Kainuu RIS3 strategy revision (Kainuu RIS3 2021-2027)

December 2020

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The Kainuu RIS3 strategy revision presents the Kainuu RIS3 2021-2027, building on the experiences of the on-going RIS3 and integrating new data. The document is structured into three parts: (i) discussion of the Kainuu regional innovation systems bottlenecks, (ii) presentation and analysis of the Kainuu 2021-2027 RIS3, and (iii) fulfillment of European Commission and national preconditions, i.e. respectively fulfilment of the Structural Funds Policy Objective 1 Enabling Condition and the seven associated criteria and the National R&D roadmap.

Kainuu regional innovation system bottlenecks

This section starts with a reference to the overall Kainuu region statistics, as this forms the framework of the Kainuu RIS3 strategy. The innovation system section follows, and then references also to the specialisation (comparative advantage), resilience, productivity, and digitalisation performance of the region, and closes with a synthesis section where the findings from the preceding discussion bottlenecks are brought together with the core issues profiling the Kainuu innovation system potential and needs are clearly stated.

Overview of Kainuu statistics

Kainuu has 72 506 inhabitants (31.12.2019), 1,3 % of Finland. Region has 27194 employees (31.12.2017) of which 8,9 % are employed in agriculture and mining (Finland 3,1 %), 15,5 % in processing (Finland 20,8 %) and 75 % in services in both areas. Lower share of processing is related to lower GDP per capita due to productivity issues (see chapter 3.3.5.1.). Processing is on average clearly more productive than services, but variety between industries is significant. Of all employed people in Kainuu 9,9 % are entrepreneurs, exact same number as in Finland on average. The highest level of entrepreneurs is in agriculture (half of employed are entrepreneurs), whereas in manufacturing industry only 5 % are entrepreneurs. In construction the share is 14 % and in services between 3-28 % (lowest in health and social services, highest in other services).

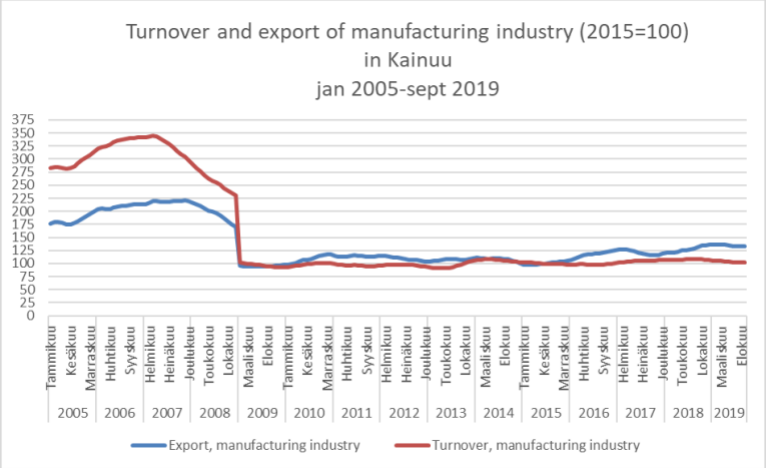
Growth of investments was during 2010-2017 125,1 % in Finland and 112,3 % in Kainuu nominally. Level of investments was 587 million € in 2017 and it was 1,1 % of Finland´s investments, a bit lower than share of population.

Kainuu´s share of Finlands population is 1,3 %. Share of employees is a bit lower, 1,2 %. Share of GDP €. GDP of Finland is 40991 € per capita. Kainuu´s rank was last in 2010, so the situation has gotten better during last decade. Nominal GDP per capita has grown in Finland 17 % during 2010-17 and in Kainuu 25 %.

Export of the manufacturing industry in Kainuu has lowered significantly in finance crisis in 2009. Some recovery has happened after 2015 and by end of 2018 export was about 10 % higher than in 2015 nominally. Export per capita in Kainuu is 5809 € in 2019, half of the level of national average (11761 €). *The rank of Kainuu is sixth lowest among nation`s 19 regions. The share of total 420 million €´s export of Kainuu is only 0,6 % of Finland´s export, under half of the share of the population. The value of import to Kainuu is 90 million€ in 2019. 75 % of value of export of Kainuu is created by foreign-owned companies. Finland´s average is 43 %.*

Figure 1 reveals the that, by looking at turnover and export indices, the recovery from the financial crisis has not been sufficient in Kainuu. These figures might have become weaker as a result of the COVID19 impact. Special attention to export strategy will be needed in the new era of structural funding.

Figure 1 Turnover and export of manufacturing industry (2015=100) in Kainuu. Jan 2005-Sept 2019.



Regional innovation system

Research and knowledge base

Kainuu has a significant comparative advantage in terms of its research, education and data analytics base and infrastructures, summarised below, alphabetically:

CSC

In Finland, high performance computing services are produced by CSC, a Finnish center of expertise in ICT. CSC provides ICT expert services for research, education, culture, public administration and enterprises. CSC is a non-profit organization with a special mission, owned by the state of Finland (70%) and the Finnish higher education institutes (30%). CSC offices are located in Espoo Keilaniemi and Kajaani Renforsin Ranta business park, which also has the universities' centralized data center environment. CSC is part of the Center for Measurement and Information Systems (CEMIS), a contract-based research and education center specializing in measurement and information systems.

Using CSC's high performance computing capacity requires strong competence in the use of the environments, mainly by researchers and research institutes. Therefore, not all potential user groups are able to actively utilize CSC's computing services due to the lack of technical knowledge and required skills. They may also experience a high threshold for learning the services, especially in the case of incidental computing experiments. Due to these factors, there is a need for complementary solutions for CSC's operations that provide high performance computing services to a larger user group. This group includes e.g. students, scholars interested in this field, and other groups that aim at practicing with high performance computing or conducting small-scale experiments and tests – getting a quick and easy start. As their expertise and skills develop, transferring to CSC's services is easier.

One of the most powerful supercomputers in the world, LUMI, will start its operations in CSC's data center in Kajaani, Finland, in 2021. The peak performance of LUMI is an astonishing 552 petaflop/s. To date, the world's fastest computer, Fugaku in Japan, reaches peak performance of 513 petaflop/s. (https://www.lumi-supercomputer.eu/lumi-one-of-the-worlds-mightiest-supercomputers/). LUMI is a European endeavor, with ten European countries and the EuroHPC Joint Undertaking (EuroHPC JU)

investing in one joint system. It is set to boost research, employment, and competitiveness throughout Europe. In addition to the remarkable computing power, LUMI is also one of the world's most advanced platforms for artificial intelligence and it will be one of the world's best known scientific instruments throughout its lifetime. LUMI contributes to the realisation of the European High-Performance Computing strategy. The pre-exascale supercomputer hosted by the LUMI consortium will be among the top 5 in the world. Together with the other EuroHPC pre-exascale and petascale supercomputers that will be deployed in 2021, the LUMI supercomputer will help Europe's public and private users address many daunting research and innovation problems across different areas from weather and climate change through cybersecurity to drug discovery and personalised medicine. LUMI supercomputer aligns the Digital and Green Deal policies of the European Commission, using 100% renewable carbon neutral energy. The heat generated will provide 20% of the district heat of the area, being one of the most efficient supercomputers in the world. LUMI is an investment of over 200 million euros, covering the whole lifecycle of the system. Exploiting the potential of the data economy is crucial for Europe's competitiveness.The uptake of HPC will remarkably increase the competitiveness of small and medium-sized enterprises (SMEs) in Europe remarkably. Up to one-fifth (20%) of LUMI's resources will be available for industry and SMEs. LUMI supercomputer will further strengthen Kajaani's and Kainuu's position as a leading data center location in Finland and the EU.

The operators of the region, including Kainuu Regional Council, City of Kajaani, Kajaani University of Applied Science (KAMK), other RDI organizations under CEMIS research and education centre.

Kajaani University of Applied Sciences (KAMK)

KAMK has incorporated smart solutions into its strategic profiling, extending through all the operations and competence areas at KAMK: Business (sport, tourism and business), Technology, and, Nursing and Health Care. The strategy has been put into practice by reinforcing data-based competence and environments in education, allocating resources for RDI projects and strengthening networks. KAMK's four RDI themes are: 1) Serious gaming, Virtual reality (VR)/Augmented reality (AR) and exergaming, 2) Artificial intelligence and Software tools for robotics, 3) Circular economy and measurement technology, and 4) Digitalization in health care and palliative care. The goal is that these themes will bring international contacts and projects, stimulate new innovations and create new businesses.

KAMK invested in following the smart environments in the recent years: 1) versatile game development laboratory equipped with the latest VR and AR devices, 3D modelling tools and supercomputing capacity, 2) esports classroom equipped with the latest technology, 3) high performance computing (HPC) environment and robotic laboratory, and 4) smart home care environment. The activities around these environments have strengthened KAMK's RDI profiling and its effectiveness both locally and internationally.

University of Jyväskylä

The University of Jyväskylä and its Vuokatti Sports Technology Unit is specialized in developing measurement technology and wireless measurements for elite Nordic Skiing testing, coaching and research. The Vuokatti Olympic Training Center has been given a special task from the Finnish Olympic Committee to act as a main training and testing location for the Nordic Skiing Sports in Finland. The co-operation between the Vuokatti Sports Technology Unit and the Olympic Training Center has been carried out for several years, and in recent years, also the skiing sport associations have joined to this co-operation. The common goal is to gather needs from the field and develop technologies to measure performance of an athlete in laboratory or in field conditions (e.g. force, acceleration, heart rate, muscle

activity, motion) and present the results immediately and in easily understandable form. Developed environments, technologies and know-how for elite sports can nowadays be also utilized e.g. for consultation and validation services for the sports technology businesses. Now, when measurement technologies have reached to a stage where data can be easily collected and stored, the next objective is to start using ML and AI for different applications to pursue better performance of an athlete. In Finland, the national development work has started during year 2019 by the Ministry of Education and Culture and the Finnish Olympic Committee to make a strategy for the elite sports data. The CSC and the University of Jyväskylä have joined this work group. The work will need extensive amount of data and developed processes to collect data taking also in to account GDPR issues. Elite athletes are however keen to keep their own data only for her/him selves or their coaches, but the CSC and University of Jyväskylä can utilize the experiences and methods used in elite sport applications to a wider scale and user groups – all the way from sports enthusiast to every other citizen as new innovative health promotion tools.

University of Oulu

The University of Oulu produces new knowledge for building a more sustainable, healthier, and more intelligent world. They participate in solving global challenges by combining multidisciplinary approaches, high-quality research, and fruitful collaboration. Their research is top-level in the world on their selected focus areas: sustainable materials and system, lifelong health, digitalization and smart society, changing climate and northern environment, and understanding humans in change. Their compact combination of a science and technology university provides an excellent basis for influential research. The eight faculties and the research units in the University of Oulu form a strong science community, which makes it possible to do ground-breaking, multidisciplinary research. They increase the effectiveness their research by systematically developing international and national networks with our selected partner universities and research institutes.

VTT

VTT's strategy is to help businesses and society to find solutions to global challenges using science and technology. Their help their customers to build new sustainable business that leads to a brighter future. The use of experimental research and technological infrastructure, demonstrations and piloting are central elements of research and innovation activities. VTT's unique research infrastructure and development environments are an important part of the Finnish national innovation infrastructure. VTT's research environments enable product development from basic research to piloting and even small-scale production. The majority of their research environments – including Bioruukki, industrial biotechnology, the development environment for fibre-based products, the 5G test network, Micronova, Mikes, PrintoCent, Smart manufacturing and robotics (SMACC), materials technology, transport and energy systems, and the Centre for Nuclear Safety – are also engaged in networking at the EU level.

Regional innovation system performance

According to the Regional Innovation Scoreboard 2019[1] , the Regional Profile dedicated to Finland[2] "Pohjois- ja Itä-Suomi (FI1D) is a Strong + Innovator; innovation performance has increased over time

[1] For 2020 results: https://ec.europa.eu/growth/sites/growth/files/eis2020_leader_map-01.png

[2] Finland report: http://ec.europa.eu/growth/industry/innovation/_facts-figures/regional_en. For the comprehensive 2019 EU report: https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf

(10.7%). … The radar graph shows relative strengths compared to Finland (orange line) and the EU (blue line), showing relative strengths (e.g. Lifelong learning) and weaknesses (e.g. Employment MHT man. + KIBS services):4", Figure 4.

