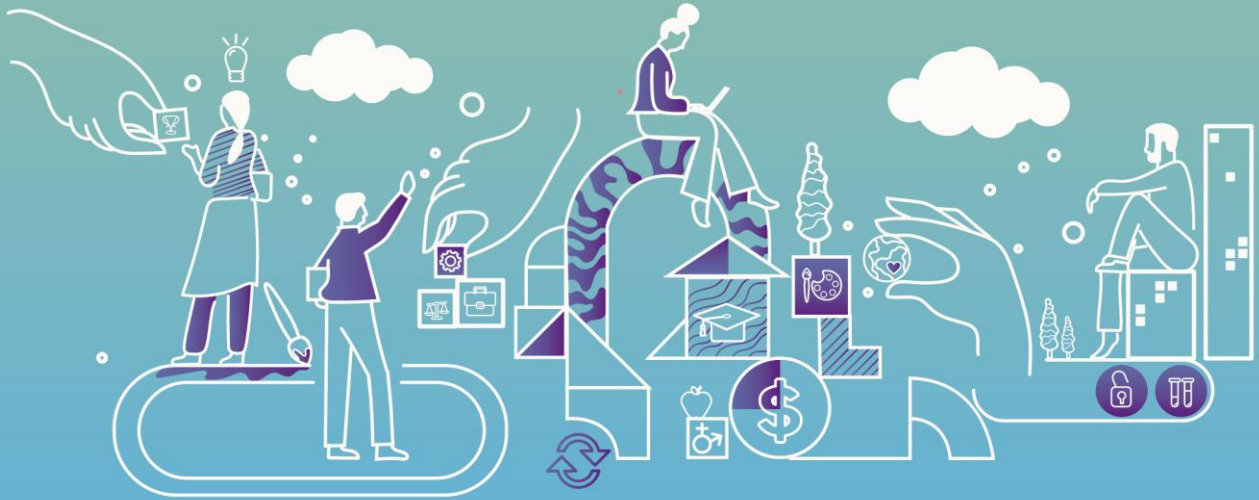




Building Self-Sustaining Research and Innovation Ecosystems in Europe through
Responsible Research and Innovation



Deliverable Title: D2.2 - Report on R&I ecosystem mapping of the territories from a comparative perspective

Work Package: WP2 – Active mapping of SeeRRI territorial R&I ecosystems and the inclusion of RRI

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Description of the deliverable (3-5 lines)	This report presents the results of the systematic quantitative mapping of the three territorial R&I ecosystems selected as cases in SeeRRI – Nordland, Lower Austria, and B30 – in terms of (i) their <i>R&I actors</i> of different organizational types, (ii) being engaged in <i>R&I activities</i> of different forms, and (iii) the actors' <i>R&D collaborations</i> and their engagement in regional, national and international networks.
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Key words	R&I ecosystems, territories, quantitative mapping, R&I actors, R&D collaborations, specialization patterns, descriptive analyses, network diagrams, bibliometric analyses
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Report on R&I ecosystem mapping of the territories from a comparative perspective_final	31/08/2019	final	Final deliverable

DEFINITIONS & ACRONYMS

<i>EPO</i>	European Patent Office
<i>FP</i>	Framework Programmes
<i>IPC</i>	International Patent Clasification
<i>NACE</i>	Nomenclature statistique des Activités économiques dans la Communauté Européenne
<i>NAT</i>	Network of Affiliated Territories
<i>NUTS</i>	Nomenclature des Unités Territoriales Statistiques
<i>PCT</i>	Patent Cooperation Treaty
<i>R&I</i>	Research and Innovation
<i>R&D</i>	Research and Development
<i>RRI</i>	Responsible Research and Innovation
<i>WoS</i>	Web of Science

EXECUTIVE SUMMARY

In line with the vision of the SeeRRI project: establishing a foundation for building self-sustaining research and innovation ecosystems in Europe through Responsible Research and Innovation (RRI), the present *Deliverable 2.2 – Report on R&I ecosystem mapping of the territories from a comparative perspective* constitutes an essential step in the establishment of a conceptual and theoretical foundation for self-sustaining R&I ecosystems. The results of the mapping will provide an important impetus for subsequent work packages, in particular, to the interactive stakeholder processes within and across the regions. The results are also intended to pave the way for the development of a generalized empirical framework that can be used to characterize territorial R&I ecosystems in the future. The empirical analysis has been accomplished following the guidelines to implement a comprehensive mapping of R&I ecosystems, as outlined in *Deliverable 2.1 – Report on procedures and guidelines for active mapping*.

The aim of this report is to present the results of the systematic quantitative mapping of the three territorial R&I ecosystems selected as cases in SeeRRI – Nordland, Lower Austria, and B30 – in terms of (i) their *R&I actors* of different organizational types, (ii) being engaged in *R&I activities* of different forms, and (iii) the actors' *R&D collaborations* and their engagement in regional, national and international networks.

The core of the present deliverable is the quantitative mapping of selected R&I ecosystems, comprising (i) a **general ecosystem characterization** featuring a sectoral and institutional composition, as well as an illustration of the specialization patterns, (ii) **R&I actors** and their **collaborations**, and (iii) a territory specific analysis of the respective **thematic focus** of each territory. In what follows, the main empirical results along these three analytical dimensions are summarized:

- (i) The results from the **general ecosystem characterization** reveal, with respect to the institutional composition, that in terms of actors active in EU FP projects, the shares of actor types are quite similar in the three territories, with the industry sector being dominant in all three territories; with around 60% industry, around 5% education, and around 13% research actors. However, when it comes to the distribution of actor types participating in projects, the shares differ quite remarkably, showing the dominance of different actor types in the three territories (industry in Nordland with 55%, research organizations in Lower Austria with 39%, and education in B30 with 47%). In B30, this highlights the exceptional role of the Autonomous University of Barcelona (UAB). Regarding the sectoral composition, in all three territories the actors are mostly active in patenting in the sectors *Human Necessities*, *Performing Operations & Transporting*¹, and *Chemistry & Metallurgy*. The sectors *Fixed Constructions*, as well as *Mechanical Engineering*, *Lighting*, *Heating*, *Weapons & Blasting* show relatively high patenting activity in Nordland compared to the other two territories, while Lower Austria has higher patenting counts in *Physics* and *Electricity*. Looking at the scientific publications, in Nordland, we observe a high disciplinary concentration, with a focus on three quite related and partly overlapping disciplines: *Environmental Sciences & Ecology*, *Biotechnology & Applied Microbiology*, and *Marine & Freshwater Biology*. Lower Austria also shows the highest publication activity in the field of *Environmental Sciences & Ecology*, however, its disciplinary concentration is relatively lower, as other dominant fields (in terms of number of publications) are *Science and Technology*, *Engineering*, and *Physics* which are rather generic disciplines. Of the most important disciplines in B30, all are relatively generic (Chemistry, Physics,

¹ See https://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=NACE_REV2 or Annex II for description of NACE classes.

Materials Science) while being active in quite many different disciplines, pointing to a relatively low disciplinary concentration.

The *specialization pattern* of Nordland shows a specialization together with high patent growth in the field of Human Necessities. Lower Austria has the most patents in the sectors Performing Operations & Transporting, as well as Mechanical Engineering, Lighting & Heating, where it also exhibits a high specialization; moreover, both sectors grew in terms of patent counts in the recent past. B30 is specialized in its three largest sectors in terms of patent counts, i.e. Human Necessities, Performing Operations & Transport, as well as Chemistry & Metallurgy. However, only Performing Operations had a moderate patent growth over the last few years; the other two sectors declined.

- (ii) Turning to the *interactions of the R&I actors*, in Nordland three clusters of actors are visible with central players National Institute of Technology, SINTEF, and others. In the case of Lower Austria, there is only one main dense network component with mostly universities and research organisations as central players, such as IASA, Donau-University Krems and other national institutions. B30 has a very dense network of national project collaborations including UAB, Leitat, and Tecnalia as central players, that constitute the backbone of this R&D collaboration network. Looking at international collaborations, Germany, UK and France are core partner countries of all three territories.
- (iii) For each **territory, specific analyses** using scientific publication data as well as project participation data, regarding a thematic focus chosen by territory representatives have been executed. Overall, these analyses show the current strengths of the ecosystem's actors in fields of science and technology, as well as their potential to diversify to similar but new fields. For Nordland, this analysis evolved around issues of environmental science and ecology. Nordland County Council is currently working on a new regional plan targeting responsible governance of nature and resources with high priority; the extensive involvement of affected actors (e.g. representing academia/research, business, public authorities etc.) is crucial for their "holistic", cross sector point of departure in this planning process. The analysis of scientific publications shows a dominance (in terms of the number of publications) in the field of microalgae with Nord University (University Nordland) being a central player. For Lower Austria, the territory specific analysis was conducted for the topic of 3D printing and additive manufacturing, revealing publications in the fields of polymer sciences, medicine and tribology. Departure point of this thematic focus is the importance of polymers for our standard lives, with polymers being used e.g. in electronic devices, packaging, and in the medical sector. However, there are big challenges that have to be managed, in particular the ecological damages caused by microplastics. Hence, Lower Austria aims at co-creating strategies linking polymer science and environmental issues (e.g. CO2 emission) with core actors in related fields. Central actors identified are EBG MedAustron, Semperit, and CEST Competence Center for Electrochemical Surface Technology. For B30, the topic of "zero waste" was used for the specific analysis, showing dominant fields such as environmental science and ecology, engineering, and water resources. The B-30 axis is the main industrial agglomeration in Catalonia with a lot of industrial land, high population density and a delicate balance between socioeconomic development and sustainability. This challenges B30 towards the transition to a sustainable, resilient socioeconomic model based on the green and circular economy. The transformation requires different players (government, academia, companies and civil society) to work together and change their mindsets. Not surprisingly, the Autonomous University Barcelona (UAB) is identified as a central actor in publishing in these fields. In general, UAB is found to have an exceptional position in the R&I landscape of B30, being the leading actor in EU projects, patenting, as well as scientific publishing – this is highly unusual in R&I ecosystems.

The analytical approach presented in this deliverable has brought interesting and comparable insights into the different characteristics of the three territorial ecosystems under consideration. It has not only disclosed the main characteristics in terms of R&I but can also serve as major impetus for the identification of stakeholders for various consultations in terms of the projects' RRI focus. Further, the analytical approach developed here can, on the one hand, be relatively easily applied to a wider set of European regions, and, on the other hand, it can be further advanced and deepened along specific aspects when needed (e.g. attaching more specific region level data on other related socio-economic phenomena, such as venture capital, business incubators, start-ups, among others).

1. INTRODUCTION

The vision of the SeeRRI project is to establish a foundation for building self-sustaining research and innovation ecosystems in Europe through Responsible Research and Innovation, and by this strengthen innovation in Europe towards resilient, inclusive and sustainable growth. The starting point of the SeeRRI project is the establishment of a conceptual and theoretical foundation for self-sustaining R&I ecosystems. In supporting this framework, a quantitative mapping of the three territorial R&I ecosystems selected as cases in SeeRRI is conducted, disentangling the differing characteristics of the three regions in terms of their knowledge creation endowments, their institutional architectures and their thematic orientations. The results of the mapping will provide an important impetus for subsequent work packages, in particular, to the interactive stakeholder processes within and across the regions. The results are also intended to pave the way for the development of a generalized empirical framework that can be used to characterize territorial R&I ecosystems in the future. The description of the empirical approach and the results are the contents of the present *Deliverable 2.2 – Report on R&I ecosystem mapping of the territories from a comparative perspective*. The empirical analysis has been accomplished following the guidelines to implement a comprehensive mapping of R&I ecosystems, as outlined in *Deliverable 2.1 – Report on procedures and guidelines for active mapping*.

In some more detail, the **aim of this report** is to present the results of the systematic mapping of the selected SeeRRI territorial R&I ecosystems – *Nordland*, *Lower Austria*, and *B30* – in terms of

- (i) their **R&I actors** of different organizational types,
- (ii) being engaged in **R&I activities** of different forms, and
- (iii) the actors' **R&D collaborations** and their engagement in regional, national and international networks.

The aim of this deliverable is to characterize the status quo of the respective R&I ecosystem, not making predictions about the future development. However, analysing sectoral and organizational distributions within the territories, and identifying the actors active in collaborative projects, patenting and publishing, does reflect the territories' current knowledge endowment, which also affects potential future R&I activities.

To identify relevant actors and their interactions, large-scale global, as well as territory-specific R&I datasets were used, covering different types of research activities such as R&D projects, patenting and scientific publishing. By this, a structural view on the actor-topic landscape in a territory is presented, allowing to interpret them individually but also from a comparative perspective. Hence, this mapping is the starting point to provide a better understanding of the selected territorial R&I ecosystems, but also for R&I ecosystems in general, such that they can be put into a larger context in terms of social, economic, geographic, and environmental dimensions.

The remainder of this report is structured as follows: Section 2 is dedicated to the conceptual and methodological background underlying this quantitative R&I ecosystem mapping. Section 3 includes the description of the data bases – global and territory-specific – used for the empirical analyses, while Section 4 presents the actual results of the mapping exercise for all three SeeRRI territories, Nordland, Lower Austria, and B30. Each of the subsections in section 4 is dedicated to individual analyses of each territory and is structured in the same way for comparative purposes: (i) general characterization of the R&I ecosystem, (ii) R&I actors and collaborations, and (iii) a territory-specific analysis of an individually chosen thematic focus. In Appendix I, some basic analyses are provided for territories in the Network Associated Territories (NATs). Importantly, additional analyses using territory-specific R&I data sets, are included in the Appendix III. There, for each territory individual analyses are presented giving

more detailed characterisations of the respective R&I ecosystem – going beyond the analysis of standard R&I indicators (patent applications, project collaborations, and scientific publications).

Note, that the report is structured in a way, such that each of the three subsections dedicated to a specific territory can be read separately without any information given in the sections targeted at the other territories (hence, any duplicated formulations are by intention). A comparison between the three territories is not the main aim of this deliverable, also because the territories are each highly unique in terms of their sectoral distributions, specializations, size, etc.

2. CONCEPTUAL AND METHODOLOGICAL APPROACH

The core of this deliverable is the **quantitative mapping of selected R&I ecosystems**, comprising a detailed characterization of the ecosystems along different dimensions such as sectoral and institutional composition, as well as R&I actors and their collaborations. This section is dedicated to the conceptual and methodological underpinning of the analyses.

In general, **R&I ecosystems** are represented by an interplay between academic, public sector and business actors being connected in networks via research, development and innovation activities supported by public policy mechanisms. Furthermore, they are characterized by a certain degree of dynamism, flexibility and openness – geographically and institutionally – resulting in a system that can respond, adapt, and transform itself responding to dynamic processes and stimuli coming from inside or outside the system. A functioning and self-sustaining R&I ecosystem is the incubator for R&I actors of any kind to effectively interact with the shared aim to contribute to a region's innovation performance and its economic impact.

These characteristics of R&I ecosystems serve as framework for the mapping of the R&I ecosystems. Hence, conceptually, the focus is on the **creation of new knowledge** and its networked character. Knowledge creation is the basis for generating innovation, and is thus a crucial factor for organizations, especially industry firms, to be competitive. Moreover, collaboration in knowledge creation has become a widespread phenomenon, in particular, in times of converging technologies and increasing market pressures due to more rapidly changing patterns of demand in a globalizing world (see e.g. Bathelt et al. 2004). The ability to create new knowledge, but also to collaborate depends to a substantial degree on the local environment the innovating actors are embedded in, also referred to as territorial R&I ecosystems.

In principle, new knowledge can be created within an organization by means of **internal research** and development (R&D) but also on an **inter-organizational** level relying on informal and formal interactions, ranging from simple networking activities of researchers to long-term and contract-based arrangements. In particular, inter-organizational collaborations are considered an indispensable and increasingly important element for an organization's knowledge creation. However, it is argued that inter-organizational network channels are by no means sufficient but rather considered complementary to internal capabilities, since similar internal capabilities are necessary to evaluate research done by collaboration partners (e.g. Inkpen and Tsang 2005; Cowan and Jonard 2009).

In the process of collaborative knowledge creation, **networks of R&D relationships** between firms, universities and research organizations are essential means by which knowledge flows between these actors, and enable access to external, new sources of knowledge. While such knowledge flows are mostly geographically localized within regions or nations due to its 'sticky' nature, such networks are assumed to serve as channels for transmitting knowledge over larger geographical distances (see e.g. Autant-Bernard et al. 2007).

Three of the most prominent and commonly used indicators to measure knowledge creation and innovation are **patent applications**, **collaborative research projects** (e.g. projects funded by the EU Framework Programmes), and **scientific publications** (see Scherngell 2019 for an overview). Whereas, patents are generally considered output of industrial innovation efforts in firms, publications are typically the product of scientific research; EU funded joint projects cover – to a certain extent – both scientific and industrial innovation efforts, though more at a pre-

competitive stage, bringing together industry firms, universities, and research organisations. Scientific research is to a large extent characterized by basic research, and hence, is usually performed in the higher education and public research sector but also in the government sector (OECD 2002). Due to the characteristics of basic research, scientific research is also identified as being largely exploration-driven, i.e. it broadens the existing knowledge base. In contrast, the focus of industrial research is on the application of new knowledge, striving for the development of new products or processes (OECD 2002). This characterizes industrial research as exploitation-driven, in the sense that exploitative innovation deepens the core knowledge base, rather than broadens it.

The **quantitative mapping of the SeeRRI R&I ecosystems** reflects on these conceptual considerations, in the following ways:

- (i) A general characterization of the status quo of R&I actors in the respective territories (regions) and their technological profiles (using patent applications), shows the region-internal knowledge base reflecting the **region-internal capabilities** that are essential for region-internal knowledge creation but also for enabling access to region-external knowledge.
- (ii) The analysis of the structure of the R&D collaboration networks comprising different types of actors being interlinked through joint research projects shows the territories' **collaboration/network capability**. The consideration of different spatial levels shows the capability of the territories to create and maintain national and global links and hence, being involved in international networks of knowledge flows to get fast and easy access to new knowledge via 'global knowledge pipelines'.
- (iii) The use of different indicators to **measure the R&I activity** (patent applications, EU funded R&D projects, scientific publications) of the territories ensures a comprehensive view of the R&I landscape, covering different modes and forms of knowledge creation (being the basis for innovation), such as exploitative and explorative knowledge creation – representing an industrial and scientific R&I landscape.

To get a comprehensive picture comprising a general R&I ecosystem characterization, the identification of the ecosystem's actors and their interactions, as well as a characterization of its sectoral specificities (including specialization patterns), three different **methodological approaches** are applied (for more details see the methodological guidelines in Deliverable D2.1):

- (i) A general description of the R&I ecosystems is given by simple **descriptive analyses**, comprising numbers of projects and actors with respect to their organisation type and technological fields. Moreover, most important actors are identified.
- (ii) The interactions between R&I actors are represented by means of **network diagrams**, based on some general ideas of Social Network Analysis (SNA). Central to the social network perspective is the notion of *networks* as a concept of describing an object composed of elements and interactions or connections between these elements. Formally, networks can be modelled by means of graphs. A graph is an abstract object formed by a set of vertices (nodes) and a set of edges (links) that connect pairs of vertices. The focus of SNA is on relationships (representing network links) among social entities (constituting network nodes), and on patterns and implications of these relationships.

In the context of this mapping, the central elements inherent in intra- and inter-regional R&D collaboration networks are (a) R&D actors (i.e. organisations such as industrial firms, universities, research

organisations, etc.) and (b) collaboration networks measured by joint R&D projects and joint publications as linkages between these actors, within and across regional boundaries.

- (iii) Specialization patterns of the SeeRRI territories are assessed by means of the **Revealed Technological Advantage (RTA)**, which is a **specialization index**² often applied to determine the relative thematic specialization of a given country in selected technological fields based on patent applications. Here, the reference category are regions, in this case the three territories Nordland, Lower Austria and B30. The index is defined as follows

$$RTA_{ik} = \frac{p_{ik}}{\sum_{i=1}^n p_{ik}} : \frac{\sum_{k=1}^m p_{ik}}{\sum_{i=1}^n \sum_{k=1}^m p_{ik}}$$

where p is the number of patent applications, i denotes the region with $i = 1, \dots, n$ and k represents the technological field (IPC patent class) with $k = 1, \dots, m$. (p_{ik} denotes the number of patent applications in region i and technological field k).

Hence, each territory's share of patents in a specific technology is set in relation the territory's share in all patent fields. The theoretical boundaries of the index are zero and infinity, where an index above one indicates specialization of the territory i in specific technology field k , while a value below one points to less patenting activity in this technological field as compared to the reference area.

- (iv) The thematic focus of the territories will be elaborated by a science mapping approach. Science Mapping serves for the identification of thematically consistent clusters for publication activities and participation in EU funded projects. Science Mapping is a relational bibliometric approach to analyse and structure a large amount of scientific publications or documents of project descriptions (see e.g. Schiebel 2012). The documents will be mapped and clustered by bibliographic coupling of publications (see e.g. Boyack and Klavans 2010). A spring model will position similar publications in local virtual spaces. The visualisation procedure will also be used for a co-word analysis to map the thematic activities. Recent work for the delineation of research issues (see Bildosola 2017, Rotolo 2015, Schiebel 2012) will be implemented to quantify the latest research activities in the territories.

All methods and concepts will be applied to the three SeeRRI territories – Nordland, Lower Austria and B30. Additionally, selected methods will be applied to some NAT territories (Network of Affiliated Territories; see subsection 3.1).

² Note that the specialization index is used to determine the relative thematic specialization and is not related to the concept of “smart specialisation”.

3. DATA DESCRIPTION

The quantitative mapping of the R&I ecosystems relies on data sets providing information on actors in the R&I ecosystems and their interactions with respect to different kinds of R&I activities. For this purpose, data sets on two different levels of aggregation are considered: (i) **global** and (ii) **territory-specific** R&I data sets. By this, we identify different, but overlapping sets of actors involved in R&I activities of different kinds. The mapping is carried out using existing and public R&I data bases. For some relevant non-public datasets, local stakeholders, funding agencies and government authorities were approached.

3.1 GLOBAL R&I DATA SETS

Three of the most prominent and commonly used indicators to measure knowledge creation and innovation are **patent applications**, **collaborative R&D projects**, e.g., funded by the EU Framework Programmes, and **scientific publications**. The use of these different indicators to measure the R&I activity of the territories ensures a comprehensive view of the R&I landscape, covering different modes and forms of knowledge creation (being the basis for innovation), such as exploitative and explorative knowledge creation – representing an industrial and scientific R&I landscape. By this, the empirical analysis at hand follows numerous recent research works, both in a scientific as well as in a policy context (for an overview see (for an overview see Scherngell 2019). The three indicators and respective datasets are shortly introduced in the following:

- i. **Patent applications** refer to new knowledge protected by patent offices and reflected in patent documents. Patents are intellectual property rights for a specific device or technology and are widely used in innovation research as empirical window to the knowledge economy (see Griliches 1990 for details on patent indicators). It thus indicates new knowledge in more competitive, industrial research and technological development, typically in manufacturing industries (Powell and Giannella 2010). It is worth noting that the invention process involves knowledge with high tacit elements, making direct, close and intensive interaction between researchers important. Regionalised patent information in this study come from the OECD REGPAT database, containing the geographical information of the organisations (mostly firms) inventing a patent, but also a detailed breakdown of technological fields which opens up a whole range of possible analytical applications.

Different criteria can be applied to count patents in terms of their geographical assignment: based on the (i) **inventor's location** or (ii) **institution's location**. Following the first criterion, the patent application is assigned according to the address of the inventor. This allows an interpretation of the regional potential for technological knowledge creation within the territory. Using the second criterion, patent applications are allocated to the region/territory of the institution which would more point to a territory's commercialisation potential. However, patent applications are often filed through the headquarters and, hence, a headquarters bias arises by overestimating the patenting activities in favour of the region of the headquarters.

- ii. **Project-based R&D networks** are usually publicly funded research partnerships focusing on precompetitive research, often designed in order to bring basic research closer to the practical application of basic research results. Collaborative projects involve a clear research focus and time horizon as well as certain conditions on the geographical range of partners. The most important data source for project-based R&D is the EUPRO database (<https://rcf.risis2.eu/dataset/4/metadata>). It contains systematic information on collaborative

projects funded by the EU Framework Programme (FP) from 1984 to 2016 (constantly updated), and has been used to analyse structure and dynamics of R&D collaboration networks from different angles (Scherngell 2019). In this study, it will be mobilized both to investigate project-based knowledge creation abilities, as well as regional internal and external R&D networks.

- iii. **Publications** refer to new knowledge reflected in scientific publications, such as journal articles, conference proceedings or (edited) books. Systematic information on publications can be, e.g., derived from the Web of Science (WoS) publication database. While in the 1990s, they have mainly been established within the institutional boundaries of the academic sphere and have typically taken place in narrow scientific fields with well-defined scientific standards (Katz and Martin 1997), international as well as inter-institutional joint scientific publications have increased considerably over the past decade (Hoekman et al. 2009). Accordingly, the empirical analysis mobilizes WoS not only for the characterisation of the scientific landscape of the regional ecosystems under consideration, but also to describe collaboration patterns.

Table 1. Specifications of data sets

Data set	Years	Selection criteria
<i>PATSTAT</i> (on patents)	2002-2014	<ul style="list-style-type: none"> Relevant EPO (European Patent Office) patents are selected via the <i>inventor's location principle</i>, i.e. patent applications are geographically assigned according to the inventor's place of residence. Only patent applications up to the year 2014 are considered due to a time lag between the publication of the patent application and the point in time at which the invention was made or completed. Location of inventors is determined by using NUTS³ classification for Lower Austria (AT12) and Nordland (NO071), and postal codes in the case of B30⁴
<i>EUPRO</i> (on FP funded R&D projects)	2002-2016	<ul style="list-style-type: none"> Relevant R&D projects are selected according the institutions' (actors) locations active in the respective projects. Location of institutions is determined by using NUTS classification for Lower Austria (AT12) and Nordland (NO071), and postal codes in the case of B30
<i>WoS</i> (on scientific publications)	Nordland: 2015-2019 Lower Austria: 2015-2019 B30: 2017-2019	<ul style="list-style-type: none"> Relevant scientific publications are selected according the author's affiliation location; publications with at least one author affiliated to an organization located in the respective territory are considered. For all territories, the location of authors' affiliations is determined by using postal codes.

³ See <https://ec.europa.eu/eurostat/web/nuts/background> for information on NUTS.

⁴ A list with the postal codes underlying the mapping is provided in the Annex.

3.2 TERRITORY-SPECIFIC DATA SETS

To complement the picture drawn using the global R&I data sets, territory-specific data sets are mobilized. This is important, as the global R&I data sets generally mostly include information on large and R&D intensive actors, and hence, smaller but still R&D intensive actors may be underrepresented. To cope with that drawback, additional territory-specific data sets are used. This type of data was exclusively made available to us by regional authorities, national and regional funding agencies, as well as cluster representatives. The availability, type and scope of the received data sets differ greatly between the three territories, which requires individually targeted analyses to represent the respective R&I ecosystem in a comprehensive manner. Note, that not all data sets received could be used (or had to be restricted) for the mapping due to missing minimum requirements or missing R&I context – these data sets are not listed and described. Table 2-4 give an overview on the specific data sets underlying this report are given.

Table 2. Overview and description of territory-specific data sets – Nordland

Data set	Type of data	Description
Funding by Innovation Norway (Innovation Norway)	National funding data	The data set includes all actors that received funding from Innovation Norway in the years 2017-2018. Innovation Norway is the state agency that funds innovations projects in companies.
Indirect Research Funding (tax refunds; SkatteFUNN)	National funding data	The data set includes companies that received a tax refund for R&I activities (i.e. “SkatteFUNN”) for the years 2015-2018 ⁵ .
Incubators (SIVA)	National data	The data set refers to incubators, knowledge and science parks governed and coordinated by SIVA, a national entity owned by the Norwegian government.
Funding by Nordland County Council (NCC)	Regional funding data	The data set includes all actors that received funding with the purpose of regional development in the years 2017-2018. Since not all funding schemes included in the data set are targeted towards funding R&D&I activities, the data set is restricted to the following relevant funding schemes: “Nasjonale tiltak for klynger og innovasjonsmiljøer”, “Utviklingstilskudd”, “Offentlige forsknings- og utviklings-kontrakter”, “Omstilling og nyskaping”, “Innovative Næringsmiljøer”.
Firms involved in clusters	Cluster data	The data subsumes firms active in four different clusters: the Arctic Cluster Team (ACT), Betongklyngen (Concrete and construction cluster), the Oil and Gas cluster, and the Cod cluster

⁵ See <https://www.skattefunn.no/en/soke-skattefunn/about-skattefunn/>

Table 3. Overview and description of territory-specific data sets – Lower Austria

Data set	Type of data	Description
Data base by Austrian Research Promotion Agency (FFG)	National funding data	The data set includes all actors that received funding from FFG in the years 2016-2019 (until June 2019). FFG is the national funding agency for industrial research and development in Austria. The data comprises several different funding schemes, such as <i>“Mobilität der Zukunft”</i> , <i>“Energieforschung”</i> , <i>“Basisprogramm”</i> , <i>“Energie der Zukunft”</i> , <i>“Produktion der Zukunft”</i> , etc.
Funding by Federal Government of Lower Austria	Regional funding data	The data set includes actors that received funding from the federal government of Lower Austria in the years 2009-2018. Since not all funding schemes included in the data set are targeted towards funding R&D&I activities, the data set is restricted to the following relevant funding schemes: <i>“F&E-Kleinprojekte”</i> , <i>“F&E Einzelentscheidungen des Fonds”</i> , <i>“FFG Anschlussförderung”</i> , <i>“Förderung von Forschung, Entwicklung und Innovation”</i> , <i>“Forschung & Entwicklung”</i> , <i>“FTI-Forschungs-, Technologie- und Innovationsprogramm Niederösterreich”</i> , <i>“Innovation in Betrieben”</i> , <i>“Innovationsassistent”</i> .
Ecoplus funding data base	Cluster funding data	The data set includes actors active in the Plastics- and Mechatronic cluster, their respective projects and collaboration partners (not necessarily cluster actors) in the years 2005-2018. The data covers projects funded by different funding authorities: mainly FFG, Federal Government of Lower Austria, EU and Ecoplus. However, also projects in exploratory state are included in the data set.

Table 4. Overview and description of territory-specific data sets – B30

Data set	Type of data	Description
UAB R&I agreements	Territorial data	The data set includes information on R&I agreements of the Universitat Autònoma Barcelona (UAB) with actors within the B30 territory in the years 2002-2019 (until April).

4. MAPPING OF THE SeeRRI R&I ECOSYSTEMS

Subject of the mapping are the three selected SeeRRI territorial R&I ecosystems: **Nordland**, **Lower Austria** and **B30**. The mapping for each territory follows exactly the analytical framework as introduced in the previous sections, enabling a comparative view between them, and pointing to a potential generalization of the framework to other contexts. In addition to the three SeeRRI case territories, the mapping is also conducted for some territories of the so-called Network of Affiliated Territories (NAT). NAT members are additional territories, with compositions that could mirror actors of the three focal territories regarding regional development policies, and innovation ecosystems. While for some of these NAT members a systematic mapping as implemented for the three SeeRRI territories makes no sense (e.g. smaller municipalities or cities) or is not feasible (e.g. large, and spatially vaguely defined cross-border or overseas areas), selected analyses have been conducted for the NAT members Montenegro, Ostrobothnia (Finland) and Haifa (Israel). These results are presented in Annex I.

4.1 NORDLAND

4.1.1 General ecosystem characterisation

The first part of the mapping of the R&I ecosystem of Nordland comprises a general characterisation of the respective ecosystem, focusing on its *institutional* and *sectoral* composition. Here, the ecosystem's actors are described with respect to their organisation type (e.g. industry firm, education, research organization, etc.), their technological, as well as their scientific disciplines – in a descriptive and aggregated way. An illustration of Nordland's **specialization patterns** complements the general characterisation by comparing the growth in sectors with their respective degree of specialization by means of a portfolio diagram.

4.1.1.1 Institutional composition

Based on the EU-projects funded in the Framework Programmes (drawn from the EUPRO data base; see Section 3.1 for details), a characterization of the R&I ecosystem based on the actors' organisational type is conducted (see Table 1). Overall, in Nordland 27 actors have been active in 38 EU-projects (in the FPs 6 to H2020, i.e. in the years 2002-2016). Note, that the object of analysis are R&D project participations rather than the projects themselves, hence two or more organisations of different type may be involved in the same project.

Regarding the distribution of the actors across different types of organisations, the majority of actors are industry firms (17 out of 27; i.e. 63%). Only two actors in educational organisations and three research organisations are involved in EU projects. However, in terms of number of projects conducted, the educational organisations - i.e. universities and colleges (*Høgskoler*) – with 15% of the total project participations are, relatively speaking, involved in more projects than industry firms with 55% of the total project participations. Though Nordland follows the European trend in the sense that public research organisations have a higher participations intensity (i.e. more participations per organisation), the 55% participation rate of industry is remarkable high and above the European average of about 30% (see Heller-Schuh et al. 2019).

Table 5. R&I ecosystem actors active in EU FP projects by organisation type

<i>Organisation type</i>	<i>Actors</i>		<i>Project participations</i>	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Industry (IND)	17	0.63	22	0.55
Education (EDU)	2	0.07	6	0.15
Research organisation (ROR)	3	0.11	5	0.13
Consulting (CON)	-	-	-	-
Government (GOV)	1	0.04	3	0.08
Others (OTH)	4	0.15	4	0.10
	-	-	40¹	1.00
Total	27	1.00	38	

¹ Multiple counting, if two or more actors of Nordland with different organisation types are involved in the same project.

4.1.1.2 Sectoral composition and science disciplines

The analysis of the patent activities (PATSTAT data base; see Section 3.1 for details) allows the characterization of the R&I ecosystem based on different fields of technology according to the International Patent Classification (IPC)⁶. The IPC patent classes are a hierarchical system of fine granularity with eight basic classes, which are used as unit of the sectoral composition.

Table 6. R&I ecosystem actors active in patenting by technological fields (including single-person applicants)

<i>Topic (IPC)</i>	<i>Actors¹</i>		<i>Patents²</i>	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Human Necessities (A)	20	0.24	26	0.31
Performing Operations & Transporting (B)	16	0.20	16	0.19
Chemistry & Metallurgy (C)	12	0.15	11	0.13
Textiles & Paper (D)	-	-	-	-
Fixed Constructions (E)	14	0.17	12	0.14
Mech. Engineering, Lighting, Heating, Weapons & Blasting (F)	11	0.13	10	0.12
Physics (G)	3	0.04	3	0.04
Electricity (H)	6	0.07	7	0.08
Total nominations	82	1.00	85	1.00
Total number of actors³	62		67	

¹ The number displayed denote actors active in respective IPC classes; actors may be active in more than one IPC class, which results in multiple counting of actors per IPC classes

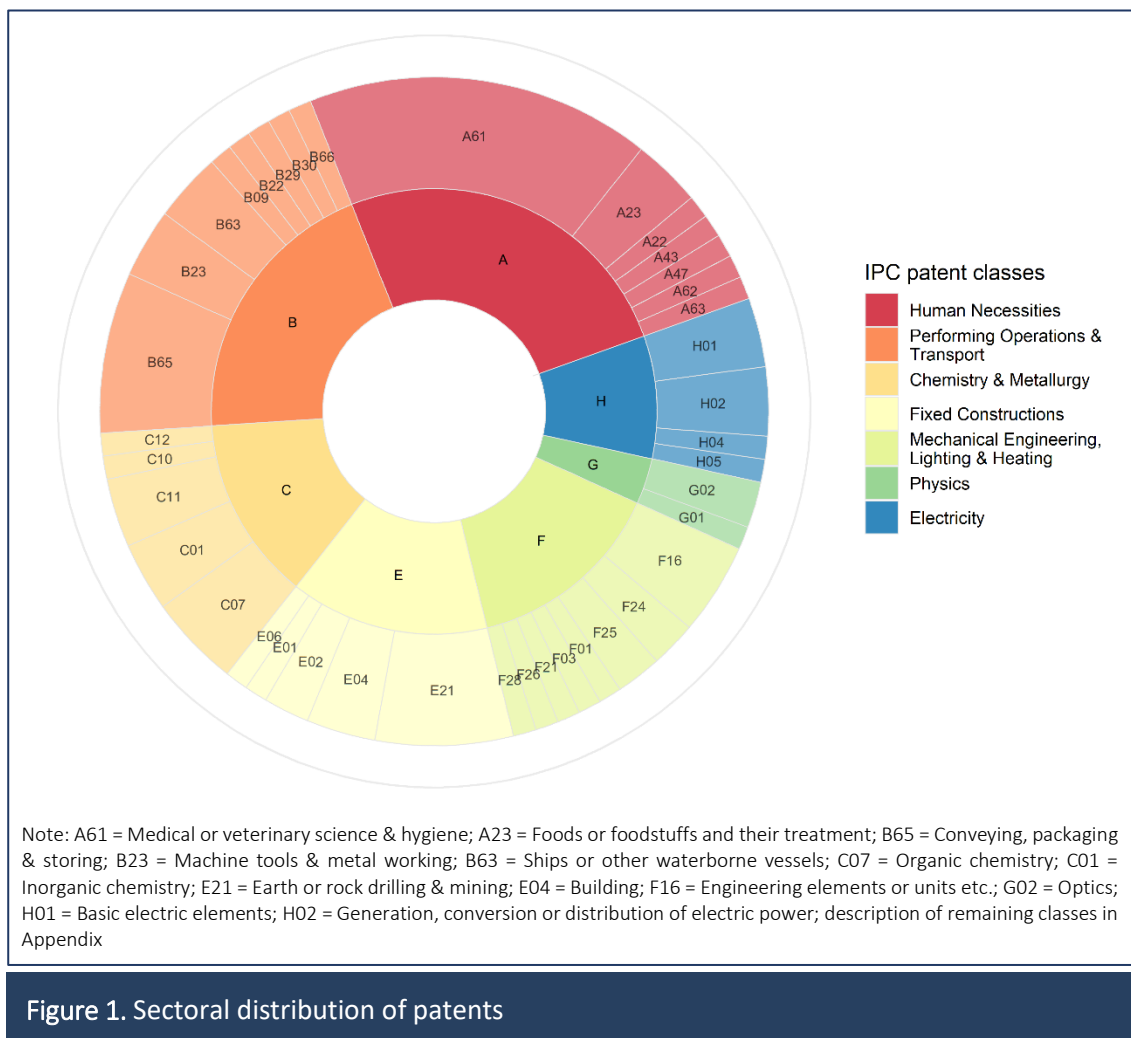
² The number displayed denote patents in respective IPC classes; patents are often assigned to multiple IPC classes, which results in multiple counting of patents per IPC classes

³ I.e. no multiple counting of actor/patents per IPC class

⁶ See <https://www.wipo.int/classifications/ipc/en/> for details on the IPC classification.

Since each patent is assigned to one or multiple patent classes, this kind of data is very well suited to gain insights into the sectoral distribution of the R&I ecosystem of Nordland. Mostly, more than one patent class are assigned to one patent, leading to multiple counting and a mismatch in the 'total of actors' and 'total of patents'.

In total, 62 actors have been patenting in Nordland over the years 2002-2014. Together, these actors applied for 67 patents; this corresponds to a share of approximately one patent per actor. However, some of these patents are co-patents, and as such have two or more inventors from different actors, leading to higher number of patents per actor (see Table 7).



In Nordland, the patenting actors' concentration in a specific technological field is not that pronounced. The highest shares of 24% and 20% are observed for Human Necessities, Performing Operations and Transporting (see Table 6 and Figure 1). The more high-tech oriented fields Physics and Electricity differ from the others in terms of patenting frequencies of the actors such that they show the lowest numbers. The sector Textiles and Paper features no patents in Nordland. Turning towards the distribution of the patents over the eight sectors, there is a

slight tilt towards Human Necessities in terms of a disproportionate number of patents given the share of actors; however, this effect is rather small. The ratio in the remaining sectors is more or less one-to-one.

A glimpse on the subclasses of the eight IPC patent classes (Figure 1) reveals that the largest subclass is Medical or veterinary science and hygiene (A61), followed by Conveying, packaging and storing (B65) and Earth rock drilling and mining (E21). Within the sector Chemistry and Metallurgy, Organic chemistry (C07) is found to be the largest subclass; in Mechanical Engineering, Lighting and Heating, Engineering elements and units etc. (F16) is predominant.

Another angle on the sectoral distribution of the R&I ecosystem of Nordland is illustrated in Figure 2 using scientific publications (2015-2019; only disciplines with more than 10 publications are illustrated). The publications are extracted from the Web of Science (WoS; see Section 3.1 for details on the data base) and are classified by scientific disciplines (categories), as specified by WoS. In total 1080 publications were published by authors located in Nordland.

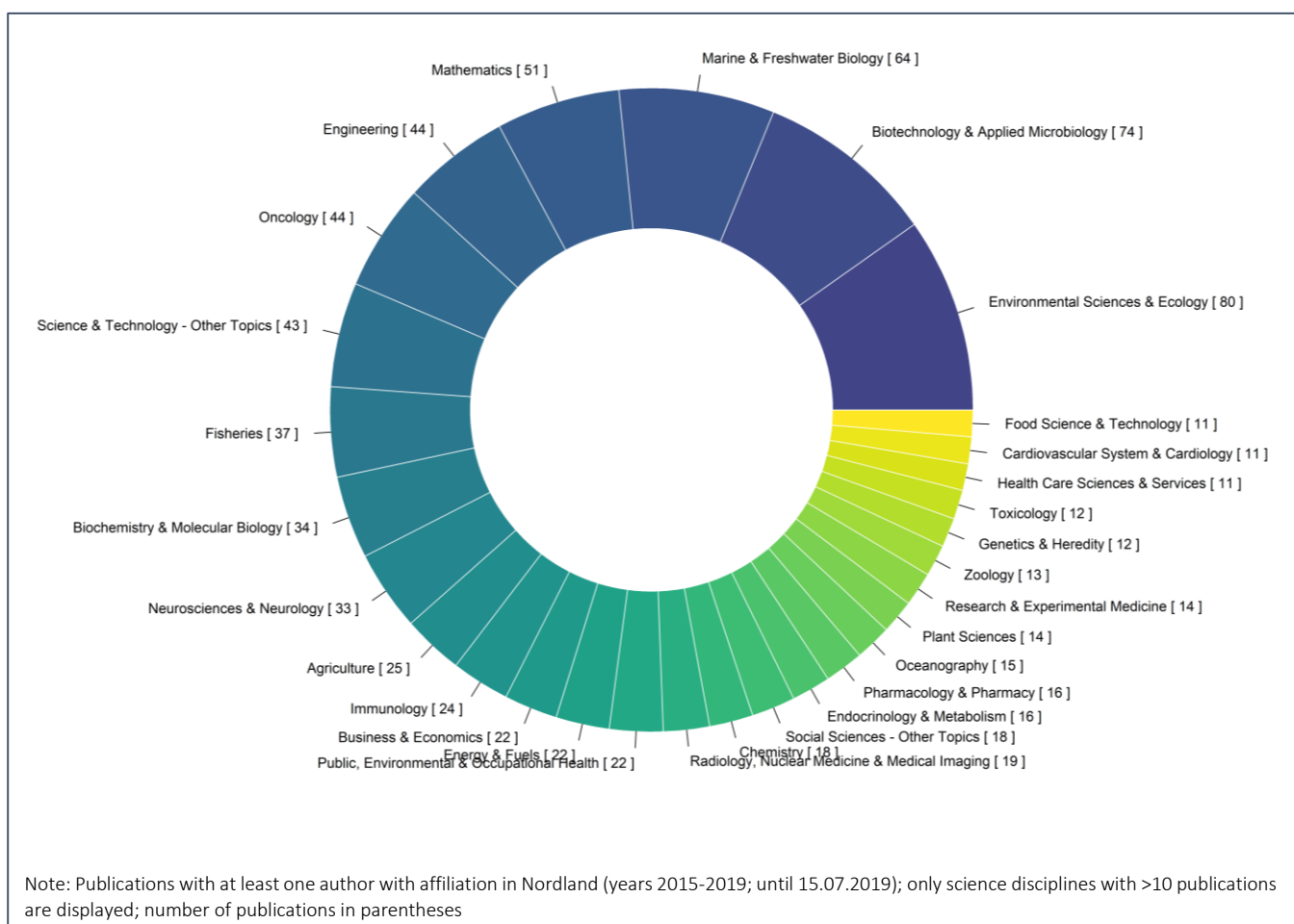


Figure 2. Distribution of publications across science disciplines

The highest number of publications is present in the discipline of Environmental Sciences & Ecology with 80 publications. Followed by Biotechnology & Applied Microbiology (74 publications), and Marine & Freshwater Biology (64 publications). These three sectors approximately account for a quarter of the total publications. Other important science disciplines are Mathematics, Engineering, and Oncology. This points to an observable correspondence between academic and technological knowledge production in Nordland as these fields are clearly underlying the strongest patenting fields of the region (Human Necessities).

