10	6.2%
2.1.8	Development of new technologies - techniques - methods of digitization and scientific documentation of cultural heritage (mobile, immovable and intangible) with emphasis on improving the quality of digitization and reducing its time and cost.	4	2	6	3.7%
2.1.10	Development of innovative tools or platforms, such as Media Asset Management platforms offered as a product or cloud service (SaaS), for the unified management and processing of audiovisual content. e.g. a platform for the digital preservation, editing and promotion of Greek cinema and other audiovisual works, including amateur material.	2	5	7	4.3%

[80] Sophia Lazaretou, 2014. "The smart economy: cultural and creative industries in Greece. Can they be a way out of the crisis? (in Greek)," Working Papers 175, Bank of Greece. Source: https://ideas.repec.org/p/bog/wpaper/175.html

2.1.11	Development of innovative digital content protection applications (existing audiovisual content, new producers, amateur films, promotional material, etc.), e.g. applications for exploitation, clearing, copyright management-Digital Rights Management, watermarking.	2	4	6	3.7%
2.1.12	Development of innovative audiovisual content and / or digital distribution platforms and methods.	1	3	4	2.5%
2.1.13	Development of ICT platforms and tools to support the design of spatial environments and interactive spatial applications (e.g. in the areas of architecture, decoration, scenery, directing, lighting design, sculpture, etc.), incorporating advanced technologies (e.g. design in mixed reality immersion environment, user interfaces in hybrid environments, event planning, simulation, optical programming, etc.).	0	1	1	0.6%
2.1.14	Development of products, technologies and methodologies to support remote collaborative and distributed design and networking by independent creators, depending on the field of application (architecture, urban design, industrial design, jewelry, fashion, performing arts, graphic design, local communities and groups of citizens, etc.).	1	1	2	1.2%
2.1.15	Development of innovative tools, applications for promoting and upgrading tourism resources and products of areas of cultural, tourist and environmental interest.	3	2	5	3.1%
2.2.1	Development of innovative applications: (a) 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.), and / or (b) highlighting and touring areas of tourist and environmental interest (e.g. areas of natural beauty, traditional settlements, chimneys, geoparks, wrecks, underwater attractions, aquariums, etc.) and / or (c) to promote specific forms of tourism (experiential, educational, alternative, medical, etc.).	16	25	41	25.3 %
2.2.2	Development of innovative applications for the revival, representation and dissemination of intangible cultural heritage and related evidence (eg folk tradition, Greek mythology, cultural events, customs, artistic events, events, activities etc.), as well as contemporary culture (modern culture) visual arts etc.) through technologies / techniques of speech, sound, imaging, augmented reality, etc.	10	20	30	18.5 %
2.2.3	Design of storytelling techniques and systems for innovative / interactive presentation of exhibits / events in places of cultural and tourist interest.	1	4	5	3.1%
2.2.5	Development of 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.	13	18	31	19.1 %
2.4.1	Leverage and develop Big Data Collection, Analysis and Visualization technologies utilizing visual communication techniques to improve the transmission and understanding	3	4	7	4.3%

	of information and / or market analysis, in the areas of design, communication, journalism, publishing, etc.				
2.4.2	Exploit and develop 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, jewelry, optical communication, industrial design, product design, etc.	0	2	2	1.2%
2.4.4	Development of applications for enriched and interactive presentation of films, exhibitions, performances, etc.	2	3	5	3.1%
	Total	**62**	**100**	**162**	**100.0%**

Regions	**Research**	**Company**	**Total**
Eastern Macedonia and Thrace	9	6	15
Central Macedonia	35	35	70
Western Macedonia	3	3	6
Epirus	7	13	20
Thessaly	5	6	11
Ionian Islands	4	3	7
Western Greece	11	12	23
Central Greece	2	4	6
Attica	**62**	**100**	**162**
Peloponnese	7	8	15
North Aegean	7	3	10
South Aegean	2	4	6
Crete	20	16	36
Total	**174**	**213**	**387**

5. Potential platforms for ecosystems development

The cultural and economic processes that turn "symbolic content" into goods and services for society are evolving constantly and digital technologies have accelerated this evolution. Artists and creators embrace experimentation with new ideas and technologies, pushing the limits of their use[81]. However, in order for the creative ecosystem to prosper, there has to be a set of actions that will facilitate interaction, coordination and cooperation.

Among the main elements that could support the development of the creative ecosystem is the **common infrastructure**. Whether in a physical or virtual space or both, the constant contact and exchange between creators, audiences, content and technologies will nourish the ecosystem, catalysing the innovation generated by the cross fertilization of ideas. Many small and

[81] 'The Orange Economy: An infinite opportunity', Inter-American Development Bank. Source: https://publications.iadb.org/publications/english/document/The-Orange-Economy-An-Infinite-Opportunity.pdf

geographically dispersed creative producers could benefit from being gathered in a large workplace. Abandoned industrial buildings or abandoned public spaces and declining infrastructures could turn into dynamic spaces of expression of new ideas, production of new products, as well as education and vocational training. The consequences of the diffusion of the beneficial effects of these territorial concentrations on the economic development of the region will probably affect other ecosystems as well, such as tourism. However, the establishment of a virtual online space that supports dynamic interaction and provides useful services can act complementarily to the physical location.

Directly or indirectly related to this common infrastructure, the establishment of a **network of relationships** through a common registry and an online portal could further support the development of the ecosystem. More specifically, such a structure could build relationships of communication, cooperation and interaction with all actors involved in the creative industry. At the same time, it could contribute to the collection of data and thus the mapping of the creative activity as well as the networking of individuals and organisations through the active participation and cooperation of all. Any steps for establishing new institutions and structures should build upon existing one, such as the gi-Cluster[82] and the Portal of Cultural Institutions[83].

[82] gi-Cluster is the first creative industries cluster established Greece. It comprises of small and large companies, academic and research institutions, all involved in the Gaming and Creative Technologies and Applications Industry and forms a domestic, industry-led value-chain developing high-tech, state-of-the art competitive products for the international market. http://www.gi-cluster.gr/en/about-gi-cluster.html
[83] http://drasis.culture.gr/