Figure 2 Relative innovation system strengths of East & North Finland (source: Regional Innovation Scoreboard 2019[3])

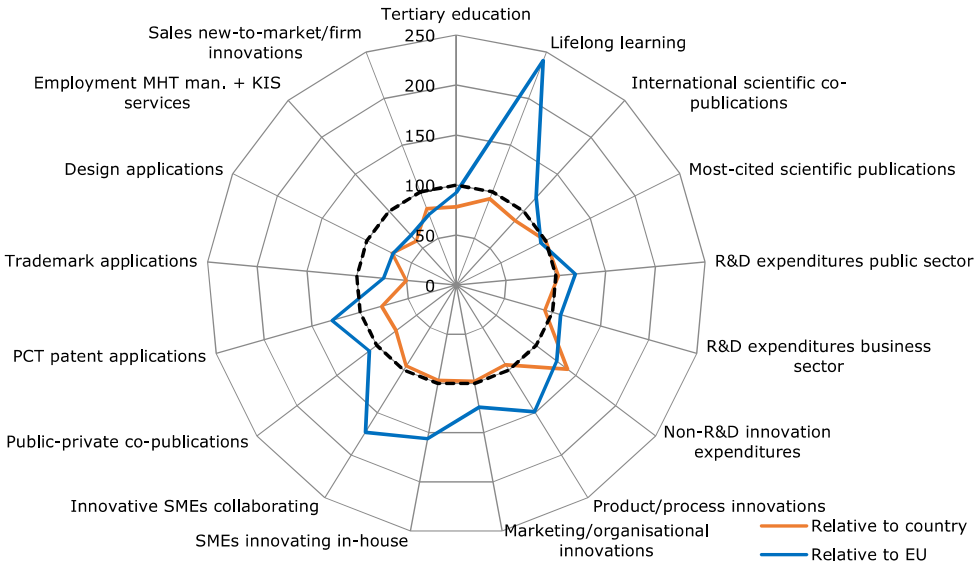


Figure 2 shows that among the fields with the weakest performance are those classified under the Sales impacts category, namely: medium and high-tech products exports, sales of new-to-market or to-the-firm innovations, exports of knowledge intensive business services (KIBS); also trademark applications, and R&D expenditures of the business sector (BERD). Table 1 confirms the same tendencies also at national level.

Table 1 Finland innovation performance (source: European Innovation Scoreboard 2020[4])

Finland	Performance relative to EU 2012 in	
	Relative to EU 2019 in 2019	2012	2019
SUMMARY INNOVATION INDEX	**139.8**	**133.3**	**152.2**
Human resources	**172.4**	**183.1**	**198.5**
New doctorate graduates Population with tertiary education Lifelong learning	143.5	167.6	158.1
New doctorate graduates Population with tertiary education Lifelong learning	114.9	136.4	146.3
New doctorate graduates Population with tertiary education Lifelong learning	284.5	254.4	306.7
Attractive research systems	**151.9**	**126.1**	**173.5**
International scientific co-publications Most cited publications Foreign doctorate students	227.8	212.8	334.6
International scientific co-publications Most cited publications Foreign doctorate students	120.5	117.8	120.6

[3] https://ec.europa.eu/docsroom/documents/36284 .

[4] https://ec.europa.eu/docsroom/documents/41874

Finland	Relative to EU 2019 in 2019	Performance relative to EU 2012 in 2012	2019
SUMMARY INNOVATION INDEX	**139.8**	**133.3**	**152.2**
International scientific co-publications Most cited publications Foreign doctorate students	124.4	67.4	143.4
Innovation friendly environment	**184.9**	**159.2**	**321.6**
Broadband penetration Opportunity-driven entrepreneurship	169.6	210.0	390.0
Broadband penetration Opportunity-driven entrepreneurship	202.3	125.1	275.6
Finance and support	**137.4**	**155.7**	**158.7**
R&D expenditure in the public sector	137.3	156.8	134.8
Venture capital expenditures	137.6	153.8	198.9
Firm investments	**129.9**	**183.3**	**168.7**
R&D expenditure in the business sector	124.7	203.6	142.9
Non-R&D innovation expenditures Enterprises providing	88.5	88.7	124.1
Enterprises providing ICT training	177.8	253.8	246.2
Innovators	**171.5**	**111.8**	**153.3**
SMEs product/process innovations	177.0	126.1	176.4
SMEs marketing/organizational innovations	141.1	95.4	115.8
SMEs innovating in-house	195.2	114.9	170.0
Linkages	**163.1**	**169.1**	**167.9**
Innovative SMEs collaborating with others	247.9	187.0	246.1
Public-private co-publications	230.4	259.4	260.4
Private co-funding of public R&D expenditures	83.1	120.9	83.9
Intellectual assets	**127.1**	**116.5**	**118.7**
PCT patent applications	149.5	144.4	138.8
Trademark applications	126.0	106.9	134.1
Design applications	93.8	85.6	78.7
Employment impacts	**86.7**	**92.0**	**93.5**
Employment in knowledge-intensive activities	133.8	132.4	144.6
Employment fast-growing enterprises	48.6	59.4	52.4
Sales impacts	**90.6**	**85.3**	**90.1**
Medium and high-tech product exports	71.9	61.6	79.7
Knowledge-intensive services exports	113.8	87.1	117.5
Sales of new-to-market/firm innovations	87.1	108.3	72.7

These weaknesses are taken into account in the RIS3 as output targets in the RIS3 monitoring system indicators, namely Indicators 3, 5 and 6.

Comparative advantage

This refers to the exports and export – related jobs in Kainuu, compared to all jobs. We applied the Balassa-Hoover index measurement. This indicator measures concentration primarily, what is called location quotient, measured at regional level. Based on this concentration measure, the immediate diversification potential can be readily visualised, in terms of industries and types of skills available. Clearly, the prioritized RIS3 industries are identified through the B-H index, Table 2.

Table 2 The RIS3 industries, excerpt from the Balassa-Hoover analysis (source: University of Turku)

Comparative advantage of Kainuu 2017	Number of jobs	Share	B-H 2017	Change in B-H 2017 vs. 2014
07 Mining of metal ores	650	2,4 %	25,55	6,68
B Mining and quarrying	797	2,9 %	11,65	2,54
30 Manufacture of other transport equipment	468	1,7 %	5,72	0,78
02 Forestry and logging	730	2,7 %	4,11	-0,32
08 Other mining and quarrying	137	0,5 %	4,04	-0,14
03 Fishing and aquaculture	43	0,2 %	3,53	0,32

Comparative advantage of Kainuu 2017	Number of jobs	Share	B-H 2017	Change in B-H 2017 vs. 2014
79 Travel agency, tour operator and other reservation service and related activities	154	0,6 %	2,92	1,97
82 Office administrative, office support and other business support activities	353	1,3 %	2,16	-0,42
A Agriculture, forestry and fishing	1609	5,9 %	2,07	-0,02
55 Accommodation	285	1,0 %	1,91	-0,16
26 Manufacture of computer, electronic and optical products	418	1,5 %	1,81	0,30
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	221	0,8 %	1,66	-0,27
16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	339	1,2 %	1,58	-0,08
O Public administration and defence; compulsory social security	2039	7,5 %	1,52	0,04
01 Crop and animal production, hunting and related service activities	836	3,1 %	1,42	-0,03
23 Manufacture of other non-metallic mineral products	191	0,7 %	1,39	0,24
95 Repair of computers and personal and household goods	45	0,2 %	1,33	-0,02
81 Services to buildings and landscape activities	1082	4,0 %	1,32	0,15
86 Human health activities	2740	10,1 %	1,32	0,04
42 Civil engineering	265	1,0 %	1,30	-0,21
N Administrative and support service activities	2444	9,0 %	1,21	0,09
49 Land transport and transport via pipelines	972	3,6 %	1,20	0,07
Q Human health and social work activities	5519	20,3 %	1,20	0,00
63 Information service activities	99	0,4 %	1,17	0,92
69 Legal and accounting activities	318	1,2 %	1,16	-0,07
93 Sports activities and amusement and recreation activities	311	1,1 %	1,16	0,00
36 Water collection, treatment and supply	34	0,1 %	1,14	0,61
88 Social work activities without accommodation	1594	5,9 %	1,10	-0,09
09 Mining support service activities	10	0,0 %	1,10	-0,30
87 Residential care activities	1185	4,4 %	1,10	0,04

1

The RIS3-industries are technology, bioeconomy and mining and health & wellbeing. There is need to organise a special study about localised value chains, and growth companies in Kainuu and study how growth companies are linked to RIS3-industries. In terms of the regional innovation system, we take note of the weakness of knowledge intensive business services (KIBS, TOL82 in Table 5 above).

Resilience

The economic resilience of Kainuu is very low. Resilience of the Finnish regions is identified through the Herfindahl-Hirschman index (Table 3), classifying Kainuu as 14th out of 19 regions. Economic resilience forms the spread, the range of economic strengths of a region is a precondition for innovation-based growth and therefore implementing also the region's innovation strategy.

Table 3 Herfindahl-Hirschman index for Kainuu (source: University of Turku)

HHI (classes 10-33) 31.12.2017	Sija
Uudenmaan maakunta	1
Varsinais-Suomen maakunta	2

HHI (classes 10-33) 31.12.2017	Sija
Päijät-Hämeen maakunta	3
Pirkanmaan maakunta	4
Satakunnan maakunta	5
Pohjois-Savon maakunta	6
Pohjois-Karjalan maakunta	7
Keski-Suomen maakunta	8
Keski-Pohjanmaan maakunta	9
Kanta-Hämeen maakunta	10
Pohjois-Pohjanmaan maakunta	11
Pohjanmaan maakunta	12
Etelä-Savon maakunta	13
Kainuun maakunta	14
Kymenlaakson maakunta	15
Lapin maakunta	16
Etelä-Pohjanmaan maakunta	17
Etelä-Karjalan maakunta	18
Ahvenanmaa	19

Productivity

Kainuu productivity has been / is a challenge. This conforms to the national & regional level findings (see Finland Country report 2019[5]), Table 4. The Productivity Table 4 compared to the Table 2 B-H index, points to the recognition of a structural weakness in Kainuu, especially important for the RIS3 implementation: even the export industries, often show productivity, i.e., low added value produced in the region thus confirming also the low resilience index, Table 3. The confluence of these three facts is indicative of a challenge specific to Kainuu region: it has a restricted RIS3 space, meaning it has a very small diversification & renewal space through specialisation. Therefore, the whole EDP issue is influenced. To confront this challenge, the revised RIS3 structure, is proposing four ways: (a) we reinforce the specialised research & knowledge base on the one hand (Theme 1); (b) we strongly support interactions between the research and RIS3 industries base (Theme 2), which we call 'cross-fertilisations between & among RIS3 Themes'; (c) we provide options for follow up projects are foreseen in order to increase the TRL of research projects under Theme 1 and associated actions for research results commercialisation; (d) there is special emphasis on achieving returns to investment through the RIS3 and acknowledge the importance of improving growth disparities across the country.

[5] COMMISSION STAFF WORKING DOCUMENT, Country Report Finland 2020. Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN CENTRAL BANK AND THE EUROGROUP: 2020 European Semester: Assessment of progress on structural reforms, prevention and correction of macroeconomic imbalances, and results of in-depth reviews under Regulation (EU) No 1176/2011, {COM(2020) 150 final}. : "*Real labour productivity declined in 2018, as value added in some industrial subsectors markedly decreased; There is an increasing gap in productivity performance across Finnish firms; The relative proportion of high-growth firms in Finland remains low, but the highest shares are observed in knowledge-intensive services; There seems to be scope to improve productivity growth by further stimulating business start-ups in Finland. … There are strong disparities in economic performance at regional and local level. Helsinki contributed 36% to the country's overall growth between 2000 and 2017*".