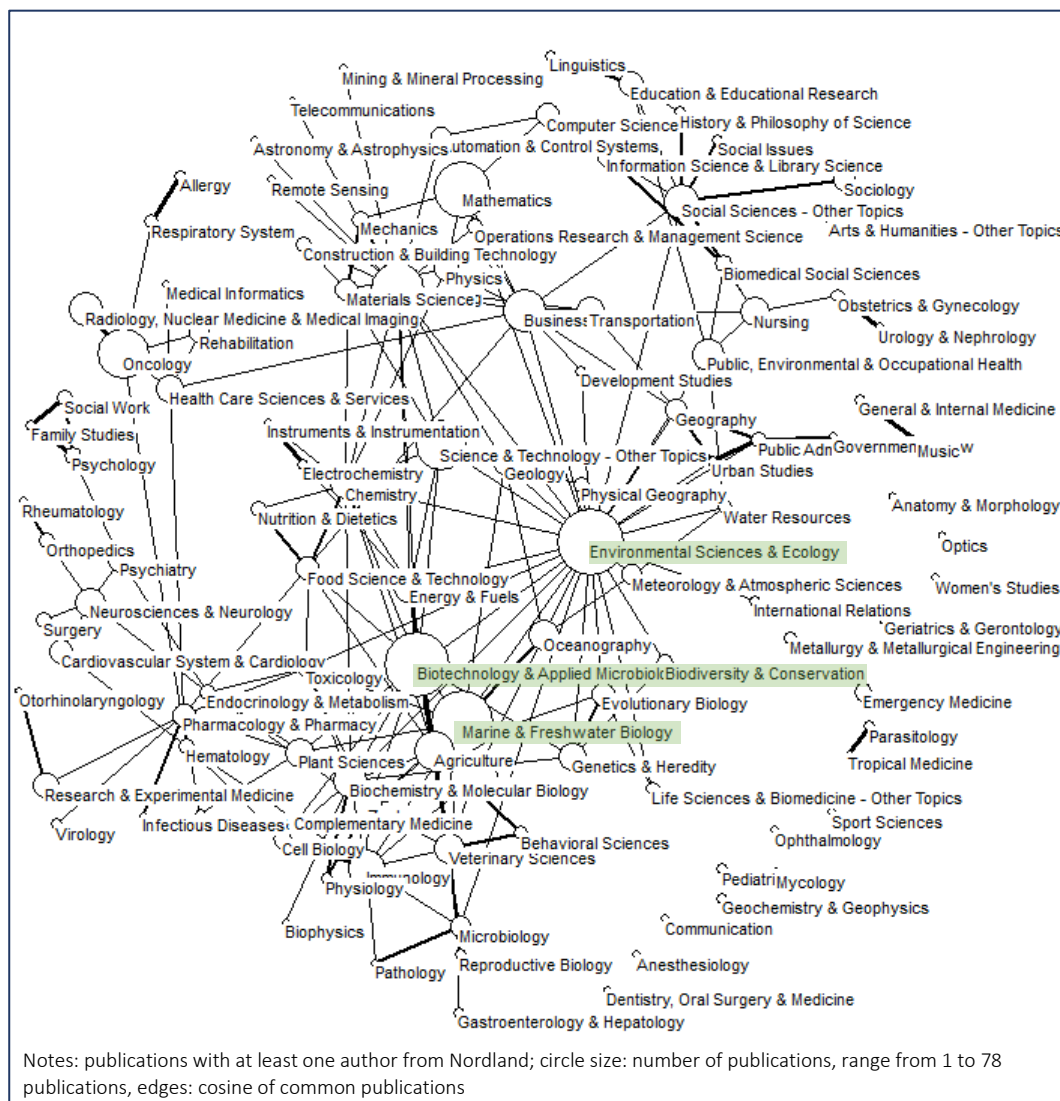


Figure 3. Cooccurrence network of science categories in publications

Looking at the cooccurrence network of the publications' science categories (see Figure 3), shows that the research output in terms of the number of publications is dominated by 80 publications in Environmental Sciences and Ecology, which also has the highest discipline degree centrality of 0.24 (27 co-disciplines); hence it is a central discipline in Nordland. Additional central disciplines in terms of the number of publications but also in terms of number of co-disciplines are Biotechnology & Applied Microbiology, as well as Marine & Freshwater Biology.

4.1.1.3 Specialization patterns

In this section we shift attention to the analysis of the overall topical and technological specialisation patterns of Nordland. For this exercise, we make use of the Revealed Technological Advantage (RTA) as introduced in Section 2, and of the patent data as described in Section 3.1. The RTA measures the relative specialisation of Nordland in a specific technological field as compared to a reference group, in this case European regions. The index ranges from zero to infinity, where a value below 1 indicates a smaller patenting activity in a specific field, while values above 1 indicate a specialisation in this field in comparison to other European regions. Note that a value of e.g. 2 in a specific technology and region indicates double as much patents in that field and that region as compared to the European average.

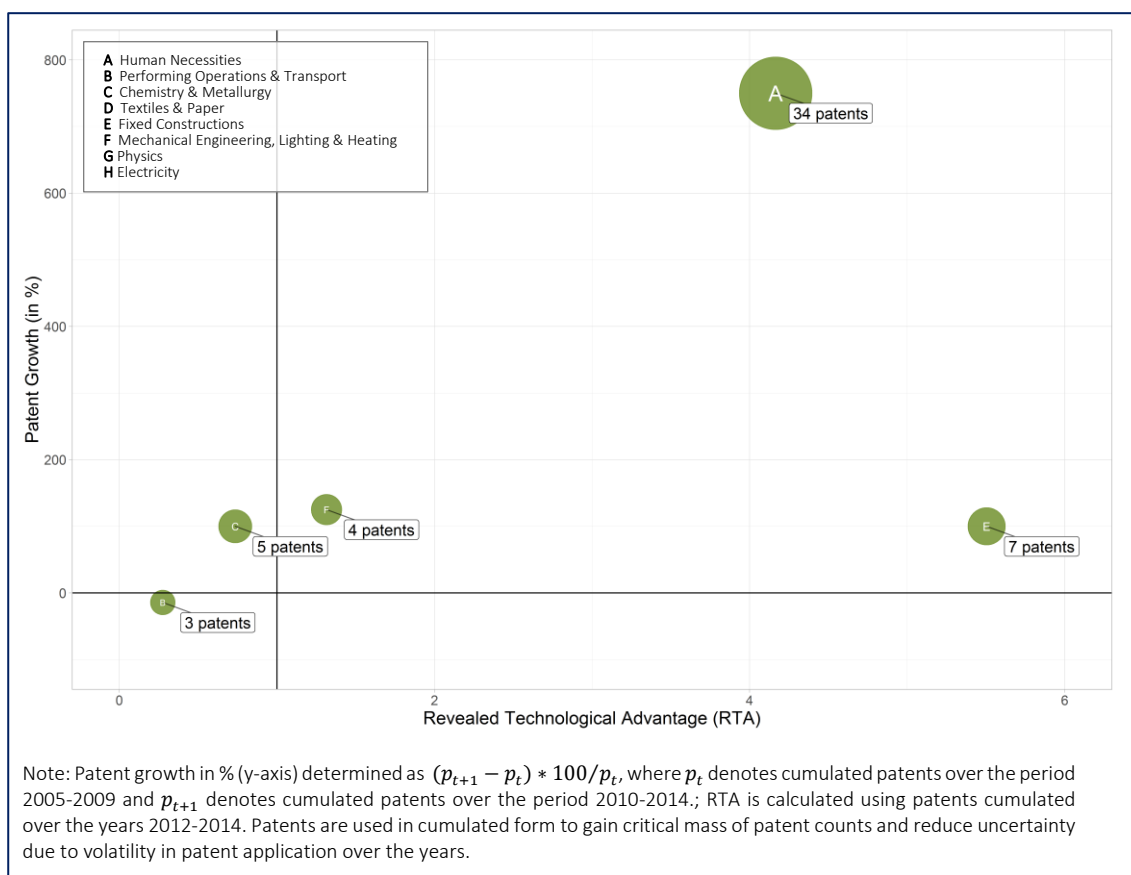


Figure 4. Sectoral specialization and growth

For the RTA calculation we use all regional patents aggregated over the period 2012-2014. In addition, it may be useful not only to look at specialisation tendencies in a specific field, but also to the growth pattern of this field in the recent past. There we compare the calculated specialisations with patenting growth from the period 2005-2009 to the period 2010-2014. Moreover, we interpret the RTA always against the total number of patents. This is necessary since in case of small numbers in patenting, specialisation measures like the RTA are to be interpreted with caution; a region with e.g. only 5 total patents, having 4 of them in one technological field, will get a high RTA value in that field, even though it has only 4 patents.

Figure 4 presents the RTA results for Nordland in form of a regional portfolio diagram. The x-axis plots the RTA values for the technologies based on the one-digit IPC classification (see Section 3.1); the y-axis displays the percentage growth between the two periods considered, while the size of the circles corresponds to the number of patents in a specific technological field.

The results for Nordland give a very clear picture that can easily be interpreted. Nordland shows an explicit specialisation in the technological field Human Necessities that is in particular driven by the subclasses medical and veterinary science as well as food. The latter may be specifically related to the fisheries sector highly developed in that region. The specialisation is underlined as Nordland also has the highest number of patents in Human Necessities as well as the highest growth rate in that field with nearly 800% between the two periods considered.

The RTA also points to a specialisation of Nordland in Mechanical Engineering, though the overall number of patenting is rather low. Also, the number has not grown between the two periods considered. Accordingly, it cannot be considered as a real specialisation advantage of Nordland. The same is the case for the remaining technological fields, e.g. Physics, Electricity, etc., where Nordland shows RTA values below or around 1, rather minor growth rates and also a low number of patenting.

4.1.2 R&I actors and collaborations

Building upon the general characterization of the R&I ecosystem of Nordland – including an analysis along institutional and sectoral dimensions on an aggregated level, this section is aimed at an analysis on the **actor-level** (i.e. organisational level). R&I actors – such as i.e. organisations such as firms, universities, research organisations, etc. – constitute the backbone of R&I ecosystems as they provide the institutional framework for research and innovations activities by individual researchers. Subsection 4.1.2.1 provides an overview of the R&I actors in terms of patenting activity, participation in EU projects, and scientific publishing.

Moreover, the interactions between these actors, in terms of collaborative R&D projects and joint scientific publications, stand in the focus of this chapter as they constitute essential means by which organizations create and/or access new knowledge. In Subsection 4.1.2.2, these interactions between R&I actors – national and international – are represented and analysed by means of network diagrams.

4.1.2.1 Actors

In total, 15 organisational actors are active in patenting in Nordland (in the years 2002-2014; private individuals are excluded). Except for the University of Nordland, the patenting organisations are exclusively industry firms, which is natural given the generally application-oriented and exploitation-driven research focus of researching industry firms. Looking at the ranking (see Table 7), ConceptoMed AS is – with seven patents – the leading patenting firm in Nordland.

Table 7. Actors active in patenting

Rank	Name	Org. type	Patents
1	ConceptoMed AS	IND	7
2	Akvadesign AS / Akvafuture	IND	3
2	Narvik Composite AS [PUB]	IND	3
3	Heatwork AS	IND	2
3	Quatee AS	IND	2
3	Rapp Hydema AS / Rapp Marine Group [PAT]	IND	2
4	Bioenergi Nord AS	IND	1
4	Bocon Holding AS	IND	1
4	Development Lofoten AS	IND	1
4	Norut Teknologi AS	IND	1
4	Rantex AS	IND	1
4	Rognan Bioenergi AS	IND	1
4	Tastein Technology AS	IND	1
4	Therm-Tech AS	IND	1
4	Nord University/University of Nordland [PUB]	EDU	1

Note: 'PROJ' and 'PUB' in squared parenthesis indicate that actors are also active in EU-funded projects (PROJ) and/or scientific publishing (PUB); see Appendix II for organisation types abbreviations

ConceptoMed creates smart medtech systems with focus on improved devices and procedures for healthcare and patient care. The second rank is shared by Akvadesign AS and Narvik Composite AS, with each three patent applications. Whereas, Akvadesign AS is a company aiming for sustainable solutions in the salmon production process, Narvik Composite AS produces composite rollers for the global mining industry.

Turning to the actors active in EU-funded projects (FP6, FP7 and H2020; Table 8), in total 27 actors were found for the R&I ecosystem of Nordland. As for the type of organisation, industry firms, research organisations, universities and a hospital are involved in projects.

The Andøya Space Center AS, as well as the Nord university are the leading actors with each five project participations. The research of Andøya Space Center focuses e.g. on the calibration and validation of satellites, space-borne observations in support to the operational monitoring of air quality, ozone and climate. Nord University is one of two universities in Nordland committed to education and research with a focus on blue and green growth, innovation and entrepreneurship, welfare, health and education.

It is worth mentioning, that the sets of actors active in patenting and those active in EU projects are almost not overlapping. I.e. only Rapp Hydema AS is active in both, patenting and EU projects (as indicated by the addition of [PROJ, PAT] to the organisation's name in the two tables 7 and 8). With a strong focus on R&D, Rapp Hydema AS has developed new generations of advanced machinery and equipment for the marine and offshore oil industries.

Table 8. Actors active in EU-funded projects

Rank	Name	Org. type	Participations
1	Andøya Space Center AS	IND	5
1	Nord University [PAT, PUB]	EDU	5
2	Registerenheten i Brønnøysund	GOV	3
3	Fjord Marin Holding ASA	IND	2
3	Gigante Offshore AS	IND	2
3	Gildeskål Forskningsstasjon	ROR	2
3	Norut Northern Research Institute AS [PUB]	ROR	2
4	Bodø Krakebolleklekkeri BKK AS	IND	1
4	Fjord Seafood ASA	IND	1
4	Hafenstrom AS	IND	1
4	Helgelandstorsk AS	IND	1
4	Hemnes Mek Verksted AS	IND	1
4	Høgskolen i Nesna	EDU	1
4	InnoTech Solar	IND	1
4	Nordlaks Produkter AS	IND	1
4	Nordland Hospital HF [PUB]	HSP	1
4	Nordlandsforskning/Nordland Res. Institute [PUB]	ROR	1
4	Norwegian Crystallites AS	IND	1
4	Norwegian Graphite AS	IND	1
4	Rapp Hydema AS / Rapp Marine Group [PAT]	IND	1
4	Salt Lofoten AS	IND	1
4	Salten Havbruk AS	IND	1
4	Sandnessjøen Engineering AS	IND	1
4	ScanWafer AS	IND	1
4	Store Norske Spitsbergen Grubekompani AS	IND	1
4	Tag Sensors AS	IND	1

Note: 'PAT' and 'PUB' in squared parenthesis indicate that actors are also active in patenting (PAT) and/or scientific publishing (PUB); see Appendix II for organisation types abbreviations

A descriptive overview of the top actors active in scientific publishing (in the years 2015-2019; drawn from WoS) is given in Table 9. Not surprisingly, the Nord University is the leading actor in terms of the number of scientific publications published (with 317 publications). With a large gap, the Nordland Hospital is on rank two, with 138 publications, followed by the Arctic University Norway with 50 publications.

Table 9. Top actors active scientific publishing (>5 publications)

Rank	Name	Org. type	Publications
1	Nord University [PROJ, PAT]	EDU	317
2	Nordland Hospital	HSP	138
3	UiT Arctic University Norway	EDU	50
4	Narvik University College	EDU	42
5	Northern Research Institute Narvik Norut [PROJ]	ROR	18
6	Norwegian Institute of Bioeconomy Research - Nibio	ROR	17
7	Nordland Research Institute	ROR	10
8	Northern Norway Regional Health Authority	GOV	6
9	Bioforsk Norwegian Institute for Agricultural & Environmental Research	ROR	6

Note: 'PROJ' and 'PAT' in squared parenthesis indicate that actors are also active in EU FP projects (PROJ) and/or patenting (PAT); see Appendix II for organisation types abbreviations

4.1.2.2 Project collaborations

Initially, Table 10 summarizes some descriptive analyses regarding project-based R&D collaborations in Nordland. On the territorial level of Nordland, in total 29 actors participated in EU FP projects (2002-2016); however, only three collaborations between these regional partners are observable. The territorial actors have 45 national collaboration partners with whom they were engaged in project collaborations 89 times. Turning to the European level, the territorial actors were engaged with 470 project partners and 619 collaborations.

Table 10. Collaborations - descriptives

<i>Spatial scale</i>	Number of actors	Number of collaborations
Territorial	27	3
National	45	89
Europe-wide	470	619

Note: based on EU FP project data drawn from the EUPRO database

Figure 5 visualises the project-based R&D collaboration network of Nordland as reflected in the EUPRO database. Note that a spring model inspired visualisation approach is used here, i.e. the dots are placed so that nodes with higher interaction and a similar partner profile come closer to each other, while nodes with less interaction and a more dissimilar partner structure are placed more apart from each other.

The partners located in Nordland are represented by nodes given in orange colour, the blue ones are located elsewhere in Norway. Interestingly, the network visualisation points to a clear community structure of the network, next to some fragmented triangles or doubles not connected to the main component. The main component clearly features three clusters (i.e. subnetwork more densely connected), with one large cluster comprising national actors in the centre.

In the other two clusters, Nordland organisations are prominently participating, but do not play the central role. Interestingly, Nordland seems to feature one important organisation acting as knowledge gatekeeper between two clusters. The organisation Fjord-Marín ‘bridges’ the central cluster with most connections, and the one located on the top left of the visualisation, featuring the National Institute of Technology (Teknologisk) as main organisation. Against the fact that Nordland features comparably few projects overall, the organisations participating take quite important positions in the collaboration networks, both within the Nordland region and across regions.

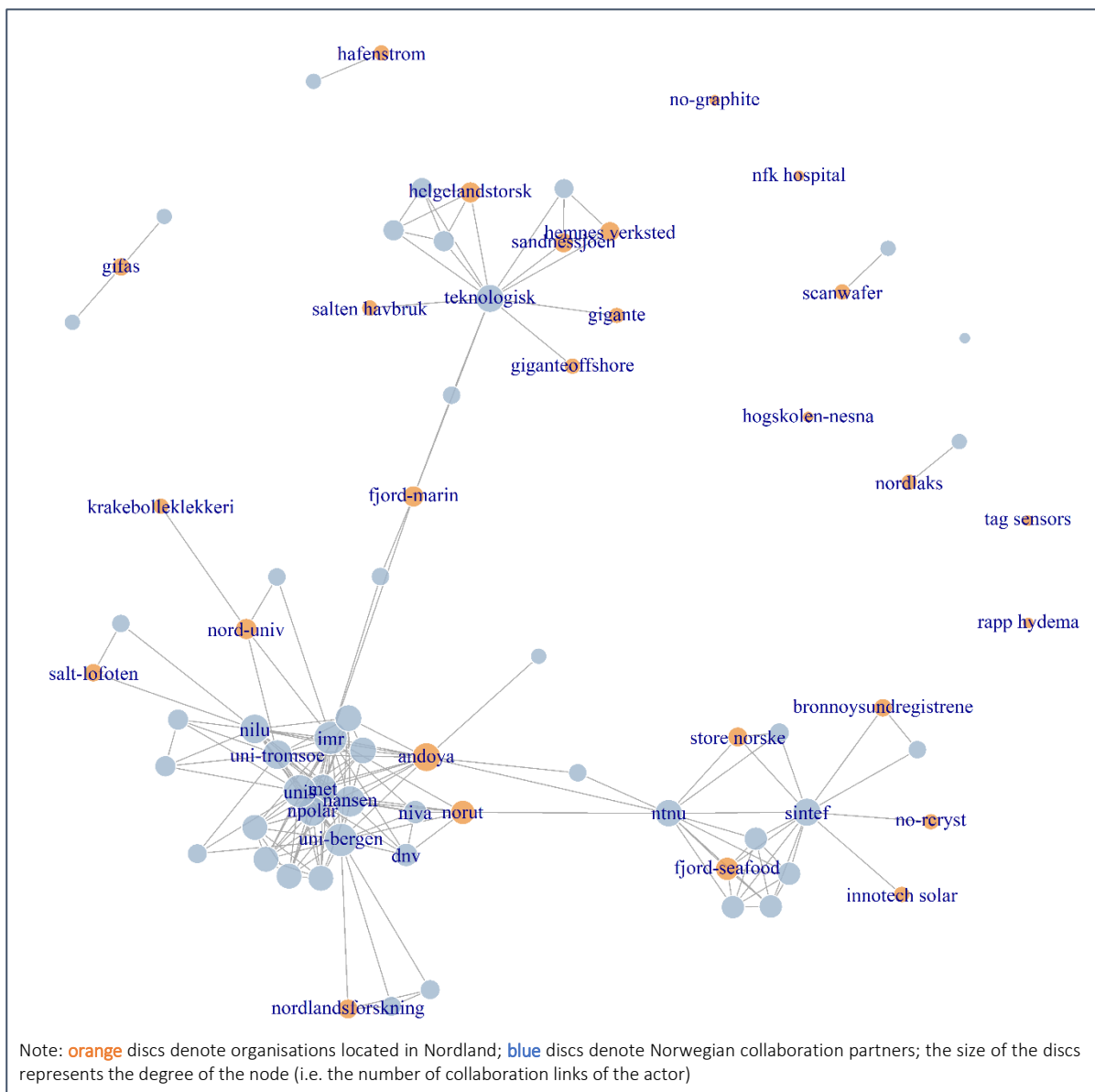


Figure 5. National project collaborations of territories' R&I actors

Turning to the extra-Norwegian links of Nordland (schematically illustrated by Figure 6, showing the top partner countries and organisations located outside of Norway), it can be seen that the UK, Denmark, France and Germany are main partner countries. As for the organisations, there is no clear pattern of highly prominent partner organisations that stand out; the collaboration intensity with partners outside Norway is quite similar among the top partners. This indicates some ability to diversify links across different partners located in different countries, which can be important to gain complementary knowledge from these diverse partners.

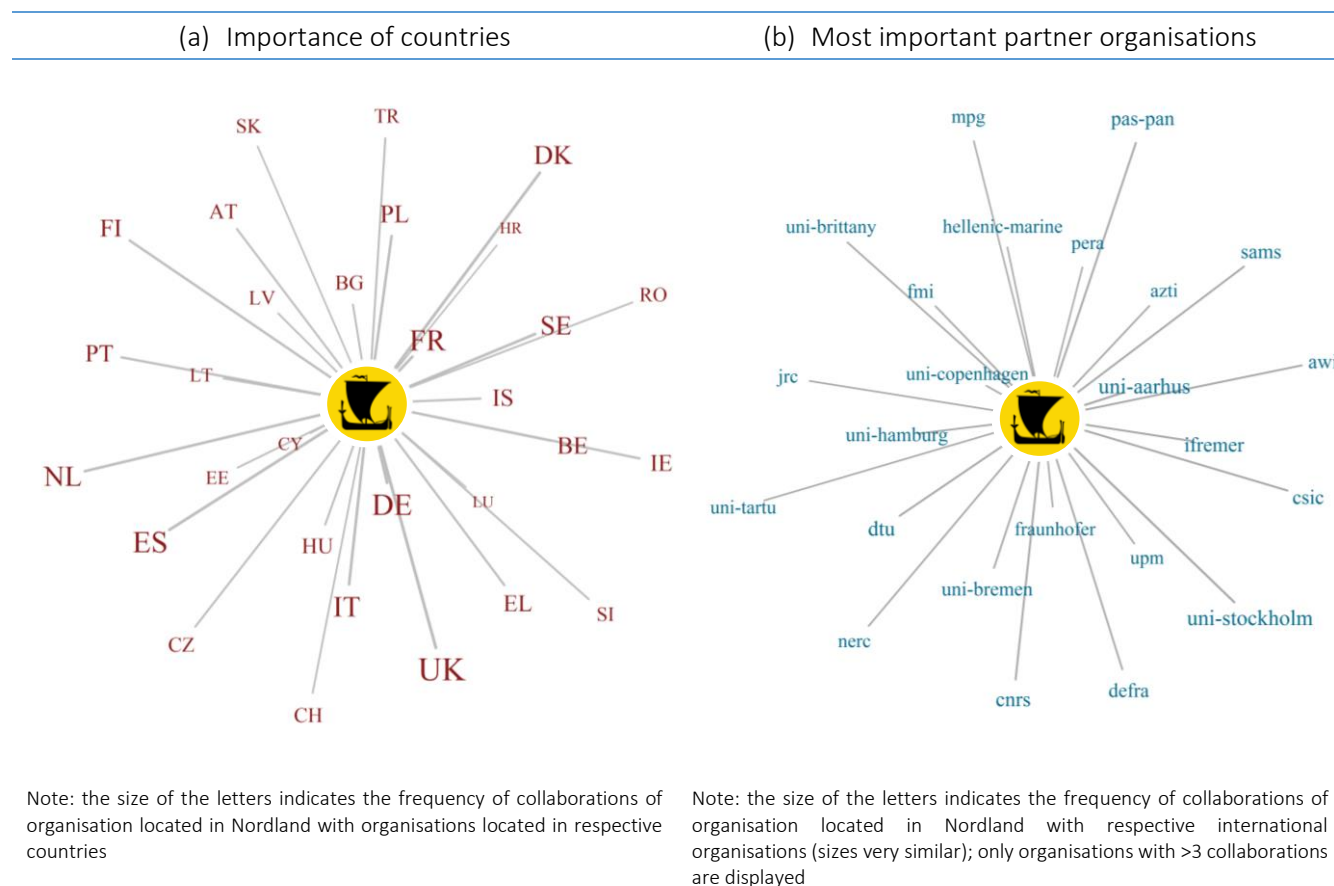


Figure 6. European project collaborations of territories' R&I actors

4.1.3 Territory specific analysis of thematic focus

For each SeeRRI territory, a thematic focus has been selected by territory representatives that will be targeted throughout the whole SeeRRI project, and hence will be highlighted from different point of views. The analysis in the course of this quantitative mapping aims to shed light on the R&I specific landscape of Nordland in the context of the thematic focus.

The thematic focus of Nordland for the SeeRRI project is defined as follows:

“The detected thematic focus for the ecosystem concerns finding new ways to develop a more sustainable society through regional strategies and planning processes as well as to involve different types of stakeholders. Finally, Nordland wants to define common and specific goals and actions to address the 17 SDGs together with relevant stakeholders.”

It was necessary to narrow down the focus such that it is suitable for a quantitative analysis, hence the focus was specified on issues in **“Environmental Sciences & Ecology”**. These issues are picked from thematic landscapes of all activities documented by publications and EU-funded projects from the region.

Consequently, the approach to elaborate the thematic focus is twofold. On one hand the scientific research activity is analysed with a map of all publications in the WoS database with at least one author with an affiliation from the region. Agglomerations of similar publications that are represented in a 3D heat map give an insight view in thematic activities. On the other hand, the content of EU funded projects with a participation of Nordland’s organizations is represented by a co-word map. Finally, actors are listed by thematic categories.

Insights from these analyses illustrate thematic fields, in which the territorial R&I actors are active, along with similar topics the actors are already involved, or could be involved in, in the future. This shows the potential of the R&I actors to diversify to other similar, but new fields of science and technology. The identification of strong science and technology fields is especially relevant in the context of Smart Specialisation⁷; showing the strengths and future potential of the R&I ecosystem regarding the thematic focus. Moreover, core actors are identified, that serve as input for the stakeholder engagement processes in subsequent work packages of this project.

4.1.3.1 Publication landscape

The publication landscape serves for the identification of thematic issues that are of relevance for the project and for the determination of thematically relevant actors.

The data basis for the publication landscape is a collection of items from the WoS database. The search strategy served to identify affiliations of authors from the Nordland region. The data base consists of 694 publications for the time span 2015 to 2019 (the retrieval date was 17.07.2019).

⁷ <https://s3platform.jrc.ec.europa.eu/de/what-is-smart-specialisation->

The analysis of the publication landscape consists of the following elements:

- i. Disciplines of publications with relevance for the thematic focus
- ii. Science map of research fields with a selection of relevant research activities
- iii. Actors by research field with publications in the thematic focus

i. Disciplines of publications with relevance for the thematic focus

Disciplines cooccurring together with “Environmental Sciences & Ecology” in the classification of publications by WoS are highlighted in the cooccurrence map of Figure 3 (see Section 4.1.1.2) and separately displayed here in Figure 7. As to be expected, the research output of 80 publications in Environmental Sciences & Ecology is highly multidisciplinary. The research in this discipline is combined with 27 other disciplines.

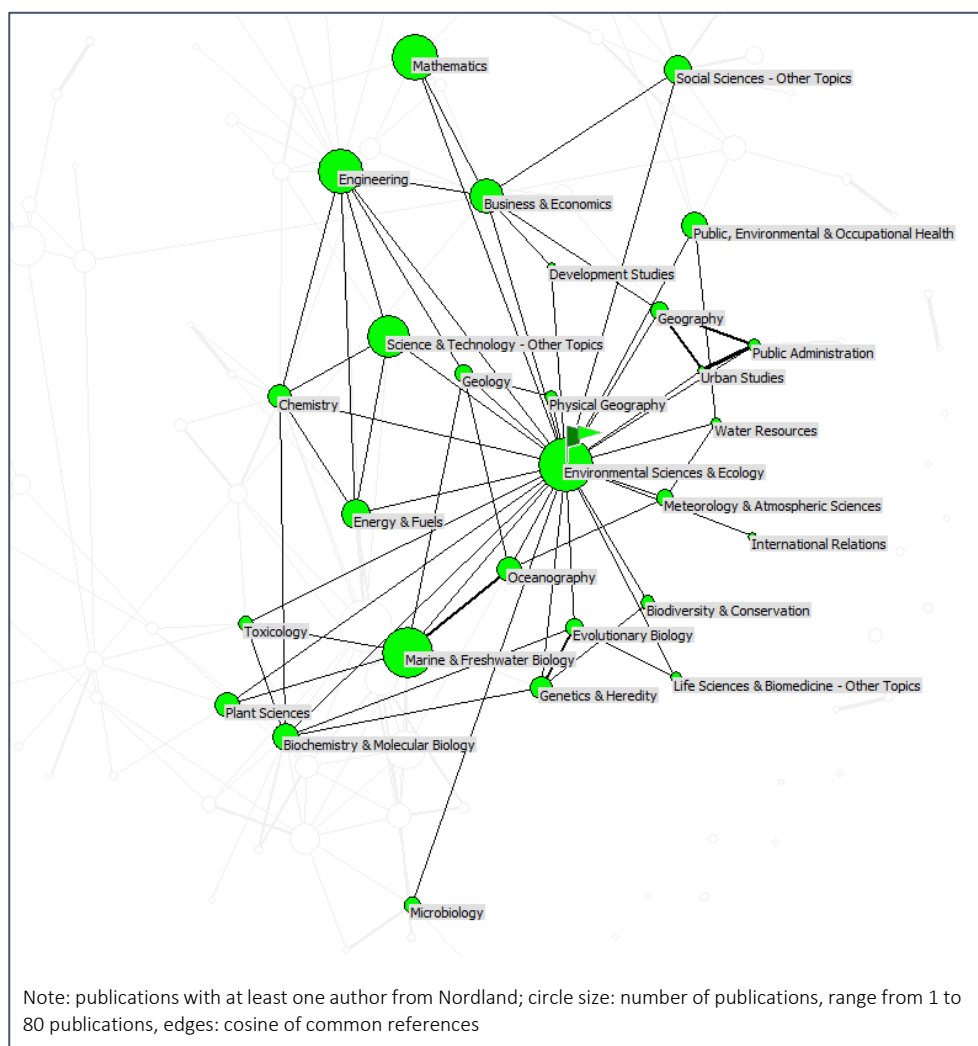


Figure 7. Environmental Sciences & Ecology with cooccurring science categories

The most dominant co-disciplines – in terms of the number of publications – are Marine & Freshwater Biology with 13 publications, Science & Technology with also 13 publications, Engineering, as well as Evolutionary Biology, both with 5 publications (i.e. the number of publications linked to the discipline of Environmental Sciences & Ecology).

ii. Science map of research fields

The thematic orientation of published research in Nordland is analysed by a relational approach of bibliographically coupled publications. The research fields are delineated from agglomerations of similar publications. The similarity is measured by the cosine of common references and displayed in a 3-dimensional map (the cosine of the dot product of vectors of all references cited in the dataset with 0 if a reference is not cited and 1 if a reference is cited in the publication). The distance of the items was calculated with a spring model. The 3D map shows the research activity in specific fields that are documented in publications in journals and proceedings of conferences, see in Figure 8.

The publication output of authors with an affiliation in the region of Nordland shows a considerable dominance of research on microalgae with 71 publications. Microalgae are often considered as a promising alternative biomass source of vegetable oils. These oils can be used for food, biofuel applications and other industrial products.

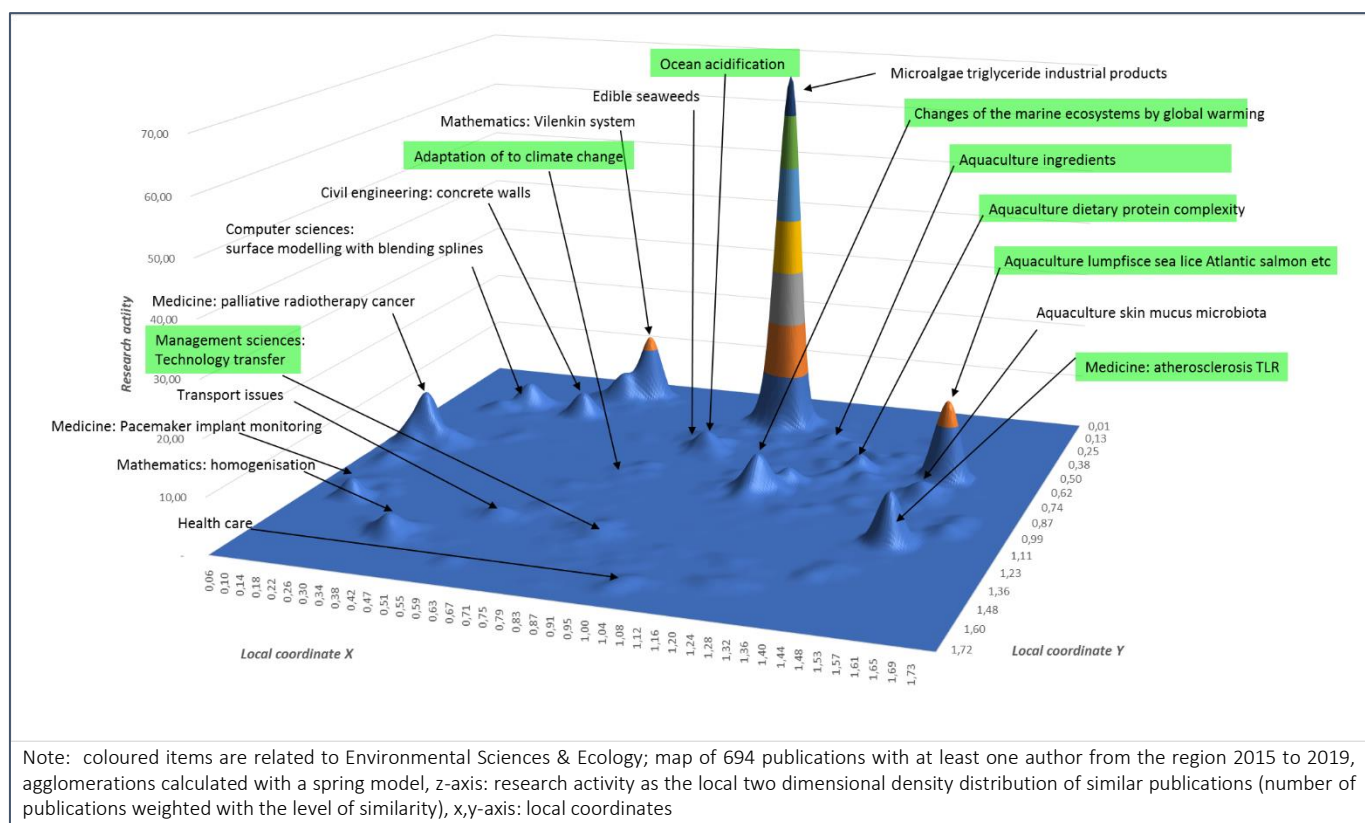


Figure 8. 3D science map of publications in research fields

One research focus in Nordland is on Microalgal triglycerides (TAGs) that hold great promise as sustainable feedstock for commodity industries. Research related to the aquaculture of fish has also reached major proportions. The research fields in the map were assigned to the thematic focus defined by the discipline “Environmental Sciences & Ecology” and marked with green colour in the science map.

Dominant thematic scientific specialties with close relation to “Environmental Sciences and Ecology” are “Changes of the marine ecosystems by global warming” with 18 publications, “Technology transfer” with 10 publications, “Adaption of ecosystems to climate change” with 7 publications. Additional research fields are listed in Table 11.

Table 11. Research fields related to Environmental Sciences & Ecology (ESE)

Research Fields	Publ. in ESE	Total publ.	ESE in %
Adaptation to climate change	7	11	64%
Aquaculture dietary protein complexity	2	19	11%
Aquaculture ingredients	1	10	10%
Aquaculture lumpfish sea lice Atlantic salmon etc	2	23	9%
Changes of marine ecosystems by global warming	18	30	60%
Management sciences: technology transfer	10	26	38%
Medicine: atherosclerosis TLR	1	29	3%
Medicine: Pacemaker implant monitoring	1	5	20%
Microalgae triglyceride industrial products	2	71	3%
Ocean acidification	3	11	27%
Other	31	258	12%

iii. *Actors by research field with publications in the thematic focus*

The organizations with the chosen thematic focus are collected from the affiliations of authors who publish in the identified research fields of Figure 7. That means that the research is related to Environmental Sciences & Ecology but is also accompanied by a remarkable number of publications that have been agglomerated to bunches of thematic issues.

Table 12. Actors by research fields in Environmental Sciences & Ecology

Research Fields	Actor	Publications
Adaptation to climate change	Nordland Res Inst, POB 1490, N-8049 Bodo, Norway	6
	Nord Univ, Fac Social Sci, Univ Saleen 11, N-8026 Bodo, Norway	1
Aquaculture dietary protein complexity	Nord Univ, Fac Biosci & Aquaculture, Postbox 1490, N-8049 Bodo, Norway	11
Aquaculture ingredients	Nord Univ, Fac Biosci & Aquaculture, Postbox 1490, N-8049 Bodo, Norway	7
	GIFAS, N-8140 Nordvagen, Inndyr, Norway	1
Aquaculture lumpfish sea lice Atlantic salmon etc	Nord Univ, Fac Biosci & Aquaculture, Postbox 1490, N-8049 Bodo, Norway	9

Research Fields	Actor	Publications
Changes of marine ecosystems by global warming	Nord Univ, Fac Biosci & Aquaculture, Postbox 1490, N-8049 Bodo, Norway	25
Management sciences: technology transfer	Nord Univ, POB 1490, N-8049 Bodo, Norway	1
Medicine: atherosclerosis TLR	Nord Univ, Business Sch, N-8049 Bodo, Norway	11
Ocean acidification	NORD Univ, Fac Hlth Sci, N-8049 Bodo, Norway	1
	Norwegian Inst Bioecon Res, Kudalsveien 6, N-8049 Bodo, Norway	6
	Bioforsk Norwegian Inst Agr & Environm Res, N-8049 Bodo, Norway	2

4.1.3.3 Project landscape

In this chapter EU-funded research projects are segmented into thematic fields. That way actors from Nordland (who are partners in EU-funded projects) could be identified and thematically classified.

i. Keyword map of EU funded Projects

In a first step the projects are thematically structured by a co-word analysis. The keywords used for this co-word analysis were extracted from the project title, objective, programme information and project subjects⁸. In total, 103 keywords have been considered. For a better understanding the extracted keywords were manually condensed to a set of 59 keywords.

The co-word map offers a valuable insight view in the thematic structure of all projects (see Figure 9). The dominant fields in EU funded research field is aquaculture with 15 project participations in the fields of fish farming, mussel harvesting and sea urchins. With 9 project participations, the second most important research are earth sciences in terms of marine research and arctic research, as well as information technology. Other important fields are energy research with projects in wind energy, hydrogen production and the development of batteries, electronics, social sciences.

⁸ One-word keywords were excluded because more words keywords have a better information value. Relevant single word keywords with more than 1 publication like “sustainability” were included. Keywords that occur only in one publication were also excluded.

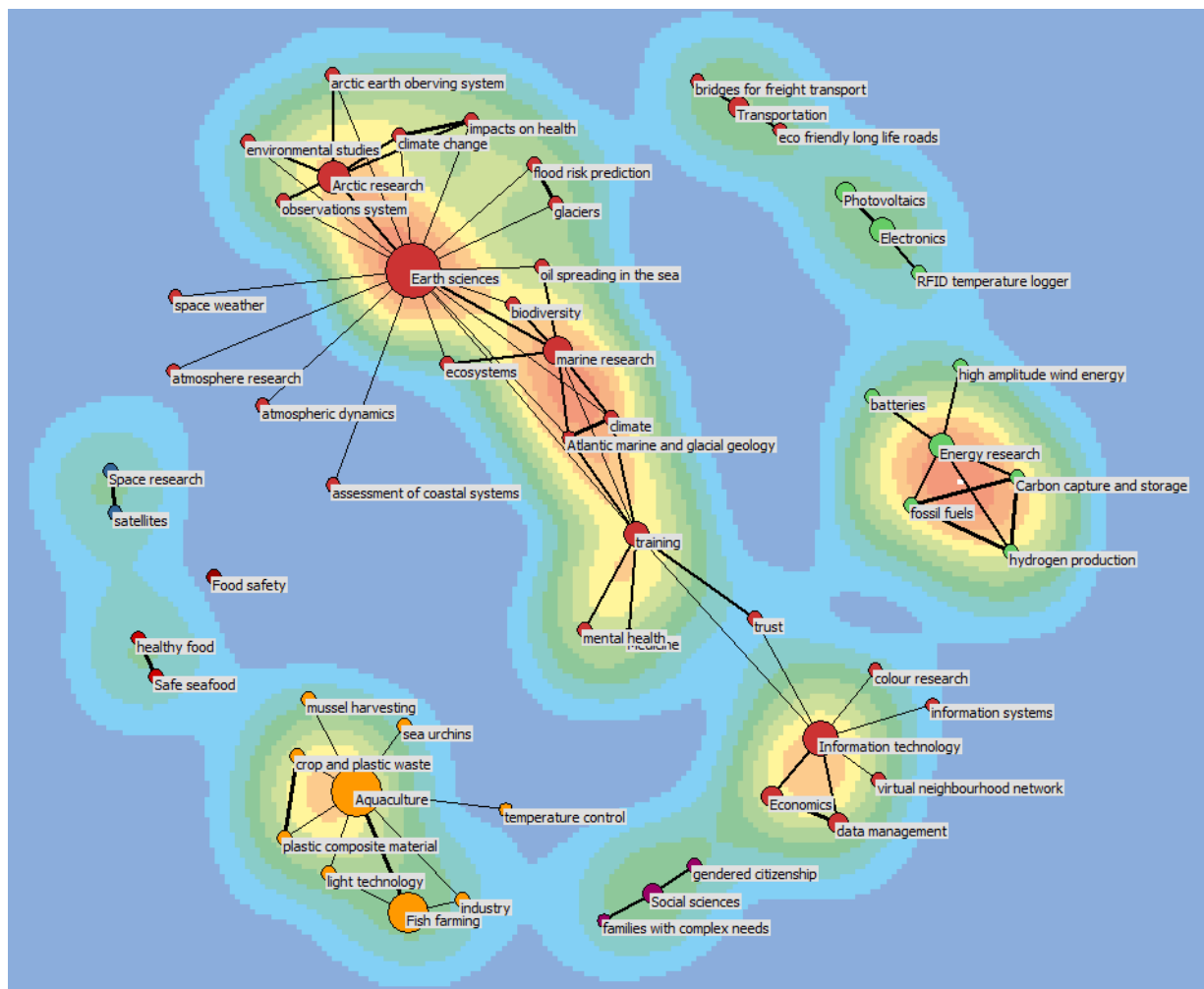


Figure 9. Co-word map of manually assigned keywords to projects

ii. Applicants of relevant projects

The second step was the selection of relevant fields for the thematic focus in this project. Earth sciences and aquaculture were selected for the identification of actors.

The applicants are listed in Table 13. The most active organisation in the field of aquaculture – in terms of EU funded projects – is Fjord Marin Holding ASA which its roots in the development of salmon farming. Nowadays, the company is a key player in cod farming (Norway), as well as farming of the Mediterranean species seabass and seabream. A number of new species have been adapted to an environment so that they are suitable for farming and industrial production.

Table 13. Applicants in projects of the EU FP projects by relevant research fields

Research subject	Organization	Projects
Aquaculture	FJORD MARIN HOLDING ASA	3
	Nord University	3
	GILDESKAL FORSKNINGSSTASJON AS	2
	SALTEN HAVBRUK AS	1
	BODO KRAKEBOLLEKLEKKERI BKK AS	1
	SANDNESSJOEN ENGINEERING AS	1
	HEMMES MEK VERKSTED AS	1
	HELGELANDSTORSK AS	1
	GIGANTE OFFSHORE AS	1
	GIGANTE AS	1
Earth Sciences	ANDOYA ROCKET RANGE AS	2
	ANDOYA SPACE CENTER AS	2
	Nord University	2
	NORDLAND HOSPITAL HF	1
	Norut Northern Research Institute AS	1
	SALT LOFOTEN AS	1

KEY FINDINGS - NORDLAND

- R&I actors active in collaborative EU projects are predominantly firms, which are also engaged in the majority of project participations; universities also amount to relatively high share of project participations.
- The dominant industry class - in terms of patenting – is Human Necessities (fishing and aquaculture).
- In terms of scientific publications, Environmental Sciences & Ecology, Biotechnology & Applied Microbiology, as well as Marine & Freshwater Biology are the three most important disciplines.
- Nordland shows a specialization (and sector growth) in the sector of Human Necessities, which is largely driven by the fishery and aquaculture industry.
- Regarding project collaborations, the 27 territorial R&I actors are engaged with 45 national partners and 470 European partners; territorial actors are linked to national network hubs, such as University Centre in Svalbard (UNIS), SINTEF, and the National Institute of Technology.
- Amongst the most important partner countries there are the UK, Denmark, France and Germany, etc.
- The publication analysis of the territory-specific focus - Environmental Sciences & Ecology – reveals Marine & Freshwater Biology, Engineering, as well as Evolutionary Biology as dominant disciplines; especially, research on microalgae and aquaculture of fish are dominant.
- Important R&I actor in terms of publications in Environmental Sciences & Ecology, is the Nord University
- Important R&I actors in terms of project participations in Environmental Sciences & Ecology are Fjord Marin Holding, Gildeskall Forskningsstasjon and Nord University (aquaculture), as well as Andoya Rocket Range and Space Center (earth sciences)

4.2 LOWER AUSTRIA

4.2.1 General ecosystem characterisations

The general ecosystem characterisation aims at creating a basic characterization of the R&I ecosystem of Lower Austria. This includes insights on the *institutional* and *sectoral* composition. In a descriptive and aggregated manner, the R&I ecosystem actors are characterized with respect to their organisation type (e.g. industry firm, education, research organization, etc.), their technological, as well as their scientific disciplines. Moreover, the illustration of *specialization patterns*, in the form of a portfolio diagram to illustrate the relationship between sectoral growth in patent classes and the specialization therein, complements the general ecosystem characterisation.

