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Characterisation of preliminary priority areas for smart specialisation in Moldova

Final draft report

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We hope this work will reinforce the national and regional evidence-based priority-setting process and support the development of open government, open science and open innovation initiatives in the Republic of Moldova.

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1. Background and presentation

1.1. Policy background

In 2016, the S3 Platform launched a pilot project on "Smart specialisation and organisational development in enlargement and H2020 associated countries" (under the Enlargement & Integration Action, E&IA), now formally part of the JRC WP 2017. The overall objective of the pilot project is to analyse and to support the strategic management capabilities in EU enlargement and neighbourhood countries, with a special emphasis on specialisation mapping and on the entrepreneurial discovery processes.

The first critical phase in this project was to provide expert support for mapping the economic, research and innovation potential. This resulted in a report prepared by Professor Hugo Hollanders, (Maastricht University) under the Expert group "Mapping for smart specialisation in E&IA countries". This report, entitled "Mapping of economic, innovative and scientific potential in the Republic of Moldova", identifies preliminary smart specialisation areas for Moldova and its regions.

As a preparation for the second phase of the pilot project, the entrepreneurial discovery process, the current work develops a targeted analysis for the identification of science and innovation topics and stakeholders in the smart specialisation areas preliminarily identified by Hollanders, using additional data sources, analysing in deeper detail and introducing semantic techniques.

To the extent that the data sources allow, the analysis will be broken down by region, to provide information on regional specialisation topics and to identify relevant actors to involve in the entrepreneurial discovery process. The Moldovan regions treated are:

- Chișinău
- Nord
- Centru
- Sud
- U.T.A. Găgăuzia

The analysis has been elaborated together with the S3 team in Moldova, especially in the part based on data from national sources.

1.2. Expert report "Mapping of economic, innovative and scientific potential in the Republic of Moldova"

1.2.1. Rationale and data sources

The previous report "Mapping of economic, innovative and scientific potential in the Republic of Moldova" by Hollanders, aimed at mapping preliminary priority areas of specialisation for Moldova and its regions.

Hollanders exploits several national and international data sources to map specialisation potential:

- **Economic potential:** "The objective of the mapping is to identify industries with both proven strengths and a potential to drive economic transformation", based on the following data sources:
    - Turnover and employment per NACE sectors (3/4 digits), establishing critical mass (volume and relative importance) and specialisation (location quotient) thresholds above which an industry or sector is selected.
    - Wages, to nuance and validate the previous selection.
- **Innovation potential:** "The mapping will use a descriptive analysis of the [innovation] indicators linking these to the results of the economic mapping", based on the following data sources:
    - Patent applications (inventors, applicants and technology classes)
    - Enterprise surveys (firms introducing new products and processes, spending on R&D and using technology licensed from foreign companies)
- **Scientific potential:** "The mapping of the scientific potential will use a descriptive analysis of the below mentioned indicators linking these to the results of the economic mapping", based on the following data sources:
    - Scientific publications (distribution by domain)
    - Researchers by R&D activity
    - Share of PhD holders by R&D activity
    - Admissions, students, and graduates in vocational secondary and post-secondary vocational education and in tertiary education (by cycle and fields of study)
    - Number and specialisation of post-secondary vocational and tertiary education institutions

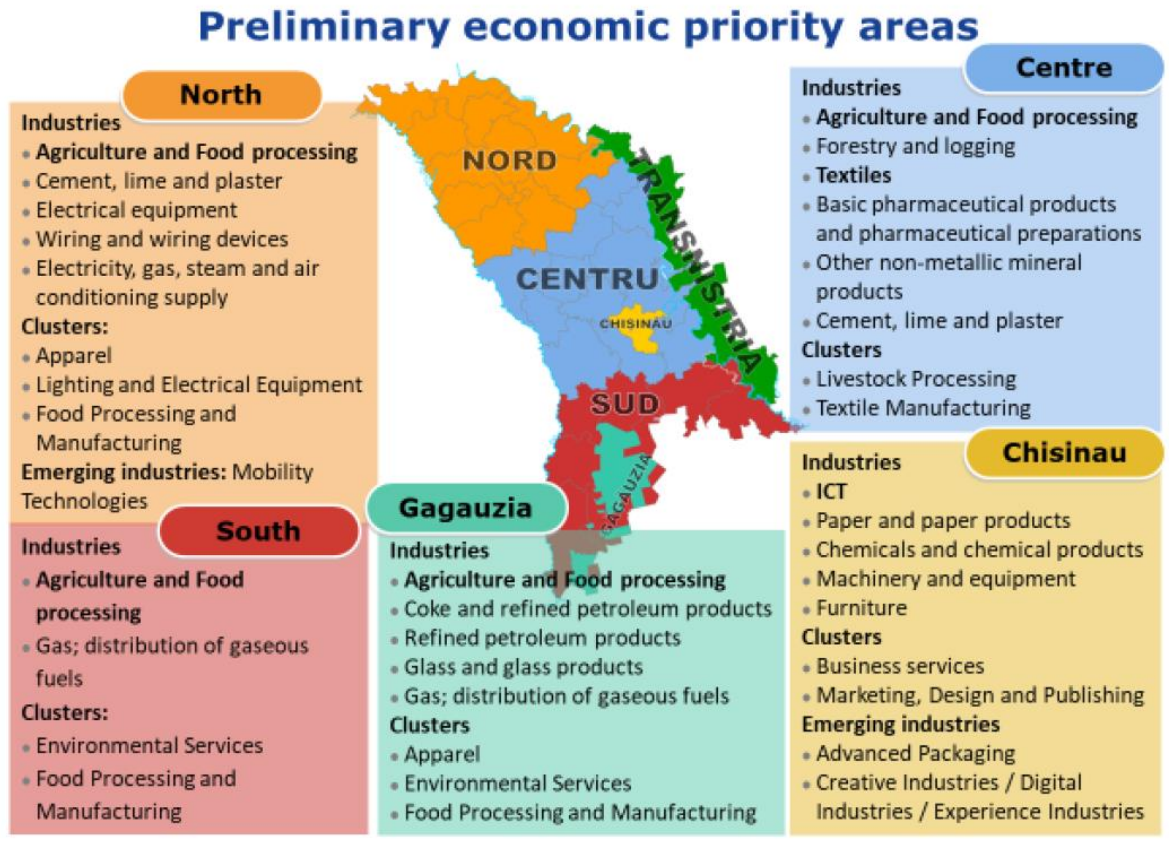
Hollanders noted that during 2018, the disaggregated results of the first Moldovan innovation survey will provide essential new information to support further mapping efforts and strategic decision-making.