Table 4 Productivity in Kainuu (source: University of Turku)

Labour productivity 2017 Kainuu vs. Finland on average, value added € per working hour			
Yellow means higher productivity for Kainuu, miinus means that Kainuu is lower	Finland	Kainuu	Difference
Economy in total	47,6	34,3	-13,3
A Agriculture, forestry and fishing (01-03)	27,7	32,0	4,4
01 Crop and animal production, hunting and related service activities	9,9	8,5	-1,4
02, 03 Forestry; Fishing	70,9	48,9	-22,0
B-F Secondary production (05-43)	55,6	47,0	-8,6
B Mining and quarrying (05-09)	81,7	55,7	-26,0
10-12 Food industry etc.	47,1	34,6	-12,6
13-15 Textile, clothing and leather industry	28,2	-3,2	-31,4
16-18 Manufacture of wood products, paper and paper products; printing and reproduction of recorded med	66,7	35,9	-30,8
16 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of strav	38,6	36,6	-2,0
17, 18 Paper industry; Printing	90,1	32,1	-58,0
19-22 Chemical industry	116,2	-2,9	-119,1
23 Manufacture of other non-metallic mineral products	54,1	35,8	-18,4
24-30 Metal industry	67,3	49,6	-17,7
24-25 Manufacture of basic metals and fabricated metal products, except machinery and equipment	50,9	30,8	-20,1
26, 27 Manufacture of electrical and electronic products	105,9	64,3	-41,5
28 Manufacture of machinery and equipment n.e.c.	64,2	47,9	-16,2
29, 30 Manufacture of transport equipment	43,2	45,6	2,4
31-33 Manufacture of furniture, other manufacturing; repair and installation of machinery and equipment	40,6	47,8	7,2
05-09, 13-15, 19-23, 31-39 Other industry	84,7	68,2	-16,5
D, E Electricity, gas, steam and air conditioning and water supply; sewerage and waste management (35-39)	136,4	163,6	27,2
F Construction (41-43)	33,8	34,2	0,4
G-T Services (45-98)	46,2	31,6	-14,7
G Wholesale and retail trade; repair of motor vehicles and motorcycles (45-47)	38,9	33,7	-5,2
H Transportation and storage (49-53)	37,4	26,1	-11,3
I Accommodation and food service activities (55-56)	23,3	22,8	-0,5
J Information and communication (58-63)	67,5	36,5	-30,9
K Financial and insurance activities (64-66)	94,1	76,7	-17,4
681, 68209, 683, M, N Real estate activities; Professional, scientific and technical activities; Office administrativ	41,5	30,8	-10,6
681, 68209, 683 Other real estate activities	132,7	92,6	-40,0
68201, 68202 Letting and operation of dwellings	1948,7	1970,0	21,3
M Professional, scientific and technical activities (69-75)	40,2	21,0	-19,2
N Administrative and support service activities (77-82)	30,4	29,0	-1,5
O Public administration and defence; compulsory social security (84)	39,6	19,8	-19,8
P Education (85)	44,2	32,7	-11,4
Q Human health and social work activities (86-88)	29,8	20,3	-9,5
R, S Other service activities (90-96)	30,5	32,6	2,1
T Activities of households as employers; undifferentiated goods- and services-producing activities of househo	20,2	20,2	-0,1

Digitalisation

According to the DESI 2019 report[6], Finland is performing very well and in some cases exceptionally well, as for example in the case of ICT sector R&D Intensity (BERD/VA), while, in the case of added value Finland is 12th[7], i.e. it implies that more actions in ICT-based products should be completed in Finland towards added value increase.

DESI makes reference to the super computers and the role they are foreseen to fulfill (page 89): "By the end of 2020, the EuroHPC JU will acquire and install 8 supercomputers: 3 high-range (pre- exascale) supercomputers in **Finland, Spain, and Italy that will place Europe back in the world's top-10**; and 5 mid-to-high range (petascale) supercomputers in Luxembourg, Portugal, Czechia, Slovenia, and Bulgaria. … For 2021-2027, under the new Multiannual Financial Framework, the EU plans to invest more than €1 billion for R&I to create a leading European innovation ecosystem. It also plans to invest more

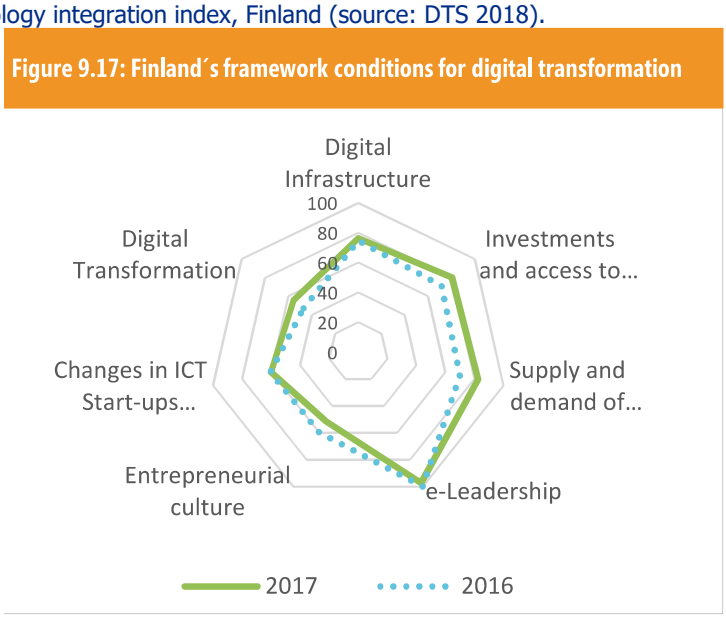
[6] Digital Economy and Society Index (DESI) 2020, https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi .

[7] Ibid., above, page 104, Figure 103.

than €5 billion for large-scale deployments and capability building, including: (i) the acquisition of exascale supercomputers and quantum computers; and (ii) the coordination of national HPC competence centres, large-scale training and skills upgrades.". It follows that the LUMI supercomputer located in Kajaani, Kainuu, is an important RIS3 resource. It is a good conjecture for Kainuu, since HPC (high performance computing, activity requiring super-computer infrastructure) is an emerging but fast developing technology with very fast-growing demand for data. The options opened by this opportunity are taken into account in Theme 1, Theme 3 and Theme 5 of the Kainuu RIS3 and the cross-fertilisations between and among the three themes, as well as applications to Theme 2.

The 2018 Digital Transformation Scoreboard [DTS 2018][8], hand identifies entrepreneurial culture to be a weak link in the overall high performance in ICT and digitalisation characterising Finland, Figure 3, which is aligned with the DESI 2020 finding on relevantly low-added value of the Finnish ICT industry.

Figure 3 Digital technology integration index, Finland (source: DTS 2018).



Note: Based on the average of the difference of the latest three imputed values. Where no data was available, the EU average was used.

The DTS 2018 comments positively on e-Leadership, while, regarding areas of improvement, the recommendation is: "Finland's performance in ICT start-ups leaves some room for improvement. Although the data indicates a high employment rate of IT-savvy people, the relatively low share of its ICT sector in proportion to the total national GDP is limiting the country's potential in this dimension. … Efforts to promote entrepreneurial culture could also be enhanced.".

From a different perspective, the MONITORING PROGRESS IN NATIONAL INIIATIVES ON DIGITISING INDUSTRY Country report, Finland, July 2019[9] identifies "*Weaknesses in the combination of software skills and management skills and lack of service and service development culture*". The former is reflected on the slow rhythm of adopting Industry 4.0 comprehensive approaches.

[8] Digital Transformation Scoreboard 2018. EU businesses go digital: Opportunities, outcomes and uptake.

[9] https://ec.europa.eu/information_society/newsroom/image/document/2019-32/country_report_-_lithuania_-_final_2019_0D30BFFC-E624-3200-70B376999BBBC75E_61212.pdf

All of the above findings are taken into account in the Kainuu RIS3 through the Theme 1 research projects, EDP sessions and follow up projects building TRL and supporting commercialisation actions of IPR:ed research.

Synthesis

Kainuu has two types of specialisation bases: an economic one and a research/innovation infrastruture one.

ECONOMIC BASE

- The statistical analysis of the economic base confirmed that the 'Kainuu RIS3 industries are extractive industries, metal industries including transport equipment, forestry, and tourism'. In this sense, the RIS3 industry-priorities continue to be the same as form the previous period.
- One important characteristic of the economic specialisation base is that a large part of it is not really benefitting from regional clustering, while, in some cases, decision making regarding research & development initiatives is located outside the region. This could be a cause of divergent values and priorities between place-based "vs" industry priorities.
- KIBS are very weak in Kainuu.
- Regional resilience and productivity are low.
- Kainuu has a restricted RIS3 space, meaning it has a very small diversification & renewal space through specialisation. Therefore, the whole EDP issue is influenced.

RESEARCH & INNOVATION INFRASTRUCTURES

- The innovation system analysis identified a localised, significant research and knowledge base, including an innovation infrastructure (LUMI super computer) of European importance. This concentration also forms an embedded specialisation resource, an important comparative advantage potential. This resource, till now, has not been sufficiently explored from the perspective of constructing regional comparative advantage. There is deepening research but not suffiicent productisation, research-spinn offs, or technology transfer to the economy.
- Digitalisation is on an overall good level, nevertheless digital transformation of SMEs, i.e. adoption of straightforward Industry 4.0 solutions needs efforts.

Therefore Kainuu is at a cross-roads: it is a sparsely populated NUTS3 region part of a similar (i.e sparsely populated) NUTS2 area facing critical mass challenges; it has an export-oriented specialisation base with low added value nevertheless; it faces challenges in the localised clustering structure; it is endowed with research capacities and innovation infrastructure resources one of which is of European importance. These findings indicate a relatively unique RIS3-context, challenging for achieving the overarching RIS3 priority which is innovation-based growth in a straightforward way.

The Kainuu RIS3 2021-2027 proposes to confront the challenges as part of a comprehensive process by building on strengths. More specifically, the revised Kainuu RIS3, is: (i) to include into the RIS3, as a separate priority (Theme 1) the reinforcement of the research & innovation infrastructure base domains linked to existing strengths; (ii) to maintain the RIS3 2014-2020 priorities (Theme 2); (iii) to strongly support interactions (cross fertilisations) between the research and RIS3 industries base (Theme 2); (iv) to provide options for follow up projects foreseen to increase the TRL of research projects under Theme 1 and associated actions for research results commercialisation; (v) to include a separate cross-cutting theme on Digital Transformation (Theme 4) addressing also interdisciplinary issues (technology capabilities x management skills) as well as data analytics issues thus linking also to the potential of the LUMI

innovation infrastructure; (vi) to invest in a separate theme (Theme 3) dedicated to different forms of transregional collaboration and also include into it a sub heading dedicated to innovation infrastructures as a potential tool of supporting the realisation of the LUMI potential; (vii) through Theme 3 and S3 – based collaborations, to support European Value Chain participation (EVC) and through that, scaled-up entrepreneurship and support export of innovations to access markets.

Kainuu RIS3 2021-2027

Introduction

Smart specialisation is a regional policy for innovation driven growth. What distinguishes smart specialisation from conventional and traditional industrial and innovation policies is, on the one hand, an ideally comprehensive and coherent focus on matching the most performing and/or promising industries hand, the concept & process of entrepreneurial discovery (EDP). A Smart specialisation strategy is holistic, detailed, place-based, self-sustaining and anticipatory. RIS3 literature argues that regions should seek critical mass and invest in national and interregional networks that can solidly address critical mass shortages (EC 2014[10] Radosevic et al[11]). This concern has been institutionalised in the new period of the Structural Funds 2021-2027 (*Component 5*/ I3 and the 7th Enabling condition for RIS3, *Measures for interregional collaboration*).

Kainuu has had its first RIS3 formulated during the 2014-2020 period of the Structural Funds and now it is revising it. The purpose it to strengthen the specialisation and related growth potential of the region.

The Kainuu regional development priorities:

1. Investment, new businesses, know-how and technology in the region
2. Increasing the degree of processing of production (products and services)
3. Increasing the volume of high-value-added production (products and services) and exports (sustainable growth based on high know-how)
4. Development of business and entrepreneurship in the region (strengthening of existing companies and new companies)
5. Skilled workforce: A more skilled workforce and a better functioning labor market> a better match between labor supply and demand. A skilled workforce is one of the key parameters in attracting investment.