4.2.1.1 Institutional composition

The analysis of the EU-funded projects (EUPRO data base; see section 3.1 for details) allows a R&I ecosystem characterization based on the actors' organisational type (see Table 14). In total, in Lower Austria 140 organisations were and are active in overall 428 EU projects (in the years 2002-2016). Note, that the object of analysis are R&D project participations rather than the projects themselves, hence two or more organisations of different type may be involved in the same project.

More than half of the total number of organisations constitute industry firms (64%), followed by research organisations with about 11% of the total R&I actors active in EU projects. However, turning to the number of projects these actors were involved in, research organisations are active in most of the projects; in about 47% of the projects a research organisation is involved, whereas 36% of the projects are with industry firm participation. This largely corresponds to the European average (see Heller-Schuh at el. 2019). The remaining 25% of actors are educational organisations - i.e. universities and universities of applied sciences (*Fachhochschulen*) - consulting agencies, and governmental actors, etc. that are involved in overall about 17% of the projects. The education sectors is lower represented than the European average (see Heller-Schuh at el. 2019) since most universities are located in Vienna that is a neighbouring region of Lower Austria.

Table 14. R&I ecosystem actors active in EU FP projects by organisation type

Organisation type	Actors		Project participations	
	total	share	total	share
Industry (IND)	90	0.64	186	0.36
Education (EDU)	6	0.04	41	0.08
Research organisation (ROR)	16	0.11	238	0.47
Consulting (CON)	7	0.05	17	0.03
Government (GOV)	4	0.03	10	0.02
Others (OTH)	17	0.12	19	0.04
	-	-	511¹	1.00
Total	140	1.00	428	

¹ Multiple counting, if more two or more actors of Lower Austria with different organisation types are involved in the same project.

4.2.1.2 Sectoral composition and science disciplines

The sectoral composition is determined using data on patent activities (PATSTAT data base; see Section 3.1 for details). The patent classes based on the International Patent Classification (IPC)⁹ provide a classification according to different areas of technology. Since each patent is assigned to one or multiple patent classes, this kind of data is very well suited to gain insights into the sectoral distribution of the R&I ecosystem of Lower Austria. Mostly, more than one patent class are assigned to one patent, leading to multiple counting and a mismatch in the ‘total of actors’ and ‘total of patents’.

The IPC classes are a hierarchical system of fine granularity with eight basic classes, which are used as unit of the sectoral composition (see Table 15). In total 1,882 actors have been active in patenting in Lower Austria in the years 2002-2014. These actors applied for 4,763 patents in total. In Lower Austria the dominating sector in terms of the actors’ patenting activities is – with a percentage of 21% - Performing Operations and Transporting; followed by the sectors Human Necessities, and Chemistry and Metallurgy with 16%. The distribution of the patents across the eight sectors are almost the same as the actors’, indicating a linear relationship between the number of actors and patents; i.e. in none of the sectors, actors are exhibiting a significantly higher patenting activity than in others – in relation to their number of actors.

Table 15. R&I ecosystem actors active in patenting by technological fields (including single-person applicants)

Topic (IPC)	Actors ¹		Patents ²	
	total	share	total	share
Human Necessities (A)	483	0.16	1001	0.16
Performing Operations & Transporting (B)	627	0.21	1279	0.20
Chemistry & Metallurgy (C)	487	0.16	1012	0.16
Textiles & Paper (D)	88	0.03	265	0.04
Fixed Constructions (E)	253	0.08	416	0.07
Mechanical Engineering, Lighting, Heating, Weapons & Blasting (F)	374	0.12	759	0.12
Physics (G)	416	0.14	787	0.13
Electricity (H)	306	0.10	727	0.12
Total nominations	3034	1.0	6246	1.0
Total number of actors³	1882		4763	

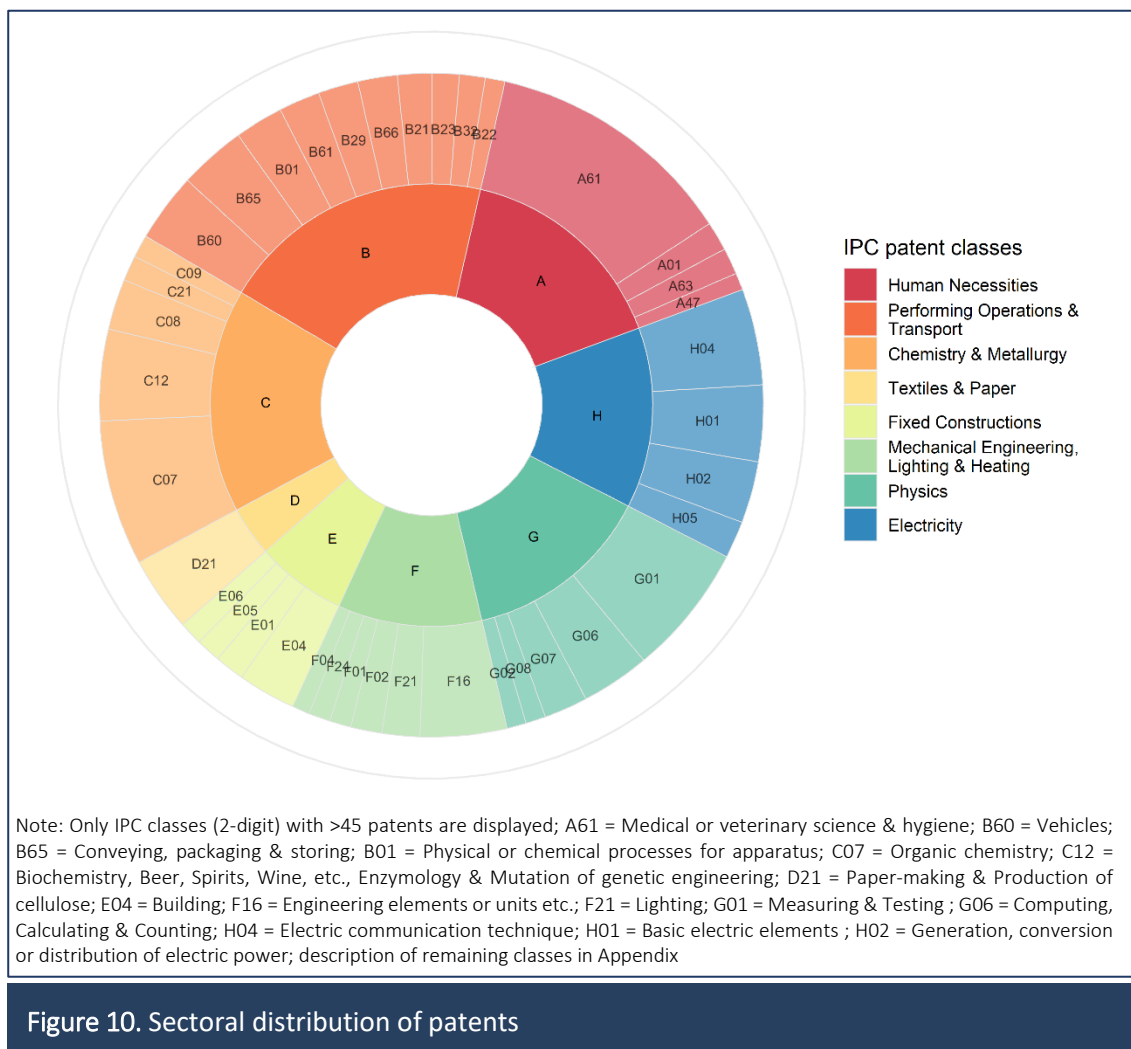
¹ The number displayed denote actors active in respective IPC classes; actors may be active in more than one IPC class, which results in multiple counting of actors per IPC class

² The number displayed denote patents in respective IPC classes; patents are often assigned to multiple IPC classes, which results in multiple counting of patents per IPC class

³ I.e. no multiple counting of actor/patents per IPC class

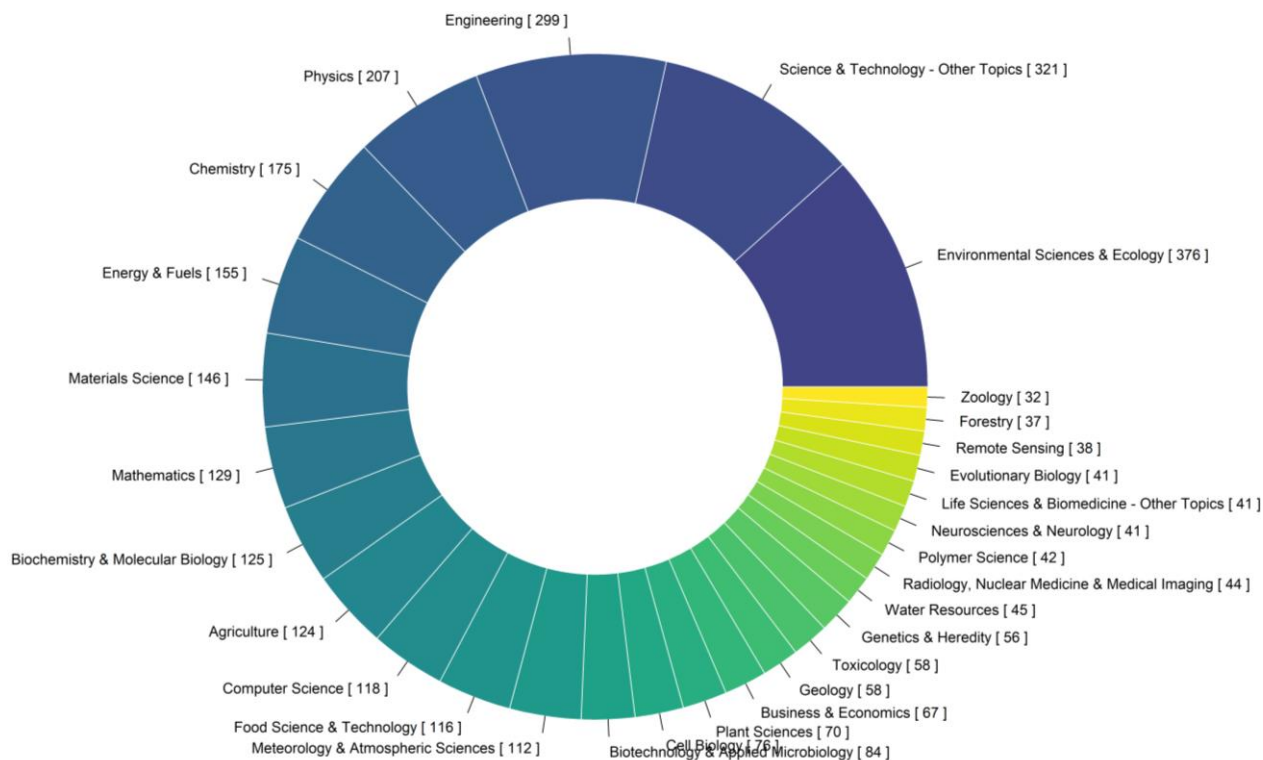
Looking at the finer level of aggregation of the eight basic IPC patent classes (see Figure 10), it can be seen that within Performing Operations and Transport, the subclasses of Vehicles, and Conveying, packaging and storing are amongst the largest. The largest subclass of Medical or veterinary science and hygiene is part of the sector Human Necessities. Other dominant subclasses are Organic chemistry (in Chemistry and Metallurgy), Measuring in testing (in Mechanical Engineering, Lighting and Heating), as well as Electric communication technique (in Electricity).

⁹ See <https://www.wipo.int/classifications/ipc/en/> for details on the IPC classification.



A more scientific angle on the sectoral distribution of the R&I ecosystem of Lower Austria is shown by using science disciplines (categories) and scientific publications therein. Figure 11 shows the most prominent science disciplines (with more than 30 publications in 2015-2019) as drawn from the Web of Science (see Section 3.1 for details on the data base); in total 2,341 publications were published in the years of interest by authors located in Lower Austria.

The most frequent category associated with publications is Environmental Science & Ecology (associated with 376 publications), followed by Science & Technology associated with 321 publications and Engineering with almost 300 publications. Note, that publications are selected if at least one author is located in Lower Austria. Approximately half of the publications belong to only seven science disciplines (each with almost over 150 publications) – Materials Science, Energy & Fuels, Chemistry, Physics, Engineering, Science & Technology, and Environmental Sciences and Ecology.



Note: Publications with at least one author with affiliation in Lower Austria (years 2015-2019; until 15.04.2019); only science disciplines with >30 publications are displayed; number of publications in parentheses

Figure 11. Distribution of publications across science disciplines

The science categories of publications were also displayed by a cooccurrence network, nodes being the number of publications and edges the cosine of common publications (see Figure 12). The research output in terms of the number of publications is dominated by 376 publications in Environmental Sciences and Ecology. With the second highest discipline degree centrality of 0.30 (37 co-disciplines) it is a central discipline in Lower Austria. High publication activities can also be noted in Science & Technology – Other Topics (321 publications) and in Engineering (299 publications). With 39 co-disciplines and a discipline degree centrality of 0.31 Engineering takes the highest interdisciplinarity level in the publication activity in the region.



4.2.1.3 Specialization patterns

This section is dedicated to the analysis of the overall topical and technological specialisation patterns of Lower Austria. For this exercise, we make use of the Revealed Technological Advantage (RTA) as introduced in Section 2, and of the patent data as described in Section 3.1. The RTA measures the relative specialisation of Lower Austria in a specific technological field as compared to a reference group, in this case European regions. The index ranges from zero to infinity, where a value below 1 indicates a smaller patenting activity in a specific field, while values above 1 indicate a specialisation in this field in comparison to other European regions. Note that a value of e.g. 2 in a specific technology and region indicates double as much patents in that field and that region as compared to the European average.

The RTA measures the relative specialisation of Lower Austria in a specific technological field as compared to a reference group, in this case European regions. We calculate the RTA with aggregated patents over the time period 2012-2014, and complement the analysis by looking at the growth from the period 2005-2009 and 2010-2014, and the absolute number of patents in each technological field.

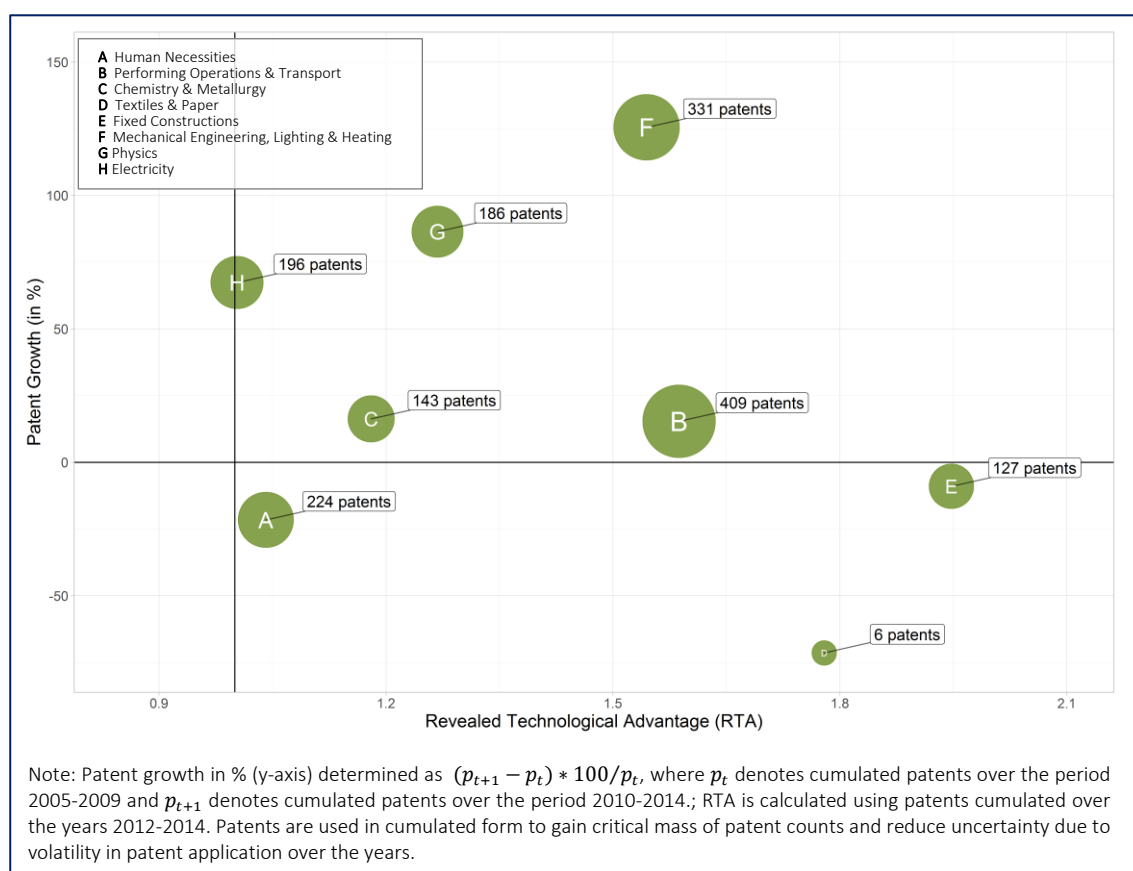


Figure 13. Sectoral specialization and growth

Figure 13 presents the respective results for Lower Austria, again in form of a regional portfolio diagram (the x-axis plots the RTA values for the technologies based on the one-digit IPC classification; the y-axis displays the percentage growth between the two periods considered, while the size of the circles corresponds to the number of patents in specific technological field). The results clearly point to a number of specialisation advantages of Lower Austria in the comparison to other European regions. The most striking result appears for the field of Mechanical Engineering, with a RTA more than 1.5 (i.e. there are 1.5 times as many patents in Lower Austria in this technological field as compared to the reference group) and a very high growth over the observed period. The strong position in Fixed constructions is obviously mainly related in a high patenting activity in Buildings, but also for other subclasses in this field.

For the field Fixed Construction, Lower Austria has the highest specialisation with a RTA of about 2, i.e. there are two times as much patents in this field in Lower Austria than in European regions on average. However, the growth between the two periods observed is slightly negative; a similar conclusion can be drawn for the field Performing operations and Transport. Lower Austria has many patents (409) in this field, a specialised position (RTA about 1.5), but low growth in the recent past. For the remaining technological fields, Lower Austria shows moderate (Physics, Chemistry) or no specialisation. For Physics the high growth rate is notable, so though the specialisation is moderate, it seems to be an emerging field in Lower Austria with increasing inventive capabilities.

4.2.2 R&I actors and collaborations

After the general characterization of the R&I ecosystem of Lower Austria, an analysis on the **actor-level** (i.e. organisational level) complements these first insights. R&I actors – such as industrial firms, universities, research organisations, etc. – constitute the backbone of R&I ecosystems as they provide the institutional framework for research and innovations activities by individual researchers. Subsection 4.2.2.1 provides an overview of the top R&I actors in terms of patenting activity, participation in EU projects, and scientific publishing.

Moreover, the interactions between these actors, in terms of collaborative R&D projects and joint scientific publications, stand in the focus of this chapter as they constitute essential means by which organizations create and/or access new knowledge. In Subsection 4.2.2.2, these interactions between R&I actors – national and international – are represented and analysed by means of network diagrams.

4.2.2.1 Actors

First, looking at the leading actors in terms of patent applications (see Table 16), it is evident that the list comprises only firms. This comes as no surprise as patents are generally considered output of industrial innovation efforts, characterized by application oriented and exploitation-driven research.

By far the most patent applications in Lower Austria (over the years 2002-2014) were filed by ZKW Group GmbH (including Zizala Lichtsysteme GmbH and ZKW Elektronik GmbH), which is a producer of lighting systems and electronic components for the automotive industry. Second in the ranking of top patenting organisations, is Novomatic AG, which is one of the largest integrated gaming groups in the world, with headquarters in Lower Austria. Third in the ranking is Knorr-Bremse GmbH. With its parent company based in Munich (Germany), Knorr-Bremse GmbH has been founded as a subsidiary in Lower Austria and is mainly involved in the development of electromagnetic rail, and eddy current brakes.

Table 16. Top actors active in patenting (>9 patents)

Rank	Name	Org. type	Patents
1	ZKW Group GmbH	IND	107
2	Novomatic AG	IND	60
3	Knorr-Bremse GmbH [PROJ]	IND	46
4	LISEC Austria GmbH [PROJ]	IND	36
5	Eaton Industries GmbH	IND	32
6	Constantia Teich GmbH	IND	29
7	Tyrolia Technology GmbH	IND	28
8	DOKA Industrie GmbH [PUB]	IND	27
9	Fritz Egger GmbH & Co OG [PUB]	IND	24
10	Berndorf Band GmbH [PUB]	IND	23
11	Seibersdorf Labor GmbH [PUB]	IND	21
12	Erber AG [PUB]	IND	20
12	Voestalpine Krems GmbH	IND	20
13	Messer Austria GmbH [PUB]	IND	19
14	Riegl Laser Measurement Systems GmbH	IND	18
15	Welser Profile AG	IND	16
17	GAT Microencapsulation AG [PROJ]	IND	11
17	Kaba GmbH	IND	11
17	Traktionssysteme Austria GmbH	IND	11
18	Böhler-Uddeholm Precision Strip GmbH	IND	10
18	Sunpor Kunststoff GmbH [PROJ]	IND	10
18	Wittmann Battenfeld GmbH [PROJ, PUB]	IND	10

Note: 'PROJ' and 'PUB' in squared parenthesis indicate that actors are also active in EU-funded projects (PROJ) and/or scientific publishing (PUB); see Appendix II for organisation types abbreviations

Second, in Table 17 the ranking of the top actors active in EU-funded projects (over the years 2002-2016) is displayed. Overall, this ranking is again dominated by firms, however, research organisations and one university are amongst the leading actors with considerably more project participations than the remaining actors. Notable is the sharp decline in the numbers of project participations after the first few leading actors, as well as the large differences between the first ranks.

With 90 projects, the International Institute of Applied Systems Analysis (IIASA) is the most active organisation in terms of project participations. IIASA is an interdisciplinary research organisation that conducts scientific research in areas such as the environment, economy, technology and population. Second in the ranking is the Institute of Science and Technology Austria (IST); it is post-gradual scientific institution aiming at top-level basic research. With 20 project participations the Donau-Universität Krems (Krems University of Continuing Education) is on the third rank, however, is clearly far behind the two leading research organizations. The Donau-Universität Krems is a university focusing on further education and hence, offering career-accompanying graduate programs.

Table 17. Top actors active in EU-funded projects (>4 projects)

Rank	Name	Org. type	Participations
1	International Institute for Applied System Analysis – IIASA [PUB]	ROR	89
2	Institute of Science and Technology Austria [PUB]	ROR	56
3	Donau-Universität Krems [PUB]	EDU	20
4	RHP-Technology GmbH & Co KG [PUB]	IND	11
4	AIT Austrian Institute of Technology GmbH [PUB]	ROR	11
4	Minpol GmbH/Günter Tiess	IND	11
5	CEST Kompetenzzentrum für Elektrochemische Oberflächentechnologie GmbH [PAT, PUB]	ROR	9
6	AC2T Research GmbH [PAT, PUB]	ROR	8
6	FOTEC Forschungs- und Technologietransfer GmbH [PAT, PUB]	IND	8
7	Amt der Niederösterreichischen Landeregierung	GOV	7
7	Engineering Center Steyr GmbH und Co KG [PAT]	IND	7
7	Femtolasers Produktions GmbH [PAT]	IND	7
7	Aerospace & Advanced Composites GmbH [PAT, PUB]	IND	7
8	Fachhochschule Wiener Neustadt für Wirtschaft und Technik GmbH [PUB]	EDU	6
8	NXT Control GmbH [PAT]	IND	6
8	Polymun Scientific Immunbiologische Forschungs GmbH [PUB]	IND	6
9	Fachhochschule St. Pölten GmbH [PAT, PUB]	EDU	5
9	Biomim Gesunde Tierernährung International GmbH [PUB]	IND	5
9	Diamond Aircraft Industries GmbH	IND	5
9	NATEX Prozesstechnologie GesmbH [PAT]	IND	5
9	Profactor Produktionsforschungs GmbH	IND	5
9	SESA Commerce GmbH	IND	5
9	WasserCluster Lunz Biologische Station GmbH [PUB]	IND	5

Note: 'PAT' and 'PUB' in squared parenthesis indicate that actors are also active in patenting (PAT) and/or scientific publishing (PUB); see Appendix II for organisation types abbreviations

Table 18 gives an overview of the leading actors active in scientific publishing in Lower Austria (in the years 2015-2019; drawn from WoS). Not surprisingly, the ranking of the top actors is dominated by research organisations (ROR) and universities (EDU). The International Institute for Applied System Analysis (IIASA) is the leading actor with 635 publications (IIASA is also on the first rank regarding the EU-project participations). Second in the ranking is the Institute of Science and Technology Austria (IST) with 565 publications. The branch of the University of Natural Resources and Life Sciences (BOKU Universität) located in Lower Austria (Tulln) with 284 publications in the time horizon under investigation.

Table 18. Top actors in scientific publishing (>10 projects)

Rank	Name	Org. type	Publications
1	International Institute for Applied System Analysis – IIASA [PROJ]	ROR	635
2	Institute of Science and Technology Austria [PROJ]	ROR	565
3	BOKU Universität (Tulln)	EDU	284
4	Donau-Universität Krems [PROJ]	EDU	164
5	AIT Austrian Institute of Technology GmbH [PROJ]	ROR	97
6	AC2T Research GmbH [PROJ, PAT]	ROR	68
7	Biomin Gesunde Tierernährung International GmbH [PROJ]	IND	61
8	Austrian Centre of Industrial Biotechnology (ACIB)	IND	46
9	EBG MedAustron GmbH	IND	41
10	WasserCluster Lunz Biologische Station GmbH [PROJ]	IND	25
1	International Atomic Energy Agency - IAEA	OTH	24
12	HBLA & BA Wein & Obstbau	EDU	33
13	CEST Kompetenzzentrum für Elektrochemische Oberflächentechnologie GmbH [PROJ, PAT]	ROR	20
14	Bioenergy 2020	IND	17
15	Karl Landsteiner Privatuniversität für Gesundheitswissenschaften	EDU	17
16	Seibersdorf Labor GmbH	IND	16
17	Fachhochschule Wiener Neustadt für Wirtschaft und Technik GmbH [PROJ, PAT]	EDU	15
18	Fachhochschule St. Pölten GmbH [PROJ, PAT]	EDU	13
19	Center for Public Mental Health	IND	11
19	Messer Austria GmbH	IND	11

Note: 'PROJ' and 'PAT' in squared parenthesis indicate that actors are also active in EU FP projects (PROJ) and/or patenting (PAT); see Appendix II for organisation types abbreviations

4.2.2.2 Project collaborations

In Lower Austria, 140 territorial R&I actors are active in EU FP projects (EU FP projects, 2002-2016). They are engaged in 43 project-based collaborations within the territory of Lower Austria; however, not all actors are involved in territorial collaborations. Nation-wide, i.e. within Austria, the territorial actors have 163 collaboration partners with whom they were engaged in 410 collaborations. Extra-territorial, the R&I actors of Lower Austria are linked to over 2500 project partners via 5363 collaborations (multiple collaborations with same partners are possible).

Table 19. Collaborations - descriptives

<i>Spatial scale</i>	Number of actors	Number of collaborations
Territorial	140	43
National	163	410
Europe-wide	2562	5363

Note: based on EU FP project data drawn from the EUPRO database

Figure 14 visualises the project-based R&D collaboration network in the same style as for Nordland drawing on information recorded in the EUPRO database. Again, the dots are placed so that nodes with higher interaction and a similar partner profile come closer to each other, while nodes with less interaction and a more dissimilar partner structure are placed more apart from each other. Partners located in Lower Austria are represented by the orange dots, in blue partners in other regions of Austria.

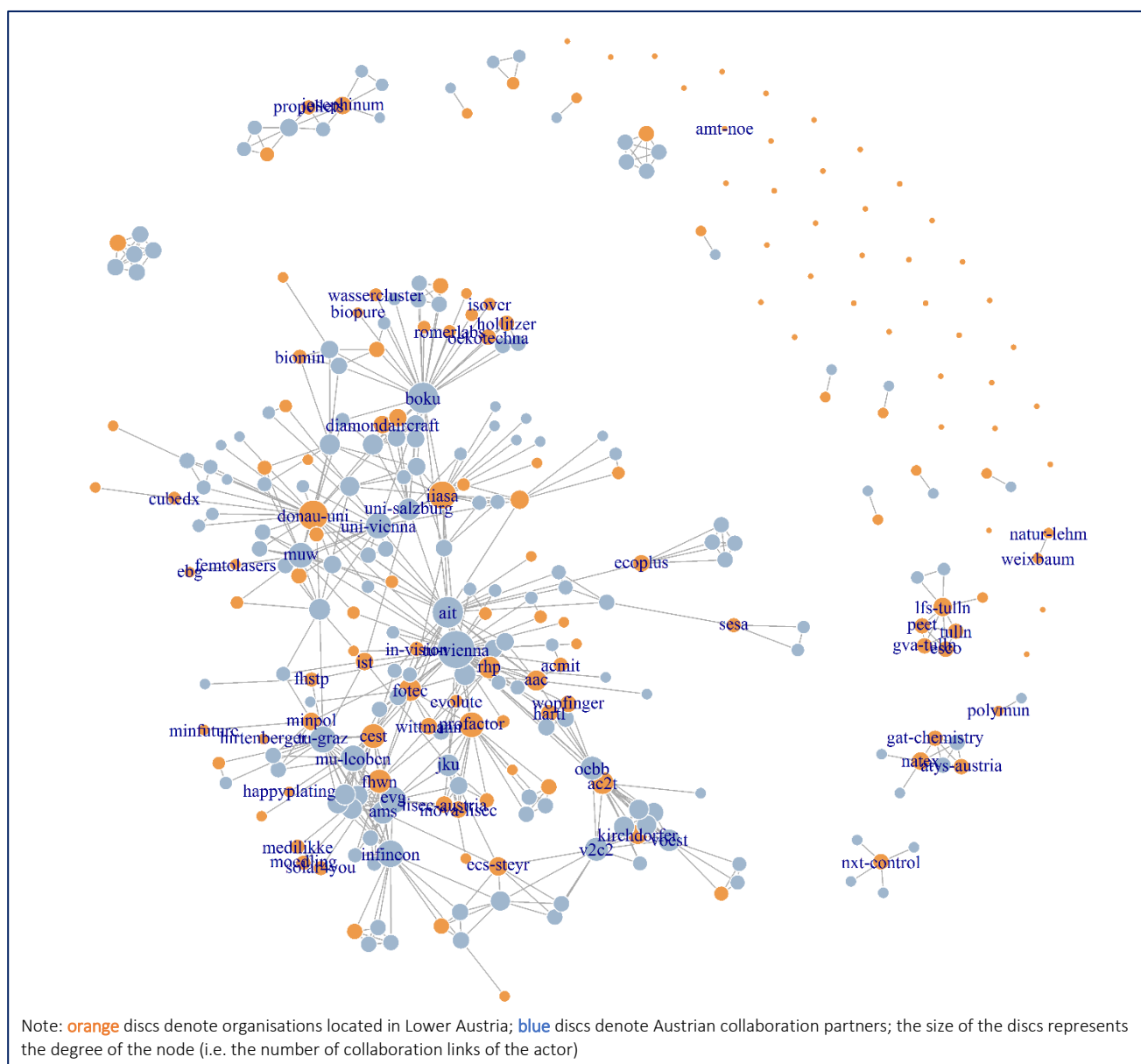


Figure 14. National project collaborations of territories' R&I actors

The network strongly differs in comparison to what we have seen for Nordland. The participation intensity in European projects is obviously much higher, reflected by the much denser network. It is shown that organisations from Lower Austria take a quite prominent role in the Austrian FP collaboration landscape, having intensive collaboration in particular, with Viennese large universities and research organisations. In some cases, some organisations from Lower Austria clearly take a gatekeeper position between different subnetworks, such as for instance eco-plus acting as intermediary between these different parts. Donau-Uni and IIASA take a very central role in the clusters themselves, but also in the network as a whole.

Turning to the international collaboration structure of Lower Austria (Figure 15), Germany comes up as the clear core partner, followed by France, the UK and Italy. This is not surprising given the geographical proximity to Germany that still plays a strong role in R&D collaboration networks. At the organisational level, there is no clear core pattern traceable, but Lower Austria features remarkable links to highly central core partners in Europe, such as Fraunhofer, Uni-Oxford or Max-Planck.

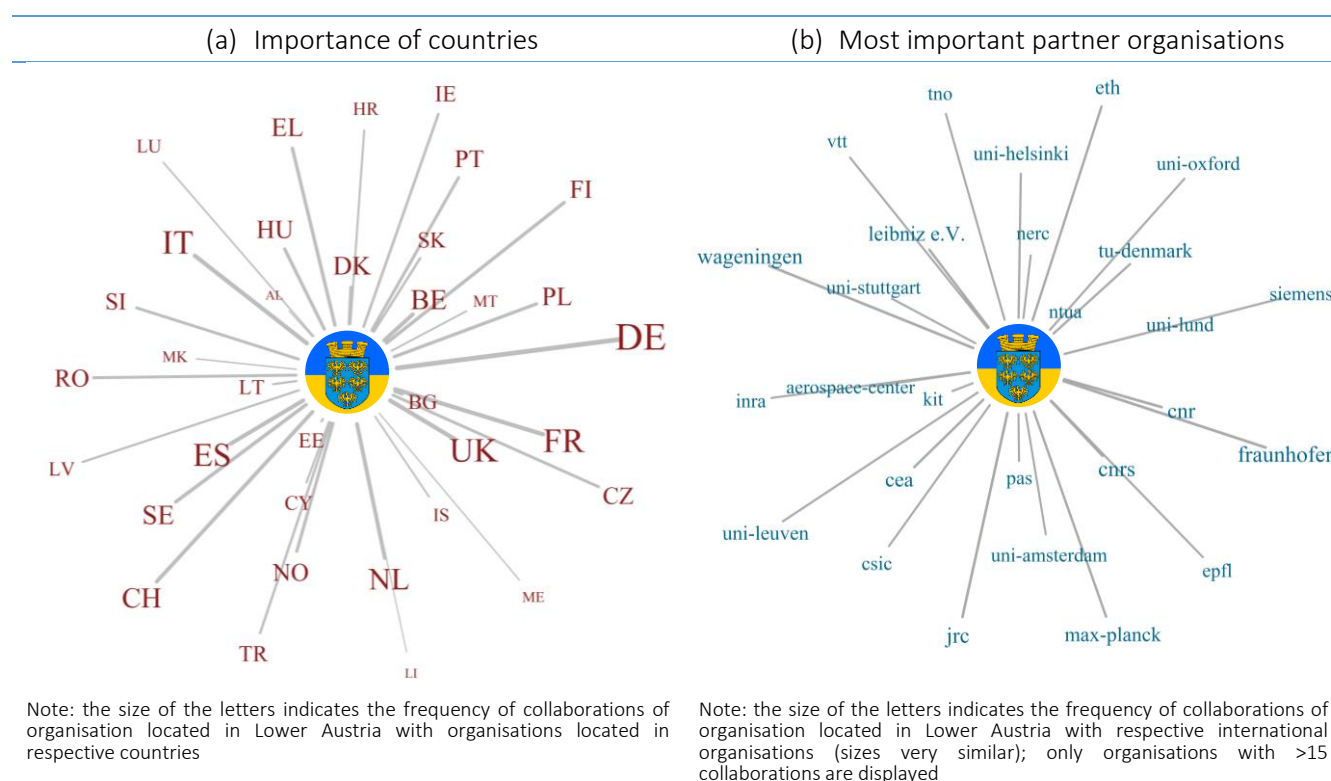


Figure 15. European project collaborations of territories' R&I actors

4.2.3 Territory specific analysis of thematic focus

For each SeeRRI territory, a thematic focus has been selected by territory representatives that will be targeted throughout the whole SeeRRI project, and hence will be highlighted from different point of views. The analysis in the course of this quantitative mapping aims to shed light on the R&I specific landscape of Lower Austria in the context of the thematic focus.

The thematic focus of Lower Austria for the SeeRRI project is defined as follows:

“The focus is on additive manufacturing (3D-printing) - this focus influences the manufacturing sector and aims to reduce the costs of production by leveraging the opportunities provided by the technology to facilitate mass customization of industrial products. The specific objective is to build up an ecosystem from education, R&D, companies, equipment producers, quality requirements and product development.”

Experts from Lower Austria have provided a list of keywords for the collection of publications and projects (Appendix III for list of keywords). These keywords were used to identify desired topics for 3D printing and additive manufacturing.

To be sure not to miss relevant documents all publications as well as all EU-funded projects with at least one author/participating organization with an affiliation from Lower Austria, were extracted. Then, a qualified search in identified research activities and in single documents was performed. Relevant issues were picked from thematic landscapes of all activities documented by publications and EU-funded projects from the territory.

Consequently, the approach to elaborate the thematic focus is twofold. On one hand we analyse the scientific research activity with a map of all publications in the WoS database with at least one author with an affiliation from the region. Agglomerations of similar publications that are represented in a 3D density map give an insight view in thematic activities. On the other hand, the content of EU funded projects with a participation of Lower Austria's organizations is represented by a co-word map. Finally, actors are listed by thematic categories.

Insights from these analyses illustrate thematic fields, in which the territorial R&I actors are active, along with similar topics the actors are already involved, or could be involved in, in the future. This shows the potential of the R&I actors to diversify to other similar, but new fields of science and technology. The identification of strong science and technology fields is especially relevant in the context of Smart Specialization¹⁰; showing the strengths and future potential of the R&I ecosystem regarding the thematic focus. Moreover, core actors are identified, that serve as input for the stakeholder engagement processes in subsequent work packages of this project.

¹⁰ <https://s3platform.jrc.ec.europa.eu/de/what-is-smart-specialisation->

4.2.3.1 Publication landscape

The publication landscape serves for the identification of thematic issues that are of relevance for the project and for the determination of thematically relevant actors. The data basis for the publication landscape is a collection of items from the WoS database. The data base consists of 2,341 publications for the time span 2015 to 2019 (the retrieval date was 15.04.2019).

The publication landscape consists of the following elements:

- i. Disciplines of publications with relevance for the thematic focus
- ii. Science map of research fields with a selection of relevant research activities
- iii. Actors by research field with publications in the thematic focus

i. Disciplines of publications with relevance for the thematic focus

The identification of disciplines that are relevant for 3D printing and additive manufacturing were identified by a keyword-based search in the publications. The keywords provided by experts from Lower Austria could be found in 26 publications. The keyword string “lithograph*” occurred in 13 publications followed by “additive manufacturing” with 8 publications and “3D printing” in 4 publications (see Table 20).

Table 20. Keywords identified with number of publications

Search keyword	Publications
lithograph*	13
additive manufacturing	8
3D printing	4
digital light processing	3
chemical vapor deposition	3
rapid prototyping	2
physical vapor deposition	2
3D model	2
electron beam deposition	1

Disciplines with publications that include one of the search keywords were selected to be of relevance for the SeeRRI project. They are highlighted in the cooccurrence map in Figure 12 and are separately displayed here in Figure 16.

As to be expected, the highest number of 9 publications on research in 3D printing and additive manufacturing are associated with the discipline Engineering, followed by Materials Science with 6 publications and Physics with also 6 publications. The next chapter gives a closer look on research activities in Lower Austria and especially in 3D printing and additive manufacturing.

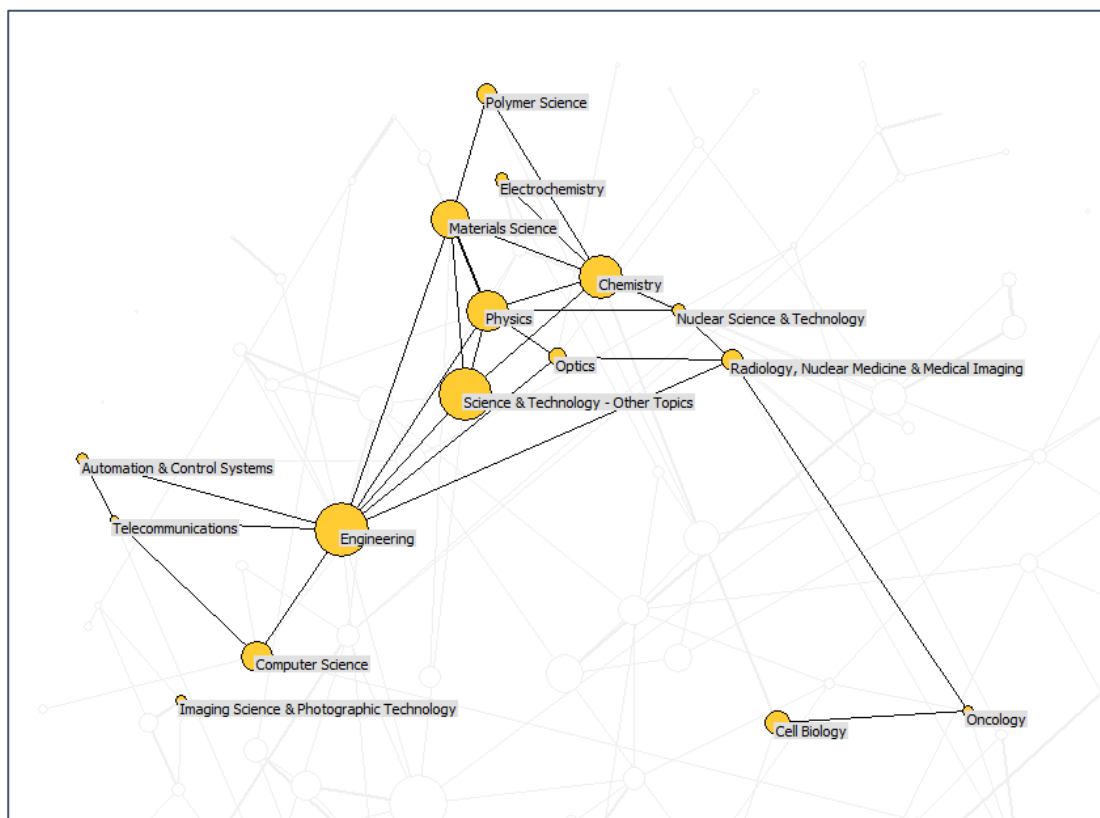


Figure 16. Disciplines of publications with relevance for 3D Printing and additive

ii. Science map of research fields

The thematic orientation of published research in Lower Austria is analysed by a relational approach of bibliographically coupled publications as a similarity measure. That way the research fields are delineated from agglomerations of similar publications. The similarity is measured by the cosine of common references and displayed in a 3-dimensional map (the cosine of the dot product of vectors of all references cited in the dataset with 0 if a reference is not cited and 1 if a reference is cited in the publication). The distance of the items in a two-dimensional space was calculated with a spring model. The 3D map shows the research activity in specific fields that are documented in publications in journals and proceedings of conferences (Figure 17).

The publication output of authors with an affiliation in Lower Austria shows a considerable dominance of research on Climate Policy with 147 publications and Food Safety with 142 publications. Other research fields with a noticeably smaller number of publications are Land Use and Climate Change with 97 publications and Biomass combustion with 87 publications. The identified 26 publications in 3D printing and additive manufacturing are not concentrated in a specific research activity but spread over the thematic science map.