The Kainuu RIS3 2021-2027 is aligned with the regional development priorities.

Kainuu RIS3 2021-2027

Objectives

1. Improving the productivity of investment / RDI financing: growth based on innovation and know-how
2. RDI expenditure / inhabitant increasing
3. Kainuu's attractiveness for investment and return on investment will improve (gross capital formation in Kainuu increases)
4. A more skilled workforce and a better functioning labor market: a better match between labor supply and demand: increase of demand for more skilled and more eduated labour; increase of demand for researchers working in industries
5. Exports increase and the degree of processing of production increases
6. Increasing the commercialisation of innovations and the transfer of innovations to production
7. The number of growth companies is increasing.

[10] EC (2014) NATIONAL/REGIONAL INNOVATION STRATEGIES FOR SMART SPECIALISATION (RIS3), pages 3-8.

[11] Slavo Radosevic, Adrian Curaj, Radu Gheorghiu (2017). Advances in the Theory and Practice of Smart Specialisation.

Structure

The revised RIS3 comprises five (5) implementation Themes and the Governance of the strategy comprising five (5) Instruments, Figure 4:

The five Themes include

- 3 vertical themes (Theme 1 Increasing research and promoting innovation, Theme 2 Strengthening and diversifying the specialisation base (2A) INDUSTRIES: Bioeconomy, mining, metals and ICT, (2B) KNOWLEDGE-BASED SERVICE INDUSTRIES, Theme 3: Connectivity and integration, measures for interregional collaboration)
- and 2 cross-cutting themes (Digital transformation and Green Deal). The two cross-cutting are applied to all industries of Kainuu region. However, RIS3 industries are expeted to absorb Themes 4 and 5 and provably improve their related performance.

The five Governance Instruments include

- (Instrument I) Stakeholder involvement
- (Instrument II) Entrepreneurial discovery process
- (Instrument III) Monitoring
- (Instrument IV) Funding & financing
- (Instrument V) Technical assistance reserve

Figure 4 Kainuu RIS3 2021 - 2027

<table>
<tr><td rowspan="15">Kainuu RIS3 governance: Stakeholder involvement, EDP, Monitoring, Funding & financing guidance, Technical assistance reserve</td><td colspan="3">Teemat ja toimialat</td></tr>
<tr><td>TEEMA 1: Tutkimuksen lisääminen ja innovaatioiden edistäminen</td><td colspan="2">TEEMA 2: Erikoistumispohjan vahvistaminen ja monipuolistaminen

Tärkeä osa teeman 2 hankkeista perustuu aihealueella 1 tuotettujen soveltavien tutkimustulosten hyödyntämiseen.</td><td>TEEMA 3: Yhteydet ja integraatio, toimenpiteet alueiden väliseen yhteistyöhön

Teema 3 on suunniteltu välineeksi, jolla helpotetaan priorisoitujen toimialojen teemoja 1 ja 2.</td></tr>
<tr><td>INNOVAATIOIDEN KEHITTÄMINEN (SOVELTAVA TUTKIMUS)
1. Mittaustekniikka
2. Pelillistäminen ja edistykselliset simulointitekniikat (3D, VR, AR)
3. Big data analytiikka ja suurteholaskenta
4. Kiertotalous kaivosteollisuudessa ja biotaloudessa</td><td>2A) TEOLLISUUDET: Biotalous, kaivostoiminta, metalli ja ICT

Teollisuuden nykyaikaistamisen edistäminen investoimalla
1. uusien tuotteiden kehittämiseen
2. tuotantoprosessien parantamiseen (esim. Industry 4.0:n käyttöönotto)
3. tuotteiden ympäristö- ja laatutason parantamiseen</td><td>2B) OSAAMISINTENSIIVISET PALVELUALAT
1. Ammattimainen (talvi)urheilu sekä urheiluvalmennus ja -harjoittelu
2. Aktiviteettimatkailu
3. Sosiaali- ja terveyspalvelut (Digitaalisuutta hyödyntäviä innovaatioita käytetään palvelujen tuotannon tehostamiseen (erityisesti sote palvelut) sekä palveluista saatavan lisäarvon kasvattamiseen. Lisätään kansainvälistä yhteistyötä palvelujen kehittämiseen liittyvässä TKI toiminnassa).</td><td>ALUEELLISEN INNOVAATIOJÄRJESTELMÄN PAREMPI TOIMIVUUS
1. Innovaatioinfrastruktuurit
2. Mukaanpääsy alueidenvälisiin kysyntävetoisiin innovaatioprosesseihin
3. Kehittyvät teollisuudenalat ja innovaatioalustat, mkl. alueiden väliset arvoketjut, klusterit, S3-kumppanuudet
4. Alustatalous
5. Investointien saaminen RIS3 teollisuude aloille</td></tr>
<tr><td colspan="3">Kaikkien RIS3-prioriteettien monialaiset teemat ja tavoitteet</td></tr>
<tr><td colspan="3">TEEMA 4: Digitaalinen muutos
Teema 4 koskee digitaalisen muutoksen vahvistamista teemassa 2 priorisoiduille teollisuudenaloille. Tätä tarkoitusta varten teeman 4 hankkeissa saatetaan hyödyntää teemassa 3 tarjottuja alueiden välisiä vaihtoehtoja ja/tai teemassa 1 kehitettyjä innovatiivisia ratkaisuja.</td></tr>
<tr><td colspan="3">1. Teollisuuden 4.0 käyttöönotto, mukaan lukien robotiikka ja automaation sovellukset</td></tr>
<tr><td colspan="3">2. Big data analytiikan ja suurteholaskennan hyödyntäminen</td></tr>
<tr><td colspan="3">TEEMA 5. Green deal
Teema 5 koskee sekä Green Deal -ratkaisujen soveltamista että niiden kehittämistä, mikä johtaa tehokkaasti teollisuuden ympäristöystävälliseen muutokseen teemassa 2. Tätä tarkoitusta varten teeman 5 hankkeissa saatetaan hyödyntää aihealueella 3 tarjottuja alueiden välisiä vaihtoehtoja ja/tai teemassa 1 kehitettyjä innovatiivisia ratkaisuja.</td></tr>
<tr><td colspan="3">1. Puhtaan, kohtuuhintaisen ja turvallisen energian tuotanto ja käyttö</td></tr>
<tr><td colspan="3">2. Kiertotalouden ja ympäristöllisesti kestävän tuotannon lisääminen teollisuudessa</td></tr>
<tr><td colspan="3">3. Pellolta pöytään: oikeudenmukainen, terveellinen ja ympäristöystävällinen ruokajärjestelmä</td></tr>
<tr><td colspan="3">4. Ilmastonmuutoksen hillitseminen ja sopeutuminen</td></tr>
<tr><td colspan="3">5. Ekosysteemien ja luonnon monimuotoisuuden säilyttäminen ja palauttaminen</td></tr>
<tr><td colspan="3">6. ”Pidetään kaikki mukana” (oikeudenmukainen siirtymä)</td></tr>
</table>

Review of the RIS3 themes & Instruments

RIS3 Themes

Theme 1 Mobilising research and fostering innovations

Objective: (1) to co-fund applied research projects based on technological strengths of Kainuu, and result in commercialiseable innovations; (2) to encourage the production of technological innovations that could benefit industries scaling up and further specialisation under Theme 2; (3) to link the Kainuu research base to the interregional opportunities supported under Theme 3.

Domains: (1) Measurement technology; (2) Games & simulators; (3) Data analytics & data driven innovations; (4) Circular economy based on the potential of the Kainuu natural resources.

Theme 2 Reinforcing and diversifying the specialisation base

Theme 2 is organised into (2.A) Manufacturing and (2.B) Knowledge-based service industries

(2.A) Manufacturing

Objectives: To support the scaling up & diversification of prioritised manufacturing industries and industrial modernisation and mobilise investments in 1) new product development; (2) improvement of production processes, improvmement of productivity; (3) improvement of the environmental & quality performance of products; (4) benefit from interregional collaboration opportunities available under Theme 3.

Domains: (1) Forest bio-economy; (2) Extractive industries (implementing the Kainuu Mining Startegy and the ecoRIS3 Interreg Europe project[12] action plan; linkagdes to S3 platforms and the Battery Alliance); (3) Metal industries; (4) Food processing.

(2.B) Knowledge-based service industries

Objectives: (1) To expand and diversify winter sports, activity tourism and well-being infrastructure & services, for attracting customers and investments; to contribute to the health-care social services digital transformation and scaling up. (2) To utilise research results developed under Theme 1 to reinforce to achieve objectives in 2.B. (3) To benefit from interregional collaboration opportunities available under Theme 3.

Domains: (1) Winter sports, solutions for coaching and training; includes professional winter sports; (2) Activity tourism; (3) Social and health care services (SOTE).

Theme 3: Connectivity & Integration, Measures for interregional collaboration

Objectives: (1) To improve the function and completeness of the regional innovation system by benefiting from complementarities and win-win collaborations at national and European levels; (2) To explore opportunities identified through interregional collaboration schemes under Theme 3 to further reinforce the results of Themes 1 and 2; (3) To explore interregional opportunities as a tool to override critical mass challenges of the Kainuu economy; (4)To explore interregional connectivity as tool for learning, constant renewal, scaling up and completeness of the regional innovation system.

[12] https://www.interregeurope.eu/ecoris3/

Domains: (1) Innovation infrastructures (e.g. improvements of the regional innovation system; linkages to European innovation hubs[13]); (2) Transregional access to innovation on demand (mainstreaming BRIDGES project[14]) and ensuring absoprtiveness for I3/Component. 5); (3) Emerging industries and innovation platforms, including interregional value chains & clusters; S3 partnerships (strengthening the benefits for S3 partnerships and the investment oriented approach; supporting the implementation of the BERRY+ S3); (4) The platform economy (supporting digitalised value chains and joint programming and implementation); (5) Attracting and facilitating investments in RIS3 industries.

Theme 4: Digital transformation

Objectives: (1) To effectively enable & support the digital transformation of the Kainuu economy; (2) To apply digital transformation innovations developed under Theme 1 to Theme 2 industries; (3) To support diffusing state of the art digital transformation technologies, models & value chain collaboration opportunities made accessible form the provisions of Theme 3 to benefit industries and research domains of Themes 2 and 1 respectively.

Prioritised actions: (1) Uptake of industry 4.0 including applications of robotics, automation (includes the implementation of the Interreg Europe project INNO PROVEMENT[15] action plan); (2) Utilisation of data analytics.

Theme 5: Green deal and green transformation

Objectives: (1) To effectively support the implementation of the Green Deal policy; (2) to strengthen the green transformation of the Kainuu economy; (3) to promote green deal innovations as a tool for improving the competitiveness of Kainuu economy; (4) To apply green transformation innovations developed under Theme 1 to Theme 2 industries; (5) To support diffusing state of the art green transformation technologies and models made accessible form the provisions of Theme 3 to benefit industries and research domains of Themes 2 and 1 respectively; (4) To support the development and application of green deal innovations under Themes 1 and 5.

Prioritised actions: (1) Supplying clean, affordable and secure energy; (2) Mobilising industry for a clean and circular economy; (3) From 'farm to fork', a fair, healthy and environmentally friendly food system; (4) Mitigation of climate change & climate adaptation; (5) Preserving and restoring ecosystems and biodiversity; (6) Leave none behind (a just transition).