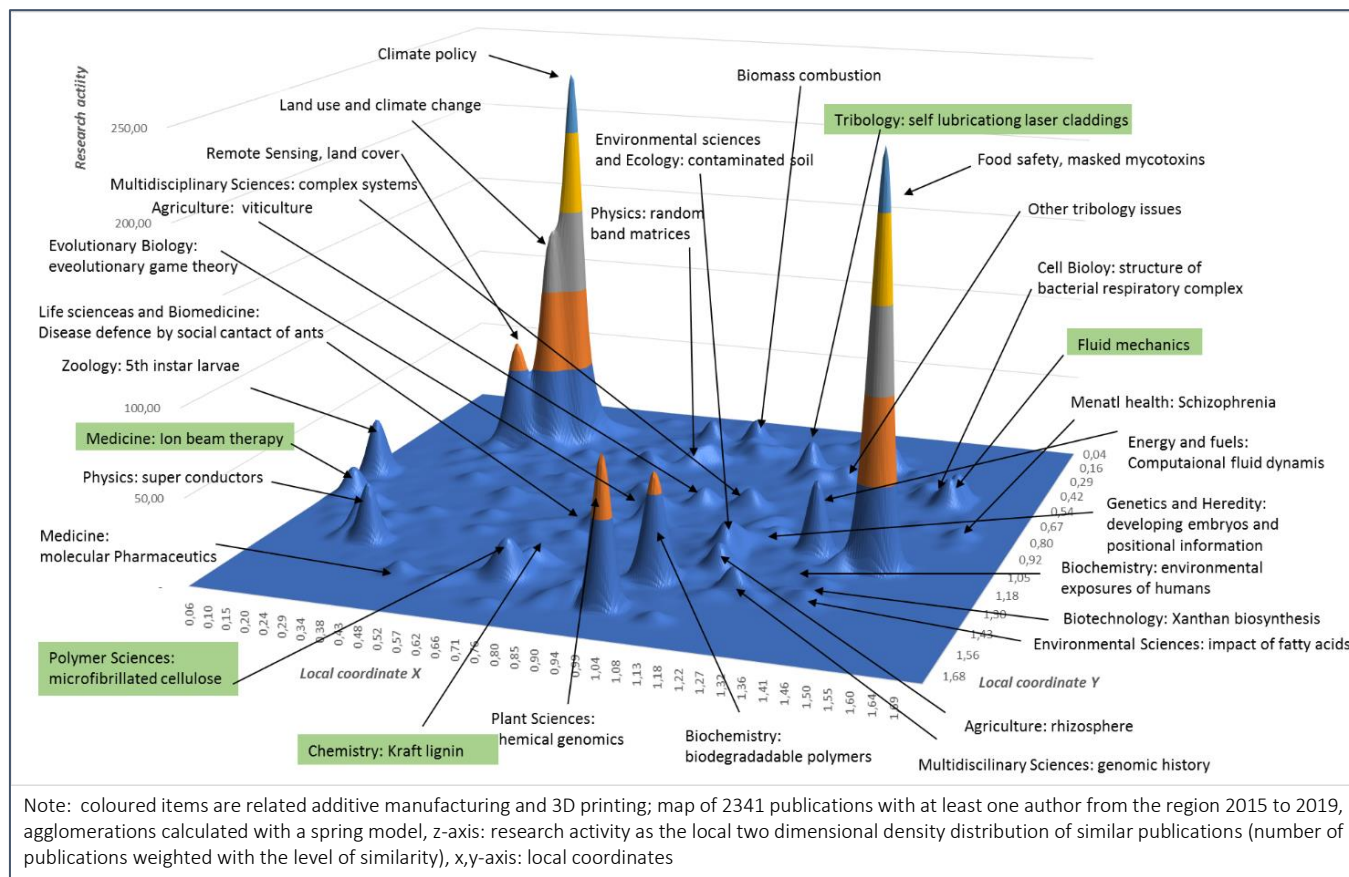


Figure 17. 3D science map of publications in research fields

15 publications could not be assigned to an agglomeration of a research field. 4 publications are part of research in Polymer Sciences concerning materials research in fibrillated cellulose as a medium for 3D printing, 3 publications are located in Medicine in the field of ion beam therapy, 2 publications deal with tribological issues, one project each in Fluid Mechanics and Kraft Lignin. The detailed research issues are:

- 3D printing material for medical instruments
- 3D printed flow cell as a tool no research
- CVD fabricated Schottky diode
- Advanced layer manufacturing space antenna feed chain systems
- Microfabrilated cellulose (MFC)-filled poly(lactic acid) filaments, a material for 3D-printing
- CVD technique for a micro dosimeter
- Additive manufacturing technology for space missions
- Micropump for medical applications build by an additive manufacturing technology
- Tailored laser interference lithography (LIL) for the rapid fabrication of metallic nanostructures
- A hybrid exposure concept for lithography-based additive manufacturing

- PVD for the fabrication of nanoparticles for biosensing using UV-NIL and lift-off
- Surface plasmon modes of nanomesh-on-mirror nanocavities prepared by nanosphere lithography
- Development of a hybrid exposure system for lithography-based additive manufacturing technologies
- Compatibility of Kraft Lignin, Organosolv Lignin and Lignosulfonate with PLA in 3D Printing
- Ongoing advances in Additive Manufacturing will for the efficient implementation of structures into mold inserts for injection molding.

iii. Actors by research field with publications in the thematic focus

The actors with the chosen thematic focus are collected from the affiliations of authors who publish in 3D printing and additive manufacturing issues with reference to the 26 identified relevant publications (see Table 21). Organizations with 3 relevant publications are: CEST Competence Center Electrochemical Surface Technology, MedAustron, and Semperit Technische Produkte GmbH.

CEST Competence Center Electrochemical Surface Technology is a research center located in Wiener Neustadt, Austria. It is Austria's competence centre for electrochemical surface technology and functions as an innovation generator and trendsetter at the interface between science and industry. CEST was founded in 2008 within the framework of the Austrian competence center programme COMET. MedAustron, the center for ion therapy and research is also located in Wiener Neustadt in Lower Austria. It offers radiation therapy (ion beam therapy, particle therapy) using protons and carbon ions for patients. Research activities range from basic to translational and applied research. Radiation oncology, medical radiation physics, and radiation biology are part of their interdisciplinary research. Semperit Technische Produkte GmbH is an Austrian company located in Wimpassing, Austria. Semperit operates in the Business-to-Business segment and manufactures medical and industrial products made of rubber.

Table 21. Actors publishing in 3D printing and additive manufacturing

Actors	Publications
AIT Austrian Institute of Technology GmbH, Biosensor Technology, Konrad Lorenz Str 24, A-3430 Tulln, Austria	2
Austrian Center for Medical Innovation & Technology, A-2700 Wiener Neustadt, Austria	1
BOKU University of Natural Resources & Life Sciences Vienna, Department of Agrobiotechnology, Konrad Lorenz Str 20, A-3430 Tulln, Austria	1
BOKU University of Natural Resources & Life Sciences Vienna, Department of Materials Sciences & Process Engineering, Konrad Lorenz Str. 24, A-3430 Tulln, Austria	1
BOKU University of Natural Resources & Life Sciences Vienna, Division of Chemical Renewable Resources, Department of Chemistry, Konrad Lorenz Str 24, A-3430 Tulln, Austria	1
CEST Competence Center for Electrochemical Surface Technology, A-2700 Wiener Neustadt, Austria	3
Danube University of Krems, Center for Integrated Sensor Systems, Dr Karl Dorrek Str 30, A-3500 Krems, Austria	2
Doka Österreich GmbH, Josef Umdasch Pl 1, A-3300 Amstetten, Austria	1
EBG, MedAustron Marie Curie St 5, A-2700 Wiener Neustadt, Austria	3
FOTEC Forschungs & Technologie Transfer GmbH, Viktor Kaplan Str 2, A-2700 Wiener Neustadt, Austria	2

Actors	Publications
IMC University of Applied Sciences Krems, Department of Life Sciences, Institute of Medical & Pharmaceutical Biotechnology, A-3500 Krems, Austria	1
IMC University of Applied Sciences Krems, Department of Life Sciences, Research Institute of Applied Bioanalytics & Drug Development, A-3500 Krems, Austria	1
In-Vision Digital Imaging Optics GmbH, Industrie Str 9, A-2353 Guntramsdorf, Austria	2
IST Austria, Campus 1, A-3400 Klosterneuburg, Austria	2
Landeskrankenhaus St Pölten Lilienfeld, Department of Maxillofacial Surgery, Probst Fuhrer Str 4, A-3100 St Pölten, Austria	1
Semperit Technische Produkte GmbH, Triester Bundesstr 26, A-2632 Wimpassing, Austria	3
Svoboda Entwicklungs-GmbH, A-3100 St Pölten, Austria	1
University Clinicum Tulln, Department of Surgery, A-3430 Tulln, Austria	1

Note: two or more actors may be involved in one publication

4.2.3.3 Project landscape

In this chapter the EU-funded project research is segmented into thematic fields. That way actors from Lower Austria who are partners in EU-funded projects with research in 3D printing and added manufacturing could be identified by a thematic classification.

i. Keyword map of EU funded Projects

In a first step the projects are thematically structured by a co-word analysis. The keywords used for this co-word analysis were extracted from the project title, objective, programme information and project subjects. In total, 1376 keywords have been considered. A clear thematic structure can be obtained with the restriction to keywords from the project subject and the program information subjects. These keywords were displayed in a co-word map, see Figure 18.

Additionally, a cluster analysis with Pearson agglomeration without standardization / Ward linkage was applied and displayed the clusters with bold labels in the gravity center of clustered keywords. Thematic clusters of projects can be identified that way in environmental protection, energy storage and energy transport, information and communication technology applications, life sciences, security research, network technologies, social sciences and humanities, industrial manufacture as well as innovation and technology transfer. In the upper part of the illustration, keywords from industrial manufacture are located. 3D printing and additive manufacturing are a part of the industrial manufacture area.

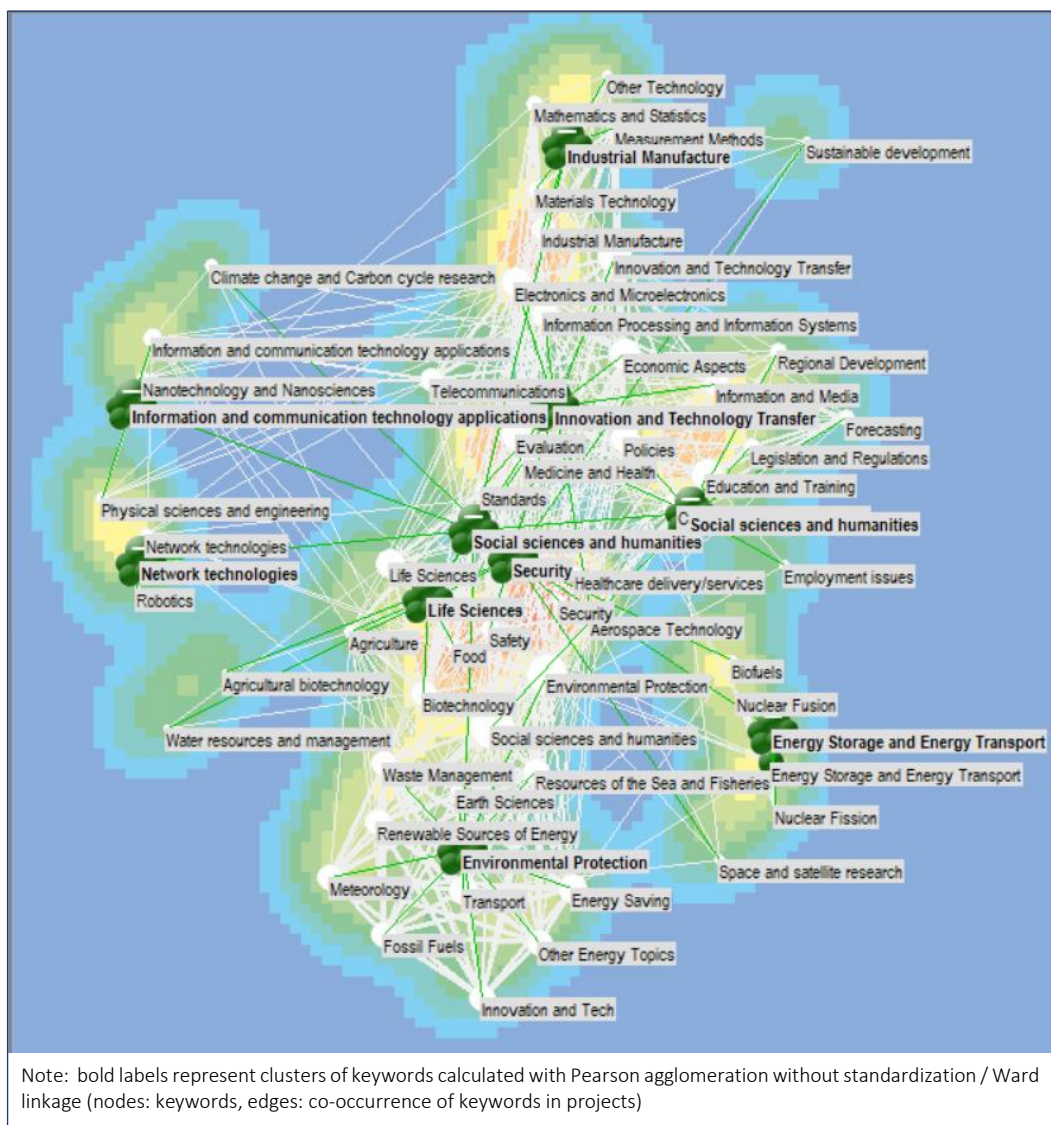


Figure 18. Co-word map of manually assigned keywords to projects

To concentrate on the given thematic focus of our project explicit issues from 3D printing and added manufacturing could be identified, see Table 22.

Table 22. EU funded projects with a participation of actors in 3D printing and additive manufacturing

Keywords found	Title of the project	Programme Name
rapid prototyping	Distributed 3D Object Design	H2020-EU.1.3.1. - Fostering new skills by means of excellent initial training of researchers
additive manufacturing, 3D printing, rapid prototyping	Novel nanoparticle enhanced Digital Materials for 3D Printing and their application shown for the robotic and electronic industry	H2020-EU.2.1.2.5. - Developing and standardisation of capacity-enhancing techniques, measuring methods and equipment
lithography, additive manufacturing, digital light processing (DLP)	Photopolymer based customized additive manufacturing technologies	FP7-NMP - Specific Programme "Cooperation": Nanosciences, Nanotechnologies, Materials and new Production Technologies
additive manufacturing, lithography	Toolless manufacturing of complex structures	H2020-EU.2.1.5.1. - Technologies for Factories of the Future

ii. Applicants of relevant projects

The applicants from Lower Austria in EU funded projects in 3D printing and added manufacturing are listed in Table 23. In-vision Digital Imaging GmbH is involved in 2 projects. The company is located in Gruntramsdorf in Lower Austria and is a world-leading manufacturer of high-end opto-electronic devices and solutions for industrial DLP applications. It is partner in the projects: "Photopolymer based customized additive manufacturing technologies" and "Toolless Manufacturing of Complex Structures". The Institute of Science and Technology Austria (IST Austria) is dedicated to cutting-edge research in the physical, mathematical, computer, and life sciences and is located in Klosterneuburg, Austria. The institute is involved in the project "Distributed 3D object design. Borealis Polyolefine GmbH in Schwechat-Mannswörth is part of the international team of the project "Novel nanoparticle enhanced Digital Materials for 3D Printing and their application shown for the robotic and electronic industry".

Table 23. Applicants in EU funded projects about 3D printing and added manufacturing

<i>Title of the project</i>	<i>Applicants from Lower Austria</i>
Photopolymer based customized additive manufacturing technologies	In-vision Digital Imaging GmbH
Toolless Manufacturing of Complex Structures	In-vision Digital Imaging GmbH
Distributed 3D Object Design	Institute of Science and Technology Austria
Novel nanoparticle enhanced Digital Materials for 3D Printing and their application shown for the robotic and electronic industry	Borealis Polyolefine GmbH

KEY FINDINGS – LOWER AUSTRIA

- R&I actors active in collaborative EU projects are predominantly firms, however research organizations are engaged in the majority of project participations
- The dominant industry class - in terms of patenting – is Performing Operations & Transporting (vehicles, conveying, packaging and storing, etc.).
- In terms of scientific publications, Environmental Sciences & Ecology, Science & Technology, Engineering as well as Physics are the four most important disciplines.
- Lower Austria shows a specialization (and sector growth) in the sector of Mechanical Engineering, Lighting & Heating, as well as Physics.
- Regarding project collaborations, the 140 territorial R&I actors are engaged with 163 national partners and 2562 European partners; central territorial actors are IIASA, the Danube University, as well as the FH Wiener Neustadt
- Amongst the most important partner countries there are Germany, France, the UK, and Italy.
- The publication analysis of the territory-specific focus – 3D printing and additive manufacturing – reveals Engineering, Materials Science and Physics as important disciplines; especially, the fields of tribology, fluid mechanics, and polymer sciences are dominant
- Important R&I actors in terms of publications in 3D printing and additive manufacturing, are the AIT Austrian Institute of Technology (Tulln), BOKU University of Natural Resources & Life Sciences, CEST Competence Center, EBG MedAustron, Semperit, and FOTEC
- Important R&I actors in terms of project participations in 3D printing and additive manufacturing are In-vision Digital Imaging, and IST Institute of Science and Technology Austria

4.3 B30

4.3.1 General ecosystem characterisation

At the beginning of the mapping of the B30 R&I ecosystem a general ecosystem characterisation provides insights into the territories' **institutional** and **sectoral** composition: first, on an aggregated level, the ecosystem's R&I actors are characterized regarding their organisational type, such as firm, education or research organization. Second, the actors are described with respect to their technological as well as their scientific disciplines. Additionally, specialization patterns are illustrated in the form of a portfolio diagram to illustrate the relationship between sectoral growth in patent classes and the specialization therein.

4.3.1.1 Institutional composition

In Table 24 the institutional composition of the B30 R&D actors – based on EU-funded FP projects (FP6, FP7, and H2020, i.e. in the years 2002-2016 drawn from the EUPRO data base; see Section 3.1 for details) - is displayed. In the B30 territory, in total 138 actors are active in 712 EU projects funded by the EU FPs. B30 is characterized by a large number of firms amounting for 82 actors, which is about 60% of all actors engaged in EU projects; followed by research organisations with only 15%. Note, that the object of analysis are R&D project participations rather than the projects themselves, hence two or more organisations of different type may be involved in the same project.

However, turning to the distribution of the projects over the organisation types, the high numbers of projects by research organisations – 304 projects that amounts to 40%, as well as the three educational organisations (i.e. UAB Universitat Autònoma de Barcelona, Fundació ESADE, Institut Universitari de Ciència i Tecnologia), which are together involved in 233 projects. However, 228 of these projects can be assigned to the UAB itself. By this research organisations in the B30 territory – and especially UAB – account for 30% of the projects. Although, industry firms are 60% of the actor population active in EU-funded R&D projects, they are involved in a comparatively small share of projects (22%) which is below the European average of about 30% (see Heller-Schuh et al. 2019). Projects by consulting and governmental actors are in an almost neglectable size.

Table 24. R&I ecosystem actors active in EU FP projects by organisation type

<i>Organisation type</i>	<i>Actors</i>		<i>Project participations</i>	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Industry (IND)	82	0.59	168	0.22
Education (EDU)	3	0.02	233	0.30
Research organisation (ROR)	21	0.15	304	0.39
Consulting (CON)	5	0.04	16	0.02
Government (GOV)	7	0.05	19	0.02
Others (OTH)	21	0.15	38	0.05
	-	-	778¹	1.00
Total	138	1.00	712	

¹ Multiple counting, if two or more actors of B30 with different organisation types are involved in the same project.

4.3.1.2 Sectoral composition and science disciplines

The sectoral composition is based on the International Patent Classification (IPC)¹¹. IPC patent classes provide a classification according to different areas of technology. Since each patent is assigned to one or multiple patent classes, this kind of data is very well suited to gain insights into the sectoral distribution of the R&I ecosystem of B30. Mostly, more than one patent class are assigned to one patent, leading to multiple counting and a mismatch in the ‘total of actors’ and ‘total of patents’. The IPC classes are a hierarchical system of fine granularity with eight basic classes, which are used as unit of the sectoral composition (see Table 25).

The analysis of the patent applications in B30 reveals (drawn from the PATSTAT data base; see section 3.1 for details) that 1,119 actors were active in patenting in the years 2002-2014, that applied in total for 2,068 patents. Actors are mainly active in four of the eight sectors: Human Necessities (28%), Performing Operations & Transporting (19%), Chemistry & Metallurgy (19%) and Physics (14%) (see Table 18, Figure 11). About 70% of the patenting activity can be assigned to the three sectors Human Necessities, Performing Operations & Transporting, Chemistry & Metallurgy. The distribution of the patents across the eight sectors are almost the same as the actors’, indicating a linear relationship between the number of actors and patents; i.e. in none of the sectors, actors are exhibiting a significantly higher patenting activity than in others – in relation to their number of actors.

Table 25. R&I ecosystem actors active in patenting by technological fields (including single-person applicants)

<i>Topic (IPC)</i>	Actors¹		Patents²	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Human Necessities (A)	482	0.28	706	0.26
Performing Operations & Transporting (B)	327	0.19	652	0.24
Chemistry & Metallurgy (C)	337	0.19	569	0.21
Textiles & Paper (D)	35	0.02	35	0.01
Fixed Constructions (E)	63	0.04	94	0.03
Mechanical Engineering, Lighting, Heating, Weapons & Blasting (F)	111	0.06	189	0.07
Physics (G)	254	0.14	269	0.10
Electricity (H)	144	0.08	195	0.07
Total nominations	1753	1.0	2709	1.0
Total number of actors³	1119		2068	

¹ The number displayed denote actors active in respective IPC classes; actors may be active in more than one IPC class, which results in multiple counting of actors per IPC class

² The number displayed denote patents in respective IPC classes; patents are often assigned to multiple IPC classes, which results in multiple counting of patents per IPC class

³ i.e. no multiple counting of actor/patents per IPC class

The illustration of the distribution of the patenting activity in B30 on the level of subclasses of the IPC sectors (see Figure 19) shows that the largest subsector is Medical or Veterinary Science & Hygiene (A61) which accounts for a large percentage of the total Human Necessities sector. Other dominant subsectors are Organic Chemistry (C07) and Vehicles (B60). In Physics, two subsectors prevail: Measuring & Testing (G01) and Computing, Calculating & Counting (G06).

¹¹ See <https://www.wipo.int/classifications/ipc/en/> for details on the IPC classification.

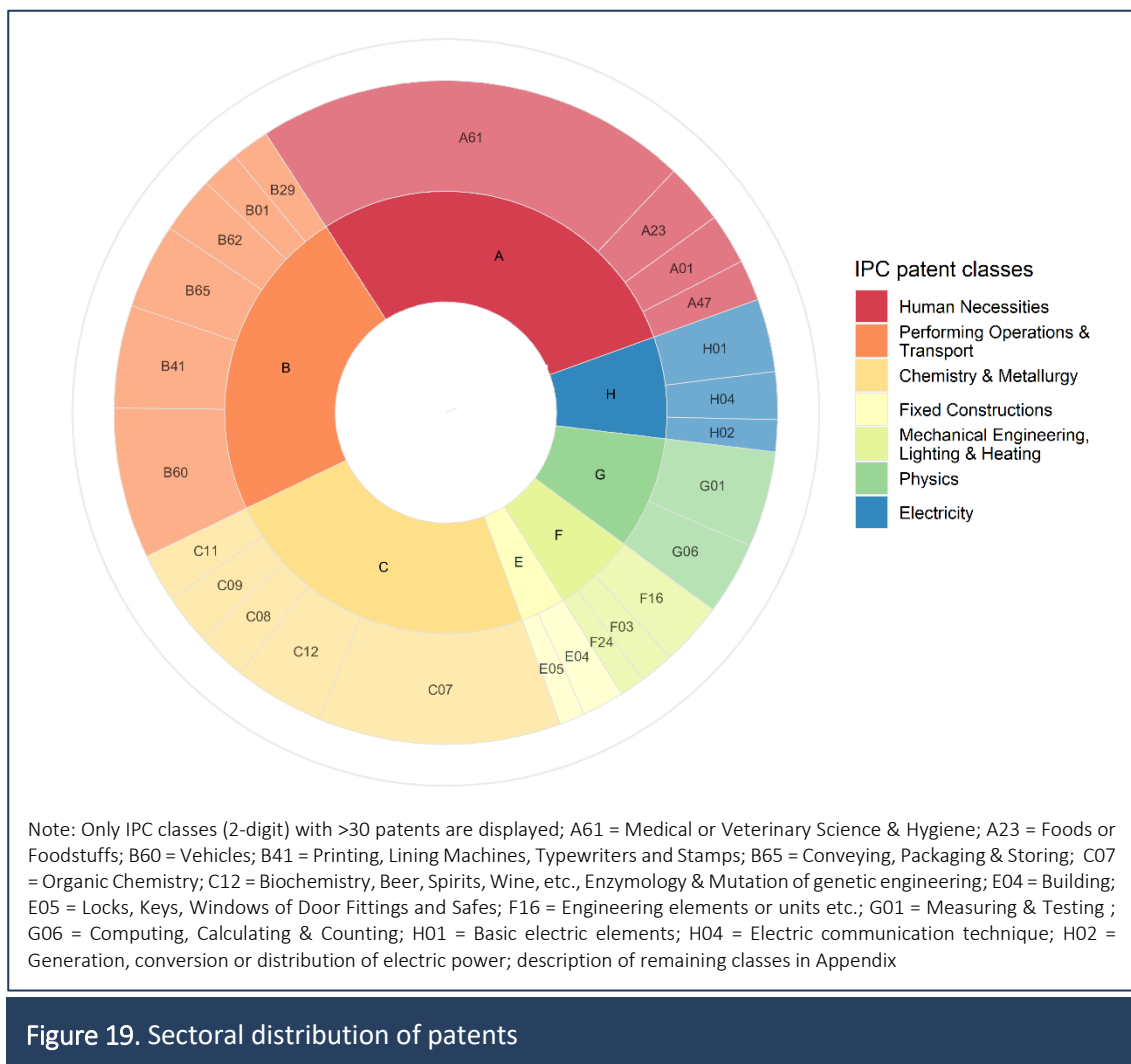


Figure 20 shows the distribution of publications across science disciplines for B30 (2017-2019; disciplines with more than 30 publications are displayed) as extracted from the Web of Science (see Section 3.1 for details on the data base); in total 3,751 were published by authors located in the B30 territory. Looking at scientific publications highlights a more scientific perspective on the sectoral distribution of the R&I ecosystem of B30.

The most frequent category associated with publications in B30 is Chemistry associated with 789 publications and Physics associated with nearly 727 publications; hence, these two disciplines sum up to about a quarter of all publications in B30. These two disciplines are followed by the disciplines and Materials Science (551), Science & Technology (529), and Astronomy & Astrophysics (399)– which amount to the second quarter of the total scientific publications of B30. Other large sectors are Engineering (389), as well as Environmental Sciences & Ecology (305).

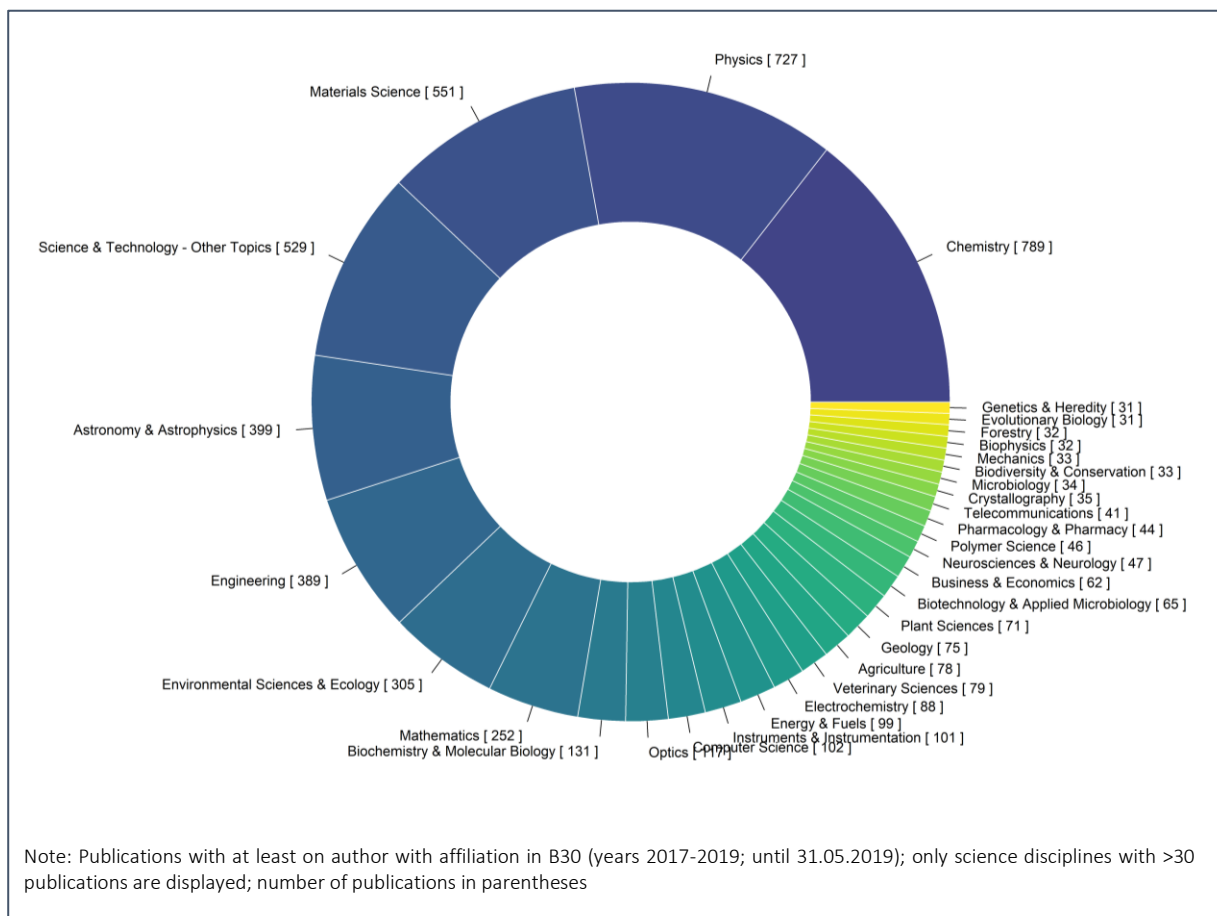


Figure 20. Distribution of publications across science disciplines

The interdisciplinary character of research can be analysed, when the science categories of publications are also displayed by a cooccurrence network, nodes being the number of publications and edges the cosine of common publications, see Figure 21.

The north region of the network shows a high interrelation between several disciplines. This very pronounced co-occurrence of the dominant disciplines Chemistry (789 publ.), Physics (727 publ.), Materials Sciences (551 publ.) and Engineering (389) indicates a remarkable interdisciplinary research in the region. The last one with a degree centrality of 0.29 has the highest interdisciplinary character. Environmental Sciences & Ecology hold also a central position with the second highest degree centrality of 0.28 (with 37 co-disciplines).



Notes: publications with at least one author from B30; circle size: number of publications, range from 1 to 3751 publications, edges: cosine of common publications

Figure 21. Cooccurrence network of science categories in publications

4.3.1.3 Specialization patterns

This subsection turns to the analysis of the overall topical and technological specialisation patterns of B30, accordingly using the Revealed Technological Advantage (RTA) index (see Section 2), and the patent data as described in Section 3.1. Again, the RTA measures the relative specialisation of B30 in a specific technological field as compared to a reference group, in this case European regions. Also, for B30, we calculate the RTA with aggregated patents over the time period 2012-2014, and complement the analysis by looking at the growth from the period 2005-2009 and 2010-2014, and the absolute number of patents in each technological field.

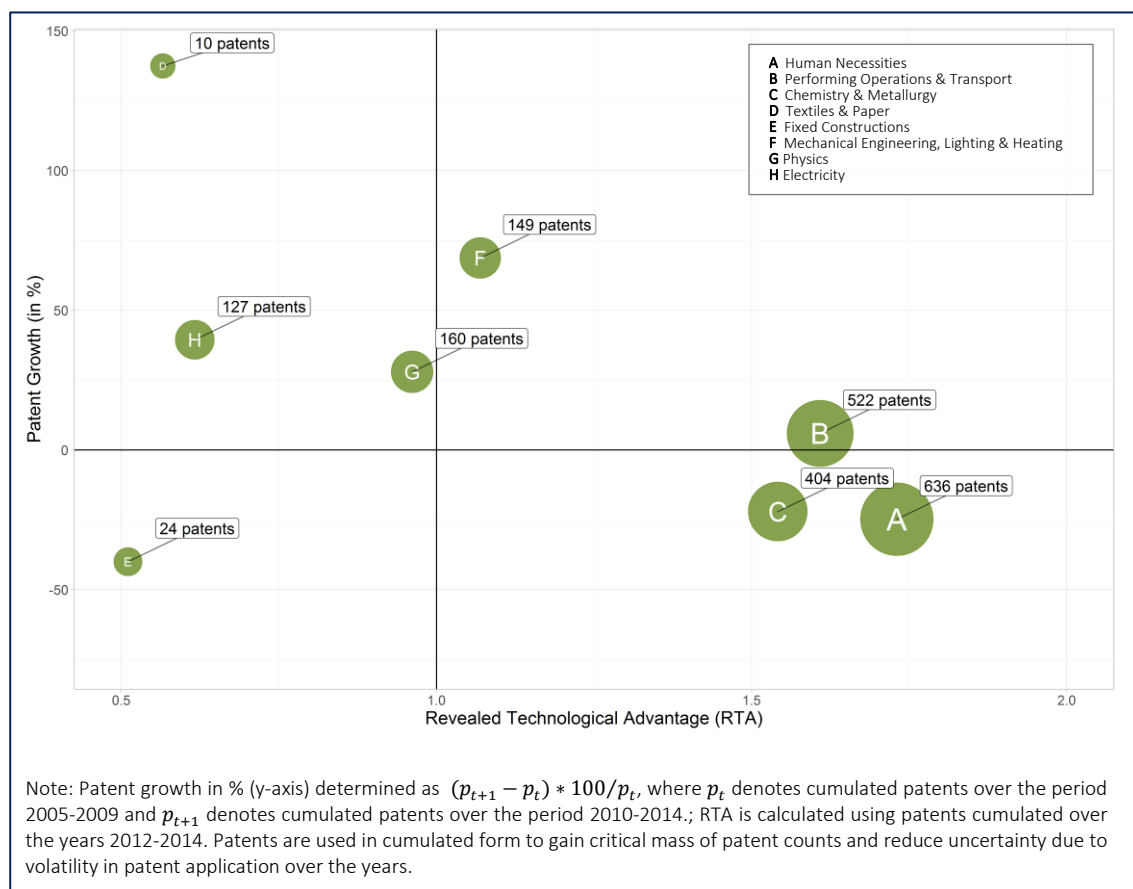


Figure 22. Sectoral specialization and growth

The index ranges from zero to infinity, where a value below 1 indicates a smaller patenting activity in a specific field, while values above 1 indicate a specialisation in this field in comparison to other European regions.

Figure 22 presents the respective results for B30, again in form of a regional portfolio diagram (the x-axis plots the RTA values for the technologies based on the one-digit IPC classification; the y-axis displays the percentage growth between the two periods considered, while the size of the circles corresponds to the number of patents in specific technological field). It can be seen that the specialisation patterns clearly differ, both from Nordland and Lower

Austria. The results reveal a cluster of three technologies, all of them having a significant number of patents (above 400), having a RTA above 1.5, i.e. in these fields B30 produces more than 1.5 patents than the average of European regions. These three technologies are Human Necessities (clearly driven by the subclass A61), followed by Performing Operations and Transport and Chemistry & Metallurgy. However, surprisingly the longitudinal analysis points to a decreasing patenting activity in these fields, two of them even with negative growth rates between the two observed time periods. This may be point to a somewhat stronger transition phase B30 is currently going through since rather well established fields are not growing.

One of the substitution activities could be rooted in the field of Mechanical Engineering (which may also be related to the smart specialisation strategies of the region). In this field, B30 features a high growth rate in patenting between the two observed time periods, and at the same time a moderate specialisation advantage with a RTA value above 1. The main driver behind this development are patenting activities in the subclass Engineering elements or units (F16). For the remaining technological fields, B30 features less patent production than in the European average, though some of them with remarkable growth rates in the recent past.

4.3.2 R&I actors and collaborations

Building upon the general R&I ecosystem characterization, including a sectoral and institutional composition on an aggregate level, this section is aimed at shifting the viewpoint towards an **actor-level** (i.e. organisational level). The identification of leading R&I actors – such as industrial firms, universities, research organisations, etc. – is essential as they constitute the backbone of R&I ecosystems as by providing the institutional framework for research and innovations activities by individual researchers. Hence, Subsection 4.3.2.1 provides an overview of the top R&I actors in terms of patenting activity, participation in EU projects, and scientific publishing.

Additionally, the interactions between these actors, in terms of collaborative R&D projects and joint scientific publications, stand in the focus of this chapter as they constitute essential means by which organizations create and/or access new knowledge. In subsection 4.3.2.2, these interactions between R&I actors – national and international – are represented and analysed by means of network diagrams.

4.3.2.1 Actors

The leading actors in terms of their patenting activities are displayed in Table 26. Generally, there are high numbers of patent applications in B30, given the size of the B30 territory (in the years 2002-2014). On rank one, Universitat Autònoma de Barcelona (UAB) shows the highest patent numbers. Apart from the leading role of UAB in the R&I ecosystem of B30, this is somewhat surprising, as usually patents are considered output of application-oriented, industrial innovation and are hence, are generally applied for by industry firms.

Ranked on the second place is Seat S.A., an international automotive company located in Martorell. Another leading R&I actor amongst the first three top actors, is the Institut Univ. de Ciència i Tecnologia, S.A. (IUCT). IUCT is a high-tech company for industrial technological innovation in the fields of chemistry, pharma, and environment.

Notably, a quite large number of leading R&I actors in B30 (with more than 30 patents) are also active in EU FP projects (as indicated by the addition of [PROJ, PUB] to the organisations' names in Table 26). This indicates a quite diverse R&D portfolio of the actors, as they engage in industrial, exploitation-driven as well as scientific and more exploitation-driven research activities. It also implies that these actors are most likely of critical size in terms of

their R&D infrastructure and R&D personnel, as patent applications as well as EU projects are generally rather resource- and cost-intensive.

Table 26. Top actors active in patenting (>30 patents)

Rank	Name	Org. type	Patents
1	Universitat Autònoma de Barcelona (UAB) [PROJ, PUB]	EDU	636
2	Seat, S.A. [PROJ]	IND	379
3	Institut Univ. de Ciència i Tecnologia, S.A. [PROJ, PUB]	ROR	333
4	Zobebe España, S.A.	IND	211
5	Kao Corporation, S.A.	IND	208
6	Fundació Ascamm [PROJ]	IND	135
7	Mespack, S.L.	IND	113
8	Draconis Pharma, S.L. [PROJ]	IND	105
8	Interquim, S.A.	IND	95
9	Jane, S.A.	IND	95
10	Institut Català De Nanotecnologia i Nanotecnologia	ROR	83
11	Cognis Iberia, S.L.	IND	73
12	Centro Tecnològic (LEITAT) [PROJ, PUB]	ROR	66
13	Afinitica Technologies, S. L.	IND	65
13	B. Braun Surgical, S.A. [PUB]	IND	65
14	Zanini Auto Grup, S.A.	IND	63
15	Corporació Sanitària Parc Taulí [PROJ, PUB]	GOV	58
16	Laboratorios Miret, S.A.	IND	51
16	Rovalma, S.A. [PROJ]	IND	51
17	Metalast, S.A.	IND	48
18	Moehs Ibérica, S.L.	IND	45
19	Sistemas Técnicos de Encofrados, S.A.	IND	44
20	Termo Fluids, S.L. [PROJ]	IND	43
21	Indo Internacional, S.A. [PROJ]	IND	42
22	Chimigraf Ibérica, S.L. [PROJ]	IND	40
23	Play, S.A.	IND	36

Note: 'PROJ' and 'PUB' in squared parenthesis indicate that actors are also active in EU-funded projects (PROJ) and/or scientific publishing (PUB); see Appendix II for organisation types abbreviations

Turning to the top actors active in EU-funded FP projects (in the years 2002-2016), UAB is again the leading actor in the B30 R&I ecosystem. UAB participated in 254 projects, which is almost three times the number of project participations of the second-ranked actor, Eurecat – Centro Tecnològica de Catalunya. Eurecat sees itself as a technology partner of companies in Catalonia, that provides innovative and differential technology to respond to innovation needs and technological competitiveness. Third in the ranking of leading actors in project participations is Centro Tecnològic (LEITAT), which is a technological center aimed at managing technologies by generating collaborative and reliable business environments in the fields of biotechnology, health, advanced materials, industrial chemistry and others.

Other actors include organisations of different types, such as public administration, research institutes, and industry firms. Again, striking is the high number of actors – besides being active in patenting – that are also engaged in EU projects (as indicated by the addition of [PAT] to the organisations' names in Table 27).

Table 27. Top actors active in EU-funded projects (>4 projects)

Rank	Name	Org. type	Participations
1	Universitat Autònoma de Barcelona (UAB) [PAT, PUB]	EDU	254
2	Eurecat - Centro Tecnológico de Catalunya	ROR	86
3	Centro Tecnológico (LEITAT) [PAT, PUB]	ROR	74
4	Catalan Institute of Nanotechnology [PUB]	ROR	67
5	Fundacion Ascamm [PAT]	IND	40
6	Centre de Recerca Agrigeeonòmica (Crag) [PUB]	ROR	29
7	Centre de Recerca Ecològica i Aplicacions Forestals (CREA)	ROR	25
8	Institut de Física d'Altes Energies (IFAE) [PAT]	ROR	16
9	Consortio para la Construcción, Equipamiento y Explotación del Laboratorio de Luz de Sincrotron	ROR	12
10	Boluda Division Industrial, S.L.	IND	11
11	Concorci Markest	ROR	9
12	Corporació Sanitària Parc Taulí [PAT, PUB]	GOV	9
12	Enide Solutions, S.L.	IND	8
13	Intelligent Software Components, S.A.	IND	8
13	Chemigraf Ibérica, S.L. [PAT]	IND	7
14	Plastiasite, S.A.	IND	7
14	Aplicaciones en Informática Avanzada, S.A.	IND	6
15	Consorti Centre de Recerca Matemàtica	ROR	6
15	Generalitat de Catalunya	GOV	6
15	Fundació Centre de Recerca en Sanitat Animal Cresa [PAT, PUB]	ROR	5
16	IDP Ingeniería y Arquitectura Iberia, S.L.	IND	5
16	Seat, S.A. [PAT]	IND	5

Note: 'PAT' and 'PUB' in squared parenthesis indicate that actors are also active in patenting (PAT) and/or scientific publishing (PUB); see Appendix II for organisation types abbreviations

In terms of scientific publications (in the years 2017-2019; drawn from WoS), again, the Autonomous University of Barcelona (UAB) is the leading actor with by far the most publications (1761). With large gaps, the Institute of Microelectronics and CELLS ALBA Synchrotron are on the second and third rank with 764 and 209 publications, respectively. In general, no firms are among the top actors active in scientific publishing, only universities and research organisations.

Table 28. Top actors active in scientific publishing (>10 publications)

Rank	Name	Org. type	Publications
1	Autonomous Univ Barcelona UAB [PROJ, PAT]	EDU	1761
2	Institut de Microelectrónica de Barcelona Biblioteca – CSIC	ROR	764
3	CELLS ALBA Synchrotron	ROR	209
4	Institut de Ciències de l'Espai - CSIC IEEC	ROR	124
5	Institut de Ciència des Materials de Barcelona (ICMAB-CSIC)	ROR	115
6	Centre de Recerca Ecològia i Aplicacions Forestals – CREA Forestals	ROR	105
7	Centre de Recerca Matemàtica	ROR	43
8	Universitat Internacional de Catalunya	EDU	25
9	Instituto de Micro y Nanotecnología-CNM – CSIC	ROR	24
10	Catalan Institute of Nanoscience & Nanotechnology - ICN2 [PROJ]	ROR	18
11	Leitat Technological Center [PROJ]	ROR	18
12	Centre de Recerca en Sanitat Animal (IRTA-CReSA) [PROJ]	ROR	15

Note: 'PROJ' and 'PAT' in squared parenthesis indicate that actors are also active in EU FP projects (PROJ) and/or patenting (PAT); see Appendix II for organisation types abbreviations

4.3.2.2 Project collaborations

In total 139 territorial R&I actors active in EU FP projects can be identified for B30. Within the B30 territory 113 project-based R&D collaborations took place in the years 2002-2016. However, not all territorial actors were involved in such intra-territorial collaborations, but rather participated in national and Europe-wide project collaborations. Nation-wide territorial actors of B30 had 493 collaboration partners, with whom they were involved in 1431 collaborations. The number of collaboration partners increases up to 3351 with 9210 collaborations, once looking at the European level.

Table 29. Collaborations - descriptives

<i>Spatial scale</i>	Number of actors	Number of collaborations
Territorial	138	113
National	493	1431
Europe-wide	3351	9210

Note: based on EU FP project data drawn from the EUPRO database

Figure 23 shifts emphasis to the project-based R&D collaboration network in the same style as for Nordland and Lower Austria, again drawing on information recorded in the EUPRO database. B30 features by far the most EU FP collaborations as compared to the other two regions. Therefore, two networks are visualized; one featuring the whole network (Figure 23a), and another featuring the backbone of main organisations (Figure 23b) which is hardly visible in the overall network. Again, the dots are placed so that nodes with higher interaction and a similar partner profile come closer to each other, while nodes with less interaction and a more dissimilar partner structure are placed more apart from each other. Partners located in B30 are represented by the orange nodes; in blue colour are partners in other regions of Spain.

Figure 23a quite impressively illustrates the central role that organisations of B30 take in the overall Spanish R&D collaboration landscape. Many B30 organisations are positioned in the very center, showing a high degree centrality. This backbone becomes even more visible from Figure 23b, highlighting Tecnalia, UAB and Leitat as most prominent nodes, acting as gatekeeper in the overall Spanish collaboration network, but also featuring a high prestige (connections to other central nodes). This points to a very high capability of the B30 ecosystem to tap external knowledge sources, and to diffuse knowledge within the region as well as across the Spanish national innovation system.

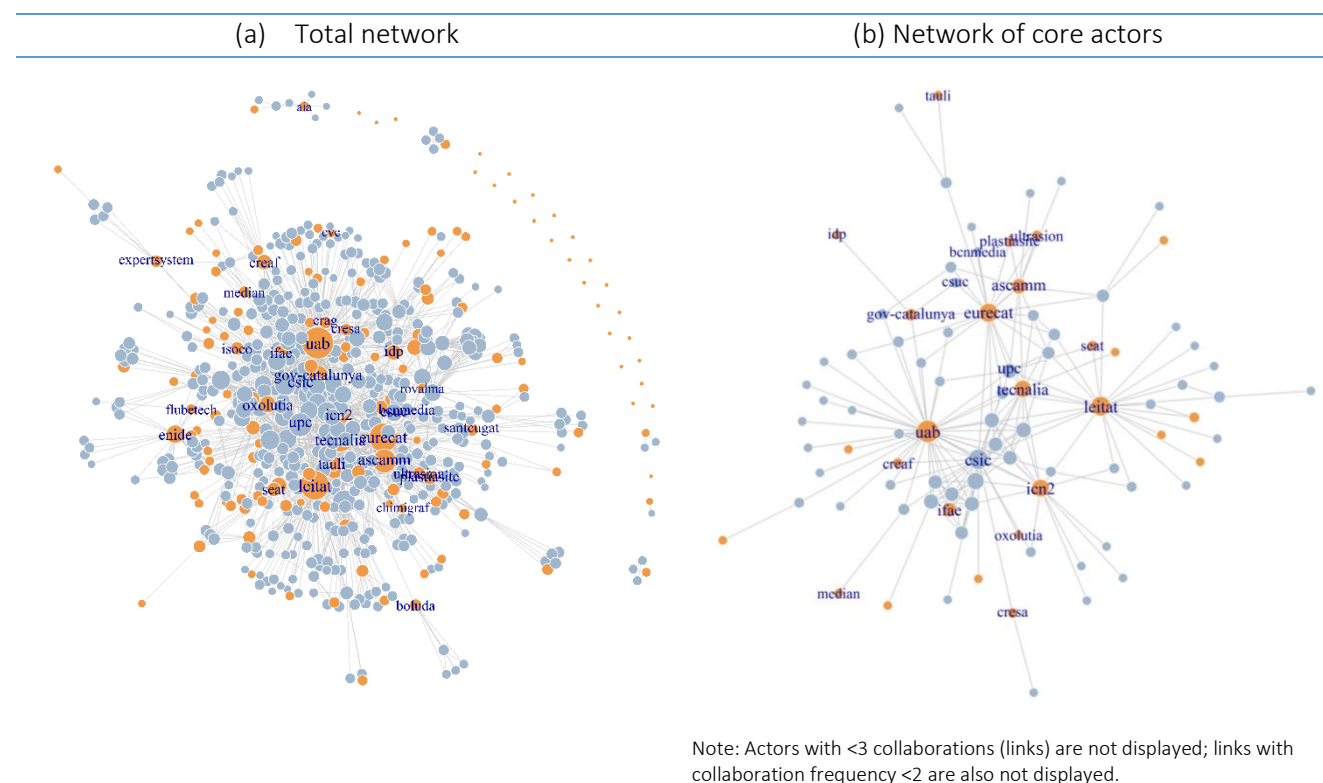


Figure 23. National project collaborations of territories' R&I actors

As for the international collaborations, the results point to a different structure than for the other regions, namely a very strong inter-linking of B30 to the main knowledge hubs in Europe. B30 is extremely well connected to all large countries of Europe, but also a strong integrator of more peripheral and smaller countries. Also, at the organisational level, B30 is the only region that has clearly the highest connections to the most central organisation in the FP, which is Fraunhofer. Moreover, it has prominent relations to the leading universities in Europe, including Uni-Cambridge and Uni-Oxford. In this context, the question arises whether these links are sustainable against the background of Brexit.

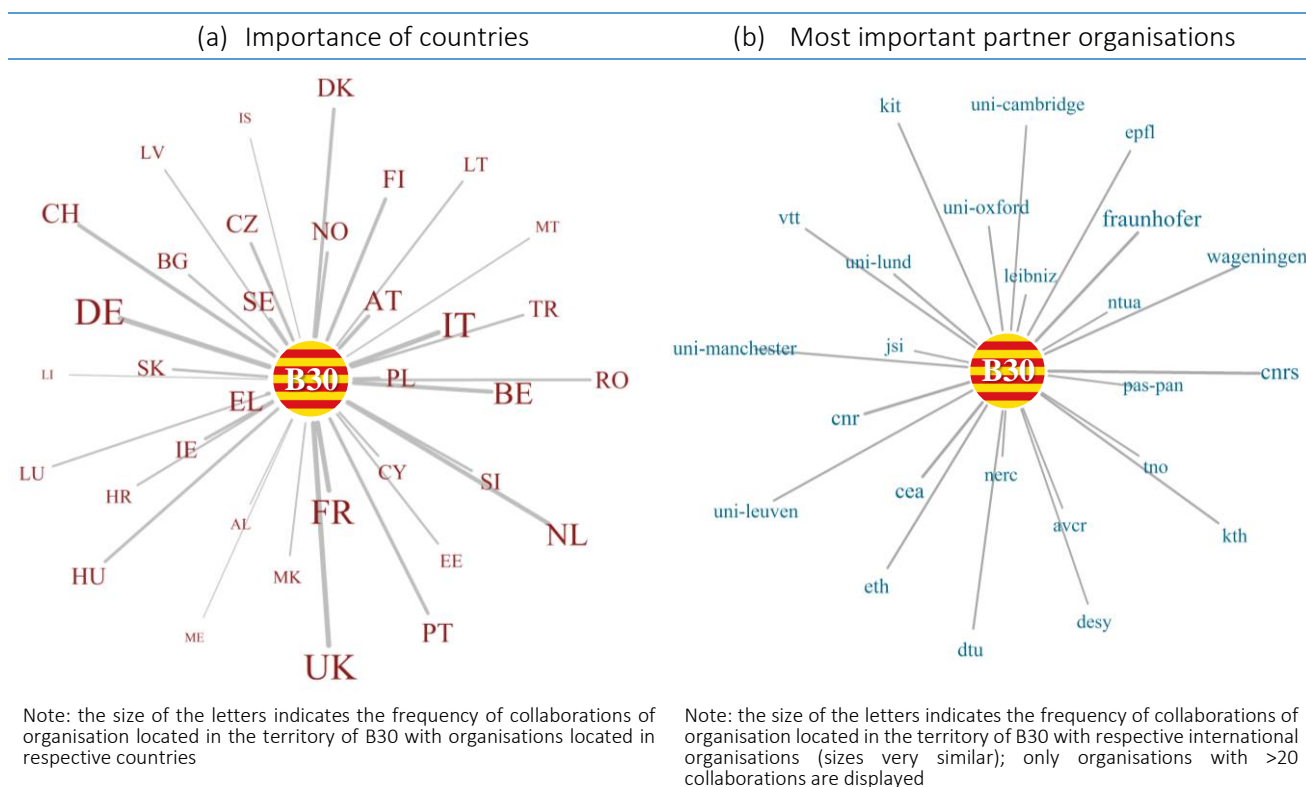


Figure 24. European project collaborations of territories' R&I actors

4.3.3 Territory specific analysis of thematic focus

For each SeeRRI territory, a thematic focus has been selected by territory representatives that will be targeted throughout the whole SeeRRI project, and hence will be highlighted from different point of views. The analysis in the course of this quantitative mapping aims to shed light on the R&I specific landscape of B30 in the context of the thematic focus.

The thematic focus of B30 for the SeeRRI project is defined as follows:

"Integration of RRI into R&I policies and ecosystem's governance. With the strategic intent of increasing the engagement of stakeholders, the SeeRRI actions will focus will on zero waste, a relevant and shared long-term objective for the main stakeholders of the ecosystem, strongly linked to SDGs. The thematic focus in the B30 is also related on how to integrate RRI into S3 strategies and on how to promote transnational learning, more specifically on how to replicate and adapt to other territories what will be explored, tested and learnt in the three SeeRRI territories."

It was necessary to narrow down the focus such that it is suitable for a quantitative analysis, hence the focus was specified on **“zero-waste”**. Experts from B30 have provided a list of keywords for the collection of publications and projects (Appendix III for list of keywords). These keywords were used to identify desired topics.

To be sure not to miss relevant documents we extracted all publications with at least one author with an affiliation from the B30 region as well as all EU-funded projects and performed a qualified search in identified research activities and in single documents. Relevant issues were picked from thematic landscapes of all activities documented by publications and EU-funded projects from the territory.

Consequently, the approach to elaborate the thematic focus is twofold. On one hand we analyse the scientific research activity with a map of all publications in the WoS database with at least one author with an affiliation from the region. Agglomerations of similar publications that are represented in a 3D density map give an insight view in thematic activities. On the other hand, the content of EU funded projects with a participation of the B30 territory's organizations is represented by a co-word map. Finally, actors are listed by thematic categories.

Insights from these analyses illustrate thematic fields, in which the territorial R&I actors are active, along with similar topics the actors are already involved, or could be involved in, in the future. This shows the potential of the R&I actors to diversify to other similar, but new fields of science and technology. The identification of strong science and technology fields is especially relevant in the context of Smart Specialisation¹²; showing the strengths and future potential of the R&I ecosystem regarding the thematic focus. Moreover, core actors are identified, that serve as input for the stakeholder engagement processes in subsequent work packages of this project.

4.3.3.1 Publication landscape

The publication landscape serves for the identification of thematic issues that are of relevance for the project and for the determination of thematically relevant actors. The data basis for the publication landscape is a collection of items from the WoS database. The search strategy was based on the identification of affiliations of authors from the B30 territory. The data base consists of 3751 publications for the time span 2017 to 2019 (retrieval date was 31.05.2019).

The analysis of the publication landscape consists of the following elements:

- i. Disciplines of publications with relevance for the thematic focus
- ii. Science map of research fields with a selection of relevant research activities
- iii. Actors by research field with publications in the thematic focus

¹² <https://s3platform.jrc.ec.europa.eu/de/what-is-smart-specialisation->

i. *Disciplines of publications with relevance for the thematic focus*

In a first step publications that contain one of the keywords were extracted (see Appendix III for keywords). The keywords “waste”, “sustainability” and “recycling” with 104, 40 and 16 publications showed the highest hit rates.

Table 30. No.of publications per keyword

Search keyword	Publications
waste	104
sustainability	40
recycling	16
reuse	8
DRS	6
environmental protection	3
circular economy	3
urban metabolism	2
economic well-being	1

In a next step, the disciplines of the so found relevant publications were identified (see Table 31). The highest absolute number of publications could be identified in Environmental Sciences & Ecology with 70 publications, in Engineering with 42 and Science & Technology – other Topics with 28 publications. It is worthwhile being mentioned that the highest share of a remarkable number of “zero waste” publications are in Water Resources with 48%. On the level of disciplines, we do not have a good picture of the kind of research. In the next chapter we analyse the research fields in the region and combine the results the relevant disciplines.

Table 31. Research fields related to “zero-waste”

Science category	All publications	Publ. „zero waste“	In percent
Environmental Sciences & Ecology	305	70	23%
Engineering	389	42	11%
Science & Technology - other Topics	529	28	5%
Chemistry	789	23	3%
Energy & Fuels	99	14	14%
Materials Science	551	13	2%
Water Resources	25	12	48%
Biotechnology & Applied Microbiology	65	11	17%
Agriculture	78	9	12%
Electrochemistry	88	8	9%
Automation & Control Systems	26	6	23%
Physics	727	4	1%
Business & Economics	62	4	6%
Biochemistry & Molecular Biology	131	4	3%
Geology	75	3	4%
Polymer Science	46	3	7%

Science category	All publications	Publ. „zero waste“	In percent
Computer Science	102	3	3%
Instruments & Instrumentation	101	2	2%
Food Science & Technology	25	2	8%
Geography	15	2	13%
Plant Sciences	71	2	3%
Sociology	7	2	29%
Robotics	6	2	33%
Public Administration	11	2	18%
Pharmacology & Pharmacy	44	2	5%
Marine & Freshwater Biology	24	2	8%
Anthropology	25	1	4%
Astronomy & Astrophysics	399	1	0%
Toxicology	13	1	8%
Biodiversity & Conservation	33	1	3%
Biomedical Social Sciences	3	1	33%
Biophysics	32	1	3%
Psychology	13	1	8%
Geochemistry & Geophysics	16	1	6%
Crystallography	35	1	3%
Oncology	13	1	8%
Oceanography	12	1	8%
Nutrition & Dietetics	10	1	10%
Evolutionary Biology	31	1	3%
Family Studies	1	1	100%
Microbiology	34	1	3%
Meteorology & Atmospheric Sciences	16	1	6%
Metallurgy & Metallurgical Engineering	12	1	8%
Zoology	28	1	4%
Construction & Building Technology	12	1	8%

ii. Science map of research fields

The thematic orientation of published research in the B30 region is analysed by a relational approach of bibliographically coupled publications as a similarity measure. That way research fields are delineated from agglomerations of similar publications. The similarity is measured by the cosine of common references and displayed in a 3-dimensional map (the cosine of the dot product of vectors of all references cited in the dataset with 0 if a reference is not cited and 1 if a reference is cited in the publication). The distance of the items was calculated with a spring model. The 3D map shows the research activity in specific fields that are documented in publications in journals and proceedings of conferences (Figure 25).

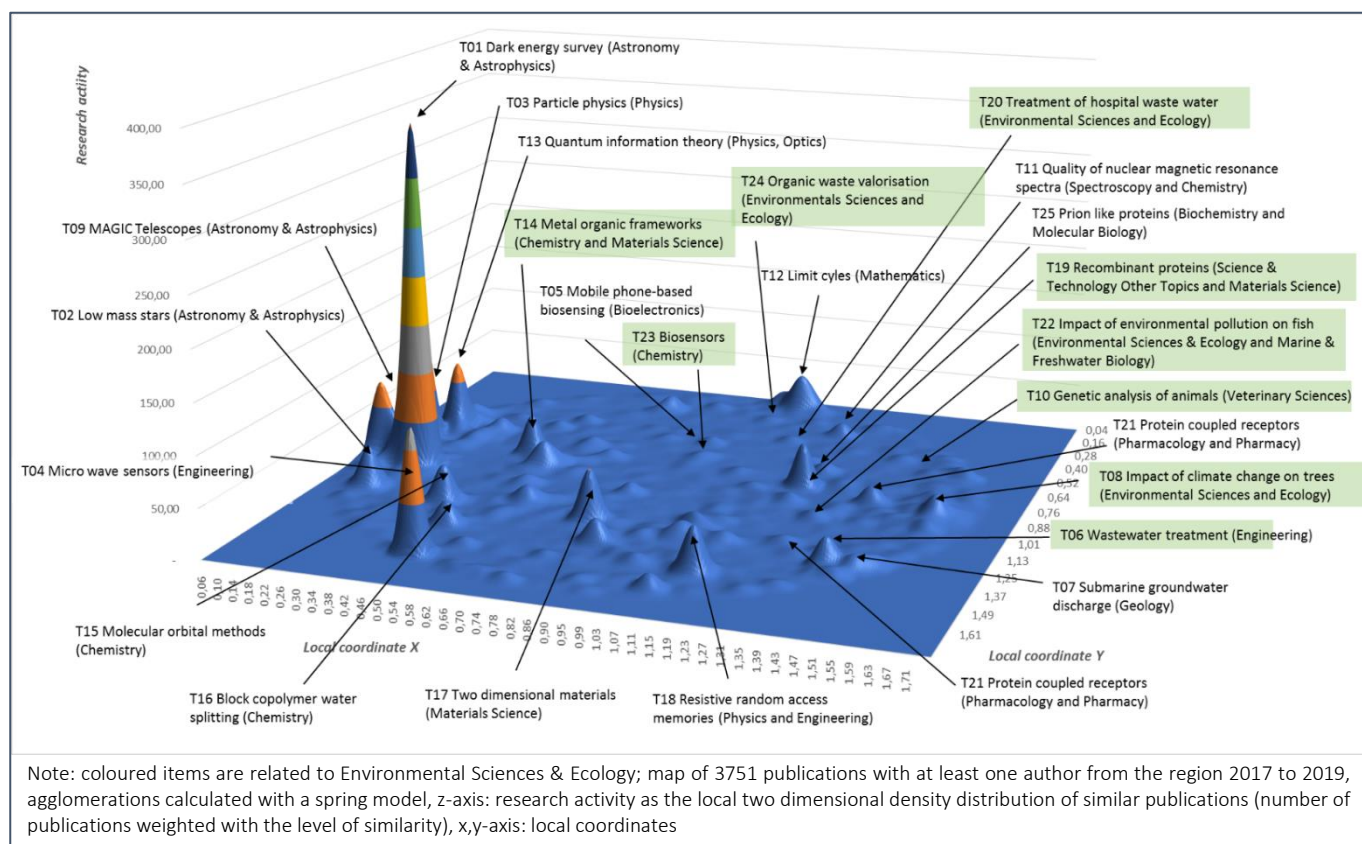


Figure 25. 3D science map of publications in research fields

The peaks illustrate the number of publications weighted by the link similarity. That means that there is a high peak with intense research about a special aspect with a remarkable number of very similar papers about incremental research results. That is the reason why the number of papers in such research fields could be smaller than in other ones. Other research about different aspects in a research fields with not so many very similar papers does not have a high and sharp peak but a broader one. In the case of the B30 region we have high sharp peaks with a smaller number of publications and small broad peaks.

The science map shows intensive research activity with high peaks in “Astronomy & Astrophysics” (173 publ.), especially in the field of dark energy and in the field of micro wave sensors (35 publ.). The research in the field “Impact of climate change on trees” covers different aspects with 229 publications. “Two dimensional materials” with 225 publications is the field with the second highest number of publications.

To summarize, research in the B30 region covers a high number of different research fields. Therefore, we have chosen the following approach to find research in “zero waste” publications: we identified publications in the research fields that contain the keywords mentioned in the first part of chapter 4.3.3. Research fields that include publications with the search keywords are marked with colour in Figure 25. Research fields with the highest number of “zero waste” publications are: “Organic waste valorization” with 12 of 15 publications, “Treatment of

hospital waste water” with 11 of 11 publications, “Waste water treatment” with 11 of 14 publications, “Impact of climate change on trees” with 8 of 229 publications and “Genetic analysis of animals” with 8 of 62 publications.

iii. Actors by research field with publications in the thematic focus

The objective was to find a manageable number of publications of high relevance. Neither the analysis of disciplines nor the identification of research fields delivered the desired publications that were needed to identify actors from research for the thematic focus. Hence, publications in disciplines and research fields with the most publications in “zero waste” were selected. The organizations with the chosen thematic focus were collected from the affiliations of authors who published in the identified disciplines and research fields.

Table 32. Actors by publication fields and science categories

Publication field	Science category	Organizations	Publications
Wastewater treatment (Engineering)	Automation & Control Systems	Univ Autonoma Barcelona, Sch Engr, Dept Telecomunicat & Syst Engr, E-08193 Barcelona, Spain	5
	Engineering	Univ Autonoma Barcelona, Sch Engr, Dept Telecomunicat & Syst Engr, E-08193 Barcelona, Spain	5
Impact of climate change on trees (Environmental Sciences and Ecology)	Environmental Sciences & Ecology	Autonomous Univ Barcelona UAB, Inst Environm Sci & Technol ICTA, Barcelona 08193, Spain	3
		Univ Autonoma Barcelona, Dept Chem Engr, Campus UAB, E-08193 Barcelona, Spain	2
		Univ Autonoma Barcelona, Dept Genet & Microbiol, Fac Biociencias, Bellaterra 08193, Spain	2
		Univ Politecn Cataluna, Dept Civil & Environm Engr DECA, BarcelonaTech, Campus Nord, C Jordi Girona 1-3, ES-08034 Barcelona, Spain	2
		Autonomous Univ Barcelona, Campus UAB, Cerdanyola Del Valles 08193, Spain	1
		CREAF, Cerdanyola Del Valles 08193, Catalonia, Spain	1
		Univ Autonoma Barcelona, Dept Chem Biol & Environm Engr, Campus UAB, E-08193 Barcelona, Spain	1
		Univ Autonoma Barcelona, Dept Geog, Cerdanyola Del Valles 08193, Spain	1
		Univ Autonoma Barcelona, Dept Math, Bellaterra 08193, Spain	1
Genetic analysis of animals (Veterinary Sciences)	Environmental Sciences & Ecology	Autonomous Univ Barcelona UAB, Inst Environm Sci & Technol ICTA, Barcelona 08193, Spain	8

Publication field	Science category	Organizations	Publications
Treatment of hospital waste water (Environmental Sciences and Ecology)	Environmental Sciences & Ecology	Univ Autonoma Barcelona, Escola Engn, Dept Engn Quim Biol & Ambiental, E-08193 Barcelona, Spain	5
		Univ Autonoma Barcelona, Chem Biol & Environm Engn Dept, Escola Engn, E-08193 Barcelona, Spain	3
		Univ Autonoma Barcelona, Inst Environm Sci & Technol, Edifici ICTA ICP, Cerdanyola Del Valles 08193, Spain	1
Organic waste valorisation (Environmental Sciences and Ecology)	Biotechnology & Applied Microbiology	Univ Autonoma Barcelona, Composting Res Grp, Dept Chem Biol & Environm Engn, Escola Engn, E-08193 Barcelona, Spain	5
	Engineering	Univ Autonoma Barcelona, Composting Res Grp, Dept Chem Biol & Environm Engn, Escola Engn, E-08193 Barcelona, Spain	4
	Environmental Sciences & Ecology	Univ Autonoma Barcelona, Dept Chem Biol & Environm Engn, GENOCOV Res Grp, Bellaterra 08193, Spain	6

4.3.3.3 Project landscape

In this chapter the EU-funded research is segmented into thematic fields. The aim is to identify and name organisations from the B30 region who are partners in EU-funded projects in the desired thematic focus.

i. Keyword map of EU funded Projects

In a first step the projects are thematically structured by a co-word analysis (see Figure 26). The keywords used for this co-word analysis were extracted from the project title, objective, programme information and project subjects. One-word keywords were excluded because more words keywords have a better information value. Relevant single word keywords with more than 1 publication like “sustainability” were included. Keywords that occur only in one publication were also excluded. 1303 keywords have been considered.

EU funded research projects in the B30 Region cover fields like Information and Media, Life Sciences, Social Sciences and Humanities, Environmental Protection, Innovation and Technology Transfer, Economy, Educations and Training, Nanotechnology and Nanosciences, Transport, Electronics and Microelectronics, Information Processing and Information Systems and others, see Figure 26 where these fields are highlighted. The search keywords that have been identified for the thematic focus “zero waste” are marked with a flag. Most frequent search keywords are Environmental Protection (44 projects), keywords that contain the string “sustainable” or sustainability, but also energy consumption and fuel consumption. Due to the variety of the search keywords for “zero waste” the issues are spread over the thematic landscape. The results do not offer a good basis for the classification of projects and stakeholders by thematic issues.

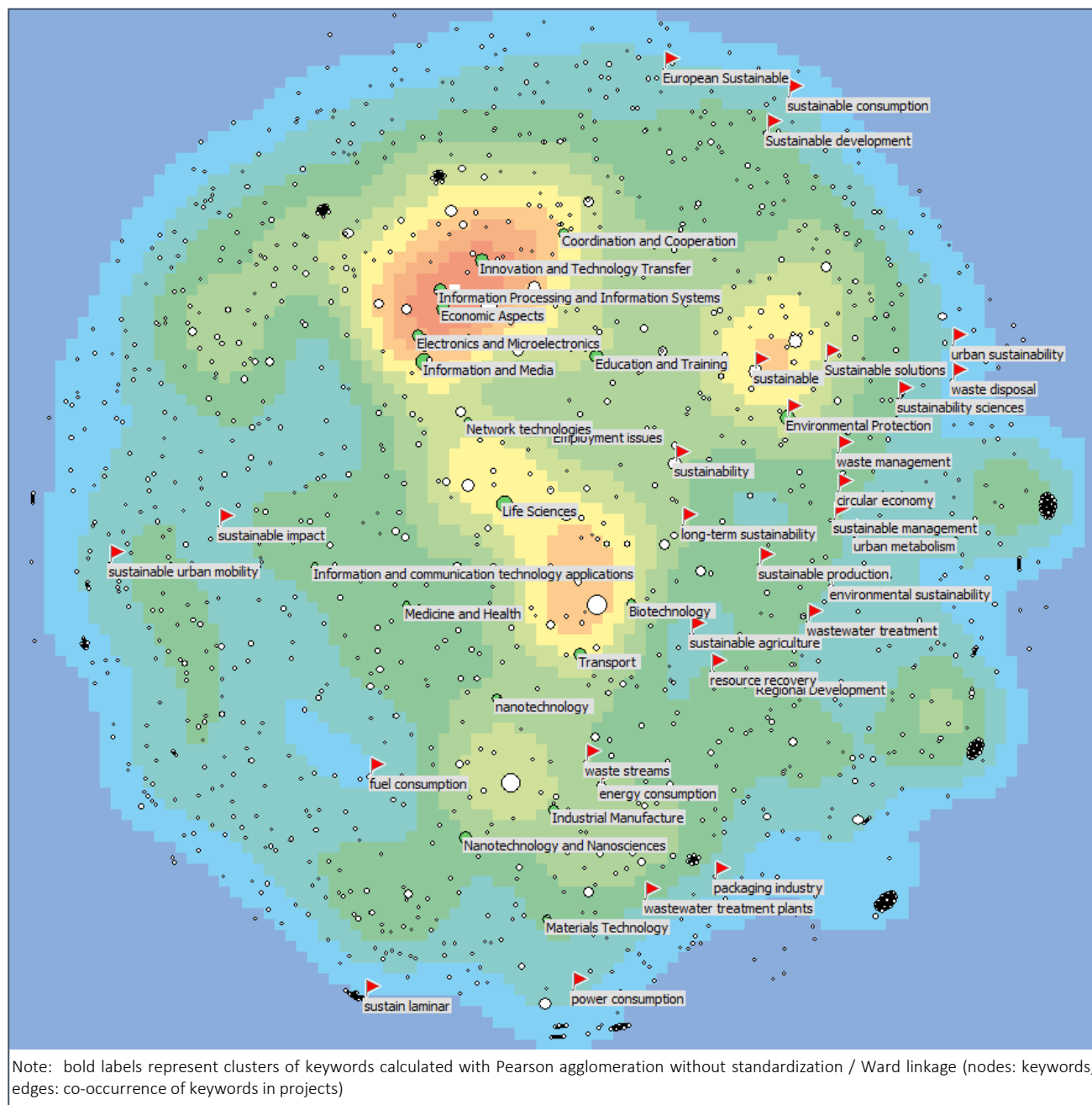
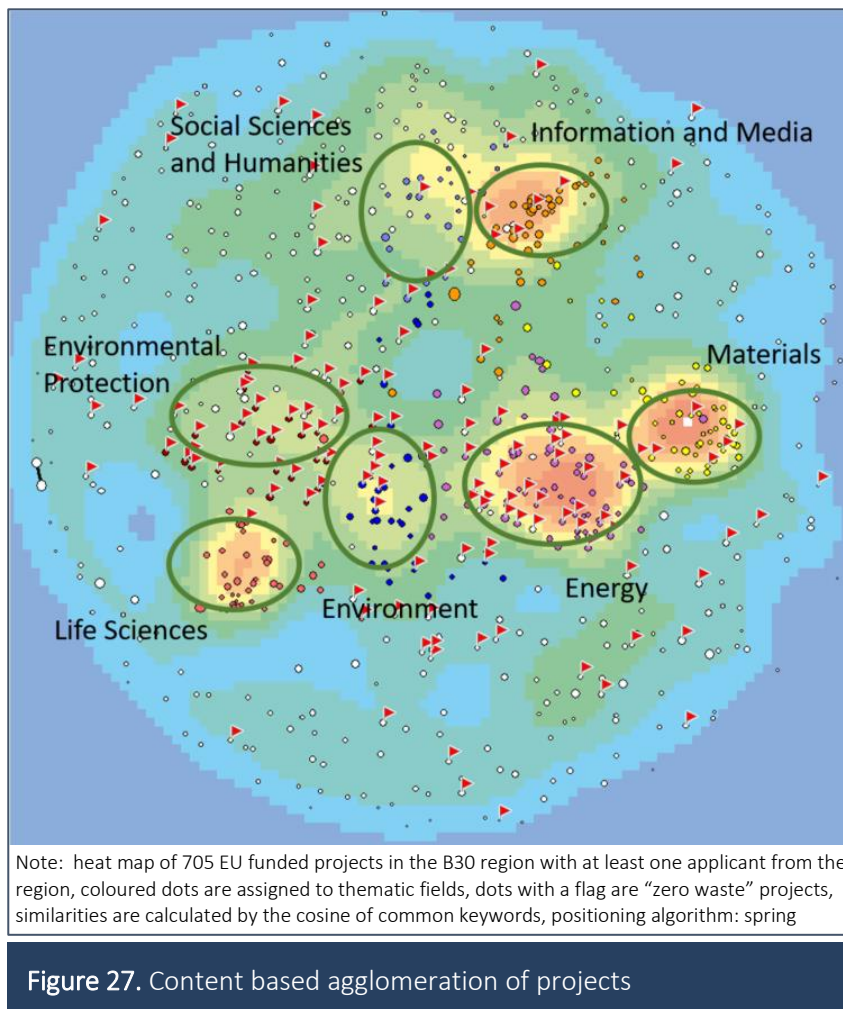


Figure 26. Identified search keywords for “zero waste” in the co-word map

In the next chapter we introduce a map of projects, that are coupled by keywords. Groups of similar projects in terms of cooccurrence of the same keywords will serve for a thematic classification.

ii. Map of projects coupled by keywords

The keywords from the project description were used to identify agglomerations of similar projects. The similarity of projects is measured by common keywords. The more common keywords the projects share the more similar they are.



The projects are displayed in a two-dimensional space and are positioned close to each other by a spring model depending on their similarity. The result of the coupling procedure is shown in Figure 27.

The keyword-based association of projects delivered 7 research fields. Energy related research dominates with 80 projects. Successfully granted projects in the region B3 also emphasize Materials research with 53 projects and Information and Media with 51 projects. When looking on projects with the focus "zero waste" most of them

cover with 100% (25) the field Environmental Protection. Lower shares with 33% (26 of 80) are to be found in Energy research and 24% (9 of 37) in issues of Environmental research.

Examples for projects in Environmental Protection field are: “Enabling the drying process to save energy and water, realizing process efficiency in the dairy chain” and “Furthering Strategic Urban Research”. Examples for projects in Energy research are: “Advanced manufacturing processes for Low Cost Greener Li-Ion batteries” and “Cost effective Fault Current Limiters (FCL) using advanced superconducting tapes for future high-voltage direct current (HVDC) power grids”. Examples for projects in “Environment” are: “Harmonised European Land Monitoring” and “Innovation Demonstration for a Competitive and Innovative European Water Reuse Sector”.

Table 33. EU funded projects with "zero waste" focus by research fields

Research fields	Projects	"zero waste" projects	"zero waste" in percent
Energy	80	26	33%
Environment	37	9	24%
Environmental Protection	25	25	100%
Information and Media	51	5	10%
Life Sciences	45	3	7%
Materials	53	6	11%
Social Sciences and Humanities	27	6	22%
not assigned	382	60	16%

iii. Applicants of relevant projects

“Zero waste” projects are or were carried out by 192 different applicants from the B30 region in sum. To have a better content motivated insight in the variety of the applicants they are structured by the research fields. Additionally, a restriction by a minimum number of projects reduces the number of relevant stake holders.

The applicants are listed in Table 34. The number of applicants by research field is reduced to the important ones in term of the number of projects. The first five organizations are listed in maximum if more are available. The most active organisation – in terms of EU funded projects - is the already well known UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona. With the exception of the research field “Life Sciences” it is the most active partner in each research field. LEITAT (Laboratorio de Ensayos e Investigaciones Textiles del Acondicionamiento Tarrasense) takes the second dominant role with 12 “zero waste” projects in in the category “not assigned”.

LEITAT was founded in 1906 and is a technology transfer center that aims at Managing Technologies to create and transfer Social, Environmental, Economic and Industrial sustainable value for companies and entities through research and technology processes. LEITAT is collaborating with more than 45 countries and develops more than 215 projects in the sectors of: Biotechnology, Health, Advanced Materials, Industrial Chemistry, Renewable Energies and New Production Processes.

Table 34. Applicants from the B30 region in “zero waste” EU FP projects by research fields

Research Fields	Organization	Projects
not assigned	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona	27
	LEITAT (Laboratorio de Ensayos e Investigaciones Textiles del Acondicionamiento Tarrasense)	12
	Eurecat - Centro Tecnológico de Catalunya	9
	PLASTIASITE S.A	5
	Fundacion Ascamm	5
Energy	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona	7
	LEITAT (Laboratorio de Ensayos e Investigaciones Textiles del Acondicionamiento Tarrasense)	7
	AERIS TECNOLOGÍAS AMBIENTALES S.L.	2
	OXOLUTIA SL	2
	Catalan Institute of Nanotechnology	2
Environment	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona	4
	FMC FORET SA	1
	PINTURAS HEMPEL SA	1
	LEITAT (Laboratorio de Ensayos e Investigaciones Textiles del Acondicionamiento Tarrasense)	1
	HIDROQUIMIA TRACTAMENTS I QUIMICA INDUSTRIAL SLU	1
Environmental Protection	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona	13
	CREAF - Centre de Recerca Ecològica i Aplicacions Forestals/Centro de Investigacion Ecologica y Aplicaciones Forestales/Centre for Ecological Research and Forestry Applications	5
	LEITAT (Laboratorio de Ensayos e Investigaciones Textiles del Acondicionamiento Tarrasense)	3
	MEDIAN SCP	2
	FUNDACIO CENTRE DE RECERCA EN SANITAT ANIMAL CRESA	1
Information and Media	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona	4
	ENIDE SOLUTIONS.S.L	1
Life Sciences	FLUBETECH S.L.	1
	IFAE - Institut de Física d'Altes Energies/Institute for High Energy Physics	1
	CREAF - Centre de Recerca Ecològica i Aplicacions Forestals/Centro de Investigacion Ecologica y Aplicaciones Forestales/Centre for Ecological Research and Forestry Applications	1

Research Fields	Organization	Projects
Materials	LEITAT (Laboratorio de Ensayos e Investigaciones Textiles del Acondicionamiento Tarrasense)	2
	Eurecat - Centro Tecnológico de Catalunya	2
	Fundacion Ascamm	1
	IDP INGENIERIA Y ARQUITECTURA IBERIA SL	1
	INDUSTRIAS PUIGJANER S.A.	1
Social Sciences and Humanities	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona	5
	CONSORCI MARKESTS_ORGANIZATIONS AND VOTES IN ECONOMICS	3

KEY FINDINGS – B30

- R&I actors active in collaborative EU projects are predominantly firms, however research organizations are engaged in the majority of project participations, followed by universities.
- The dominant industry class - in terms of patenting – is Human Necessities, with a focus on Medical or Veterinary Science & Hygiene and Foods of Foodstuffs
- In terms of scientific publications, Chemistry, Physics, as well as Materials Science are the three most important disciplines.
- B30 shows a specialization and sector growth in the sector of Mechanical Engineering, Lighting & Heating; other specialized sectors are Human Necessities Performing Operations & Transport, as well as Chemistry & Metallurgy
- Regarding project collaborations, the 138 territorial R&I actors are engaged with 493 national partners and 3351 European partners; central territorial actors are UAB, Tecnalia, Eurecat, as well as LEITAT.
- Amongst the most important partner countries there are Germany, France, Italy, and the UK.
- The publication analysis of the territory-specific focus – zero waste – reveals Environmental Sciences & Ecology, Engineering, Science & Technology, as well as Chemistry as important disciplines; especially, the fields of wastewater treatment, organic waste valorization, and impact of climate change are dominant.
- Important R&I actor in terms of publications in zero waste, is the Autonomous University Barcelona (UAB) – in all related science categories.
- Important R&I actors in terms of project participations in zero waste are UAB and LEITAT (Energy), UAB and CREAF (Environmental Protection), as well as LEITAT and Eurecat (Materials)

4.4 Comparative perspective on key findings

After the detailed presentation of the mapping results of the three territories Nordland, Lower Austria, and B30 with respect to their general characteristics, R&I actors and their interactions, as well as their thematic focus, this subsection is dedicated to highlight the differences and similarities of these three territories of interest.

However, it needs to be noted that the three territories are each highly unique, each with its own strengths and potentials. Hence, a simple comparison of descriptive statistics from the quantitative mapping may lead to misleading conclusions (e.g. one territory is superior to the others in terms of patenting or scientific publishing). Nevertheless, put into a policy context, a comparison may be useful, e.g. motivating an analysis of underlying factors and/or affecting policy implications. However, one has to be careful which dimensions to compare. We refrain from including a comparison of the results of the territory-specific foci in this subsection, due to their non-comparability in terms of their scope.

(a) Institutional composition

With respect to the institutional composition (using data on EU-funded projects), the shares of actor types are quite similar in the three territories, with around 60% industry, around 5% education, and around 13% research actors. However, turning to the distribution of actor types participating in projects, the shares differ quite remarkably, showing the dominance of different actor types in the three territories. Whereas, in Nordland industry actors participate in 55% of the projects, in Lower Austria and B30 this share is considerably lower with 15% and 13% respectively. In Lower Austria, the highest share of actors participating in EU projects are research organizations (30%), similarly, also in B30 this share is relatively high with 39%. However, looking at B30, the importance of educational institutions becomes apparent (with a share of 47%), highlighting the role of the Autonomous University of Barcelona (UAB) in the B30 territory.

(b) Sectoral composition

The sectoral composition (determined by means of the analysis of patent activities) reveals similar tendencies in the distribution of actor types across the different fields of technology (IPC patent classes): all three territories show relatively high patent activity in the sectors *Human Necessities*, *Performing Operations & Transport*, and *Chemistry & Metallurgy*. The sectors *Fixed Constructions*, as well as *Mechanical Engineering*, *Lighting*, *Heating*, *Weapons & Blasting* have relatively high patenting activity in Nordland compared to the other two territories, while Lower Austria has higher patenting counts in *Physics* and *Electricity*. For all territories, the number of patents and actors involved is quite proportional.

(c) Science disciplines

A comparison of the science disciplines (using data on scientific publications), show three quite distinguished landscapes of scientific publishing for the three territories; although some of the most prominent science disciplines are the same for the territories. In Nordland, we observe a high disciplinary concentration, with a focus on three quite related and partly overlapping disciplines: *Environmental Sciences & Ecology*, *Biotechnology & Applied Microbiology*, and *Marine & Freshwater Biology*. Similar to Nordland, Lower Austria also shows the highest publication activity in the field of *Environmental Sciences & Ecology*, however, its disciplinary concentration is relatively lower, as other dominant fields are *Science and Technology*, *Engineering*, and *Physics* which are all rather generic disciplines. The most important disciplines in B30 are consistently quite generic (Chemistry, Physics, Materials Science) while being active in quite many different disciplines, pointing to a relatively low disciplinary concentration.

(d) Specialization patterns

Comparing the territories' specialization (in relation to other European NUTS2 regions), specifically, the relation between specialization in a certain technology class and the respective growth rate (using data on patent applications) reveals quite different patterns. Standing out, Nordland (although exhibiting only small number of patents) shows a high specialization, as well as patent growth in the field of *Human Necessities*, driven by medical and veterinary science as well as food, related to the highly developed fishery sector. Since this is also the sector with the highest number of patents in Nordland, it clearly is the most crucial sector in these terms in Nordland. The specialization portfolio of Lower Austria shows a much more diverse picture, being more or less specialized in all of the eight sectors under consideration (and exhibiting growth in 5 out of eight sectors). However, *Performing Operations & Transport*, and *Physics* are particularly standing out in terms of their patent growth and number of patents, while e.g. *Human Necessities* exhibits negative growth. Interestingly, in B30 three sectors stand out with high specialization, *Human Necessities*, *Performing Operations & Transport*, as well as *Chemistry & Metallurgy*. But, only *Performing Operations & Transport* grows slightly, while the other two sectors are not growing (this may point to a somewhat stronger transition phase of B30 since rather well-established fields are not growing).

(e) R&I actors

In terms of leading actors in the different R&I activities, patenting, scientific publishing and participation in EU-funded projects, Nordland and Lower Austria show a quite characteristic picture that is also found for many other European regions, namely the dominance of firms in patenting, while universities and research organizations have a strong role in EU projects and scientific publishing (with generally a low overlap of actors being engaged in patenting and projects or publishing). However, B30 is different in this respect: with UAB taking the leading role in patenting, scientific publications and project participation; which is quite unique.

(f) Project collaborations

Interesting findings with respect to project collaborations are the different collaboration networks of national collaborations, i.e. showing the embeddedness of the territories' actors in the national R&I ecosystem. Evidently, the networks of the three territories look different due to the varying number of actors involved EU-funded projects, nevertheless in all networks a certain backbone of central actors is observable. In the case of Nordland, the network is quite fragmented with clusters of actors being connected via some actors functioning as gatekeepers. In the case of Lower Austria, the network of national collaborations has one main component with universities and large research organizations as central actors. The respective network of B30 is even more dense than the one for Lower Austria; and more importantly reducing the network to key actors, shows that these actors are indeed local actors from the B30 territory, not other national actors as it is the case for Nordland and Lower Austria. Hence, central actors in the B30 territory are not only of relevance with the territory itself but also act as key players in the nation-wide network of collaborations.

Remark on comparing R&I ecosystems in the three territories

The SeeRRI project's vision is to establish a foundation for building self-sustaining research and innovation ecosystems throughout Europe through RRI. Self-sustaining innovation ecosystems are complex. The mapping presented in this report has used patents, publications, and collaboration in EU projects to reveal a snapshot of research and innovation activities related to the thematic focus of three European territories. On this basis we have begun to piece together an overview picture of the complexity and structure of three R&I ecosystems. The mapping presented in this report will be supplemented with territory specific analysis, we reveal how the ecosystems' ability to be self-sustaining is built in widely different ways, with different institutions and actors taking leading roles.

In order to deliver strategies for building self-sustaining innovation ecosystems throughout Europe, we need to exploit the diversity between our three territories. While doing so, we will uncover context-dependent strategies, created by policy-makers driven by regional strengths and pre-conditions in regards to which building blocks are available to the territory.

The key to supplement the mapping dimensions provided by SeeRRI—patents, publications, and collaboration—is territory-specific information. This follow up analysis is expected to provide an understanding of how regional and national interventions may build social innovations which in turn help self-sustained R&I ecosystems grow. In our preliminary analysis, we found that Nordland is quite different from the other two territories in terms of how they orchestrate their interventions. This is likely due to a consequence of their peripheral location within Europe which in-turn necessitates a broad set of interventions in order to compensate for other mechanisms in-place in more central regions. Understanding how Nordland capitalizes on such regional characteristics can be useful for other, similar, regions. Therefore, we will synthesize a model which we call the “Nordland model.”

5. OUTLOOK

The results of this quantitative mapping of the three territorial R&I ecosystems selected as cases in SeeRRI project – Nordland, Lower Austria and B30 – constitute the starting point in establishing a conceptual and theoretical foundation for self-sustaining R&I ecosystems. The mapping disentangled the differing characteristics of the three regions in terms of their knowledge creation endowments, their institutional architectures and their thematic orientations by means of a series of different visualisations, in particular, network illustrations.

Generally, the results are also intended to pave the way for the development of a generalized empirical framework that can be used to characterize territorial R&I ecosystems in the future. Specifically, the results of the mapping provide an important input for subsequent work packages, in particular, to the interactive stakeholder processes within and across the regions. Specifically, this deliverable provides lists of core R&I actors in each of the three territories, with respect to

- different organisation types (firms, universities, research organisations, ...)
- different forms of R&I activities – participation in R&D projects, patenting and scientific publishing, and
- their engagement in regional, national and international R&D collaboration networks.

These lists serve as starting point for the selection of a representative set of stakeholders considering the heterogeneity and uniqueness of each territory; they serve as an immediate initial input for WP3.

The analysis of territory-specific specialization patterns, industrial distribution, as well as considering territory-specific thematic focuses, by means of the analysis of dominant science fields, allows to assess current territorial strengths and future potential of R&I actors. These findings allow to derive influencing factors and determinants in the constitution of the R&I ecosystems; which serve as important impetus for the stakeholder workshops.

To deliver strategies for building self-sustaining innovation ecosystems throughout Europe, the next immediate steps will include

- exploiting the diversity between the three territories, as well as
- understanding territory-specific mechanisms

to provide a more in-depth understanding of how regional and national interventions may build social innovations that help self-sustained R&I ecosystems grow.

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ANNEXES

Annex I – Network of Affiliated Territories (NAT)

In addition to the three SeeRRI case territories, a mapping is also conducted for some territories of the so-called Network of Affiliated Territories (NAT); selected analyses have been conducted for the NAT members Haifa (Israel), Ostrobothnia (Finland), and Montenegro. The results of these analyses are presented here in Annex I.

AI.1 Haifa

(i) Organisational composition in EU FP projects

Table AI 1. R&I ecosystem actors active in EU FP projects by organisation type

<i>Organisation type</i>	Actors		Project participations	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Industry (IND)	17	0.65	49	0.09
Education (EDU)	2	0.08	443	0.80
Research organisation (ROR)	3	0.12	37	0.07
Consulting (CON)	-	-	-	-
Government (GOV)	-	-	-	-
Others (OTH)	4	0.15	21	0.04
	-	-	550¹	1.00
Total	26	1.00	517	

¹ Multiple counting, if more two or more actors of Haifa with different organisation types are involved in the same project.

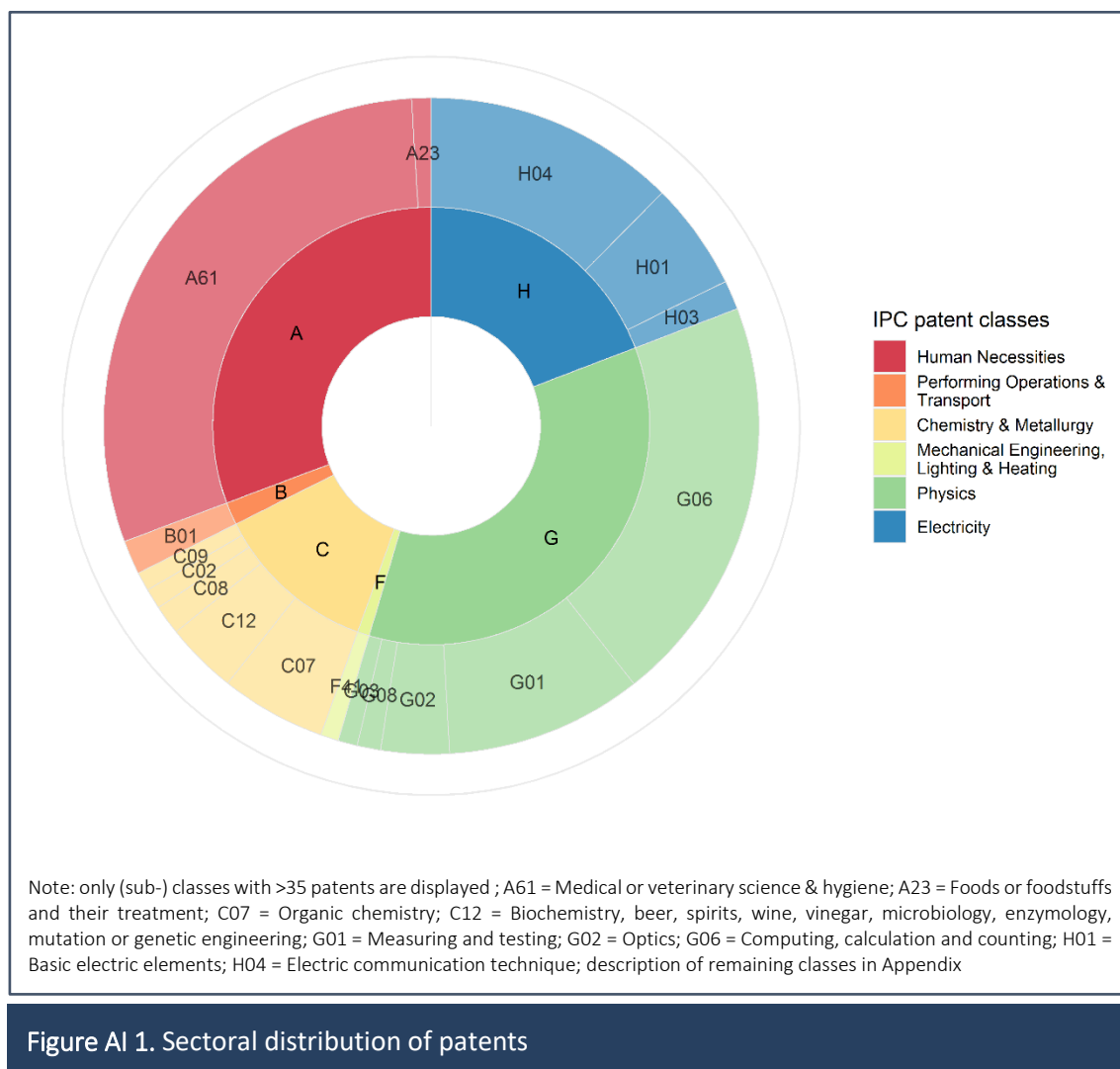
(ii) Sectoral composition in patent applications (PCT patents¹³)

Table AI 2. R&I ecosystem actors active in patenting by technological fields (including single-person applicants)

<i>Topic (IPC)</i>	Actors¹		Patents²	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Human Necessities (A)	751	0.30	1449	0.28
Performing Operations & Transporting (B)	228	0.09	346	0.07
Chemistry & Metallurgy (C)	257	0.10	514	0.10
Textiles & Paper (D)	16	0.006	17	0.003
Fixed Constructions (E)	35	0.01	41	0.008
Mechanical Engineering, Lighting, Heating, Weapons & Blasting (F)	100	0.04	151	0.03
Physics (G)	690	0.28	1594	0.31
Electricity (H)	310	0.12	874	0.17
Total nominations	2503	1.00	5145	1.00
Total number of actors³	1725		4088	

¹³ Here, the PCT (Patent Cooperation Treaty) patents, i.e. worldwide granted patents, were used for the analysis, as patents taken from the EPO (European Patent Office) are quite scarce.