Review of the Governance of the Kainuu RIS3: the five Instruments

The competent regional institution for the management of the Kainuu RIS3 is the Regional Council of Kainuu (RCK). The Centre for Environment, Transport and Employment (ELY Keskus) is part of the Kainuu RIS3 management. The RIS3 management comprises planning of activities, funds management, implementation coordination, monitoring and evaluation. To ensure better delivery of the RIS3 on-the-ground and of the management of the strategy, the Regional Council of Kainuu has included five

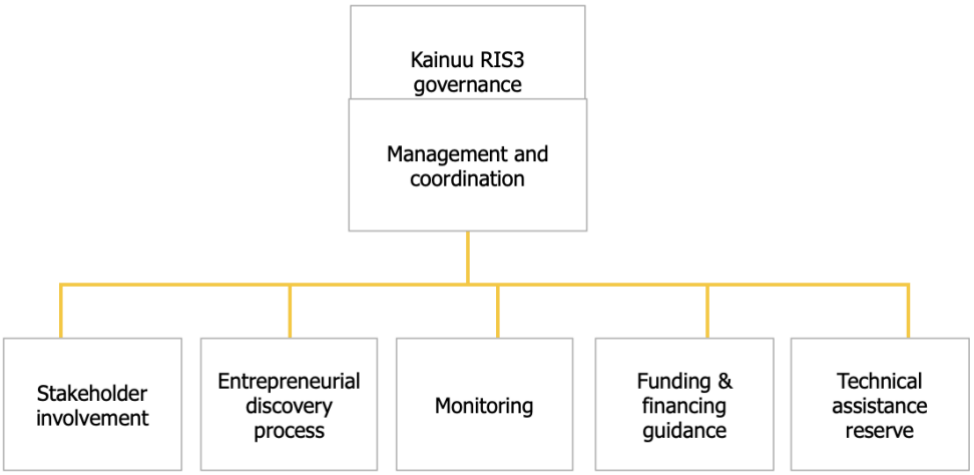
[13] This is aligned with the EC provision that digital innovation hubs will ensure ERDF funding only by being aligned with the RIS3 of the respective regions, see Gabriel Rissola (2020). Digital Innovation Hubs (DIHs): A place-based EU policy initiative to boost Digital Transformation of SMEs and public sector, 28.10.2020. https://www.digitalsme.eu/digital/uploads/DIH-Presentation-by-Gabriel-Rissola.pdf .

[14] https://www.interregeurope.eu/bridges/

[15] https://www.interregeurope.eu/innoprovement/

Instruments in to the RIS3. **"Instruments"** are tools, directly managed and implemented by the Regional Council of Kainuu, planned with the purpose to facilitate and strengthen the RIS3 implementation. The five (5) Instruments planned are: (Instrument I) Stakeholder involvement; (Instrument II) Entrepreneurial discovery process; (Instrument III) Monitoring; (Instrument IV) Funding & financing facilitation; (Instrument V) Technical assistance reserve, Figure 5.

Figure 5 The Kainuu RIS3 Governance structure



(Instrument I) The RIS3 regional stakeholders group

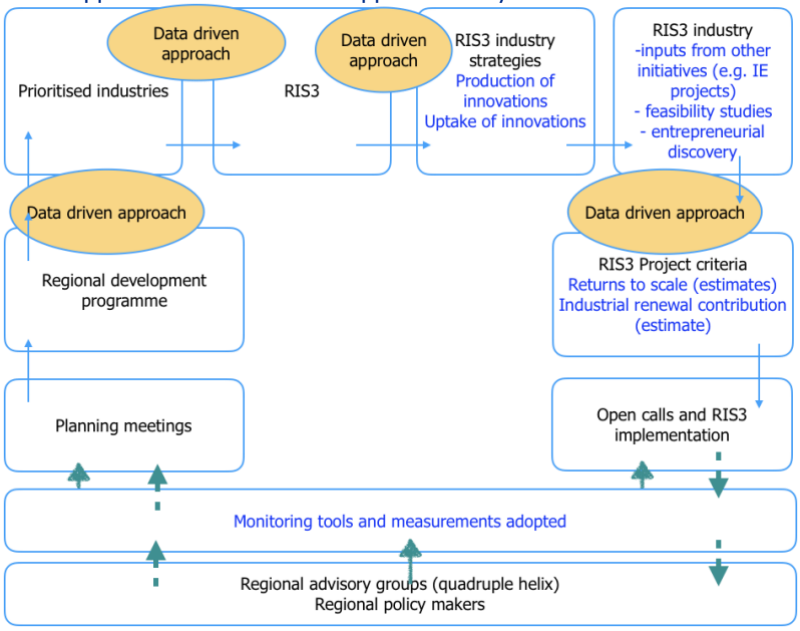
Intrinsically associated with the Kainuu RIS3 is the Kainuu stakeholder involvement (quadruple helix) and the linkages of RIS3 to the Kainuu regional programme and strategies. The overarching priority is to maximise, through innovation-based growth, the RIS3 added value for the region through constructive and coherent initiatives.

The Kainuu RIS3 stakeholders include representatives of the research & knowledge base, businesses, and the civil sector. The business sector includes for the first time, once Instrument III Funding & Financing is fully organised, representatives of the financing sector (banks). It is possible to include, into the regional stakeholder groups experts from other regions, national and EU levels, once the need is evidenced. The establishment of the Kainuu RIS3 stakeholder group follows the usual process for establishing & operating regional advisory groups. The data driven approach is closely followed, Figure 6.

External costs such as experts, meetings organised outside the Regional Council's premises, and so on, are addressed by Instrument IV Technical assistance reserve.

The RIS3 governance is planned in three phases, the RIS3 planning phase, the RIS3 implementation monitoring and the RIS3 implementation evaluation phase.

Figure 6 The governance approach which has been applied already since rthe start of the RIS3 revision.



(Instrument II) The entrepreneurial discovery process (EDP)

Entrepreneurial discovery is about the identification of novel product (and subsequently) business opportunities suitable to a region's RIS3 investments. It can be about new product niches or improved products. For Kainuu, EDP is above all, a tool to economic renewal through specialisation and diversification. It builds on two options mainly: (i) the already existing specialisation base (Balassa-Hoover index) through sessions exploring options for new or improved products linked to mainstream strong demand trends or emerging demand and (ii) on the potential of productisation of research results, addressing new product niches. It is expected that the EDP application will contribute also to improving the resilience of the Kainuu region.

EDP sessions refer mainly to Theme 1 Increasing research & promoting innovation and Theme 2 Reinforcing and diversifying the specialisation base of the RIS3 and their cross fertilization with themes 3 (Connectivity & Integration, Measures for interregional collaboration), 4 (Digital Transformation), and 5 (Green deal and Green Transformation).

The entrepreneurial discovery process is applied at least during two stages in the Kainuu RIS3: at the policy planning level and following evaluations of the progress of the RIS3 implementation, for the improvement of measures and types of projects. Nevertheless, EDP is applied also in ad hoc cases / project requests leading to new product niches. The EDP application is coordinated by the Regional Council of Kainuu (Instrument I Governance). The EDP implementation is funded by funds foreseen to be utilised in Instrument IV Technical reserve. EDP sessions involve regional stakeholders, experts and networks from the national and EU levels if need be.

Figure 7 describes the process, in principle, for identifying new and promising product niches on the base of the region's specialisation base, while Figure 8 describes the EDP relevance to Theme 1 implementation. In particular, EDP is applied to the productization of the research results and foreseen sequence of projects improving the TRL of research findings.

Figure 7 Entrepreneurial discovery process as contributing factor to the ERDF project criteria

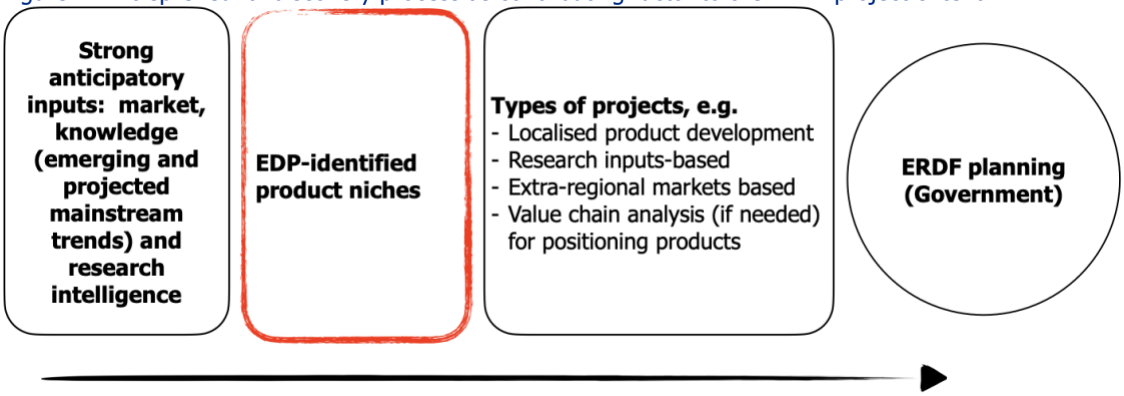
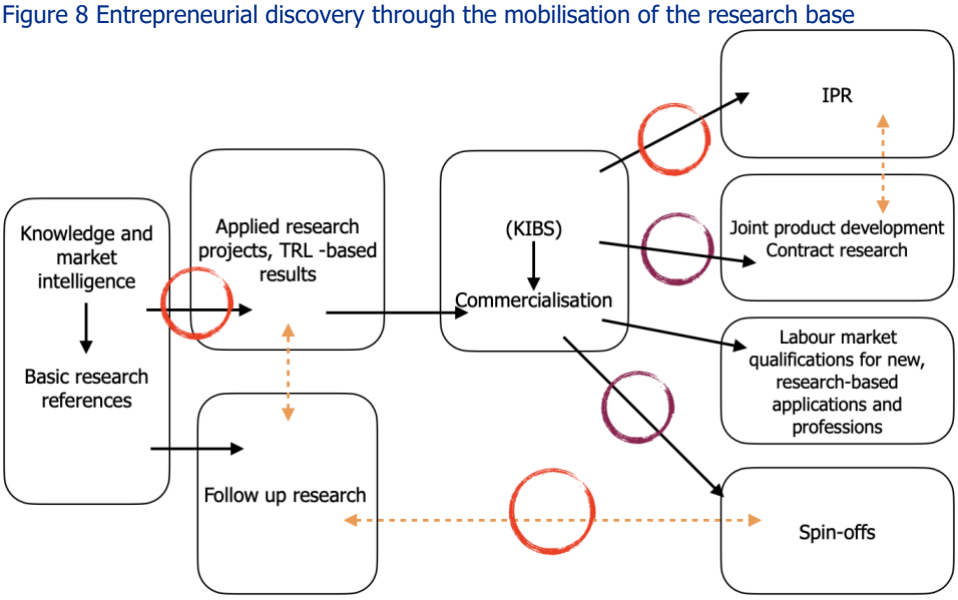


Figure 8 Entrepreneurial discovery through the mobilisation of the research base



(Instrument III) Monitoring

Six RIS3 monitoring indicators have been adopted to reflect the objectives of the Kainuu RIS3.

In spite of the extensive literature on RIS3, a definitive methodological framework of metrics for planning, monitoring and evaluating RIS3 does not exist, information on how the impact of S3 can be measured quantitatively remains relatively scarce (e.g., Rodríguez-Pose et al., 2013[16], Foray and Goenaga 2013[17]:10) point out that 'the need for data and indicators about smart specialisation are critical ... [to] track progress, assess structural transformations and compare strategies. According to the 2016 Guidelines for S3 monitoring (Gianelle et al, 2015[18]), it is stated that the monitoring system for S3 should pursue two

[16] Rodriguez-Pose, A. and E. Garcilazo (2013). Quality of Government and the Returns of Investment: Examining the Impact of Cohesion Expenditure in European Regions. OECD Regional Development Working Papers, 2013/12, OECD Publishing. http://dx.doi.org/10.1787/5k43n1zv02g0-en.

[17] Foray, D. and Goenage, X. (2013). The goals of smart specialisation. S3 Policy Brief Series n° 01/2013 – May 2013 S3 Platform, JRC-IPTS.

[18] Gianelle, C. and Kleibrink, A. (2015). Monitoring Mechanisms for Smart Specialisation Strategies. S3 Policy Brief Series No. 13/2015.

essential objectives: (i) assess the output produced by funded projects within the realm of each S3 priority; and (ii) measure the result in terms of socio-economic objectives achieved for each S3 priority. However, despite this set of guidelines, monitoring continues to be regarded not sufficiently 'as an instrument for strategic management' (Gianelle et al., 2016[19]: 112). In the case of the Kainuu RIS3 revision, the data approach selected reflects the operationalisation of RIS3 (Kaivo-Oja et al, 2017[20]) and therefore also, part of its impacts.

Six indicators are selected. The selection of the indicators reflects mainstream measurements of innovation-based growth (such as those proposed by the literature cited above), crucial improvement needs of Kainuu, EC Finland Country Report and Recommendations, and the national R&D Roadmap. The monitoring process is continuous as part of the RIS3 management tasks; evaluations are planned for every 18 months, based on the data driven approach, with expected outputs: reports, stakeholder review meetings and possible improvements in the implementation approach of the RIS3. The costs for the evaluation reports, when outsourced, are operated under Instrument V Technical assistance reserve.

In the following paragraphs, the six (6) indicators are introduced in terms of what they measure, how they link to the RIS3 objectives, to what types of projects they lead, and how they are reflected in the RIS3 Themes.

INDICATOR 1 COMPARATIVE ADVANTAGE

The industry-based concentration of employment (Balassa-Hoover index[21]). This indicator defines the number of employed people in a region and in a certain industry. We measure the comparative advantage of Kainuu in terms of jobs in the main export industries industries compared to the same industries for the rest of the country.

- In the revised RIS3 we want to increase the comparative advantage of Kainuu, i.e. exports-orientation of the economic specialisation base.
- Indicator 1 contributes to the implementation of objectives 1, 2, 4 and 5.
- Output indicators:
  - Number of projects improving the productivity of RIS3 industries, e.g. applications of RIS3 Theme 4 FW: TAF workshop on 9/12 (digital transormation) to industries of Theme 2 (expanding the economic base through RIS3 industries).
  - Number of technology and know-how transfer projects with clients outside the region, for example

[19] Gianelle, C., Kiriakou, D., Cohen, C., Przeor, M. (eds.) (2016). "Implementing Smart Specialisation Strategies. A Handbook", Brussels: European Commission.

[20] Kaivo-oja, Jari; Vähäsantanen, Saku; Karppinen, Ari; Haukioja, Teemu (2017). Smart specialization strategy and its operationalization in the regional policy: case Finland. Business, ManageMent and education. ISSN 2029-7491 / eISSN 2029-6169. 2017, 15(1): 28–41 doi:10.3846/bme.2017.362.

https://trepo.tuni.fi/bitstream/handle/10024/101769/smart_specialization_strategy.pdf?sequence=1&isAllowed=y .

[21] The Balassa-Hoover Index (BHI / or, equivalently the location quotient of industry i in region region) is the number of employed people in region s and in industry i, (Xsi/Xi) is corresponding share for all sub-regions. If BHIsi ≥ 1, there is revealed comparative advantage in relation to all regions. The formula for calculating the BHI is:

$$\mathrm{BHI}_{si} = \frac{\frac{x_{si}}{X_i}}{\frac{x_s}{X}}$$

where x_{si} is the number of employed people in region s and in industry i, (Xs_i/Xi) is corresponding share for the whole country. If $BHI_{si} \geq 1$, there is revealed comparative advantage in relation to all regions. (Kaivo-Oja et al, 2017, pages 3-5).

results of projects in RIS3 Theme 1 IPR:ed and applied to businesses within and beyond the region.

INDICATOR 2 RESILIENCE

Resilience relates to the potential of a regional economy to expand and renew itself through more than one options. In the RIS3, resilience is a precondition for regional specialisation, diversification and renewal, i.e. the existence of a significant base of the local economy that can evolve and expand through innovation-based growth initiatives.

Resilience is measured by the spatial concentration of industry-specific shares in relation to the whole regional output (Herfindahl-Hirschman index (HHI[22])). This indicator measures the resilience of a region, according to the diversification of its economic base. A very high HHI indicates potentially that resilience is at a risk since the competitiveness of the region appears to be asymmetrical.

-- Kainuu has very low resilience, it is 14th out of 19 regions in Finland. In the revised RIS3 we want to increase the resilience of Kainuu. This is one of the aims of diversification of the economy in Kainuu.
-- Indicator 2 contributes to the implementation of objectives 2,3, and 7.
-- Output indicators:

- Number of projects aiming at the expansion and scaling up of the range of products produced by RIS3 industries, this is especially relevant to RIS3 Theme 2 and cross-fertilisations of Theme 2 with Themes 1 (research), 4 (Digital transformation), and 5 (Green Deal).
- Number of projects aiming at increasing the value chain explansion or re-localisation of different product lines in Kainuu, through local and interregional investments.

INDICATOR 3 INNOVATION PERFORMANCE

A regional innovation performance indicator is not definitively and universally agreed. Here we adopt an indicator proposed by Brenner et al. 2009[23] as follows: we measure the *average innovation outputs of RDI development & investment projects facilitated regionally (i.e. S3-co funded).* Innovation outputs are measured *by the level of technology readiness levels (TRL) resulting from S3 co funded RDI development & investment projects*. They are traced through the co-funded projects, and organised by RIS3 industry and finally comprehensively. Measuring innovation performance and improvement is especially important in the case of Kainuu, whereby the research & education base is very prominent in the regional innovation funding projects.

-- In the revised RIS3 we want to increase the innovation performance of Kainuu. During the recent period,

[22] The Herfindahl-Hirschman index (HHI) is a commonly accepted measure of market concentration. In this case, what is analysed is not market shares but the industry shares of the Kainuu economic base as per the number of employed persons per indsutry. The HHI formula is the following:

$$HHI_s = \sum_{i=1}^{n} \left(\frac{x_i}{\bar{x}} \right)_s^2$$

where xi is the number of employed people in industrial sector (i) and x is total number of people employed in all industrial sectors in region (s) and n is number of industrial sectors (n). HHI-index is calculated as the sum of squared industry shares. (Kaivo-Oja et al, 2017, pages 3-5).

[23] [23] Brenner, Thomas; Broekel, Tom (2009) : Methodological Issues in Measuring Innovation Performance of Spatial Units, Working Papers on Innovation and Space, No. 01.09, Philipps-University Marburg, Department of Geography, Marburg. http://hdl.handle.net/10419/111861. : The average innovation output of one individual i located in the spatial unit s by $E(I_i) = \eta_i(c_i, F_S)$, (1) where Ii denotes the innovation output of individual i and E() stands for the expected or average value in a certain time period. The functional dependence of the innovation output on the innovation facilitators might differ between innovation generators. In order to obtain an equation for the spatial unit we have to sum the expected values, E(Ii) for all innovation generators. There are Gs innovation generators within the spatial unit s. This number depends on the innovation attractors, As. Hence, Gs is a function of As.

Kainuu public and private R&D expenditure has regressed. Through the RIS3 we need to ensure that both public and private funding increases in the development of production processes and products.
-- Indicator 3 contributes to the implementation of objectives 1,2,4, and 6.
-- Output indicators:

- Number of projects under RIS3 Theme 1 (research) reaching results up to TRL 4 especially on dsata analytics (Theme 4) or Green Deal (Theme 5)
- Number of R&D projects advancing the TRL level of research results developed in RIS3 Theme 1, to TRL 5+.
- Number of projects in RIS3 Theme 1 (research) developing data analytics processes targeted & tailored to the needs of concrete industries.

INDICATOR 4 ENTREPRENEURSHIP

In Kainuu, entrepreneurship is at about the same level as all over Finland.

--In the RIS3, we want to encourage entrepreneurship in the RIS3 industries.
--Indicator 4 contributes to the implementation of objectives 2,4,6,7.
--Output indicators:

- Number of new businesses, business-spinn offs, and university spinn offs active in the RIS3 space. This corresponds to RIS3 Theme 2 and cross fertilisations with themes 1, 4, and 5.

INDICATOR 5 RIS3 RETURNS TO INVESTMENT

Indicator 5 is about increasing the RIS3-based regional resilience and specialisation base. It is contributing to regional innovation-based growth as well as to improving the regional 'RIS3 renewal & specialisation space'.

Based on the output (investments), S3 co-funded and otherwise, as recommended by Gianelle et al, 2015[24], increase of employment in the RIS3 industries / increase of employment in the total regional economy as a result of the total business investments (faciliatetd by the public sector and otherwise), increase of exports of the RIS3 industries "…innovation performances seem to be positively influenced by the rate of employment and by the presence of firms with high values of exports" (Barra et al 2015:14[25]).

--Indicator 5 contributes to the implementation of objectives 3,6, 7.
--Output indicators:

- Increase of exports of the RIS3 industries
- Increase of employment in the RIS3 industries
- Increase of employment in the total regional economy as a result of the total business investments.
- Increase of commercialisation of research results including cross-fertilisation between RIS33 themes 1 and 2.
- Medium and high-tech product exports [same as the homonymous indicator in the European Innovation Index]
- Sales of new-to-market/firm innovations [same as the homonymous indicator in the European Innovation Index]

[24] Gianelle, C. and Kleibrink, A. (2015). Monitoring Mechanisms for Smart Specialisation Strategies. S3 Policy Brief Series No. 13/2015.

[25] Barra, Cristian & Zotti, Roberto, 2015. "Regional innovation system (in)efficiency and its determinants: an empirical evidence from Italian regions," MPRA Paper 67067, University Library of Munich, Germany.

INDICATOR 6 CONNECTIVITY & INTEGRATION, MEASURES FOR INTERREGIONAL & INTERNATIONAL COLLABORATION

This indicator is adopted in view of the analysis of the innovation system challenges and bottlenecks, and it is also backed by research indicating that interactiveness within and beyond regions, constructing integrative spaces of RIS3 operation, are important factors for RIS3 delivery.

Kainuu needs to invest in and benefit from transregional collaboration and networks within the region, within the country, within the EU and beyond. It is expected that transregional interactions will enhance by complementing the regional innovation system, allow further specialisation, access to new markets and address also critical mass challenges. Moreover, transregional RIS3 integrative spaces will facilitate knowledge spillover functions.

--Kainuu needs all of the above, spillovers and safe, and predictable access to quality partners, networks and markets.
--Indicator 6 contributes to the realisation of objectives 2,4,5,6.
--Output indicators:

(1) Number of projects undertaken to improve functionalities of the regional innovation system.

(2) Knowledge-intensive services exports, valuating the Innovation infrastructures sub-heading of Theme 3; [same as the homonymous indicator in the European Innovation Index]

(3) Implementing interdisicplinary projects combining Themes 1,2,4,5 with the Theme 3 (measures for interregional collaboration) facilitations.

(4) Number of network & platform participations.

(5) Number of transregional partnerships and access to innovation on demand.

(6) Number and range of joint programming initiatives with other regions within Finland and beyond.

(7) Participating and being active in macro-regional efforts.

Coherence between RIS3 objectives, Themes, and indicators

Table 5 RIS3 objectives & RIS3 indicators

RIS3 objectives	RIS3 indicators					
	Ind 1	Ind 2	Ind 3	Ind 4	Ind 5	Ind 6
1.-Improving the productivity of investment / RDI financing: growth based on innovation and know-how	■		■			
2.-RDI expenditure / inhabitant increasing	■	■	■	■		■
3.-Kainuu's attractiveness for investment and return on investment will improve (gross capital formation in Kainuu increases)		■			■	
4.-A more skilled workforce and a better functioning labor market: a better match between labor supply and demand: increase of demand for more skilled and more eduated labour; increase of demand for researchers working in industries	■		■	■		■
5.-Exports increase and the degree of processing of production increases	■					■
6.-Increasing the commercialisation of innovations and the transfer of innovations to production			■	■	■	■
7.-The number of growth companies is increasing.		■		■	■	
Legend: Indicator 1 Comparative advantage; Indicator 2 Resilience; Indicator 3 Innovation performance; Indicator 4 Entrepreneurship; Indicator Returns to investment; Indicator 6 Integration						

Table 6 RIS3 indicators & RIS3 themes

RIS3 indicators	RIS3 themes				
	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5
1.-Comparative advantage					
2.- Resilience					
3.- Innovation performance					
4.-Entrepreneurship					
5.- Returns to investment					
6.- Integration					

Legend: Theme 1 Mobilising research and fostering innovations; Theme 2 Reinforcing and diversifying the specialisation base (2A Manufacturing, 2B Knowledge intensive services); Theme 3 Connectivity & Integration, Measures for interregional collaboration; Theme 4 Digital transformation; Theme 5 Green Deal and Green Transformation.