- ¹ The number displayed denote actors active in respective IPC classes; actors may be active in more than one IPC class, which results in multiple counting of actors per IPC classes
- ² The number displayed denote patents in respective IPC classes; patents are often assigned to multiple IPC classes, which results in multiple counting of patents per IPC classes
- ³ I.e. no multiple counting of actor/patents per IPC class



(iii) R&D collaborations

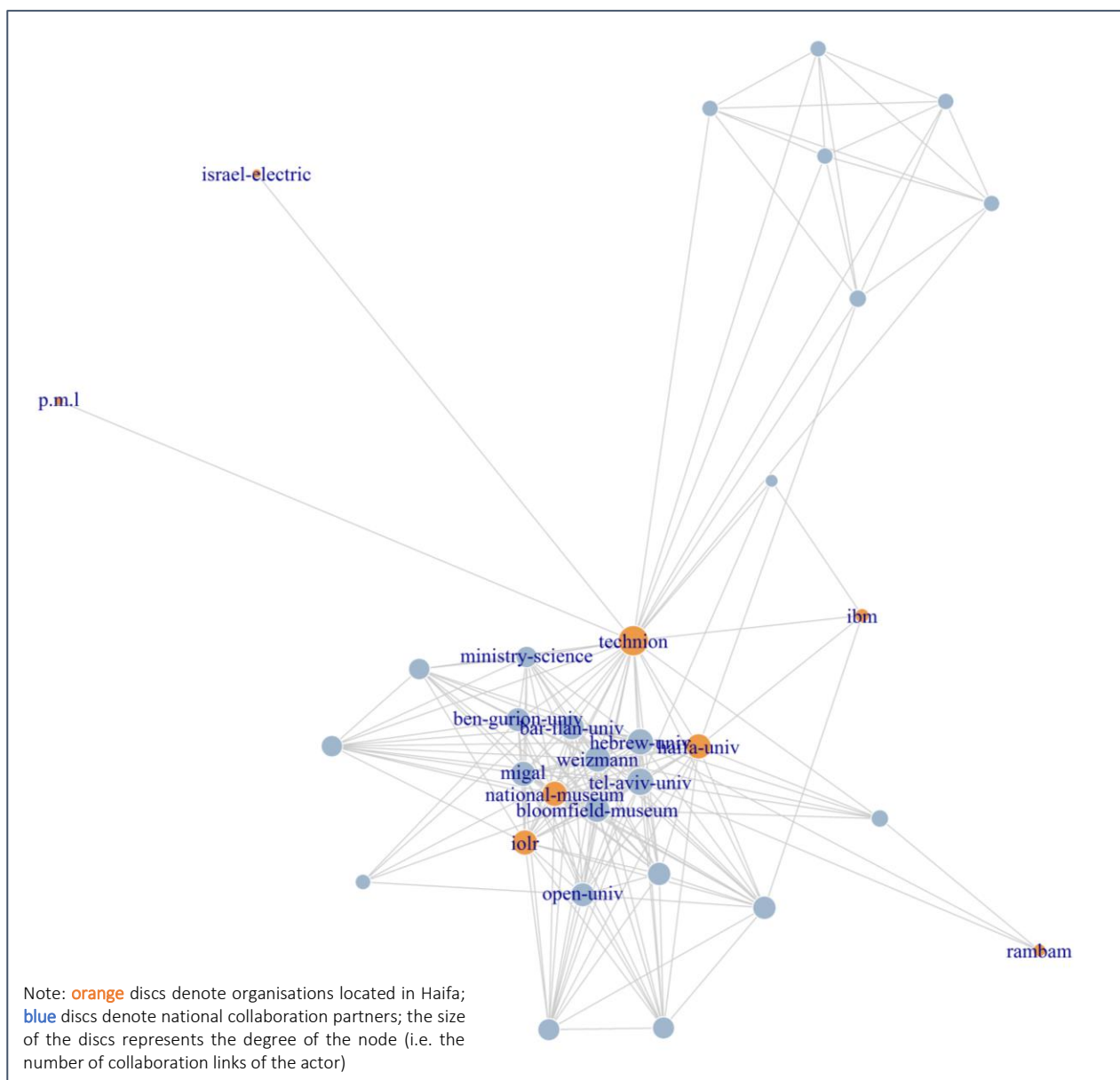


Figure AI 2. Core network of national project collaborations of territories' R&I actors (number of links > 4)

Table AI 3. Abbreviations of organisation names

Abbreviation	Actor name
bar-ilan-univ	Bar-Ilan University - BIU
ben-gurion-univ	Ben Gurion University of the Negev - BGU
bloomfield-museum	BLOOMFIELD SCIENCE MUSEUM JERUSALEM (BSMJ)
e.w.r.e	E.W.R.E. LTD
elbit	Elbit System Ltd
haifa-univ	University of Haifa - HaifaU
hebrew-univ	Hebrew University of Jerusalem (HUJ)
ibm	IBM Corporation
innowattech	INNOWATTECH LTD
iolr	Israel Oceanographic and Limnological Research Ltd - IOLR
israel-electric	THE ISRAEL ELECTRIC CORPORATION LIMITED
migal	Migal - Galilee Technology Center, Ltd
ministry-science	Ministry of Science and Technology, Israel
national-museum	Israel National Museum of Science, Technology, and Space
neaman-inst	THE SAMUEL NEAMAN INSTITUTE FOR ADVANCED STUDIES IN SCIENCE AND TECHNOLOGY OF THE TECHNION LTD (PSC)
open-univ	Open University of Israel (e-openu)
p.m.l	P.M.L.- PARTICLE MONITORING TECHNOLOGIES LTD
pluristem	PLURISTEM LTD.
rambam	Rambam Health Care Campus
technion	Israel Institute of Technology - Technion
tel-aviv-univ	Tel Aviv University - TAU
weizmann	Weizmann Institute of Science (Weizmann)

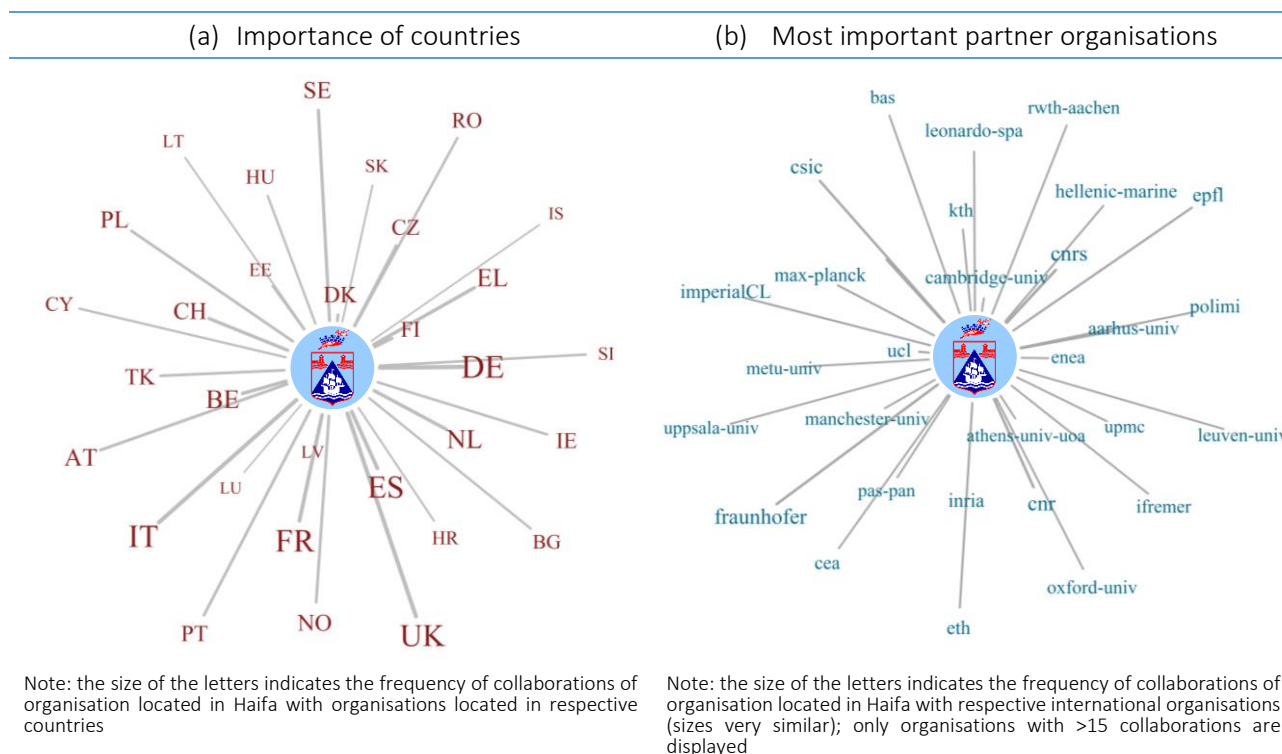


Figure AI 3. European project collaborations of territories' R&I actors

AI.2 Ostrobothnia

(i) Organisational composition in EU FP projects

Table AI 4. R&I ecosystem actors active in EU FP projects by organisation type

<i>Organisation type</i>	Actors		Project participations	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Industry (IND)	20	0.77	46	0.78
Education (EDU)	1	0.04	7	0.12
Research organisation (ROR)	-	-	-	-
Consulting (CON)	1	0.04	2	0.03
Government (GOV)	1	0.04	1	0.02
Others (OTH)	3	0.12	3	0.05
	-	-	59¹	1.00
Total	26	1.00	51	

¹ Multiple counting, if more two or more actors of Ostrobothnia with different organisation types are involved in the same project.

(ii) Sectoral composition in patent applications

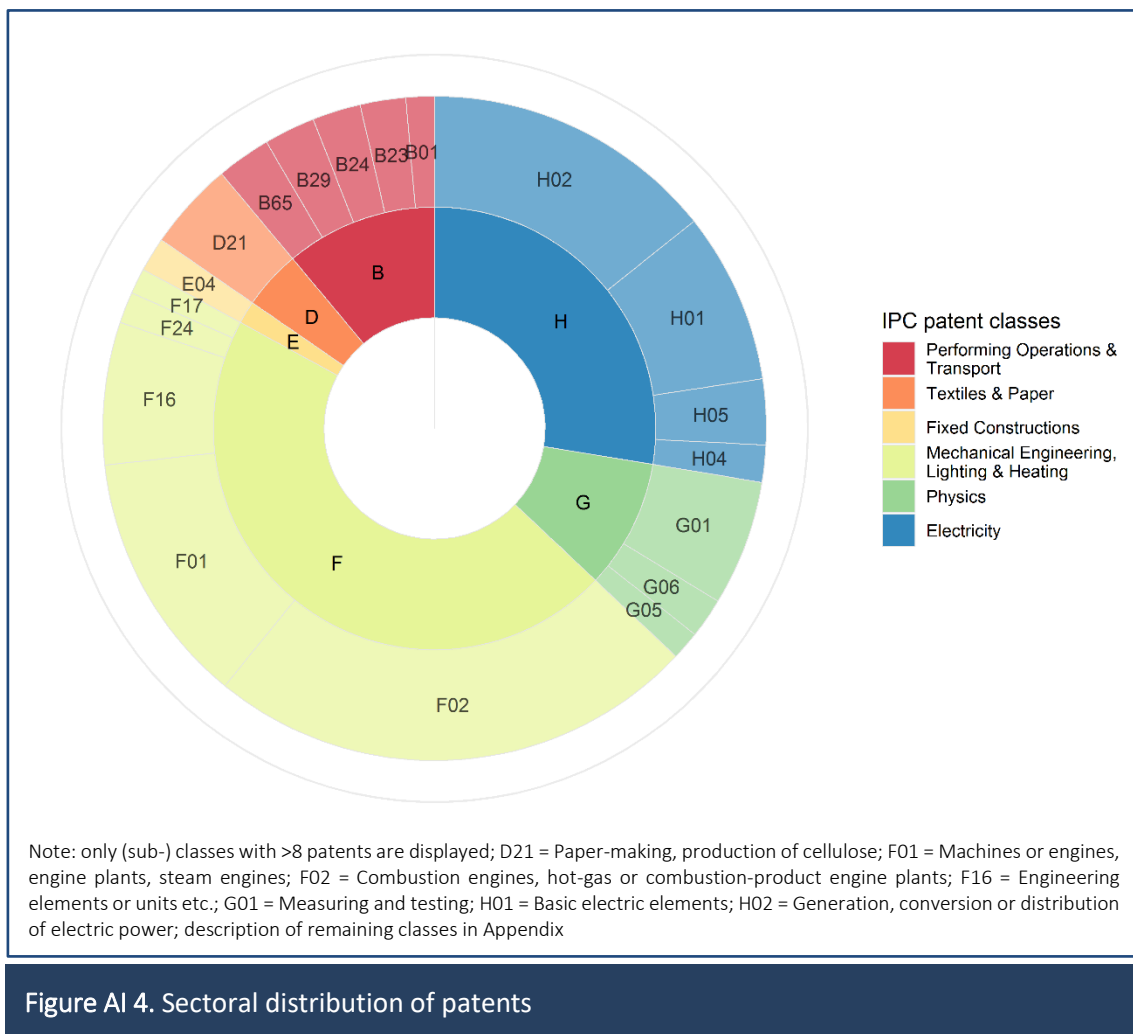
Table AI 5. R&I ecosystem actors active in patenting by technological fields (including single-person applicants)

<i>Topic (IPC)</i>	Actors¹		Patents²	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Human Necessities (A)	22	0.10	30	0.04
Performing Operations & Transporting (B)	61	0.27	119	0.16
Chemistry & Metallurgy (C)	17	0.08	23	0.03
Textiles & Paper (D)	11	0.05	32	0.04
Fixed Constructions (E)	15	0.07	24	0.03
Mechanical Engineering, Lighting, Heating, Weapons & Blasting (F)	35	0.16	280	0.37
Physics (G)	20	0.09	66	0.09
Electricity (H)	41	0.18	185	0.24
Total nominations	222	1.00	759	1.00
Total number of actors³	145		630	

¹ The number displayed denote actors active in respective IPC classes; actors may be active in more than one IPC class, which results in multiple counting of actors per IPC classes

² The number displayed denote patents in respective IPC classes; patents are often assigned to multiple IPC classes, which results in multiple counting of patents per IPC classes

³ I.e. no multiple counting of actor/patents per IPC class



(iii) R&D collaborations

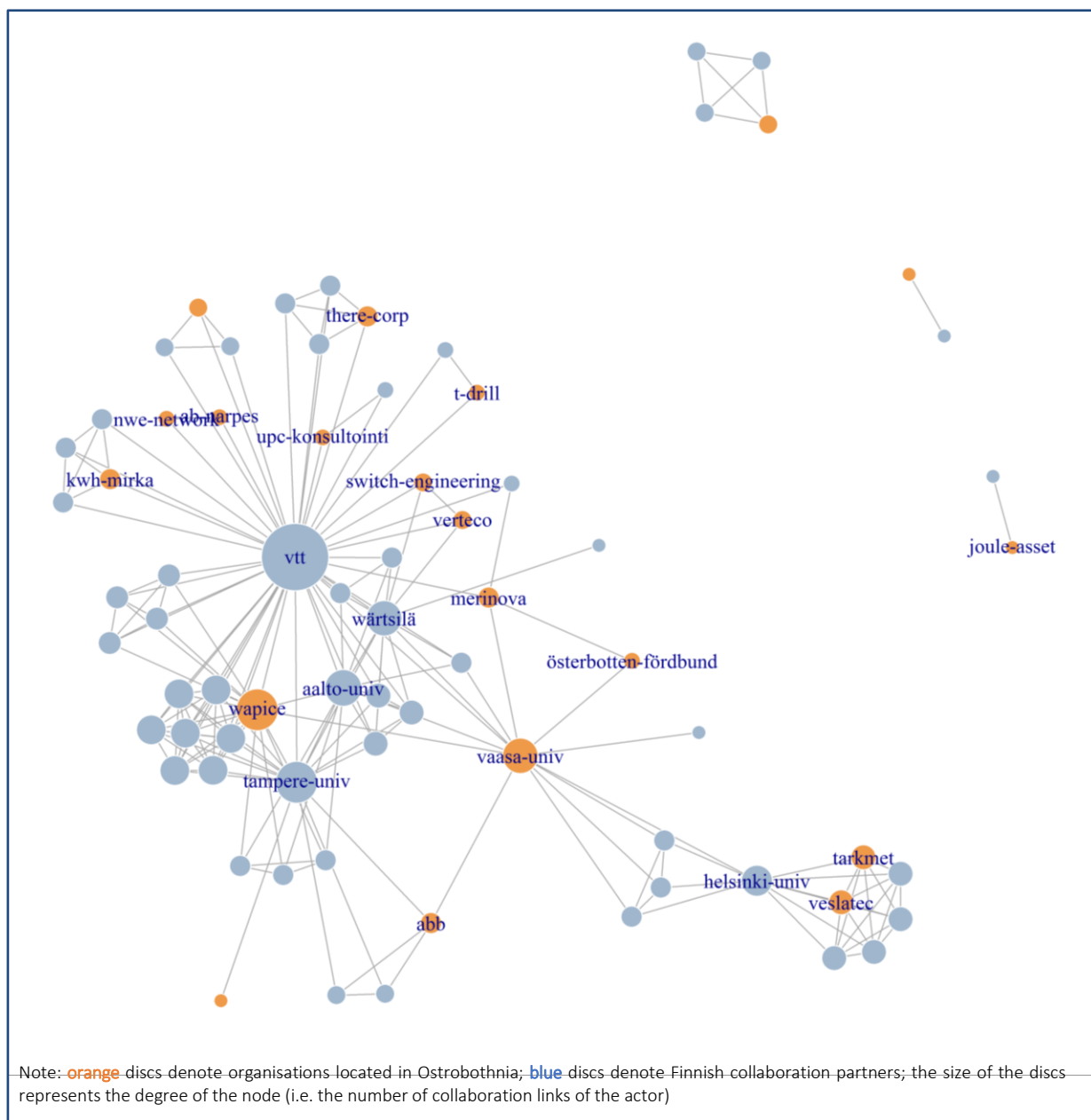


Figure AI 5. National project collaborations of territories' R&I actors

Table AI 6. Abbreviations of organisation names

Abbreviation	Actor name
aalto-univ	Aalto University
abb	ABB - Asea Brown Boveri AG/Ltd
ab-narpes	AB NARPES TRA & METALL - OY NARPIONPUU JA METALLI
cmt	Center of Maritime Technologies e.V. (CMT)
helsinki-univ	University of Helsinki, Helsingin Yliopisto
joule-asset	JOULE ASSET EUROPE AB OY
kwh-mirka	KWH-MIRKA
merinova	Oy Merinova Ab
nwe-network	NWE NETWORK ENGINEERING OY AB
österbotten-fördbund	ÖSTERBOTTENS FÖRBUND (REGIONAL COUNCIL OF OSTROBOTHNIA)
switch-engineering	THE SWITCH ENGINEERING OY
tampere-univ	Tampere University of Technology, Tampereen Teknillinen Yliopisto
tarkmet	TARKMET OY
t-drill	T-Drill Oy
there-corp	There Corporation Ltd.
upc-konsultointi	UPC KONSULTOINTI OY
vaasa-univ	University of Vaasa, Vaasan Yliopisto
verteco	VERTECO OY
veslatec	VESLATEC OY
vtt	VTT Technical Research Centre of Finland
wapice	WAPICE OY
wärtsilä	Wärtsilä Corporation Oy

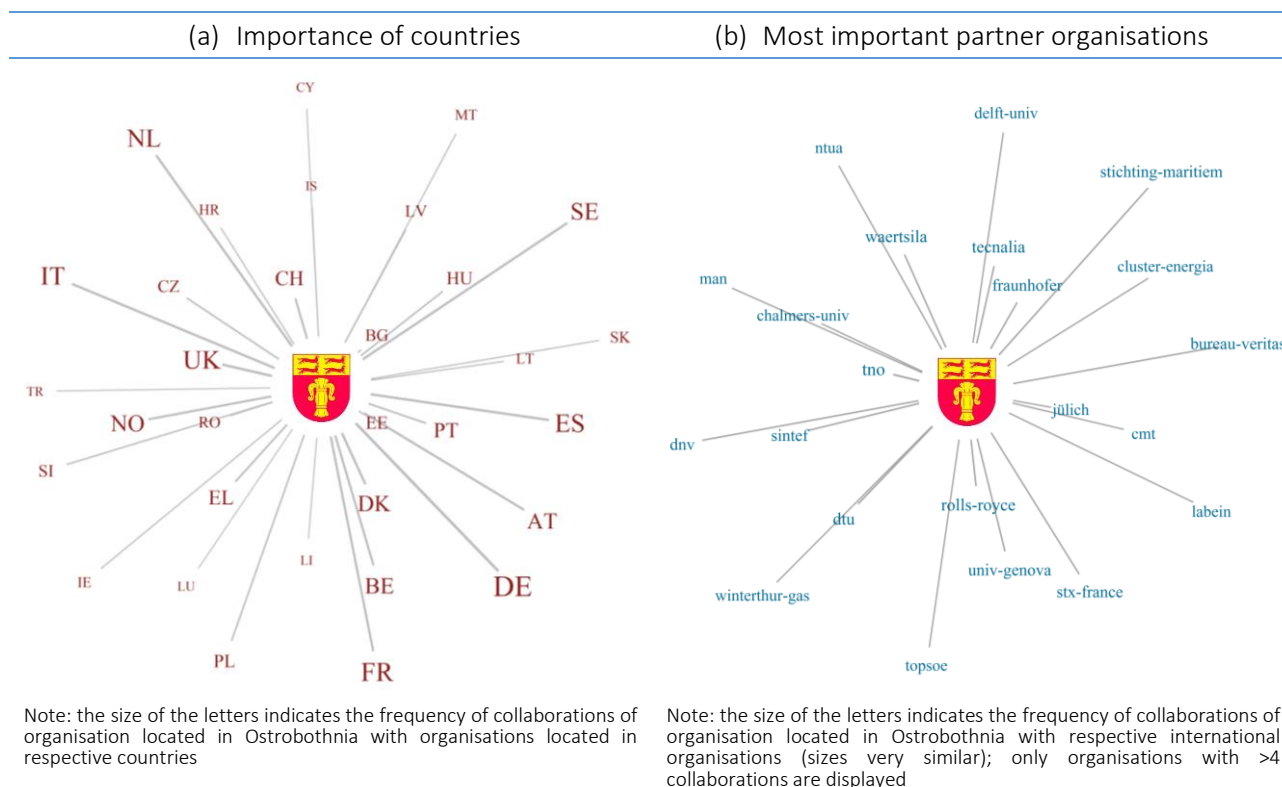


Figure AI 6. European project collaborations of territories' R&I actors

AI.3 Montenegro

(i) Organisational composition in EU FP projects

Table AI 7. R&I ecosystem actors active in EU FP projects by organisation type

<i>Organisation type</i>	Actors		Project participations	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Industry (IND)	1	0.06	1	0.01
Education (EDU)	4	0.22	31	0.45
Research organisation (ROR)	3	0.17	3	0.04
Consulting (CON)	-	-	-	-
Government (GOV)	6	0.33	25	0.36
Others (OTH)	4	0.22	9	0.13
	-	-	69¹	1.00
Total	18	1.00	45	

¹ Multiple counting, if more two or more actors of Montenegro with different organisation types are involved in the same project.

(ii) Sectoral composition in patent applications (PCT patents¹⁴)

Table AI 8. R&I ecosystem actors active in patenting by technological fields (including single-person applicants)

<i>Topic (IPC)</i>	Actors¹		Patents²	
	<i>total</i>	<i>share</i>	<i>total</i>	<i>share</i>
Human Necessities (A)	2	0.14	4	0.22
Performing Operations & Transporting (B)	-	-	-	-
Chemistry & Metallurgy (C)	2	0.14	2	0.11
Textiles & Paper (D)	-	-	-	-
Fixed Constructions (E)	-	-	-	-
Mechanical Engineering, Lighting, Heating, Weapons & Blasting (F)	3	0.21	4	0.22
Physics (G)	1	0.07	1	0.06
Electricity (H)	6	0.43	7	0.39
Total nominations	14	1.00	18	1.00
Total number of actors³	11		15	

¹ The number displayed denote actors active in respective IPC classes; actors may be active in more than one IPC class, which results in multiple counting of actors per IPC classes

² The number displayed denote patents in respective IPC classes; patents are often assigned to multiple IPC classes, which results in multiple counting of patents per IPC classes

³ I.e. no multiple counting of actor/patents per IPC class

¹⁴ Here, the PCT (Patent Cooperation Treaty) patents, i.e. worldwide granted patents, were used for the analysis, as patents taken from the EPO (European Patent Office) are quite scarce.

Note, that the illustration of the sectoral distribution of the patent classes was omitted for Montenegro due to a lack of patents.

(iii) R&D collaborations

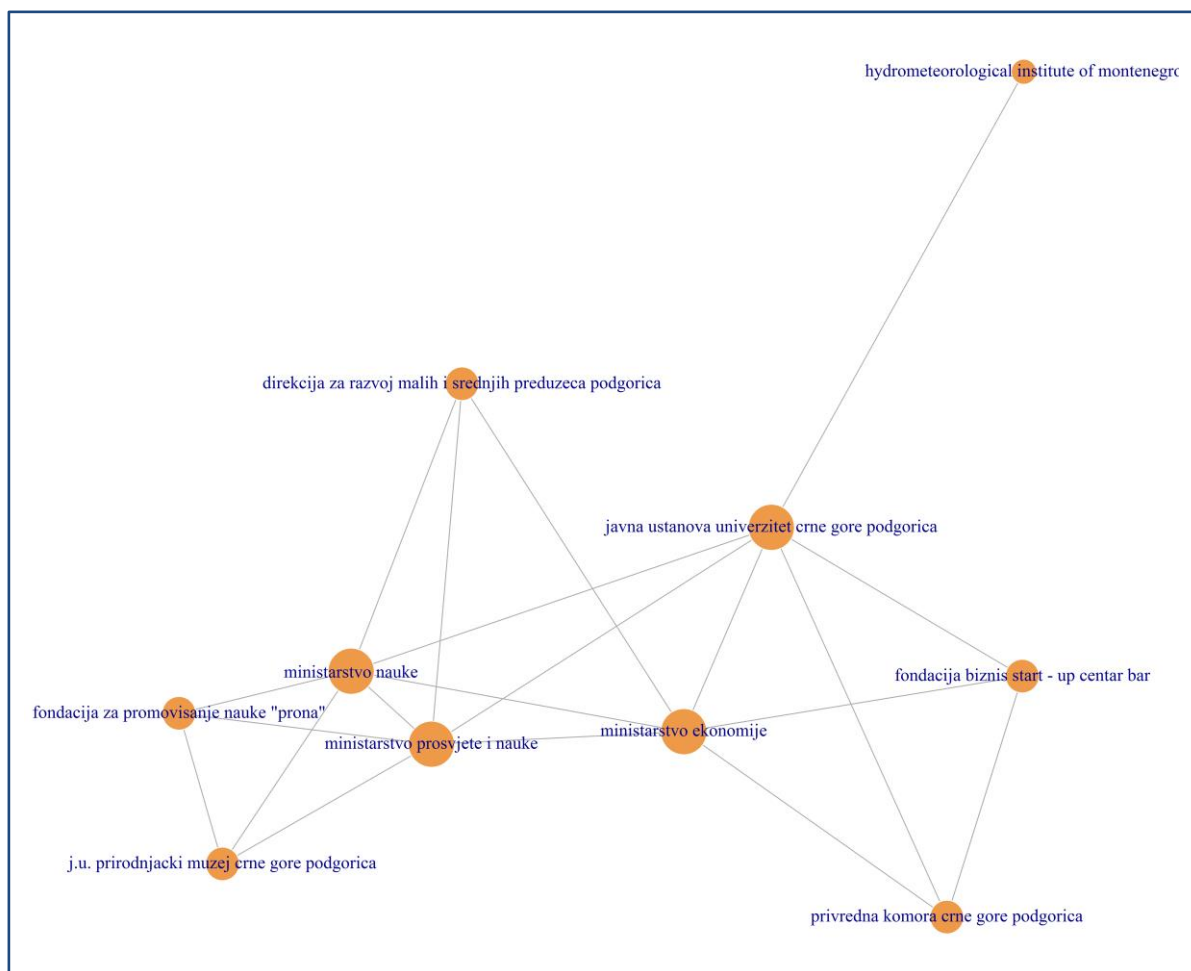


Figure AI 7. National project collaborations of R&I actors

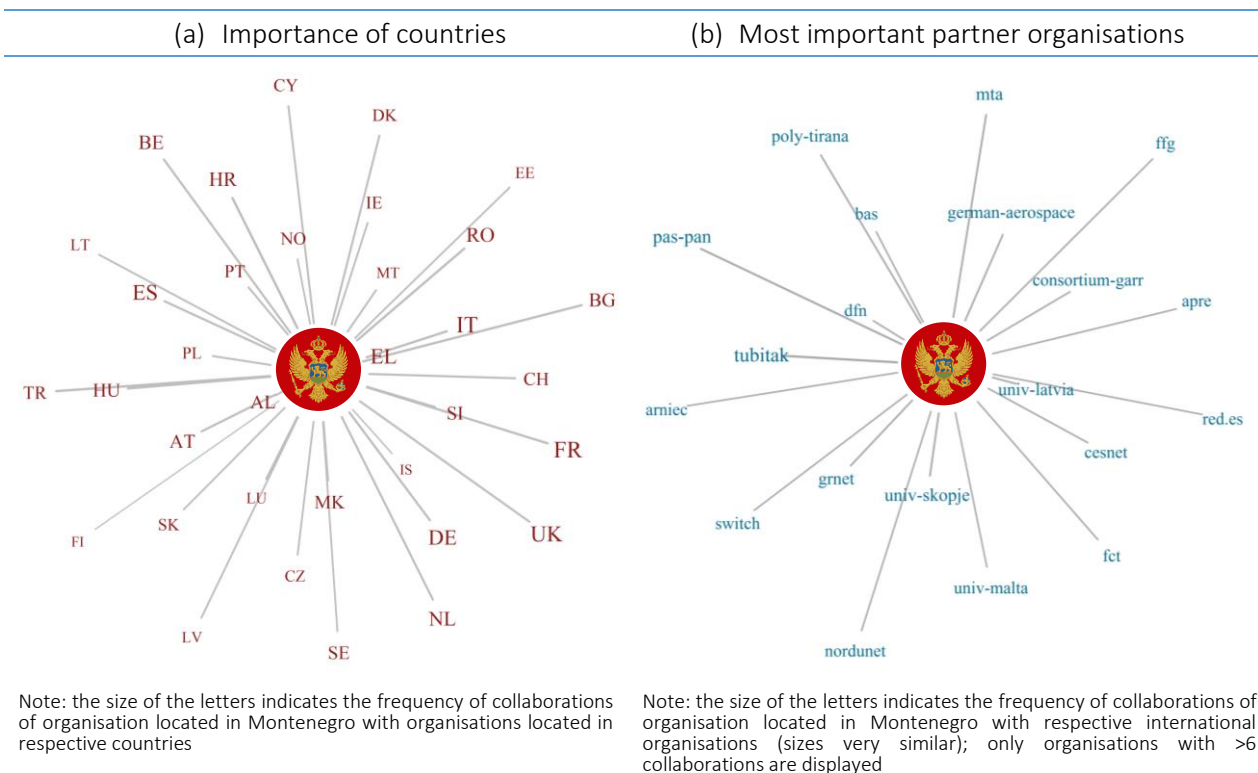


Figure AI 8. European project collaborations of territories' R&I actors

Annex II – General additional information

Table All 1. Description of IPC patent codes

Code	Description	Code	Description
A01	Agriculture	C12	Biochemistry
A21	Baking	C13	Sugar industry
A22	Butchering	C14	Skins
A23	Foods or foodstuffs	C21	Metallurgy of iron
A24	Tobacco	C22	Metallurgy
A41	Wearing apparel	C23	Coating metallic material
A42	Headwear	C25	Electrolytic or electrophoretic processes
A43	Footwear	C30	Crystal growth
A44	Haberdashery	C40	Combinatorial technology
A45	Hand or travelling articles	C99	Section C Other - Chemistry
A46	Brushware	D01	Natural or artificial threads or fibres
A47	Furniture	D02	Yarns
A61	Medical or veterinary science	D03	Weaving
A62	Life-saving	D04	Braiding
A63	Sports	D05	Sewing
B01	Physical or chemical processes or apparatus in general	D06	Treatment of textiles or the like
B02	Crushing, pulverising, or disintegrating	D07	Ropes
B03	Separation of solid materials using liquids or using pneumatic tables or jigs	D21	Paper-making
B04	Centrifugal apparatus or machines for carrying-out physical or chemical processes	E01	Construction of roads, railways, or bridges
B05	Spraying or atomising in general	E02	Hydraulic engineering
B06	Generating or transmitting mechanical vibrations in general	E03	Water supply
B07	Separating solids from solids	E04	Building
B08	Cleaning	E05	Locks
B09	Disposal of solid waste	E06	Doors, windows, shutters, or roller blinds, in general
B21	Mechanical metal-working without essentially removing material	E21	Earth or rock drilling
B22	Casting	F01	Machines or engines in general
B23	Machine tools	F02	Combustion engines
B24	Grinding	F03	Machines or engines for liquids
B25	Hand tools	F04	Positive-displacement machines for liquids
B26	Hand cutting tools	F15	Fluid-pressure actuators
B27	Working or preserving wood or similar material	F16	Engineering elements or units
B28	Working cement, clay, or stone	F17	Storing or distributing gases or liquids
B29	Working of plastics	F21	Lighting
B30	Presses	F22	Steam generation
B31	Making paper articles	F23	Combustion apparatus
B32	Layered products	F24	Heating
B41	Printing	F25	Refrigeration or cooling
B42	Bookbinding	F26	Drying
B43	Writing or drawing implements	F27	Furnaces
B44	Decorative arts	F28	Heat exchange in general
B60	Vehicles in general	F41	Weapons
B61	Railways	F42	Ammunition
B62	Land vehicles for travelling otherwise than on rails	G01	Measuring
B63	Ships or other waterborne vessels	G02	Optics
B64	Aircraft	G03	Photography

Code	Description	Code	Description
B65	Conveying	G04	Horology
B66	Hoisting	G05	Controlling
B67	Opening or closing bottles, jars or similar containers	G06	Computing
B68	Saddlery	G07	Checking-devices
B81	Micro-structural technology	G08	Signalling
B82	Nanotechnology	G09	Educating
C01	Inorganic chemistry	G10	Musical instruments
C02	Treatment of water, waste water, sewage, or sludge	G11	Information storage
C03	Glass	G12	Instrument details
C04	Cements	G21	Nuclear physics
C05	Fertilisers	G99	Section G Other - Physics
C06	Explosives	H01	Basic electric elements
C07	Organic chemistry	H02	Generation, conversion, or distribution of electric power
C08	Organic macromolecular compounds	H03	Basic electronic circuitry
C09	Dyes	H04	Electric communication technique
C10	Petroleum, gas or coke industries	H05	Electric techniques not otherwise provided for
C11	Animal or vegetable oils, fats, fatty substances or waxes		

Table All 2. Organisation type abbreviations

Abbreviation	Organisation type (Org. type)
IND	Industry
EDU	Education
CON	Consulting
HSP	Hospital
GOV	Government
OTH	Other

Table All 3. Country name abbreviations

Code	Country name	Code	Country name
BE	Belgium	LT	Lithuania
BG	Bulgaria	LU	Luxembourg
CZ	Czechia	HU	Hungary
DK	Denmark	MT	Malta
DE	Germany	NL	Netherlands
EE	Estonia	AT	Austria
IE	Ireland	PL	Poland
EL	Greece	PT	Portugal
ES	Spain	RO	Romania
FR	France	SI	Slovenia
HR	Croatia	SK	Slovakia
IT	Italy	FI	Finland
CY	Cyprus	SE	Sweden
LV	Latvia	UK	United Kingdom
NO	Norway	IL	Israel
ME	Montenegro		

Annex III – additional and underlying information of the three territories

This Annex presents some more detailed information and underlying information on the three SeeRRI territories which does not fit in the main test. It involves additional statistics on the R&I ecosystems, full lists of actors as of identified in the data sources, as well as all abbreviations for actors used in the main text.

Nordland

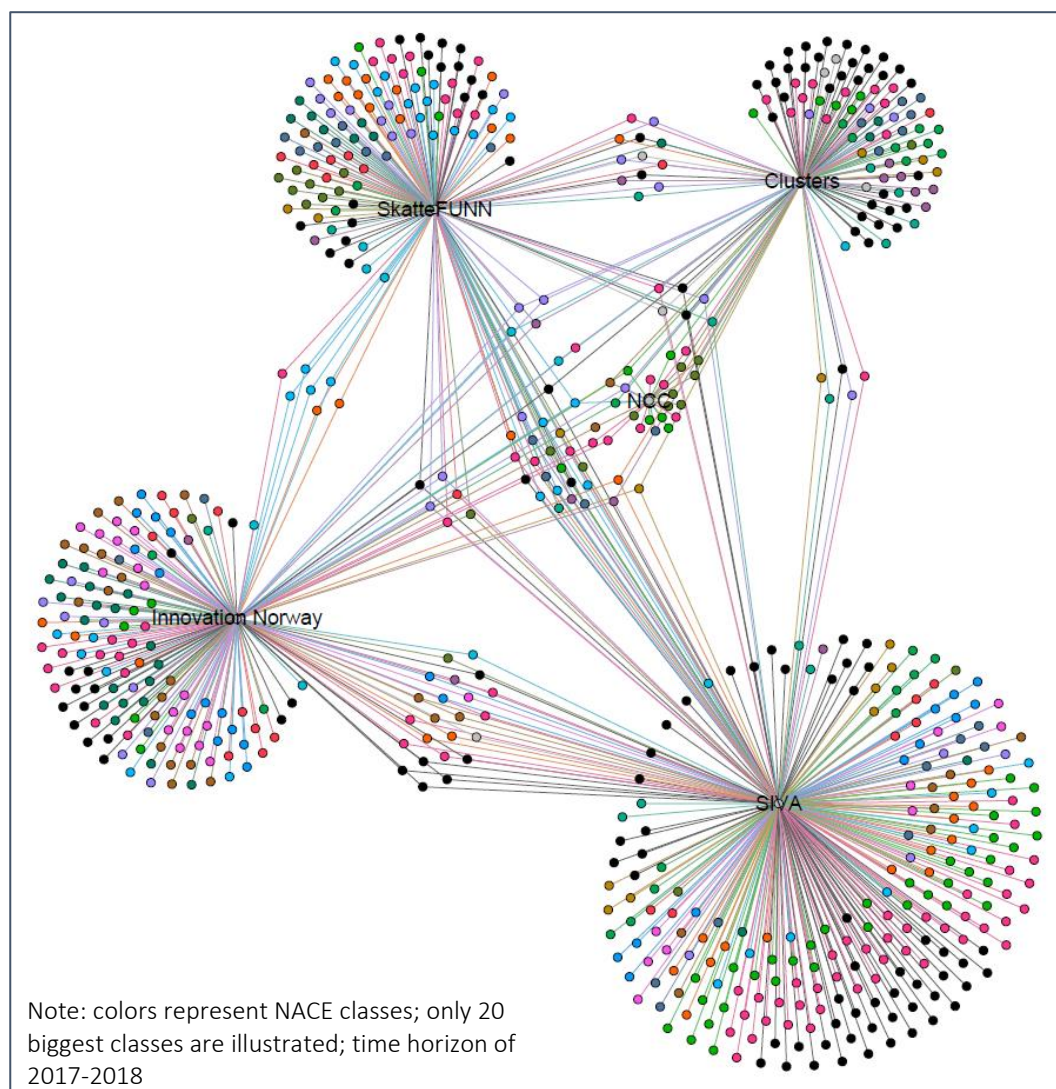


Figure A III 1. Interplay between funding agencies in Nordland

In the following, the territory-specific data sets from SkatteFUNN and Innovation Norway are analysed in more detail (the data sets are described in Subsection 3.2).

Analyses regarding SkatteFUNN

Table A III 1. Most important actors receiving tax refunds for R&D projects

Actor name	No. projects
BIOMAR A.S.	57
LORENTZEN HYDRAULIKK AS	10
THE QUARTZ CORP AS	10
CELSA ARMERINGSSTÅL AS	9
ANDØYA SPACE CENTER AS	8
HEPRO AS	8
NORSEAQUA AS	7
ALCOA NORWAY ANS	6
CERMAQ NORWAY AS	6
CERPUS TECHNOLOGY AS	6
ELLINGSEN SEAFOOD AS	5
HOVDE MARITIM AS	5
WIDERØE'S FLYVESELSKAP AS	5
ARCTIC MUSTARD AS	4
HELGELAND MARINASYSTEMER AS	4
MO INDUSTRIIPARK AS	4
NOFIR AS	4
NORDLAKS OPPDRETT AS	4
NORLENSE AS	4
RANA GRUBER AS	4
STÅLE NILSEN SEAFOOD AS	4
TASTE OF NORTH DRIFT AS	4

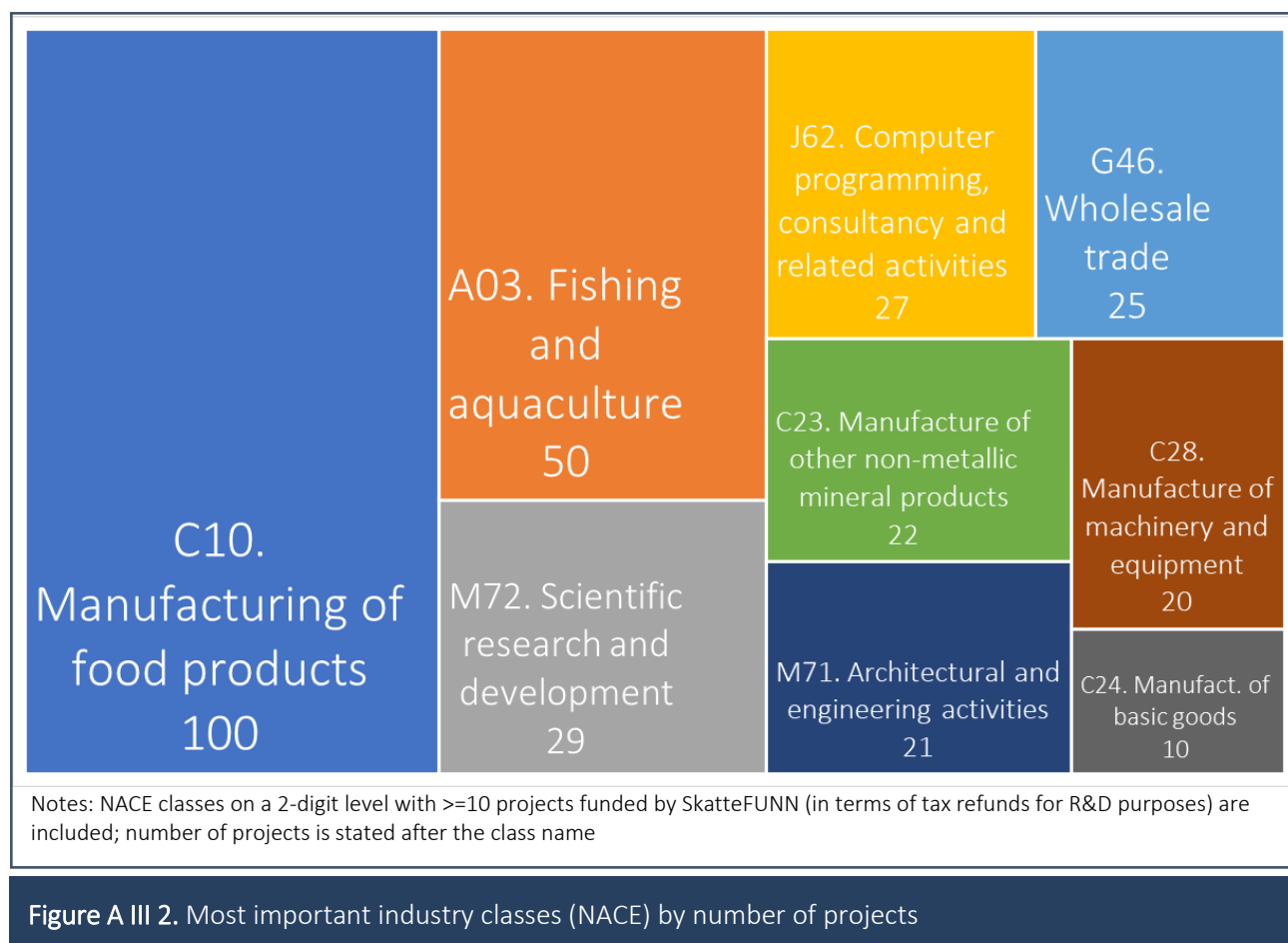


Table A III 2. Actors by most important industry classes receiving tax refunds for R&D projects

NACE class/Actor name	No. projects
10.910 – Production of animal feed for livestock	59
AQUAMED AS	1
BIOMAR A.S.	57
SALTEN ECO AS	1
03.211 – Production of food fish and shellfish in marine and coastal fish farming	23
AKVAFUTURE AS	1
AMINOR AS	1
ANDFJORD SALMON AS	1
BALLANGEN SJØFARM AS	1
CODFARM AS	1
ECOMARIN SEAFARM AS	1
EIDSFJORD SJØFARM AS	2
GIGANTE OFFSHORE AS	1
ISQUEEN AS	1

Kvarøy Fiskeoppdrett A/S	2
LOVUNDLAKS AS	2
NORDLAKS OPPDRETT AS	4
NORDLAND AKVA AS	3
NORDNORSK STAMFISK AS	2
72.190 – Other research and other development work in science and technology	21
ANDØYA SPACE CENTER AS	8
ENERGY HARVEST AS	1
GREENFISH AS	2
LETSEA AS	3
LETSEA NUTRITION AS	2
MIZAR BIO AS	2
SALMO PHARMA AS	2
SEARIS AS	1
62.010 – Programming Services	18
BAAHDY & BIRDY AS	2
CERPUS TECHNOLOGY AS	6
DIALOG EXE AS	2
DIGITALT BYRÅ AS	1
LEARN PLAYGROUND AS	1
NORTH VISION AS	2
OPSCOM SYSTEMS AS	2
SERIA AS	2
23.990 – Manufacture of non-metallic mineral products not elsewhere specified	15
ALCOA NORWAY ANS	5
THE QUARTZ CORP AS	10
28.221 – Production of lifting and handling equipment for ships and boats	15
HOVDE MARITIM AS	5
LORENTZEN HYDRAULIKK AS	10
10.201 – Production of salt fish, dry fish and rockfish	14
FUTURUM SEAFOOD AS	1
HOVDEN FISKEINDUSTRI AS	3
JM LANGAAS DRIFT AS	2
RØST SJØMAT AS	1
SAGA FISK AS	1
SOMMARØY PRODUKSJONSLAG AS	2
TASTE OF NORTH DRIFT AS	4
71.129 – Other technical consultancy	13
AQUACULTURE INNOVATION AS	1
ARCTIC FLEXIBLES AS	1
DEVELOPMENT LOFOTEN AS	1
HEINZMANN AUTOMATION AS	2
MIVANOR AS	1
MOMEK TECHTEAM AS	2
NARVIK COMPOSITE AS	2
OFOTLAB AS	2
TOCIRCLE INDUSTRIES AS	1
03.111 – Sea and coastal fishing	12
AKER BIOMARINE ANTARCTIC AS	3

DAG IVAR KNUTSEN AS	2
KNUT OLAV AS	1
LOFOTEN BLUE HARVEST AS	1
NORDLAND HAVFISKE AS	1
OLAGUTT AS	2
SELVÅG SENIOR AS	1
SHELL FISH AS	1
10.209 – Other processing and preservation of fish and fishery products	11
ELLINGSEN SEAFOOD AS	5
LOFOTEN SEAWEED COMPANY AS	2
LOFOTPRODUKT AS	1
MODOLV SJØSET FISK AS	1
MYRE FISKEMOTTAK AS	1
VESTERAALENS INNOVASJON AS	1
46.692 - Wholesale of marine equipment and fishing gear	10
NORSEAQUA AS	7
PHARMAQ FISHTEQ AS	2
SEALINE PRODUCTS AS	1

Notes: NACE classes with >=10 projects that received tax refunds for R&D purposes (SkatteFUNN) and respective actors are listed

Analyses regarding funding from Innovation Norway

The data set from Innovation Norway was restricted to selected R&I related funding programmes:

Funding scheme (English)	Virkemiddelgruppe (Norwegian)
Enterprise Development Grants	Bedriftsutviklingstilskudd
Bioenergy programme	Bioenergiprogrammet
Establishes Grants	Etablerertilskudd
Industrial research and development contracts	Industrielle forsknings- og utviklingskontrakter
Innovative Business Environments	Innovative Næringsmiljøer
Nationwide Establishment Grants	Landsdekkende etablerertilskudd
Nationwide Development Grants	Landsdekkende utviklingstilskudd
Environmental Technology	Miljøteknologi
National measures for clusters and innovation environments	Nasjonale tiltak for klynger og innovasjonsmiljøer
Public research and development contracts	Offentlige forsknings- og utviklingskontrakter
Restructuring and innovation	Omstilling og nyskaping
Development program for local food and green tourism	Utviklingsprogram for lokalmat og grønt reiseliv
Development Grant	Utviklingstilskudd

Table A III 3. Most important actors in terms of funding volumes received (≥ 1 Mio. NOK)

Rank	Actor name
1	BODØ KOMMUNE
2	KUNNSKAPSPARKEN HELGELAND AS
3	NORDIC COMFORT PRODUCTS AS
4	IN Nordland*
5	BEDRIFTSNETTVERKET INNOVATIVE OPPLEVELSER
6	FREYR AS
7	ARCTIC CAPACITY AS
8	MILJØTEKNIKK TERRATEAM AS
8	WENBERG FISKEOPPDRETT AS
9	GIGANTE OFFSHORE AS
10	SAFE TRACK FOOD AS
11	ALGENETTVK NORD AS
12	BØ GÅRDSSLAKTERI AS
12	TOR STABBFORSMO

Note: Due to confidentiality, actual funding values are not displayed; *Innovation Norway (IN) Nordland itself receives funding from Innovation Norway and is hence, also included in this ranking

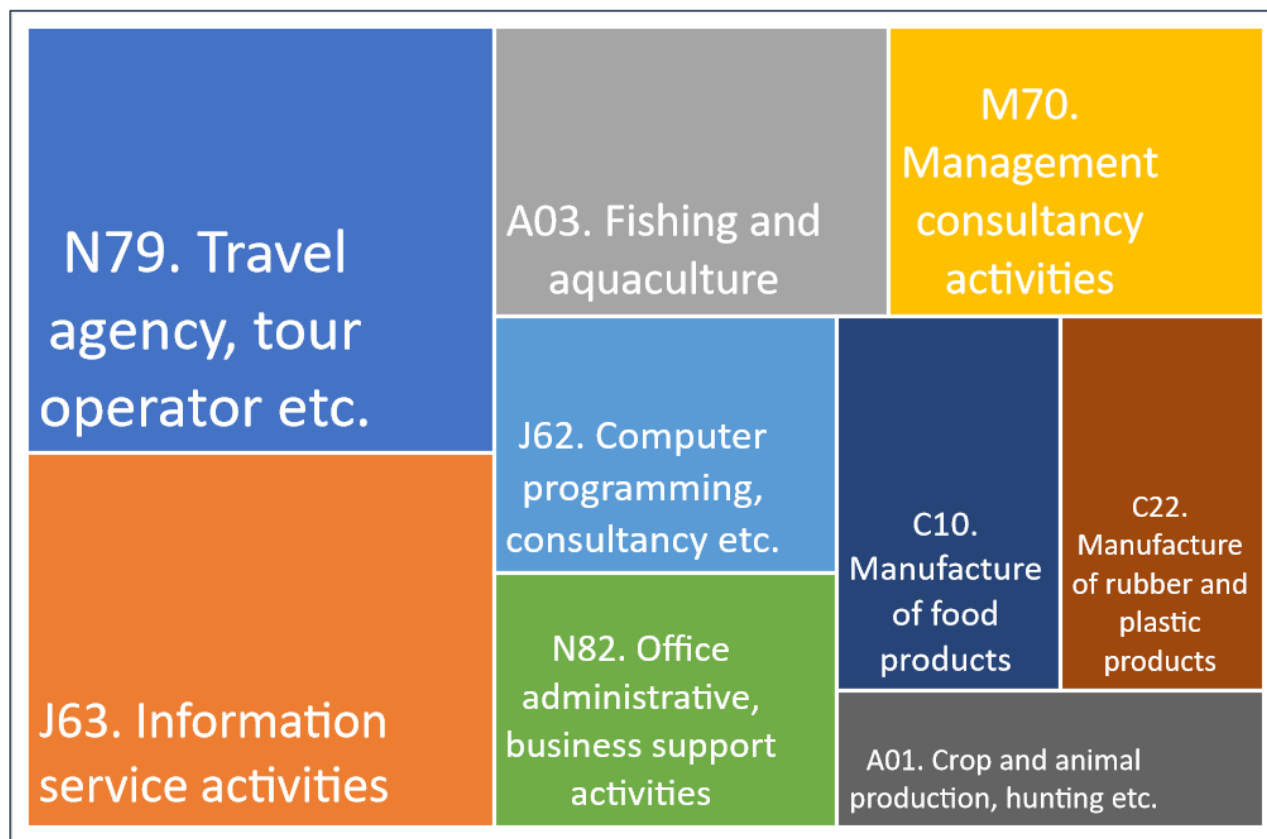


Figure A III 3. Most important industry classes (NACE) in terms of funding volume received

Table A III 4. Actors by most important industry classes that received R&D funding

Rank	NACE class/Actor name
1	N79 - Travel agency, tour operator and other reservation service and related activities BEDRIFTSNETTVERKET INNOVATIVE OPPLEVELSER DESTINATION LOFOTEN AS KUNNSKAPSPARKEN HELGELAND AS KYSTRIKSVEIEN REISELIV AS NARVIKFJELLET AS NORWEGIAN ADVENTURE COMPANY AS OKSTINDAN NATUR- OG KULTURPARK POLAR TOURS AS SALTFJELLET HOTELL POLARSIRKELEN AS STØTT BRYGGE AS UT I ØYAN AS VEFSNA REGIONALPARK

VINN

3 **A3 - Fishing and aquaculture**

ARCTIC ALGAE AS
BALLANGEN SJØFARM AS
GIGANTE OFFSHORE AS
IN Nordland
Kvarøy Fiskeoppdrett A/S
SALT LOFOTEN AS
SALTEN HAVBRUKSPARK AS
WENBERG FISKEOPPDRETT AS

4 **M70 - Activities of head offices; management consultancy activities**

ANDØY KOMMUNE
BINDAL UTVIKLING AS
FABRIKKEN NÆRINGSHAGE AS
FUTURUM AS
IN Nordland
Kuraas & Sønner AS
LOFOTEN MATPARK AS
NORAEQUOR AS
RANA UTVIKLINGSSKAP A/S

5 **J62 - Computer programming, consultancy and related activities**

ARCTIC CAPACITY AS
BAAHDY & BIRDY AS
COMPANYCASTS AS
GOMAP AS
PEOPLE ID AS
RESCUE CONSULT AS

Note: NACE classes are ranked by funding volume (starting with the highest); the actors are not in order of their funding volume due to confidentiality; NACE classes with only one actor were also excluded due to confidentiality

Table A III 5. Total actors active in EU funded R&D projects (2002-2016)

ID	Actor name	ID	Actor name
1	Andøya Space Center AS	15	Nordland Hospital HF
2	Bodø Krakebolleklekkeri BKK AS	16	Nordlandsforskning
3	Fjord Marin Holding ASA	17	Norut Northern Research Institute AS
4	Fjord Seafood ASA	18	Norwegian Crystallites AS
5	Gigante AS	19	Norwegian Graphite AS
6	Gigante Offshore AS	20	Rapp Hydema AS
7	Gildeskål Forskningsstasjon	21	Registerenheten i Brønnøysund
8	Hafenstrom AS	22	Salt Lofoten AS
9	Helgelandstorsk AS	23	Salten Havbruk AS
10	Hemmes Mek Verksted AS	24	Sandnessjøen Engineering AS
11	Høgskolen i Nesna	25	ScanWafer AS
12	InnoTech Solar	26	Store Norske Spitsbergen Grubekompani AS
13	Nord University	27	Tag Sensors AS
14	Nordlaks Produkter AS		

Table A III 6. Total actors active in patenting (2002-2014)

ID	Actor name	ID	Actor name
1	Akvadesign AS / Akvafuture	9	Quatee AS
2	Bioenergi Nord AS	10	Rantex AS
			Rapp Hydema AS / Rapp Marine
3	Bocon Holding AS	11	Group
4	ConceptoMed AS	12	Rognan Bioenergi AS
5	Development Lofoten AS	13	Tastein Technology AS
6	Heatwork AS	14	Therm-Tech AS
7	Narvik Composite AS	15	Nord University
8	Norut Teknologi AS		

Table A III 7. Total actors active in scientific publishing (2002-2014)

ID	Actor name	ID	Actor name
1	Bioforsk Norwegian Institute for Agriculture & Environmental Research	12	Nesna University College
2	BioVivo Technology AS	13	NKS Kloverasen AS
3	Department of Anesthesiology	14	Nord University
4	Ferskvannsbiologen Ltd	15	Nordland Fylkeskommune
5	GIFAS AS	16	Nordland Hospital/Nordlandssykehuset
6	Graminor Ltd	17	Nordland Research Institute
7	Helgeland Hospital Trust	18	Northern Norway Regional Health Authority
8	Husbanken	19	Northern Research Institute Narvik Norut
9	Narvik AS	20	Norwegian Institute of Bioeconomy Research
10	Narvik University College	21	Norwegian Public Roads Administration
11	National Air Ambulance Service Norway	22	UiT Arctic Univ Norway

Table A III 8. Abbreviations of organisation names

Abbreviation	Actor name
alstom	Alstom
andoya	Andoya Space Center AS
armines	ARMINES - Structure de Recherche Contractuelle
awi	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research
azti	Fundacion AZTI - AZTI Fundazioa
bronnoysundregistrere	Registerenheten i Brønnøysund
cesca	CESCA - Centre de Supercomputacio de Catalunya (Centre for Supercomputation of Catalunya)
cnr	Consiglio Nazionale delle Ricerche – CNR
cnrs	Centre National de la Recherche Scientifique – CNRS
csic	CSIC - Consejo Superior de Investigaciones Científicas/Higher Council for Scientific Research
defra	Department for Environment Food and Rural Affairs (DEFRA), UK
dnv	DNV GL
dtu	Technical University of Denmark - Danmarks Tekniske Universitet (DTU)
eurocean	Fundacao Eurocean
eurogoos	Eurogoos - European global ocean observing system
fjord-marin	Fjord Marin Holding ASA
fjord-seafood	Fjord Seafood ASA
fmi	Finnish Meteorological Institute, FMI, Ilmatieteen Laitos
fraunhofer	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
geus	Geological Survey of Denmark and Greenland (GEUS)
gfz	Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences
gifas	Gildeskal Forskningsstasjon AS
gigante	Gigante AS
giganteoffshore	Gigante Offshore AS
hafenstrom	Hafenstrom AS
helgelandstorsk	Helgelandstorsk AS
hellenic-marine	Hellenic Centre for Marine Research
hemnes verksted	Hemmes Mek Verksted AS
hogskolen-nesna	Hogskolen i Nesna
ifremer	Institut Francais de Recherche pour l'Exploitation de la Mer (IFREMER)
imr	Institute of Marine Research – Havforskningsinstituttet
innotech solar	InnoTech Solar
johnson-seafarm	Johnson Seafarms Ltd
jrc	Joint Research Centre - JRC - Commission of the European Communities
krakebolleklekkeri	Bodo Krakebolleklekkeribkk AS
matiss	Matis Ohf
met	Norwegian Meteorological Institute - Det Norske Meteorologiske Institutt MET
mpg	Max-Planck-Gesellschaft zur Förderung der Wissenschaften eV (MPG)
nansen	Nansen Environmental and Remote Sensing Center
nerc	Natural Environment Research Council (NERC)
nfk hospital	Nordland Hospital HF
nilu	Norwegian Institute for Air Research
niva	Norwegian Institute for Water Research
no-graphite	Norwegian Graphite AS
no-rcryst	Norwegian Crystallites AS
nordlaks	Nordlaks Produkter AS
nordlandsforskning	Nordlandsforskning
nord-univ	Nord University
nord-univ	University of Nordland
norut	Norut Northern Research Institute AS

Abbreviation	Actor name
npolar	Norwegian Polar Institute of the Ministry of Environment
ntnu	Norwegian University of Science and Technology - Norges Teknisk-Naturvitenskapelige Universitet (NTNU)
openu	Open University UK - OpenU
pas-pan	Polish Academy of Sciences / Polska Akademia Nauk (PAS/PAN)
pera	Pera Group
rapp hydema	Rapp Hydema AS
salten havbruk	Salten Havbruk AS
salt-lofoten	Salt Lofoten AS
sams	Scottish Association for Marine Science
sandnessjoen	Sandnessjoen Engineering AS
scanwafer	Scanwafer AS
sintef	SINTEF - Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology/NTNU
smhi	Swedish Meteorological and Hydrological Institute/Sveriges meteorologiska och hydrologiska institut - SMHI
store norske	Store Norske Spitsbergen Grubekompani AS
tag sensors	Tag Sensors AS
teknologisk	National Institute of Technology - Teknologisk Intstitutt TI
uarcic	Nordisk Fond For Miljø Og Udvikling
uni-aarhus	University of Aarhus - Aarhus Universitet (AU)
uni-bergen	Universitetet i Bergen/University of Bergen
uni-bremen	Universität Bremen/University of Bremen
uni-copenhagen	University of Copenhagen - Københavns Universitet (KU)
uni-hamburg	Universität Hamburg/University of Hamburg
uni-helsinki	University of Helsinki, Helsingin Yliopisto
uni-maynooth	National University of Ireland, Maynooth - Nui Maynooth
unis	University Centre in Svalbard
uni-stockholm	University of Stockholm/Stockholms Universitet
uni-tromsø	University of Tromsø
upm	UPM Universidad Politecnica de Madrid/Madrid Polytechnical University
vu-amsterdam	Vrije Universiteit Amsterdam/VU University Amsterdam
wageningen	Wageningen UR

Lower Austria

Table A III 9. Top actors Ecoplus (>10 projects)

Rank	Name	Projects
1	Miraplast Kunststoffverarbeitungsgesellschaft GmbH	32
2	OFI Technologie & Innovation GmbH	30
3	Montanuniversität Leoben	27
3	Universität für Bodenkultur	27
4	Ecoplus. Niederösterreichs Wirtschaftsagentur GmbH	23
5	FOTEC Forschungs- und Technologietransfer GmbH	20
5	Technische Universität Wien	20
6	GW St. Pölten Integrative Betriebe GmbH	19
7	NAKU e.U.	17
8	TCKT Transfercenter für Kunststofftechnik GmbH	16
9	Gabriel Chemie GmbH GmbH	15
9	INDAT GmbH	15
10	IFT - Institut für Fertigungstechnik und Photonische Technologien	14
10	Wind GmbH	14
11	Mack Gesellschaft mbH	13
11	Wittmann Battenfeld GmbH	13
12	AGRANA Research & Innovation Center GmbH	12
12	Geberit Produktions GmbH & Co KG	12
12	Thermoplast Kreislauf GmbH	12
13	Ernst Wittner GesmbH	11
14	Constantia Teich GmbH	10
14	Institut für industrielle Ökologie	10
14	KBA Mödling AG	10

Note: Data covers the years 2004-2019; however, in the years 2004 and 2019 only one observation is present

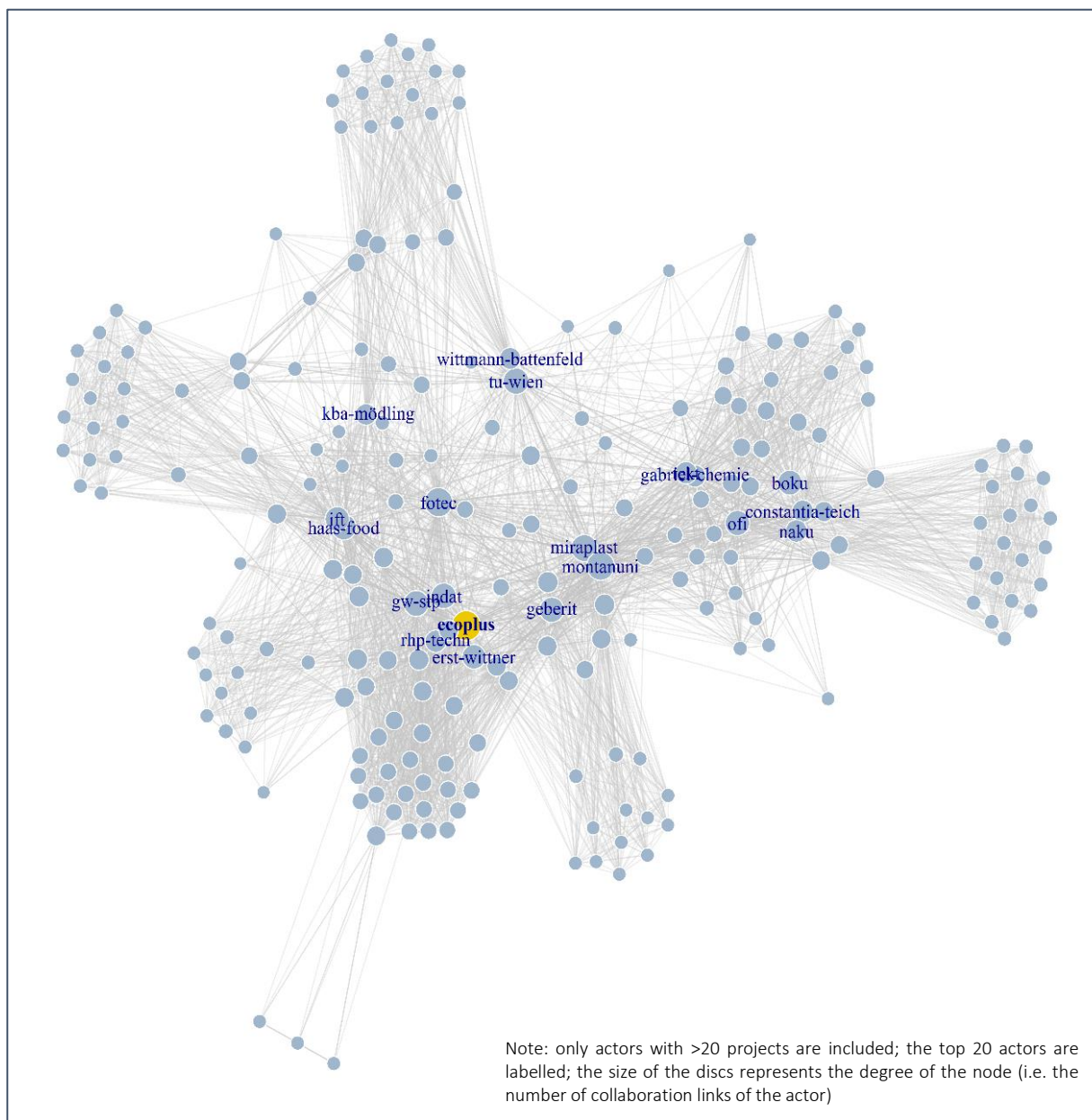
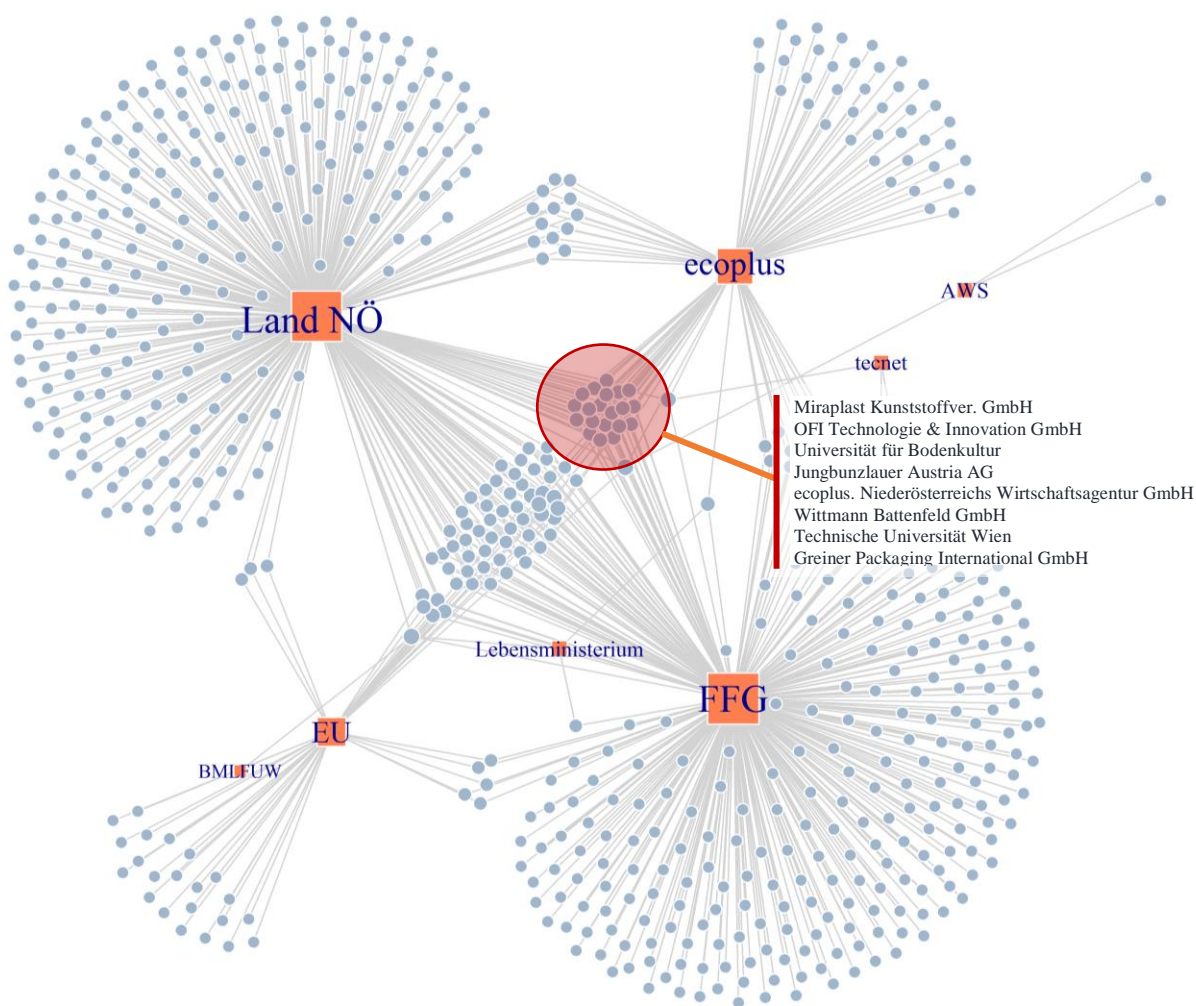


Figure A III 4. Network of Ecoplus affiliated organisations



Note: Size of squares (funding agencies) represent the number of funded actors; the size of discs (actors) represents the number of agencies they receive funding from; actors funded by WKNÖ (only two), which don't receive funding from any other agency are excluded

Figure A III 5. Ecoplus data base – funding landscape

Table A III 10. R&I-related activities across industries funded by federal government of Lower Austria

Industry (English)	Industry (German)	Projects
Construction	Bau	34
Mining	Bergbau	6
Energy supply	Energieversorgung	1
Education	Erziehung und Unterricht	1
Self-employed/technical services	Freiberufliche/techn. Dienstleistungen	117
Trade	Handel	72
Production	Herstellung von Waren	387
Information and communication	Information und Kommunikation	84
Art, entertainment and recreation	Kunst, Unterhaltung und Erholung	1
Agriculture and forestry	Land- und Forstwirtschaft	3
Transport	Verkehr	2
Water supply and waste disposal	Wasserversorgung und Abfallentsorgung	4
Other services	Sonst. Dienstleistungen	14
Other economical services	Sonst. wirtschaftl. Dienstleistungen	19

Note: Data covers the years 2009-2018; the following funding schemes are considered: "F&E-Kleinprojekte", "F&E Einzelentscheidungen des Fonds", "FFG Anschlussförderung", "Förderung von Forschung, Entwicklung und Innovation", "Forschung & Entwicklung", "FTI-Forschungs-, Technologie- und Innovationsprogramm Niederösterreich", "Innovation in Betrieben", "Innovationsassistent"

Table A III 11. Top actors in R&I-related projects funded by federal government of Lower Austria

Rank	Name	Projects
1	AGRANA Research & Innovation Center GmbH	31
2	Engineering Center Steyr GmbH & Co KG	10
3	DOKA GmbH	9
4	M. Swarovski GmbH	7
4	SECURIKETT Ulrich & Horn GmbH	7
5	Rebeat Digital GmbH	6
5	ZKW Lichtsysteme GmbH	6
6	Attphotronics Biosciences GmbH	5
6	Baumit Beteiligungen GmbH	5
6	FunderMax GmbH	5
6	Happy Plating GmbH	5
6	HÜTTE KLEIN-REICHENBACH GESELLSCHAFT M.B.H.	5
6	IFE Aufbereitungstechnik GmbH	5
6	Kirchdorfer Fertigteilholding GmbH	5
6	Knorr-Bremse Gesellschaft mit beschränkter Haftung	5
6	Liebherr-Transportation Systems GmbH & Co KG	5
6	SEMENTIS Engineering GmbH	5
6	Softsolution GmbH	5
6	Verein zur Förderung der Mohn- und Getreidezüchtung	5

Rank	Name	Projects
6	WimTec Sanitärprodukte GmbH	5
6	Zizala Lichtsysteme GmbH	5

Note: Data covers the years 2009-2018; only actors with > 4 projects; the following funding schemes are considered: "F&E-Kleinprojekte", "F&E Einzelentscheidungen des Fonds", "FFG Anschlussförderung", "Förderung von Forschung, Entwicklung und Innovation", "Forschung & Entwicklung", "FTI-Forschungs-, Technologie- und Innovationsprogramm Niederösterreich", "Innovation in Betrieben", "Innovationsassistent"

Table A III 12. Keywords on *additive manufacturing* used for the thematic specific analyses

additive manufacturing	nano particle jetting	electron beam additive manufacturing
3D-printing	DOD	WAAM
generative manufacturing	drop on demand	wire arc additive manufacturing
3DP	binder jetting	LOM
SLA	BJ	laminated object manufacturing
stereolithography	powder bed fusion	sheet lamination
DLP	MJF	support structure
digital light processing	multi jet fusion	manufacturing in layers
CDLP	SLS	layer by layer
continuous digital light processing	selective laser sintering	slice
FDM	DMLS	3d-model
Fused deposition modeling	SLM	complex geometries
FFF	direct metal laser sintering	bionic
fused filament fabrication	selective laser melting	lightweight construction
material extrusion	EBM	individualisation
material binder jetting	electron beam melting	individual manufacturing
MJ	direct energy deposition	rapid prototyping
material jetting	LENS	bionic structures
NPJ	laser engineering net shape	

Table A III 13. Abbreviations of organisation names

Abbreviation	Actor name
aac	Aerospace & Advanced Composites GmbH
ac2t	AC2T Research GmbH
acmit	Acmit GmbH
ait	AIT Austrian Institute Of Technology GmbH
ams	Austriamicrosystems AG (AMS)
amt-noe	Amt der Niederösterreichischen Landeregierung
atys-austria	Atys-Austria GmbH
biomin	Biomin Gesunde Tierernaehrung International GmbH
biopure	Biopure Referenzsubstanzen GmbH
boku	Universität für Bodenkultur Wien (Boku Wien)/University Of Agricultural Sciences Vienna
cea	Commissariat A L'Energie Atomique (CEA)
cest	CEST Kompetenzzentrum für Elektrochemische Oberflächentechnologie GmbH
cnr	Consiglio Nazionale Delle Ricerche – CNR
cnrs	Centre National De La Recherche Scientifique - CNRS
csic	CSIC - Consejo Superior de Investigaciones Científicas/Higher Council for Scientific Research

Abbreviation	Actor name
cubedx	Cube DX GmbH
diamondaircraft	Diamond Aircraft Industries GmbH
donau-uni	Donau-Universität Krems
ebg	EBG (Entwicklungs- Und Betriebsgesellschaft) Medastron GmbH
ecoplus	Ecoplus. Niederösterreichs Wirtschaftsagentur GmbH
ecs-steyr	Engineering Center Steyr GmbH & Co KG
epfl	Ecole Polytechnique Federale de Lausanne - EPFL - Swiss Federal Institute Of Technology, Lausanne
esco	Verein der Europäischen Burgwissenschaften - ECSA E.V.
esco	Verein Nachhaltige Stoffstromwirtschaft und Energiemanagement
eth	ETH Zürich - Eidgenössische Technische Hochschule - Swiss Federal Institute Of Technology
evg	EV Group E. Thallner GmbH
evolute	Evolute GmbH
femtolasers	Femtolasers Produktions GmbH
fhstp	Fachhochschule St Pölten GmbH
fhwn	Fachhochschule Wiener Neustadt für Wirtschaft Und Technik GmbH
fotec	Fotec Forschungs- Und Technologietransfer GmbH
fraunhofer	Fraunhofer-Gesellschaft Zur Förderung Der Angewandten Forschung E.V.
gat-chemistry	GAT-Formulation Chemistry GmbH
gva-tulln	Gemeindeverband für Abfallbeseitigung in der Region Tulln
happyplating	Happy Plating GmbH
hartl	Hartl GmbH
hirtenberger	Hirtenberger AG
hollitzer	Hollitzer Baustoffwerke Betriebs GmbH
iiasa	International Institute For Applied System Analysis - IIASA
infineon	Infineon Technologies AG
inova-lisec	Inova Lisec Technologiezentrum GmbH
inra	Institut National de la Recherche Agronomique (INRA)
in-vision	In-Vision Digital Imaging GmbH
isover	Saint-Gobain Isover Austria GmbH
ist	Institute of Science and Technology Austria
jku	Johannes Kepler Universität Linz/University of Linz - JKU
josephinum	Höhere Bundeslehr Und Forschungsanstalt für Landwirtschaft, Landtechnik Und Lebensmitteltechnologie Francisco Josephinum In Wieselburg
jrc	Joint Research Centre - JRC - Commission of the European Communities
kirchdorfer	Kirchdorfer Fertigteilhaolding GmbH
kit	Karlsruher Institut Für Technologie/Karlsruhe Institute of Technology - KIT
leibniz	Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz E.V.
lfs-tulln	Landwirtschaftliche Fachschule Tulln
lisec-austria	Lisec Austria GmbH
max-planck	Max-Planck-Gesellschaft zur Förderung der Wissenschaften EV (MPG)
medilikke	Medilikke Immobilien - Bauträger Ges.m.b.H.
minfuture	Guenter Tiess
minpol	Minpol GmbH
moedling	Stadt Mödling/City of Mödling
mu-leoben	Montanuniversität Leoben/University of Mining and Metallurgy Leoben - MU Leoben
muw	Medizinische Universität Wien/Medical University of Vienna – MUW
natex	Natex Prozesstechnologie Gesmbh
natur-lehm	Natur And Lehm Lehmbaumstoffe GmbH
nxt-control	Nxtcontrol GmbH
oebb	Österreichische Bundesbahnen (ÖBB)
oekotechna	Ökotechna Entsorgungs und Umwelttechnik Gesmbh
peet	Plattform Erneuerbare Energie Tullnerfeld

Abbreviation	Actor name
polymun	Polymun Scientific Immunbiologische Forschungs GmbH
profactor	Profactor Produktionsforschungs GmbH
propellets	Propellets Austria - Netzwerk Zur Forderung Der Verbreitung Von Pelletsheizungen Verein
rhp	RHP-Technology GmbH & Co Kg
romerlabs	Romer Labs Diagnostic GmbH
romerlabs	Romer Labs Division Holding GmbH
sesa	Sesa - Commerce GmbH
siemens	Siemens AG
solar4you	Solar 4 You Consulting Ges.m.b.H.
tu-denmark	Technical University of Denmark - Danmarks Tekniske Universitet (DTU)
tu-graz	Technische Universität Graz (TU Graz)/Graz University of Technology
tulln	Stadtgemeinde Tulln an der Donau
tu-vienna	Technische Universität Wien/ Technical University Vienna (TU Wien)
uni-amsterdam	Vrije Universiteit Amsterdam/VU University Amsterdam
uni-helsinki	University of Helsinki, Helsingin Yliopisto
uni-leuven	Katholieke Universiteit Leuven
uni-lund	Lund University
uni-salzburg	Universität Salzburg/University of Salzburg
uni-vienna	Universität Wien/University of Vienna (UNIVIE)
v2c2	Kompetenzzentrum - Das Virtuelle Fahrzeug Forschungsgesellschaft m.b.H.
voest	Voestalpine AG
vtt	VTT Technical Research Centre of Finland
wageningen	Wageningen UR
wassercluster	Wassercluster Lunz Biologische Station GmbH
weixbaum	Bauunternehmen Weixlbaum GesmbH
wittmann	Wittmann Battenfeld GmbH
wopfinger	Wopfinger Baustoffindustrie GmbH

Table A III 14. Total actors active in EU funded R&D projects (2002-2016)

ID	Actor name	ID	Actor name
1	7Reasons Medien GmbH	71	Inova Lisec Technologiezentrum GmbH
2	Ac2T Research GmbH	72	Institut fuer Industrielle Oekologie
3	Acmit GmbH	73	Institute of Science and Technology Austria
4	Aerospace & Advanced Composites GmbH	74	Inte:Ligand GmbH
5	AGES - Österreichische Agentur Für Gesundheit Und Ernährungssicherheit/Austrian Agency For Health And Food Safety	75	Integrated Microsystems Austria GmbH
6	Agrom KG	76	International Federation for Information Processing
7	Aichelin Ges.m.b.H	77	International Institute for Applied System Analysis – IIASA
8	Airborne Technologies GmbH	78	In-Vision Digital Imaging GmbH
9	AIT Austrian Institute of Technology GmbH	79	ISCC GmbH
10	Amt der Niederösterreichischen Landesregierung	80	Isovolta Oesterreichische Isolierstoffwerke AG
11	Aquaconsult Anlagenbau GmbH	81	Johann Fuchs & Sohn GesmbH
12	Arche Noah Schaugarten GmbH	82	Josef Stroebel und Söhne
13	Atys-Austria GmbH	83	Käferhaus GmbH
14	Austria Institut für Europa- Und Sicherheitspolitik (AIES)	84	Kirchdorfer Fertigteilhöolding GmbH
15	Austrian Fenco Initiative	85	Kirchner Soft- & Hardware Entwicklungsgesellschaft m.b.H.

ID	Actor name	ID	Actor name
16	Austro Engine GmbH	86	Knorr-Bremse AG
17	Battenfeld Kunststoffmaschinen GmbH	87	Kossler GmbH
18	Bauunternehmen Weixlbaum GesmbH	88	Kunststofftechnik Waidhofen GmbH
19	Benda Lutz Werke KG	89	L. Kasses & Co E U
20	Bio-Ferm, biotechnologische Entwicklung Und Produktion GmbH	90	Landwirtschaftliche Fachschule Tulln
21	Biomin Gesunde Tierernaehrung International GmbH	91	Lisec Austria GmbH
22	Biopure Referenzsubstanzen GmbH	92	Lkw Walter Internationale Transportorganisation AG
23	Bohler Miller Messer Und Sagan GmbH	93	Mbonline GmbH
24	Borealis Polyolefine GmbH	94	Medilikke Immobilien - Bauträger Ges.m.b.H.
25	Calma-Tec Lärmschutzsysteme GmbH	95	Microtronics Engineering GmbH
26	Ceit Alanova Gemeinnützige GmbH	96	Minpol GmbH
27	Ceit Raltec Gemeinnuetzige GmbH	97	Mondi Business Paper Services AG
28	Cellstrom GmbH	98	Natex Prozesstechnologie GesmbH
29	Cest Kompetenzzentrum für Elektrochemische Oberflächentechnologie GmbH	99	Natur und Lehm Lehmbaumstoffe GmbH
30	Cogent Systems GmbH	100	NXTcontrol GmbH
31	Community of Schwarzenbach	101	Oesterreichische Bundesforste AG
32	Conplusultra GmbH	102	Ökotechna Entsorgungs und Umwelttechnik GesmbH
33	Cosma Engineering Europe AG	103	Oncolab Diagnostics GmbH
34	Croma-Pharma GmbH	104	Onkotec GmbH
35	Cube Dx GmbH	105	Opentech EDV Research GmbH
36	Diamond Aircraft Industries GmbH	106	Österreichische Akademie der Wissenschaften/Austrian Academy of Sciences - ÖAW
37	Dipl.-Ing. Dr. Hermann Buehler GmbH	107	Pharm-Analyt Labor GmbH
38	Donau-Universität Krems	108	Plattform Erneuerbare Energie Tullnerfeld
39	DSTS Advisers to Executives, Mag. Schrank & Partner KG	109	Polymun Scientific Immunbiologische Forschungs GmbH
40	EBG (Entwicklungs- Und Betriebsgesellschaft) Medastron GmbH	110	Prisma Solutions EDV-Dienstleistungen GmbH
41	Ecoduna Produktions GmbH	111	Profactor Produktionsforschungs GmbH
42	Ecoplus. Niederösterreichs Wirtschaftsagentur GmbH	112	Proman Management GmbH
43	Ecosan Club	113	Propellets Austria - Netzwerk zur Förderung der Verbreitung von Pelletsheizungen Verein
44	Egston System Electronics GmbH	114	Rehau Gesellschaft M.B.H.
45	Electrovac Fabrikation Elektrotechnischer Spezialartikel GmbH	115	RHP-Technology GmbH & Co Kg
46	Elk Fertighaus Ag	116	Riegl Research Forschungsgesellschaft
47	Energiea Umwelttechnologie GmbH	117	Romer Labs Diagnostic GmbH
48	Engineering Center Steyr GmbH & Co Kg	118	Ronge & Partner GmbH
49	Environmental Software & Services GmbH (ESS)	119	Saatzucht Donau Ges.m.b.H. & Co. KG
50	Ertext Solartechnik GmbH	120	Saint-Gobain Isover Austria GmbH
51	Eurofinder Econet GmbH	121	Sealife Pharma GmbH
52	Evolute GmbH	122	Sesa - Commerce GmbH
53	Fachhochschule St Poelten GmbH	123	Solar 4 You Consulting Ges.m.b.H.
54	Fachhochschule Wiener Neustadt für Wirtschaft Und Technik GmbH	124	Stadt Mödling/City Of Mödling
55	Femtolasers Produktions GmbH	125	Stadtgemeinde Tulln an der Donau
56	Fleischwaren Berger Gesellschaft mbh & Co Kg	126	Sunpor Kunststoff GmbH
57	Forderung der Baudenkmalpflege Verein	127	Sustec GmbH
58	Fotec Forschungs- und Technologietransfer GmbH	128	Technisches Büro Hauer Umweltwirtschaft GmbH
59	Fresnex GmbH	129	Teichwirtschaft Thomas Kainz

ID	Actor name	ID	Actor name
60	GAT-Formulation Chemistry GmbH	130	Test & Training International
61	Gemeindeverband für Abfallbeseitigung in der Region Tulln	131	TI Beteiligungs GmbH
62	Guenther Tiess	132	Universität für Bodenkultur Wien (Boku Wien)/University of Agricultural Sciences Vienna
63	Hamburger Recycling Group GmbH	133	Verein Nachhaltige Stoffstromwirtschaft Und Energiemanagement
64	Happy Plating GmbH	134	Waldland Vermarktungsgesellschaft mbh
65	Hartl GmbH	135	Wasserkcluster Lunz Biologische Station GmbH
66	Hirtenberger AG	136	Wiesbauer Gourmet Gastro GmbH
67	Höhere Bundeslehr Und Forschungsanstalt für Landwirtschaft, Landtechnik Und Lebensmitteltechnologie Francisco Josephinum In Wieselburg	137	Wittmann Battenfeld GmbH
68	Hollitzer Baustoffwerke Betriebs GmbH	138	Wopfinger Baustoffindustrie GmbH
69	IGM Robotersysteme AG	139	Xephor Solutions GmbH
70	Infomedia Services GmbH	140	Zentrum für Energie und Innovative Technologien

Table A III 15. Total actors active in patenting (2002-2014)

ID	Actor name	ID	Actor name
1	A Tec Holding GmbH	132	Kaba GmbH
2	AC2T Research GmbH	133	'Kaizen' Consulting GmbH
3	Aerospace & Advanced Composites GmbH	134	Kalgeo Anlagenbau GmbH
4	Agrana Stärke GmbH	135	Karl Walter GmbH
5	Alexander Schärf & Söhne GmbH	136	Kemira Chemie Ges.mbh
6	Allomed Medizintechnik GmbH	137	Kemira Chemie GesmbH
7	Aquaconsult Anlagenbau GmbH	138	Key Technologies Industriebau GmbH
8	Arcana Pool Systems GmbH	139	Kirchdorfer Fertigteilhholding GmbH
9	Asta Elektrodraht GmbH	140	Knorr-Bremse GmbH
10	Axiom Angewandte Prozesstechnik Ges. M.b.H.	141	Kollegger GmbH
11	Böhler Miller Messer und Sägen GmbH	142	KOSME Gesellschaft mbH
12	Böhler Profil GmbH	143	Krems Chemie Chemical Services AG
13	Böhler-Uddeholm Precision Strip GmbH	144	Kunststofftechnik Waidhofen an der Thaya GmbH
14	Batsch Waagen & EDV GmbH & Co KG	145	LB Engineering GmbH
15	Battery Pool Cleaner GmbH Nfg. KG	146	Leinweber Maschinen GmbH
16	Baumit Beteiligungen GmbH	147	Leit-wolf Luftkomfort e.U.
17	BCA Vertriebsgesellschaft mbH	148	Liebherr-Transportation Systems GmbH & Co. KG
18	BCD Rohstoffe für Bauchemie HandelsGmbH	149	Lindner GmbH
19	Bene AG	150	LISEC Austria GmbH
20	Berndorf Band GmbH & Co	151	Loba Feinchemie AG
21	Berndorf Hueck Band und Pressblechtechnik GmbH	152	Logotherm Regelsysteme GmbH
22	Biegler GmbH	153	Lohmann & Rauscher GmbH
23	Binder Consulting GmbH	154	LOPAS AG
24	Biotop Landschaftsgestaltung GmbH	155	Maba Fertigteilindustrie GmbH
25	BMB Gebäudehygiene GmbH	156	MAPLAN Maschinen und technische Anlagen, Planungs- und Fertigungsgesellschaft m.b.H
26	Buntmetall Amstetten Ges.m.b.H.	157	Maschinenfabrik KBA-MÖDLING Aktiengesellschaft
27	Busatis GmbH	158	MBM Holding GmbH
28	Calma-Tec Lärmschutzsysteme GmbH	159	Messer Austria GmbH

ID	Actor name	ID	Actor name
29	CamCat Systems GmbH	160	Metadynea Austria GmbH
30	Carter Process Control GmbH	161	Metall- und Kunststoffwaren Erzeugungs GmbH
31	CEST Kompetenzzentrum für Elektrochemische Oberflächentechnologie GmbH	162	Metran Rohstoff-Aufbereitungs GmbH
32	Christian Doppler Labor für spezifische Adsorptionstechnologien in der Medizin	163	Microtronics Engineering GmbH
33	CNH Industrial Österreich GmbH	164	mlu-recordum Environmental Monitoring Solutions GmbH
34	Compag Rohstoffaufbereitung GMBH	165	Moeller Gebäudeautomation GmbH
35	Constantia Teich GmbH	166	Mondi Business Paper Services AG
36	Cosma Engineering Europe AG	167	Mondi Release Liner Austria GmbH
37	COTRACO Holding GmbH	168	Moradi Consulting GmbH
38	Croma-Pharma GMBH	169	NÖM Aktiengesellschaft
39	CTP-DUMAG GmbH	170	NATEX Prozesstechnologie GesmbH
40	DAS Energy GmbH	171	Neuman Aluminium Fließpresswerk GmbH
41	Delta Bloc Europa GmbH	172	NEUSIEDLER AKTIENGESELLSCHAFT
42	DirectSens GmbH	173	New Design Product Development 'DPD' Zeller & Steindl OEG
43	DOKA Industrie GmbH	174	NEW PLASMA GMBH & CO KEG
44	Domoferm International GmbH	175	NHKM Consulting GmbH
45	Donau-Universität Krems	176	Novomatic AG
46	DonauWind Erneuerbare Energiegewinnung und Beteiligungs GmbH & Co KG	177	NUA Abfallwirtschaft GmbH
47	Dynea Austria GmbH	178	NXTControl GmbH
48	Eaton Industries (Austria) GmbH	179	OncoLab Diagnostics GmbH
49	Ecoduna OG	180	Onkotec GmbH
50	Econicsystems innovative Kühllösungen GesmbH	181	Ovotherm International Handels GmbH
51	Egston System Electronics Eggenburg GmbH	182	P & F Maschinenbau GmbH
52	Electrovac AG	183	'P1' Handels GmbH
53	Elektronik Werkstätte Ing. Wurmb Ges.m.b.H.	184	Parker-Origa Pneumatik GmbH
54	Elektrotechnik Reiter	185	PATERNOSTER Leopoldine
55	EMOCeLL GmbH	186	Pauer Maschinenbau GmbH
56	EMS Handels Gesellschaft m.b.H.	187	Petwalk Solutions GmbH & Co KG
57	Engineering Center Steyr GmbH & Co KG	188	Pharm Analyt Labor GmbH
58	Erber Aktiengesellschaft	189	Pipelife Austria GmbH & CO. KG
59	Ergo GmbH	190	Pollmann Austria GmbH
60	EVVA Sicherheitssysteme GmbH	191	Polycube Systems GmbH
61	EYBL International AG	192	Polysan Handelsgesellschaft m.b.H.
62	Fachhochschule St. Pölten GmbH	193	PORISMA Trading GmbH
63	FCT Fiber Cable Technology GmbH	194	Prefa Aluminium Produkte GesmbH
64	Feller GmbH	195	Prevent Austria GmbH
65	Femtolasers Produktions GmbH	196	Prinz GmbH & Co. KG
66	Fine Foods Handels- und Beteiligungs GmbH	197	Puchegger u. Beisteiner Parkett Gross u. Einzelhandels Ges.m.b.H.
67	Forster Metallbau Gesellschaft m.b.H.	198	Pumpenfabrik Ernst Vogel Gesellschaft m.b.H.
68	Fotec Forschungs- und Technologietransfer GmbH	199	Quintsysteme für holopathische Medizin Ges.m.b.H.
69	f-Oxyde GmbH	200	Re.mo.bic. GmbH
70	Franz Seidl & Sohn GesmbH	201	Rebloc GmbH
71	Fresnex GmbH	202	Riegl Laser Measurement Systems GmbH
72	Friedrich Schöls	203	Rohrbacher Schlosswarenfabrik Wilh. Grundmann Gesellschaft m.b.H.
73	Fritz Egger GmbH & Co	204	ROTH-TECHNIK AUSTRIA Gesellschaft m.b.H.