(Instrument IV) Funding & financing

RIS3 is part of regions' Structural Funds [SF] and the RIS3 budget is expected to be clearly indicated in the Kainuu Structural funds component. However, is it expected that for the implementation of the RIS3, funds are mobilised beyond the SF original source. Information on and sharing of information of additional national or EU funds is regularly updated and diffused (e.g. through the Europe 1 Office of the Regional Council of Kainuu).

Facilitation to access additional funds is foreseen, for example:

1. Access to financial institutions and investors, including access and guidance for the tools of the EIB and the EIF. The terms of this activity have not been clarified yet, they will be developed once Instrument IV is approved.
2. Supporting the use of InvestEU (e.g. funding and co-investment financing aspects are addressed to include new initiatives and ensure alignment to updated European Commission (EC) SME policy priorities).
3. Closely cooperate with the Invest EU Advisory Hub and the Enterprise Europe Network (EEN)
4. Providing support to leverage public procurements especially in relation to ICT.
5. Providing information and guidance on the available competitive EU funding channels, for example: Coordinated actions for strategic value chains (SVC); Interreg programmes; Structural Funds I3 calls; Digital Europe programme; Green Deal calls; Horizon Europe program; European Space Programme; European Defence Fund; etc.

In addition, the Regional Council of Kainuu participates

1. and/or leads national, transnational and interregional initiatives related to the improvement of regional policy approaches and especially RIS3.
2. in suitable Horizon EUROPE programmes such as WIDENING, aiming at building long term interregional partnerships and knowledge-based networks between regions.

(Instrument IV) Technical assistance reserve

The Regional Council of Kainuu will invest through preparatory actions in the introduction and dissemination of new or advanced RIS3 activities. This is one of the main anticipatory aspects of the revised RIS3. It is the first time such activities are distinctively foreseen in the Kainuu RIS3. The establishment of Instrument IV responds to absorptive capacity improvement needs that have been identified in the analysis of the innovation system challenges and bottlenecks.

As part of Instrument IV the Regional Council of Kainuu will support by subcontracting: — feasibility studies, awareness raising and networking events for the diffusion of advanced types of market and science & intelligence; — projects effectively supporting clusters to increase their innovation absorptive capacity; — EDP implementation in mainstream & emerging niches, and access required knowledge also beyond the region; — exploratory activities and the development of new networks.

This list is not exhaustive, it might evolve according to justified needs.

Kainuu RIS3 Implementation process

It is expected that the Kainuu RIS3 2021-2027 will be implemented as of late 2021 or even as of 2022. Nevertheless, the implementation of the RIS3 is a systematic, iterative, step-wise approach, which is summarised, as a first concept in Table 7 below.

Table 7 Kainuu RIS3 2021-2027 implementation steps

RIS3 components	**Implementation steps**					
Instruments						
1 Government and governance of the Kainuu RIS3						
1.1 Set up of the RIS3 implementation and monitoring team; operational level						
1.2 Set up and operation of the regional stakeholder groups (RSG)						
2. Entrepreneurial discovery						
2.1 Organisation of entrepreneurial discovery process (EDP) sessions						
2.2 EDP-identified domains for product development						
3. Funding and financing						
3.1 Create information material about RIS3 funding						
3.2 Regular updates on funding & financing options						
4. Technical assistance reserve						
Awareness raising						
Feasibilty studies						
Networking events						
Absorptive capacity improvement seminars and events						
Exploratory and pilot actions for the development of new networks						
Other						
Themes						
Theme 1 Mobilising research and fostering innovations						
Theme 2 Reinforcing and diversifying the specialisation base						
Theme 3: Connectivity & Integration, Measures for interregional collaboration						
Theme 4: Digital transformation						
Theme 5: Green deal and green transformation						

Mahdollistan edellytyksen täyttymistä koskevat kriteerit

Summary

In the case if the Kainuu RIS3 2021-2027, these criteria were taken into account during the data collection and formulation of the evidence base, while they also are part of the RIS3 planning & monitoirng indicators selected, the RIS3 structure and, where relevant, the RIS3 output indicators, Table 8.

Table 8 The SF, PO1 Enabling condition, the seven criteria in the Kainuu RIS3 2021 – 2027.

Enabling condition, the seven (7) criteria	**Kainuu RIS3 2021-2027**
(i) Up-to-date analysis of bottlenecks for innovation diffusion, including digitalisation	Please see text under the homonymous section
(ii) Existence of competent regional / national institution or body, responsible for the management of the smart specialisation strategy	The role of the Regional Council of Kainuu as intermediate Body (IB) is reinforced.
(iii) Monitoring and evaluation tools to measure performance towards the objectives of the strategy	RIS3 indicators: comparative advantage, resilience, innovation performance, entrepreneurship, integration. Instrument I Governance of the Kainuu RIS3, includes monitoring and evaluation provisions. Project criteria reflect the themes and priorities of the RIS3 strategy
(iv) Effective functioning of the entrepreneurial discovery process (EDP- applied to RIS3 industries)	Instrument II is dedicated to EDP. EDP is ppanned to explore both, divesification based on specialisation (B-H index) and emerging product options.
(v) Actions necessary to improve national or regional research and innovation systems	Country report recommendations[26] have been taken into account. All of Theme 3 Connectivity & Integration; Measures for interregional and international collaboration; Theme 1 projects.
(vi) Actions to manage industrial transition	Participation in industrial transition projects such as ELMO. • Preparing for the jobs of tomorrow: Recommendations on types of skills and qualifications needed, especially when it comes to data analytics are made through Theme 5 applications. • Broadening and diffusing innovation: Theme 1, 4, 5 and interactions between Themes 1,4,5 and Theme 2. • Promoting entrepreneurship and private sector engagement: Theme 1 and Theme 2. • Transitioning towards a climate-neutral economy. Theme 5 and cross fertilisation with all other four Themes. • Promoting inclusive growth. Theme 3.
(vii) Measures for international collaboration.	All of Theme 3 Connectivity & Integration; Measures for interregional and international collaboration. Encouragememt of cross fertilisation between: Theme 1 reuslts with research and businesses beyond Kainuu; Theme 2 to technological trasnfer an dknow how from resources beyond the region.

Discussion

[26] https://ec.europa.eu/info/sites/info/files/2020-european_semester_country-report-finland_en.pdf. Country Report Finland 2020, 26.2.2020. Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN CENTRAL BANK AND THE EUROGROUP. 2020 European Semester: Assessment of progress on structural reforms, prevention and correction of macroeconomic imbalances, and results of in-depth reviews under Regulation (EU) No 1176/2011 {COM(2020) 150 final}.

1.- Up-to-date analysis of bottlenecks for innovation diffusion, including digitalisation / Analyysi innovaatiotoiminnan haasteiden ml. innovaatioiden levittämisen pullon-kauloista

GUIDANCE: Strategioiden on sisällytettävä ajantasainen analyysi tki-toiminnan haasteista, ml. haasteet tutkimuksen ja osaamisen muuntamisesta innovaatioiksi sekä digitalisaation hyödyntämiseen ja eri toimijoihin (mm. yritykset, korkeakoulut, toisen asteen oppilaitokset, tutkimuslaitokset) kytkeytyvät haasteet innovaatioprosessissa. Ajantasaisuus edellyttää, että haasteita ja kehittämistarpeita analysoidaan säännöllisesti.

Analysis of bottlenecks of Kainuu's region innovation system is found in the first part of the report, under the homonymous heading.

2.- Existence of competent regional / national institution or body, responsible for the management of the smart specialisation strategy / Strategian seuranta- ja arviointivälineet, joilla arvioidaan strategisten tavoitteiden toteutumista

GUIDANCE: Älykkään erikoistumisen toimeenpanon onnistuneisuutta ja vaikuttavuutta tulee mitata maakunnissa seuraamalla TKI-toiminnan ja elinkeinojen kehitystä sekä hanketoiminnan vaikuttavuutta. Älykkään erikoistumisen seurannan ja arvioinnin tulee olla osoitettavissa strategisten valintojen pohjalta teema –tai painopistealakohtaisesti. Strategioiden toteu- tumisen seurantaa ja arviointia on hyvä kehittää maakuntien yhteistyönä ja hyödyntää myös S3-Platformin tietopohjaa. Liittojen ylläpitämät tilastotietopalvelut voivat toimia alus- tana älykkään erikoistumisen kärkien seurannassa.

The Ministry of Employment and the Economy is responsible for coordinating RDI activities and smart specialisation at the national level. Smart specialization strategies are regularly discussed as part of the implementation of regional development and EU regional and structural policies in cross-administrative discussions on regional development.

The Regional Council of Kainuu is an Intermediate Body and the competent organization responsible for the management of the smart specialisation strategy. The role of the Regional Council of Kainuu in the Kainuu RIS3 management is described in *Instrument I Governance of the Kainuu RIS3.*

3.- Monitoring and evaluation tools to measure performance towards the objectives of the strategy /Strategian seuranta- ja arviointivälineet, joilla arvioidaan strategisten tavoitteiden toteutumista

GUIDANCE: Älykkään erikoistumisen toimeenpanon onnistuneisuutta ja vaikuttavuutta tulee mitata maakunnissa seuraamalla TKI-toiminnan ja elinkeinojen kehitystä sekä hanketoiminnan vaikuttavuutta. Älykkään erikoistumisen seurannan ja arvioinnin tulee olla osoitettavissa strategisten valintojen pohjalta teema –tai painopistealakohtaisesti. Strategioiden toteu- tumisen seurantaa ja arviointia on hyvä kehittää maakuntien yhteistyönä ja hyödyntää myös S3-Platformin tietopohjaa. Liittojen ylläpitämät tilastotietopalvelut voivat toimia alus- tana älykkään erikoistumisen kärkien seurannassa.

Kainuu RIS3 has adopted six RIS3 monitoring indicators, discussed extensively under Instrument III Monitoring of the Kainuu RIS3 governance provisions.

4.- Effective functioning of the entrepreneurial discovery process (EDP- applied to RIS3 priority domains) /Sidosryhmäyhteistyön toimivuus yrittäjämäisen etsimisen prosessin (Entrepre- neurial discovery process) mukaisesti.

GUIDANCE: Maakuntien liittojen tulee huolehtia, että strategian valmistelun, toimeenpanon ja arvioin- nin eri vaiheissa varmistetaan elinkeinoelämän (etenkin pk-yritykset) tutkimus- ja koulu- tusorganisaatioiden (korkeakoulut, tutkimuslaitokset ja toisen asteen oppilaitokset) julki- sen sektorin (kaupungit, kunnat ja kehittämisyhtiöt) sekä kansalaisyhteiskunnan tasapuo- linen osallistuminen älykkään erikoistumisen teemojen ja toimintamallin valmisteluun sekä toteutukseen. Prosessiin tulee sisällyttää säännöllinen uusien kumppanuuksien ja painopisteiden tunnistaminen.

Instrument II of the Kainuu RIS3 2021-2027 is dedicated to the EDP. The responsibility of the EDP implementation lies with the Regional Council of Kainuu, reference in Instrument I Governance and EDP initiatives are foreseen to be funded by the funds allocated to Instrument IV Technical reserve.

5.-Tarvittavien toimenpiteiden määrittely tutkimus- ja innovaatiojärjestelmien kehittämiseksi

GUIDANCE: Strategioihin on sisällytettävä toimenpiteet innovaatiotoiminnan haasteisiin (kriteeri 1) vastaamiseksi. Toimenpiteiden suunnittelussa on otettava huomioon Euroopan unionin talouden ohjausjaksoon sisältyvät maaraportit ja maakohtaiset suositukset sekä muut Suomea koskevat erityisarvioinnit.

The improvement of the regional innovation system is addressed in terms of structural priorities as well as project-based initiatives. Regional innovation systems require transregional connectivity (-ies) to be able to function effectively and creatively. Innovation infrastructures are catalysts to this purpose. Improvement of the regional innovation system is one of the objectives of Theme 3 Connectivity & Integration, Measures for interregional collaboration, with a specific sub-heading dedicated to it, *Improvement of innovation infrastructures* and the 6th RIS3 indicator is measuring Integration.

Theme 3 addresses also S3 platforms, innovation infrastructures and measures for national, interregional and international collaboration. In this sense it contributes also to the national R&D Roadmap directly.