ID	Actor name	ID	Actor name
74	FTS Computertechnik Ges.mbh	205	Rupert Fertinger GmbH
75	Furtenbach GmbH	206	SCA Hygiene Products GmbH
76	GAT Microencapsulation AG	207	Schmid Schrauben Hainfeld Gesellschaft m.b.H.
77	Gebauer & Griller Kabelwerke Gesellschaft m.b.H.	208	Schnabl Stecktechnik GmbH
78	Gebrüder Busatis Gesellschaft m.b.H.	209	Schoeller-Bleckmann Oilfield Technology GmbH & Co KG
79	Gebrüder Reichsfeld GesmbH & Co.	210	Schukra Gerätebau GmbH
80	Gemmini EU	211	Science & Research Marketing GesmbH
81	GEOPLAST Kunststofftechnik Ges.m.b.H.	212	Sciotec Diagnostic Technologies GmbH
82	Georg Fischer Fittings GmbH	213	Sealife Pharma GmbH
83	GILDEMEISTER energy storage GmbH	214	Security & Electronic Technologies GmbH
84	Ginzler Stahl- u. Anlagenbau GmbH	215	Seibersdorf Labor GmbH
85	Gisela Nagel GmbH	216	Seiler Verfahrenstechnik GmbH
86	Globopharm Pharmazeutische Produktions- und Handelsgesellschaft m.b.H.	217	SF SOEPENBERG-COMPAG GMBH
87	Griesmayer	218	Softsolution GmbH
88	Grund- Pfahl- und Sonderbau GmbH	219	Sonneck GmbH
89	Grundmann Beschlagtechnik GmbH	220	SPL Powerlines Austria GmbH & Co. KG
90	GUNYTRONIC gasflow sensoric systems GmbH	221	Stanzbiegetechnik Ges.m.b.H.
91	Häusermann GmbH	222	Stora Enso Wood Products GmbH
92	Hörmann Interstall GmbH & Co. KG	223	Strasser & Gruber Ges.m.b.H.
93	Hütte Klein-Reichenbach Gesellschaft m.b.H.	224	Styx Naturcosmetic GmbH
94	HADI Maschinenbau Gesellschaft m.b.H.	225	Sunpor Kunststoff Ges.m.b.H.
95	HAFNERTEC Bicker GmbH	226	Svoboda Entwicklungs GmbH & Co. KG
96	Hans Brantner & Sohn Fahrzeugbaugesellschaft m.b.H.	227	Swarco Futurit Verkehrssignalsysteme Ges.m.b.H.
97	Happy Plating GmbH	228	Sy-Lab VGmbH
98	HEITEC Systemtechnik GmbH	229	TB-Göschl GmbH
99	Heliovis AG	230	TCI Produktions- und Vertriebs GmbH
100	Hirtenberger Automotive Safety GmbH	231	'TECHNOPOR' Handels GmbH
101	Hirtenberger Defence Systems GmbH & Co KG	232	Tecnet Equity NÖ Technologiebeteiligungs Invest GmbH
102	Hirtenberger-Schaffler Automotive Zünder GesmbH	233	Tecon Engineering GmbH
103	HL Hutterer & Lechner GmbH	234	Test-Fuchs GmbH
104	Horst Kriechbaum Gesellschaft m.b.H.	235	Theysohn Extrusionstechnik GmbH
105	HTM Sport- und FreizeitgerÄtze Aktiengesellschaft	236	Thonhauser GmbH
106	Husky-KTW GesmbH	237	Tiefenbacher GmbH
107	Huyck Austria Ges. m.b.H.	238	Tissue Med Biosciences Forschungs- und Entwicklungsgesellschaft mbH
108	HUYCK.WANGNER Austria GmbH	239	Traktionssysteme Austria GmbH
109	Hydrantenservice GmbH	240	Tyrolia Technology GmbH
110	IAG Industrie Automatisierungsgesellschaft mbH	241	Ultimate Transportation Equipment GmbH
111	IBS Umwelt- Und Verkehrstechnik GmbH	242	Unipack Ges M.B.H
112	IFE Aufbereitungstechnik GmbH	243	UniversitÄt für Weiterbildung Krems
113	IGM Schweistechnik GmbH	244	Variotherm Heizsysteme GmbH.
114	IMA Integrated Microsystems Austria GmbH	245	Vetropack Austria GmbH
115	IMG Medizintechnik GmbH	246	Voest Alpine Krems Finaltechnik GmbH
116	Indoo.rs GmbH	247	Voest Alpine Precision Strip GmbH
117	Ing. Friedrich Bauer GmbH	248	Voith Turbo GmbH
118	Inject Star Pökelmaschinen Gesellschaft m.b.H	249	VST Building Technologies AG
119	INO Therapeutics GmbH	250	VWM GmbH
120	Inova Lisec Technologiezentrum GmbH	251	Vyro Components GmbH
121	Institute of Science and Technology Austria	252	Wagner Austria GmbH
122	Integrated Microsystems Austria GmbH	253	Waldland Naturstoffe GmbH

ID	Actor name	ID	Actor name
123	Intellectual Capital and Asset Management GmbH	254	Welser Profile AG
124	Intertechno Funktechnik Ges.m.b.H.	255	WITO-Waldviertler Innov. Techn. Biomassekraftwerk Errichtungs- und Betriebsgesellschaft m.b.H.
125	Intier Automotive Eybl GmbH (Ebergassing) & Co. OHG	256	Wittmann Battenfeld GmbH
126	IPA Produktions- und Vertriebsges.m.b.H.	257	Wopfinger Baustoffindustrie GmbH
127	Isoplus Fernwärmetechnik Gesellschaft m.b.H.	258	WPS-GES.M.B.H.
128	Jawoi GmbH	259	XiberScience GmbH
129	Joma Kunststofftechnik GmbH & Co. KG	260	Zentrum Für Biomedizinische Technologie Der Donau-Universität Krems
130	Josef Höller GmbH	261	Zipfinger Mechatronik GmbH
131	Josef Schaidler Privatstiftung	262	ZKW Group GmbH /Zizala Lichtsysteme GmbH

Table A III 16. Total actors active in scientific publishing (2015-2019)

ID	Actor name	ID	Actor name
1	AAC GmbH	53	HLBA & BA Wein & Obstbau
2	AC2T Research GmbH	54	HLBFA Francisco Josephinum
3	ACMIT GmbH	55	International Atomic Energy Agency - IAEA
4	Aerospace & Advanced Composites GmbH	56	Interuniversitäres Department für Agrarbiotechnologie (IFA)
5	Agricultural Research & Education Centre Raumberg Gumpenstein	57	International Institute of Applied Systems Analysis - IIASA
6	Agrana Research & Innovation Centre GmbH	58	IK Traisental
7	Air Liquid GmbH	59	IMC University of Applied Sciences Krems
8	AIT Austrian Institute of Technology GmbH	60	Institute of Environmental Biotechnology
9	Alpharm	61	Institute for Science & Technology Austria - IST
10	Angothera GmbH	62	International Agency Minerals Policy MinPol GmbH
11	Austrian Agency for Health & Food Safety AGES	63	International Avian Research
12	Austrian Centre of Industrial Biotechnology (ACIB)	64	Isis Papyrus Europe AG
13	Austrian Centre for Medical Innovation & Technology	65	Jungbunzlauer Austria AG
14	Austrian Fed Agency Water Management	66	Karl Landsteiner University for Health Sciences
15	Austrian Marketing University of Applied Sciences	67	Konrad Lorenz Institute for Evolution & Cognition Research (KLI)
16	B Geos	68	Krankenanstalt Rudolfstiftung Wien
17	Berndorf Band GmbH	69	Landeskrankenhaus Baden Mödling
18	Biegler GmbH	70	Landeskrankenhaus Horn
19	Bioenergy 2020	71	Landeskrankenhaus Korneuburg
20	Biomim Holding GmbH/Biomim Research Centre	72	Landeskrankenhaus St. Pölten
21	BLT Wieselburg Research Centre Francisco Josephinum	73	Landeskrankenhaus Tulln
22	BOKU University Vienna	74	Landeskrankenhaus Wiener Neustadt
23	Bundesamt Wein & Obstbau Klosterneuburg	75	Landwirtschaftskammer Niederösterreich
24	CEST Competence Centre for Electrochemical Surface Technology	76	Lehr & Forschungszentrum Francisco Josephinum BLT
25	Christian Doppler Lab Mycotoxin Metab	77	Lebensmittelversuchsanstalt GmbH
26	Competence Ctr Wood Composites & Wood Chem	78	Liebherr Transportation Systems GmbH & Co KG
27	Centre for Analytical Chemistry	79	Lindner Consulting GmbH
28	Centre Electrochemical Surface Technology GmbH	80	LK Baden Mödling Hainburg
29	Centre Energy & Innovation Technology CET	81	M Swarovski GmbH
30	Centre for Public Mental Health	82	Messer Austria GmbH
31	Danube University Krems	83	Metadynea Austria GmbH
32	Doka GmbH	84	OMV Exploration & Production GmbH
33	Donau Chemie AG	85	OrthoSera GmbH

ID	Actor name	ID	Actor name
34	DPU	86	Phornano GmbH
35	EBG MedAustron GmbH	87	Polymun Scientific Immunbiologische Forschung GmbH
36	Erber Future Business	88	Regular Hospital Wiener Neustadt
37	Ertex Solartech GmbH	89	RHP Technology GmbH
38	EVN AG	90	Riegl Laser Measurement System GmbH/Riegl Research Forschungsgesellschaft mbH
39	Faschhochschule St. Pölten	91	ROHKRAFT Green
40	Fachhochschule Wiener Neustadt	92	Romer Labs
41	Federal Agency of Water Management	93	Saatzucht Donau GesmbH
42	Federal Hospital Horn	94	Salvagnini Maschinenbau GmbH
43	FOTEC Forschungs & Technologie Transfer GmbH	95	Seibersdorf Labor GmbH
44	Fresenius Med Care Adsorber Tec GmbH	96	Semperit Technische Produkte Gesellschaft mbH
45	Fritz Egger GmbH & Co OG	97	Sipwise GmbH
46	Fürstenbergsche Forst & Güterdirektion	98	Tech Off Ecological & Landscape Assessment
47	General Hospital Wiener Neustadt	99	UK Krems
48	General Public Teaching Hospital Korneuburg	100	Universitäts & Forschungszentrum Tulln
49	Glanzstoff Industry	101	WasserCluster Lunz
50	Happy Plating GmbH	102	Weingut Stift Klosterneuburg
51	Haus Digitalisierung	103	Wittmann Battenfeld GmbH
52	Hausermann GmbH	104	Wolf Science Centre

B30

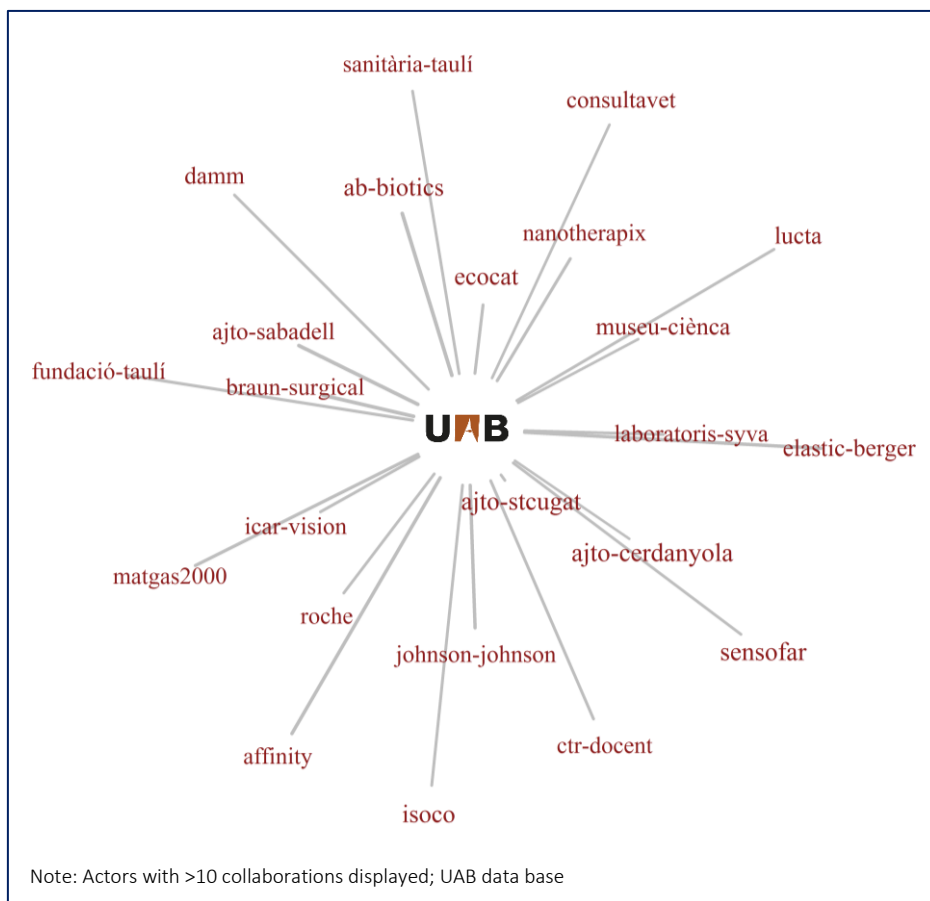


Figure A III 6. Important collaboration partners of UAB

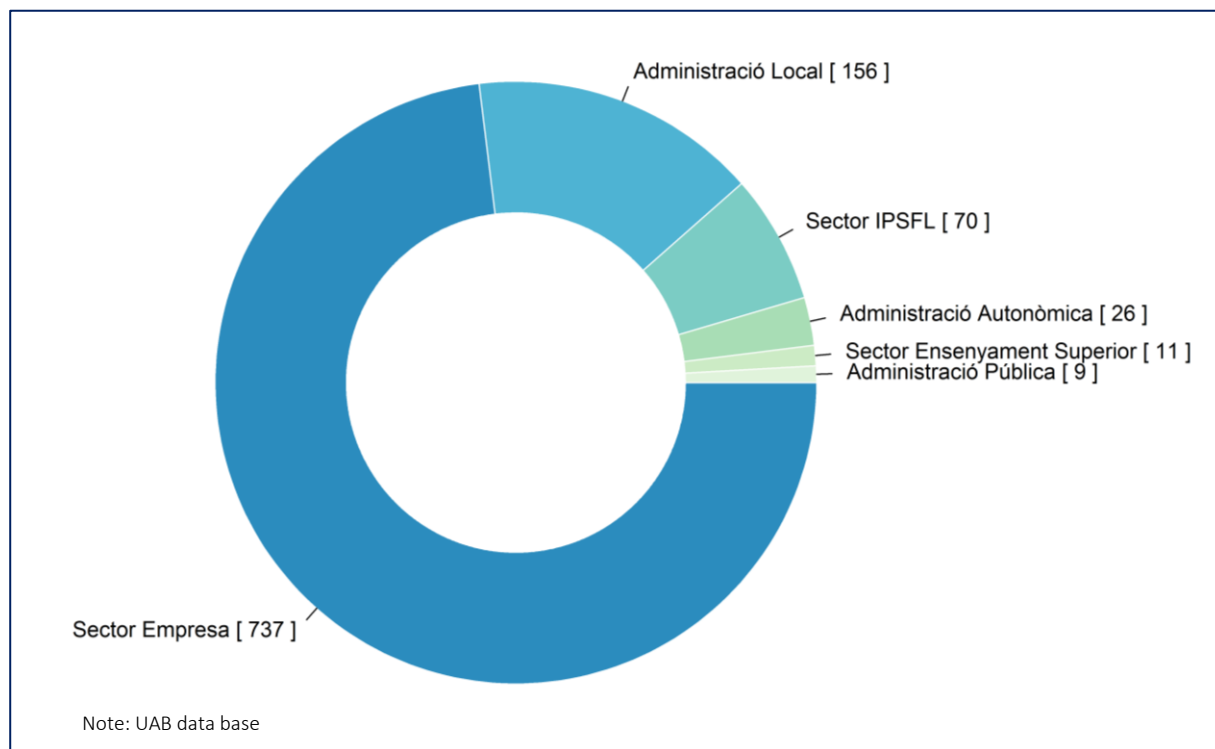


Figure A III 7. Sectors of collaboration partners of UAB

Table A III 17. Keywords on *zero waste* used for the thematic specific analyses

waste	reparability	landfills
resource conservation	packaging	industrial cycl
recycling	cradle-to-cradle	foodwaste
urban metabolism	prevention	refillable
circular economy	product design	incineration
future cities	product life cycle,	deposit return systems (DRS)
responsible production	sustainability	Extended Producer Responsibility (EPR)
consumption	economic well-being	ecodesign
reuse	environmental protection	planned obsolescence
recovery	social well-being	conscious consumption

Table A III 18. Abbreviations of organisation names

Abbreviation	Actor name
aia	Aplicaciones en Informatica Avanzada SA
ascamm	Fundacion Ascamm
avcr	Academy of Sciences of the Czech Republic / Akademie ved Ceske Republiky
bas	Bulgarian Academy of Sciences (BAS)
bcnmedia	FUNDACIO BARCELONA MEDIA
boluda	BOLUDA DIVISION INDUSTRIAL SL
cea	COMMISSARIAT A L'ENERGIE ATOMIQUE (CEA)
chalmers-univ	Chalmers University of Technology
chimigraf	CHIMIGRAF IBERICA SL
cnr	Consiglio Nazionale delle Ricerche - CNR
cnrs	Centre National de la Recherche Scientifique - CNRS
crag	CENTRE DE RECERCA AGRIGIONOMICA CONSORCI CSIC-IRTA-UAB (Crag)
creaf	CREAF - Centre de Recerca Ecològica i Aplicacions Forestals/Centro de Investigacion Ecologica y Aplicaciones Forestales/Centre for Ecological Research and Forestry Applications
cresa	FUNDACIO CENTRE DE RECERCA EN SANITAT ANIMAL CRESA
csic	CSIC - Consejo Superior de Investigaciones Cientificas/Higher Council for Scientific Research
csuc	FUNDACIO PRIVADA BARCELONA DIGITAL CENTRE TECNOLOGIC
cvc	Centre de Visio per Computador - Computer Vision Center (CVC)
desy	Deutsches Elektronen-Synchrotron
dtu	Technical University of Denmark - Danmarks Tekniske Universitet (DTU)
enea	ENEA - Ente per le Nuove tecnologie, Energia e Ambiente
enide	ENIDE SOLUTIONS.S.L
epfl	Ecole Polytechnique Federale de Lausanne - EPFL - Swiss Federal Institute of Technology, Lausanne
eth	ETH Zürich - Eidgenössische Technische Hochschule - Swiss Federal Institute of Technology
eurecat	Eurecat - Centro Tecnológico de Catalunya
expertsystem	EXPERT SYSTEM IBERIA SL
fiat	FIAT Gruppo
flubetech	FLUBETECH S.L.
forth	FORTH, Foundation for Research and Technology - Hellas
fraunhofer	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
gov-catalunya	Generalitat de Catalunya - Government of Catalunya
icn2	Catalan Institute of Nanotechnology
idp	IDP INGENIERIA Y ARQUITECTURA IBERIA SL
ifae	IFAE - Institut de Fisica d'Altes Energies/Institute for High Energy Physics
imperialcl	Imperial College London - ImperialCL
infn	Istituto Nazionale di Fisica Nucleare (INFN)
isoco	Intelligent Software Components SA
jrc	Joint Research Centre - JRC - Commission of the European Communities
jsi	Jozef Stefan Institute (JSI)
kit	Karlsruher Institut für Technologie/Karlsruhe Institute of Technology - KIT
kth	Royal Institute of Technology - Kungliga Tekniska Högskolan (KTH)
leibniz	Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e.V.
leitat	LEITAT (Laboratorio de Ensayos e Investigaciones Textiles del Acondicionamiento Tarrasense)
median	MEDIAN SCP
mta	Magyar Tudományos Akademia - Hungarian Academy of Sciences (MTA)
nerc	Natural Environment Research Council (NERC)
ntua	National Technical University of Athens (NTUA)
oxolutia	OXOLUTIA SL
pas-pan	Polish Academy of Sciences / Polska Akademia Nauk (PAS/PAN)
plastiasite	PLASTIASITE S.A

Abbreviation	Actor name
polito	Politecnico di Torino
rovalma	ROVALMA, S.A
santcugat	AJUNTAMIENTO DE SANT CUGAT DEL VALLES
seat	SEAT SA
stfc	Science and Technology Facilities Council (STFC)
tauli	Corporacio Sanitaria Parc Tauli
tecnalia	FUNDACION TECNALIA RESEARCH & INNOVATION
thales	Thales Group
tno	TNO - Netherlands Organisation for Applied Scientific Research
tu-vienna	Technische Universität Wien/ Technical University Vienna (TU Wien)
uab	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona
ultrasion	ULTRASION, S.L.
uni-cambridge	University of Cambridge (CU)
uni-eindhoven	Eindhoven University of Technology
uni-leuven	Katholieke Universiteit Leuven
uni-lund	Lund University
uni-manchester	University of Manchester (ManU)
uni-oxford	University of Oxford (OU)
upc	Universitat Politècnica de Catalunya (UPC)
upmc	Université de Paris VI (Université Pierre et Marie Curie) (UPMC)
vtt	VTT Technical Research Centre of Finland
wageningen	Wageningen UR

Table A III 19. Total actors active in EU funded R&D projects (2002-2016)

ID	Actor name	ID	Actor name
1	AB Biotics Producciones Industriales De Mircrobiotas, S.L.	70	Generalitat de Catalunya - Government of Catalunya
2	Aeris Tecnologías Ambientales, S.L.	71	Gremi Textil De Terrassa
3	Aero Club Barcelona-Sabadell	72	Habitatges Municipals De Sabadell, S.A.
4	Ahidra Agua Y Energia, S.L.	73	Hidroquímica Tractaments I Química Industrial S.L.U.
5	Ajuntament de Granollers (City Council of Granollers)	74	Hydromodel Host, S.L.
6	Ajuntament De Mollet Del Vallès	75	IALE Tecnologia SL
7	Ajuntament De Sabadell	76	ICAR Vision Systems, S.L.
8	Ajuntamiento De Sant Cugat Del Valles	77	IDP Ingeniería Y Arquitectura Iberia, S.L.
9	Alternative Energy Innovations, S.L.	78	IFAE - Institut de Física d'Altes Energies/Institute for High Energy Physics
10	Animua, S.A.	79	Indo Lens Group, S.L.
11	Aplicaciones en Informatica Avanzada, S.A.	80	Industrias De Optica, S.A.
12	Arquebio, S.L.	81	Industrias Puigjaner, S.A.
13	Aslogic 2011, S.L.	82	Ingeniería Magnética Aplicada, S.L.
14	Asociacion Espanola De Empresas De Tratamiento Y Control De Agua	83	Innegia Automation Solutions, S.L.
15	Asociacion Espanola De Rapid Manufacturing	84	Inovyn España, S.L.
16	Asociacion PEC 4	85	Institut Universitari De Ciència I Tecnologia, S.A.
17	Atmosfera Projects, S.L.	86	Instituto De Seguridad Publica De Cataluna
18	Banco de Sabadell, S.A.	87	Instituto Grifols, S.A.
19	Barcelona Technical Center, S.L.	88	Intelligent Software Components, S.A.

ID	Actor name	ID	Actor name
20	BCN Cambra Logica de Projectes	89	Ittestit, S.L.
21	BCN Innova Technological Evolution, S.L.	90	Jallut Pinturas, S.L.U.
22	Bebe Due Espana, S.A.	91	Kern-Liebers TMG, S.A.
23	Biochemize, S.L.	92	Lead Molecular Design, S.L.
24	Boluda Division Industrial, S.L.	93	Laboratorio De Ensayos E Investigaciones Textiles Del Acondicionamiento Tarrasense (LEITAT)
25	Camina Lab, S.L.	94	Logitek, S.A.
26	Catalan Institute of Nanotechnology	95	Lubrizol Advanced Materials Manufacturing Spain, S.L.
27	Centre D'Alt Rendiment Esportiu De Sant Cugat Del Valles	96	Lucta, S.A.
28	Centre de Recerca Agrigeonòmica (CRAG)	97	Manufacturas Goma, S.L.
29	Centre de Visio per Computador - Computer Vision Center (CVC)	98	Matgas 2000, A.I.E.
30	Chimigraf Iberica, S.L.	99	Median SCP
31	CIMA Centro de Investigacion y Mejora Agraria	100	Median Sustainability, S.L.
32	Cirprotec, S.L.	101	Mutua De Terrassa Mutualitat De Previso Social A Prima Fixa
33	Code Factory, S.L.	102	Nanomol Technologies, S.A.
34	Colores Y Compuestos Plasticos, S.A.	103	Naturalea Conservacio, S.L.
35	Companyia D'Aigues De Sabadell, S.A.	104	Naturality Research & Development
36	Consorti Centre De Recerca Matematica	105	Nuevas Tecnicas De Coloracion, S.L.
37	Consorti Markets Organizations and Votes in Economics	106	Oxolutia, S.L.
38	Consorti Sanitari De Terrassa	107	Pibarquitecturasix, S.L.P
39	Consortio Para La Construccin, Equipamiento Y Explotacion Del Laboratorio De Luz De Sincrotron	108	Pilz Industrieelektronik, S.L.
40	Corporacio Sanitaria Parc Tauli	109	Pinturas Hempel, S.A.
41	CREAF - Centre de Recerca Ecològica i Aplicacions Forestals/Centro de Investigacion Ecologica y Aplicaciones Forestales/Centre for Ecological Research and Forestry Applications	110	Plasitasite S.A.
42	Dena Resarrollos, S.L.	111	Playforapply Technologies, S.L.
43	Draco Systems, S.L.	112	Polimeros Y Sistemas De Aplicación Tecnica, S.L.
44	Draconispharma, S.L.	113	Reytraplast, S.A.
45	Ecopath International Initiative Asociacion	114	Roche Diagnostics, S.L.
46	Emubutidos Dany, S.L.	115	Rovalma, S.A.
47	Enerbyte Smart Energy Solutions, S.L.	116	Ruffini, S.A.
48	Energea Ingenieria En Eficiencia Energetica, S.L.	117	S.P.M. Promocions Municipals De Sant Cugat Del Vallès, S.A.
49	Enide Solutions, S.L.	118	Sairem Iberica, S.L.
50	Esenergia Vortex, S.L.	119	Seat, S.A.
51	Eurecat - Centro Tecnologico de Catalunya	120	Sensofar-Tech, S.L.
52	Expert System Iberia, S.L.	121	Simulacions Optiques, S.L.
53	Faurecia Automotive Exteriors España, S.A.	122	Sinter Pres, S.L.
54	Fisa Iberica S.L.	123	Southern European Cluster in Photonics & Optics Asociacion
55	Flowlab Proyectos De Innovacion, S.L.	124	Sunilei Tecnologia Solar, S.A.
56	Flubetech, S.L.	125	TAF Helicopters, S.L.
57	FMC Foret, S.A.	126	Tecni-Plasper, S.L.
58	Foodreg Technology, S.L.	127	Telstar Technologies, S.L.U.
59	Foundation Epson Iberica	128	Termo Fluids, S.L.
60	Fractus, S.A.	129	Tetralec Electronica Industrial S.L.
61	Fundacio Centre De Recerca En Sanitat Animal Cresa	130	The Big Van Theory

ID	Actor name	ID	Actor name
62	Fundacio Hospital Asil De Granollers	131	UAB Universitat Autònoma de Barcelona - Autonomous University of Barcelona
63	Fundacio Mutua De Terrassa Per A La Docencia I Recerca Biomedica I Social Fundacio Privada Catalana	132	Ultrason, S.L.
64	Fundacio Privada Cecot Innovacio	133	Vetgenomics, S.L.
65	Fundacio Privada Parc De Recerca UAB	134	Video Stream Networks, S.L.
66	Fundacion Ascamm	135	Visual Tagging Services
67	Fundación Creafutur	136	Voztelecom Sistemas, S.L.
68	Fundacion ESADE	137	W-One Sys, S.L.
69	Gema Medical, S.L.	138	Zero 2 Infinity, S.L.

Table A III 20. Total actors active in patenting (2002-2014)

ID	Actor name	ID	Actor name
1	A3 - Advanced Automotive Antennas	119	Intier Automotive Interiors Zippex, S.A.U.
2	AB-Biotics, S.A.	120	Inventos para Sistemas Vending, S.L.
3	Advanced Automotive Antennas, S.L.	121	Ion Oil, S.L.
4	Aero Engineering, S.L.	122	Ipagsa Industrial, S.L.
5	Afinitica Technologies, S. L.	123	Isofix, S.L.
6	Aigeltec Ingenieria, S.L.	124	ITW Metal Fasteners, S.L.
7	Air Products and Chemicals, Inc.	125	JANE, S.A.
8	ALSTOM Renewable Technologies	126	Jorge Urriaga Baonza Solutions, S.L.
9	Amadeo Farell S.A.U.	127	Kao Corporation, S.A.
10	Ambiensys, S.L.	128	Karelic Skok & Gueler, S.L.
11	Analisi Tecnologica Innovadora Per A Processos Industrials Competitius, S.L.	129	Kartsana, S.L.
12	Andersen, S.A.	130	KERN PHARMA, S.L.
13	Anortec, S.L.	131	Kledos Cell Tech, S.L.
14	Antonio Mengibar, S.A.	132	Kvani Urban Collection, S.L.
15	APC Europe S.A.	133	Kymera Creativa, S.L.
16	Aplicaciones Placas Solares, S.L.	134	Laboratorios Byly, S.A.
17	Aplisun Develop, S.L.	135	Laboratorios Miret, S.A.
18	Apolo Fijaciones y Herramientas, S.L.	136	Laboratorios Rubio, S.A.
19	Appliances Components Companies Spain, S.A.	137	Lamp, S.A.
20	Applus Servicios Tecnologicos, S.L.	138	Lan-Fop Systems, S.L.
21	Aseptis, S.L.	139	Livead Space Mark Up, S.L.
22	Astral Pol Group, S.L.U.	140	Loncar, S.L.
23	Astral Pool España, S.A.	141	Lucta, S.A.
24	ATP Engineering & Packaging, S.L.	142	Lykera Biomed, S.A.
25	Aurep Dos S.L.	143	Macfer Engineering, S.L.
26	Auxiliar de Construcciones Metalicas, S.A.	144	Magar Invest, S.L.
27	Azbil Telstar Technologies, S.L.	145	Magic Box Int. Toys, S.L.U.
28	B. Braun Surgical, S.A.	146	Manusa Gest, S.L.
29	Bandim Activities, S.L.	147	Marcs Urnas Bach, S.L.
30	Barcelona Orthopedic Necklace S.L.	148	Martomagic, S.L.
31	Barcelona Technical Center, S.L.	149	MAT Communication Solutions, S.A.
32	Batec Mobility, S.L.	150	MAT Global Solutions S.L.
33	BCN Distribuciones, S.A.	151	Matgas 2000, A.I.E.
34	Bebe Due España, S.A.	152	Medva Mecanismos Del Valles, S.L.
35	Bericap, S.A.	153	Mespack, S.L.

ID	Actor name	ID	Actor name
36	Bobinajes Nugar, S.L.	154	Metalast, S.A.
37	Bolsaplast S.A.	155	MIKALOR, S.A.
38	Bossar Packaging, S.A.	156	Moehs Ibérica, S.L.
39	Bossauto Innova, S.A.	157	Montajes Y Proyectos Electrotecnicos, S. L.
40	Bycmo RC Models, S.L.	158	Motocono, S.A.
41	Canaled, S.L.	159	NAD, S.L.
42	Careseal, S.L.	160	Natura Bisse International, S.A.
43	CARINSA. Creaciones Aromaticas Industriales, S.A.	161	Navets J. Mazo, S.A.
44	Celo Distribucion, S.A.	162	Neos Surgery, S.L.
45	Centro Tecnològico (LEITAT)	163	Nirco, S.L.
46	Ceramica Sugrañes, S.A.	164	Njoy Baby, S.L.
47	Chemplate Materials, S.L.	165	Nlife Therapeutics S.L.
48	Chimigraf Iberica, S.L.	166	Nordenia Iberica Barcelona, S.A.
49	CIMCO, S.L.	167	Nova Corbyn, S.A.
50	Cirprotec, S.L.	168	Novocat Farma, S.A.
51	Cognis Iberia, S.L.	169	NTD Labs, S.L.
52	ColorDisplay, S.L.	170	Oxolife, S.L.
53	Comercial Industrial Maquinaria Carton Ondulado, S. L.	171	Palau Pharma, S.A.
54	Comercial Nicem-Exinte, S.A. - Coniex	172	Panrico S.A.
55	Corporació Sanitària Parc Taulí	173	Pipo Systems, S.L.
56	CRAG - Centre de Recerca en Agrigenomica	174	Plasmia Biotech, S.L.
57	DBK Espana, S.A.	175	Play, S.A.
58	Desarrollos Industriales del Laser, S.L.	176	Praesentis, S.L.
59	Diewersol, S.L.	177	Precision Process Technology, S.A.
60	Digital Aeronautics Engineering Services, S.L.	178	Proaseptic Technologies S.L.U.
61	Digital Internet Transport System, S.L.	179	Progenika Biopharma, S.A.
62	Dode, S.A.	180	Pulltap's, S.L.
63	Draconis Pharma, S.L.	181	Relieves Egara, SL
64	Draka Cables Industrial, S.A.	182	Rolen Technologies & Products, S.L.
65	Easy Laser, S. L.	183	Rovalma, S.A.
66	Eco-Sistems Watermakers, S.L.	184	RS Isolsec, S.L.
67	Edarma, S.L.I	185	S.A. Sistel
68	Educa Borrás, S.A.	186	S.O.R. Internatcional, S.A.
69	Eficiencia y Tecnología, S.A.	187	Sallo Kyra S.L.
70	Electric Waves, S.L.	188	Seat, S.A.
71	Electronica Santamaria, S.L.	189	Seetech Sabadell S.C.P
72	Enco Electronics, S.A.	190	Sensient Fragrances S.A.
73	Encopim, S.L.	191	Sensofar Medical S.L.
74	Ensobrados Martorell, S.A.	192	Sepmag Systems, S.L.
75	Eqtec Iberia, S.L.	193	Servicios Tecnologicos Para la Peritacion S.L.
76	Errequerre Design & Gaming, S.L.	194	Sicosa Gestion, S.L.
77	Especialidades Electricas Daga, S. A.	195	Sima 11, S.L.
78	Espiroflex, S.A.	196	Simulacions Optiques S.L.
79	Fabrica Electrotecnica Josa, S.A.	197	Sistel, S.A.
80	Faders, S.A.	198	Sistemas Tecnicos de Encofrados, S.A.
81	Farmont, S.L.	199	Smarten 2000, S.L.
82	Fezoo Labs, S.L.	200	Smilics Technologies, S.I.
83	Fico Cables, S.A.	201	Sociedad Anonima Metalografica
84	Fico Transpar, S.A.	202	Sociedad Espanola de Carburos Metalicos, S.A.
85	Fico Triad, S.A.	203	SOGEFI FILTRATION SPAIN, S.A.
86	FMC Foret, S.A.	204	SOL3G, S.L.

ID	Actor name	ID	Actor name
87	Fractus, S.A.	205	Soler & Palau Research, S.L.
88	Frimal Trading, S.L.	206	Sovitec Iberica, S.A.U.
89	Fundació Centre de Recerca en Sanitat Animal	207	Sucspoonworkshop, S.L.
90	Fundació Eurecat	208	Tag Innovacion, S.A.
91	Fundació Privada Ascam	209	Talleres Plain, S.A.
92	Geotics Innova, S.L.	210	Tecnolclinic, S.A.
93	Germans Boada, S.A.	211	Tecno-Tau Automatitzacions, S.L.
94	Giga Games System, S.L.	212	Tejidos Estambril, S.A.
95	GJM, S.A.	213	TELSTAR TECHNOLOGIES, S.L.
96	GRASSOLER, S.A.	214	Termo Fluids, S.L.
97	Grupo Mecanica de Vuelo Sistemas S.A.	215	Thick Imaging, S.L.U.
98	HEXASCREEN Culture Technologies, S.L.	216	Transportes Continuos Interiores, S.A.
99	I2M-Design	217	Trisal, S.A.
100	Icar Vision Systems, S.L.	218	Twistechology, S.L.
101	IMAJE TECNOLOGIAS DE CODIFICACION	219	Udiat Centre Diagnostic, S.A.
102	Imc. Toys, S.A.	220	Ultrason, S.L.
103	INCABO, S.A.	221	Universitat Autònoma De Barcelona (UAB)
104	Indiba, S.A.	222	University of Nebraska Medical Center
105	Indo Internacional, S.A.	223	Urbiotica, S.L.
106	Industrias Galtes S.A.	224	Urquima, S.A.
107	Industrias Ragi, S.A.	225	Valeo, Climatizacion, S.A.
108	Industrias Technoflex SA	226	Valvules i Racords Canovelles, S.A.
109	Ingenieria de Encofrados y Servicios, S.L.	227	Veltek Europe, S.L.
110	INKE, S.A.	228	Vernis Motors, S.L.
111	Innovative Minds, S.L.	229	Vertigo Motors, S.L.
112	Institut Català De Nanotecnologia i Nanotecnologia	230	Vetgenomics, S.L.
113	Institut de Física d'Altes Energies	231	Vila-Inox, S.L.
114	Institut Univ. de Ciencia i Tecnologia, S.A.	232	Vitae Natural Nutrition, S.L.
115	Instruments Utills de Laboratori Geniul, S.L.	233	Volpak, S.A.
116	Intermedic Arfran, S.A.	234	Zanini Auto Grup, S.A.
117	International Capacitors, S. A.	235	Zobebe España, S.A.
118	Interquim, S.A.		

Table A III 21. Total actors active in scientific publishing (2017-2019)

ID	Actor name	ID	Actor name
1	Autonomous Univ Barcelona UAB	30	Hospital Universitari Terrassa
2	B Braun Surgical SA	31	Inst Catala Paleontol Miquel Crusafont
3	Campus Universitat Bellaterra	32	Institut Català de Paleontologia Miquel Crusafont
4	Catalan Institute of Nanoscience & Nanotechnology - ICN2	33	Institut de Ciència des Materials de Barcelona (ICMAB-CSIC)
5	CELLS ALBA Synchrotron	34	Institut de Ciència i Tecnologia Ambientals (ICTA - UAB)
6	Centre de Promoció Empresarial	35	Institut de Ciències de l'Espai - CSIC IEEC
7	Centre de Recerca Ecològia i Aplicacions Forestals - CREA	36	Institut de Física d'Altes Energies (IFAE)
8	Centre de Recerca en Agrigenòmica (CRAG)	37	Institut de Microelectrònica de Barcelona (CSIC)
9	Centre de Recerca en Sanitat Animal (IRTA-CReSA)	38	Institut de Microelectrónica de Barcelona Biblioteca - CSIC
10	Centre de Recerca Matemàtica	39	Institute of Space Science - CSIC IEEC
11	Centro Invest Biomed Red Bioingn Biomat & Nanomed	40	Instituto de Micro y Nanotecnología-CNM - CSIC

ID	Actor name	ID	Actor name
12	Centro Invest Biomed Red Enfermedades Raras	41	Kao Corporation, SA
13	Cerba Internacional SAE	42	Leitat Technological Center
14	Consejo Super Invest Cient ICMAB CSIC	43	Mina Aigues Terrassa SA
15	Consorti CSIC IRTA UAB UB	44	Museu Ciències Nacional Granollers
16	Consorti Gestio Residus Valles Oriental	45	Museum of Natural Sciences Granollers
17	Consorti Sanitari Parc Tauli	46	Nanomol Technologies SL
18	Consorti Sanitari Terrassa	47	Oxolutia SL
19	Corp Sanitaria Parc Tauli	48	Pen & Tec Consulting SLU
20	Cuquantum Medical Cosmetics	49	Port d'Informació Científica - PIC
21	Ecological and Forestry Applications Research Centre - CREAM	50	Roche Diagnostics SL
22	Escoles Universitàries Gimbernat	51	SENER Ingn & Sistemas
23	Euncet Business School	52	Sensofar Med SL
24	Flubetech SL	53	Sensofar Tech SL
25	Fractus, SA	54	Sequentia Biotech SL
26	Government of Catalunya	55	UAB Facultat de Veterinària
27	Hospital Generalitat Granollers	56	UIC Barcelona Campus Sant Cugat
28	Hospital Universitari Dexeus	57	Universitat Internacional de Catalunya
29	Hospital Universitari Parc Tauli		