6.-Toimenpiteet teollisuuden ja toimialojen muutosprosessiin vastaamiseksi

GUIDANCE: Strategioihin on sisällytettävä analyysi alueen toimialoista ja ammateista, jotka kohtaavat haasteita teknologisen murroksen, globalisaation ja vähähiiliseen talouteen siirtymisen vuoksi. Strategioissa on määritettävä tarvittavat toimenpiteet siirtymän sujuvoittamiseksi. Merkittäviä rakennemuutoksia kokeneiden alueiden on määriteltävä toimenpiteet työvoi- man uudelleen kouluttamiseksi, talouden monipuolistamiseksi, yrittäjyyden vahvista- miseksi ja pk-yritysten teknologisen kyvykkyyden parantamiseksi. ICT-teknologian ja di- gitalisaation soveltamisen mahdollisuudet innovaatiotoiminnassa on tunnistettava laajasti ja määriteltävä toimenpiteet niiden edistämiseksi.

Industrial transition initiatives are interwoven across the Kainuu RIS3. Kainuu region has already experience with industrial transition: In 2019 the European Commission[27] and the Organisation for Economic Cooperation and Development (OECD) presented a report (Regions in industrial transition[28]) on an initiative launched in 2017 to help 12 EU regions and Member States[29] achieve industrial transition and hold their own a globalised economy. One among those 12 regions, was North East Finland, and the ELMO industrial transition project (https://elmoenf.eu) focusing on increasing linkages among the seven NUTS2 regions towards developing a joint smart specialisation strategy for the north – east Finland area. The themes it tackles include the formulation of a joint North-East Finland RIS3 aiming especially at broadening and diffusing innovation and preparing for the jobs of tomorrow.

[27] https://ec.europa.eu/regional_policy/sources/docgener/brochure/Industrial_transition_no_region_left_behind_en.pdf

[28] https://www.oecd.org/publications/regions-in-industrial-transition-c76ec2a1-en.htm

[29] https://ec.europa.eu/regional_policy/en/newsroom/news/2019/05/05-08-2019-commission-presents-results-of-initiative-supporting-regions-in-industrial-transition

ELMO project is still on going. Two key lessons learnt, to-date, are the importance of transregional linkages and of building thematic continuities cutting across different projects and policy instruments.

Most of the themes of industrial transition are addressed by the Kainuu RIS3, through the various themes.

For example,

- Preparing for the jobs of tomorrow[30]: Recommendations on types of skills and qualifications needed, especially when it comes to data analytics are made through RIS3 Theme 5 applications.
- Broadening and diffusing innovation[31]: (i) On going: ELMO (see above); (ii) RIS3: Theme 1, 4, 5 and interactions between Themes 1,4,5 and Theme 2.
- Promoting entrepreneurship and private sector engagement[32]: (i) On going: The thematic priority is *Advanced materials for batteries*[33]. This priority is further sustained in the Kainuu RIS3 2021-2027 especially through Theme 2 Reinforcing and diversifying the specialisation base, 2A Manufacturing, under which one of the prioritised domains are the Extractive industries and their sideflows valorisation, with cross fertilisation with Theme 5 Green deal and green transformation, sub-theme 2 Mobilising industry for a clean and circular economy; (ii) RIS3: Theme 1 and Theme 2.
- Transitioning towards a climate-neutral economy[34]. RIS3 Theme 5 and cross fertilisation with all other four Themes.
- Promoting inclusive growth[35]. RIS3 Theme 3.

7.- Yhteistyön kehittäminen kansainvälisten kumppaneiden kanssa painopistealoilla

GUIDANCE: Strategioissa tulee kartoittaa ja määritellä tutkimus- ja innovaatiotoimijoiden sekä yritysten ylialueellisen, kansallisen ja kansainvälisen yhteistyön mahdollisuudet ja toimenpiteet valituilla teema- tai painopistealoilla ja toimet alueellisten sidosryhmien (mm. pk-yritykset, koulutus- ja tutkimusorganisaatiot) sitouttamiseksi kansainvälisten arvoketjujen luomiseen.

This priority is addressed through Theme 3, across all of its subheadings.

In regard to European Innovation Hubs (classified in Theme. 3 under Innovation Infrastructures), the recommendations issued by the JRC (see for example event 28.10.2020) and the provisions clarified by DG Regio are explicitly taken into account, i.e. that innovation hubs may get ERDF funding if and only if they are aligned with the RIS3 of the respective regions[36].

Moreo

ver, steps to prepare for I3 calls are foreseen (under the S3 platforms initiatives), as well as ad hoc transregional innovation needs to be addressed (under Transregional access to innovation on demand).

[30] Challenge: Lack of skilled workers for emerging economic sectors. Policy responses: anticipate skills needs for industrial transition; strengthen companies' capacity to address their human resource needs internally; involve local stakeholders in the planning and design of regional skills initiatives.

[31] Challenge: Lack of innovation capacity in small and medium businesses; Policy responses: accelerate the digital transformation; expand business innovation networks and support clusters; strengthen links between academia and local business spheres.

[32] Challenge: Limited access to entrepreneurship skills and networks for start-ups and scale-ups. Policy responses: support entrepreneurs with information, training, coaching and mentoring, strengthen entrepreneurial networks, increase start-up and SME participation in collaborative research.

[33] https://ec.europa.eu/regional_policy/sources/docgener/brochure/Industrial_transition_no_region_left_behind_en.pdf, page 12.

[34] Challenge: Reconciling the long-term dimension of a climate-neutral transition with short-term economic action. Policy responses: foster local energy transitions through financial support schemes; integrate the transition to a climate-neutral economy into larger regional development strategies.

[35] Challenge: Spatial discrepancies and territorial linkages. Policy responses: encourage territorial co-operation through rural-urban partnerships; ensure digital connectivity and digital services in remote regions.

[36] Gabriel Rissola (2020). Digital Innovation Hubs (DIHs): A place-based EU policy initiative to boost Digital Transformation of SMEs and public sector, 28.10.2020. https://www.digitalsme.eu/digital/uploads/DIH-Presentation-by-Gabriel-Rissola.pdf .

Älykkään erikoistumisen yhdyspinnat kansallisen TKI-tiekartan[37] toteutukseen

Summary

Table 9 TKI-tiekartta ja tutkimus- ja innovaatiopolitiikkaa koskevat muut ajankohtaiset linjaukset ja prosessit.

TKI tiekarta priorities	**How RIS3 takes the *TKI tiekarta into account***
A 4% share of GDP by 2030 in the level of private and public investment and financing	RIS3 Themes & Instruments: all Themes and especially their cross-fertilisation. Instrument II EDP, Instrument IV Technical assistance reserve.
Finland's goal is to be a competitive expert and developer of new technology and innovations, a quick adopter and the best adopter.	RIS3 Themes & Instruments: Theme 1, Theme 2, cross fertilised with. Themes 4 and 5, access to markets Theme 3; Instrument II EDP, Instrument IV Technical assistance reserve.
An orchestrated approach to development Closer cooperation and dialogue between national and regional innovation activities.	RIS3 Themes & Instruments: Prioritised industries, cross-fertilisation between research results & industries, improvement of regional innovation systems, measures for innovation system integration at national and EU levels.
Competitiveness of the regions is strengthened	RIS3 Themes & Instruments: all Themes and especially their cross-fertilisation. Instrument II EDP, Instrument IV Technical assistance reserve.
The research and innovation system must encourage long-term and diversified cooperation between the public and private sectors.	RIS3 Themes: all Themes and especially their cross-fertilisation. Instrument II EDP, Instrument III Funding & financing, Instrument V Technical assistance reserve.
The utilisation of various funding sources and networks and their synergies can be discussed (eg Structural Funds, Business Finland, Horizon, S3 Platform).	RIS3 Themes & Instruments: Instrument IV Funding & financing. Permanent functions of the Regional Council of Kainuu: Europe Direct Office.
The preparation and implementation of smart specialization strategies must take into account university city ecosystem agreements.	Kainuu RIS3 is taking into account the Ecosystem agreement between Kajaani and Sotkamo in terms of development themes and activities, i.e. on the base of stong complementarities, as ffollows: RIS3 Themes & Instruments: LUMI data analytics and mesurement technology further development are taken ointo account expressly in Theme 1 (reinforcement of the research base), Theme 2 Reinforcmeent of the economic base (follow up porjects to icnrease. Research results TRL, spinn offs, knowledge intensive services

[37] Kestävän ja kehittyvän yhteiskunnan ratkaisuja tuottava Suomi, 23.4.2020. Valtioneuvosto. https://minedu.fi/documents/1410845/4449678/Tutkimus-%2C+kehittämis-+ja+innovaatiotoiminnan+tiekartta/259864dc-a31c-cbcf-30ad-e2222724ccfa/Tutkimus-%2C+kehittämis-+ja+innovaatiotoiminnan+tiekartta.pdf .

Guidance: Pääministeri Marinin hallitusohjelman mukaisesti Suomeen laaditaan pitkän aikavälin kansallinen tutkimus-, kehittämis- ja innovaatiotoiminnan tiekartta (TKI-tiekartta), jonka avulla TKI-toimintaympäristö paranee, ja sitä kautta yksityisten ja julkisten inves- tointien ja rahoituksen tasossa tavoitellaan neljän prosentin bruttokansantuoteosuutta vuoteen 2030 mennessä. Tavoite edellyttää merkittäviä julkisia ja yksityisiä lisäinvestoin- teja TKI-toimintaan Suomessa. Suomen tavoitteena on olla uuden teknologian ja innovaatioiden kilpailukykyinen osaaja ja kehittäjä, nopea omaksuja ja paras soveltaja. Tutkimus- ja innovaatiojärjestelmän tulee kannustaa julkisen ja yksityisen sektorin pitkäjänteiseen ja monipuoliseen yhteistyöhön. Tiekartan toimenpiteillä tavoitellaan ennakoitavaa ja pitkäjänteistä TKI-rahoitusympäristöä sekä kannustetaan yhteistyöhön, voimavarojen kokoamiseen ja uusien toimintatapojen hyödyntämiseen.

Älykkään erikoistumisen strategioiden lähtökohtana on niiden aluelähtöinen toteuttami- nen ja hallinta siten, että alueiden kilpailukyky vahvistuu. Tämä edellyttää kansallisen ja alueellisen innovaatiotoiminnan nykyistä tiiviimpää yhteistyötä ja vuoropuhelua. Kansallinen TKI-tiekartta luo laajemman viitekehyksen tutkimus- ja innovaatiotoiminnan kehittämiselle Suomessa. Alueellisten älykkään erikoistumisen strategioiden toimeenpanoa ja yhteyttä kansallisen TKI-tiekarttaan voidaan käsitellä osana aluekehittämisen keskusteluja. Sen lisäksi työ- ja elinkeinoministeriö vastaa myös muilla tavoin TKI-tiekartan yh-teensovituksesta alueellisiin älykkään erikoistumisen strategioihin ja varmistaa riittävän ja jatkuvan yhteistyön eri toimijoiden (mm. maakuntien liitot, opetus- ja kulttuuriministeriö, ELY-keskukset ja Business Finland) välillä.Aluekehittämisen keskusteluissa ja muussa liittojen, ELY-keskusten, TEM:n ja muiden toimijoiden yhteistyössä voidaan ottaa esille strategioiden toimeenpano, seuranta ja arvi- ointi, hyvät käytännöt sekä kansallisen ja kansainvälisen yhteistyön mahdollisuudet alu- eiden temaattisten painopisteiden pohjalta. Samalla voidaan käsitellä erilaisten rahoitus- lähteiden ja verkostojen hyödyntämistä ja niiden synergioita (mm. rakennerahastot, Business Finland, Horizon, S3 Platform). Älykkään erikoistumisen strategioiden valmistelussa ja toimeenpanossa on lisäksi otettava huomioon yliopistokaupunkien ekosysteemi- sopimukset.

TKI tiekarta priorities	How RIS3 takes the *TKI tiekarta into account*
	specialisation and diversification), Theme 4 Digital transformaiton interma of applications across all inndustries, and Theme 3 national level collaborations and transregional actions.

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