1.2.2. Preliminary priority domains for smart specialization

Hollanders' identification of potential specialisation domains is grounded on the economic mapping (NACE sectors), which is nuanced and extended with the inputs and insight from the innovation and scientific potential mappings.

Beyond the selection of preliminary priority aggregates of NACE sectors, Hollanders identifies traded clusters and emerging industries (as defined by the European Cluster Observatory in 2017, adapted from the U.S. Cluster Mapping Benchmark Definitions), to better assess "cross-sectoral linkages and competitiveness and entrepreneurship opportunities in emerging industries". These provide additional domain classifications in which Hollanders computes the previous indicators, defines thresholds and identifies clusters and emerging industries.

The following table summarises the selection of **preliminary economic priority areas,** under three rubrics, "industries", "clusters" and "emerging industries":



Preliminary economic priority areas

North

Industries
- **Agriculture and Food processing**
- Cement, lime and plaster
- Electrical equipment
- Wiring and wiring devices
- Electricity, gas, steam and air conditioning supply

Clusters:
- Apparel
- Lighting and Electrical Equipment
- Food Processing and Manufacturing

Emerging industries: Mobility Technologies

South

Industries
- **Agriculture and Food processing**
- Gas; distribution of gaseous fuels

Clusters:
- Environmental Services
- Food Processing and Manufacturing

Gagauzia

Industries
- **Agriculture and Food processing**
- Coke and refined petroleum products
- Refined petroleum products
- Glass and glass products
- Gas; distribution of gaseous fuels

Clusters
- Apparel
- Environmental Services
- Food Processing and Manufacturing

Centre

Industries
- **Agriculture and Food processing**
- Forestry and logging
- **Textiles**
- Basic pharmaceutical products and pharmaceutical preparations
- Other non-metallic mineral products
- Cement, lime and plaster

Clusters
- Livestock Processing
- Textile Manufacturing

Chisinau

Industries
- **ICT**
- Paper and paper products
- Chemicals and chemical products
- Machinery and equipment
- Furniture

Clusters
- Business services
- Marketing, Design and Publishing

Emerging industries
- Advanced Packaging
- Creative Industries / Digital Industries / Experience Industries

Preliminary economic priority areas per Region identified in the report "Mapping of economic, innovative and scientific potential in the Republic of Moldova"

Source: "Mapping of economic, innovative and scientific potential in the Republic of Moldova". Hugo Hollanders, Maastricht University, 2017

The identified preliminary priority domains based on **innovation potential,** as determined from patent applications, are:

- Agriculture and food processing:
    - Food chemistry (International patents)
    - Wine, Foods, Planting (National patents)
- Pharmaceuticals (International patents)

The identified preliminary priority domains based on **scientific potential**, as determined from international publications, are:

- Agricultural and biological sciences
- Computer science
- Energy
- Chemistry, Chemical engineering

These three complementary preliminary priority mappings (economic, innovation, science) allow for a wide-spectrum analysis of the science and innovation activities in Moldova and its regions, object of the current report.

1.3. Presentation and objectives of the current project

Following the preliminary S3 priority definition by Hollanders presented above, the current project aims to map Moldovan science and innovation ecosystems, in particular:

1. Characterise and describe the identified preliminary priority areas to a finer grain
2. Produce indicators by area
3. Identify the relevant actors
4. Map and visualise collaboration patterns among these actors
5. Identify key foreign partners
6. Provide insight to support strategic and operational decision-making in:
    a. economic specialisation and public support to private R&D investment
    b. science and innovation policies and capacity-building.

To advance on these aims, the current project relies on science and technology data sources: scientific publications, publicly-funded R&D projects and patents, and does not incorporate economic statistics or indicators. It uses the most granular data available, that is, the single record for each Moldovan publication, patent or project in the covered period. Science and innovation activities and ecosystems in Moldova are explored, for the period 2007-2017, through the following sources:

- **Scientific publications**
- Competitive **European projects** (FP7 and H2020)
- Competitive **national projects** funded by the Moldovan Academy of Sciences
- National **patent applications**

The results of the work are presented in three deliverables:

1. The current **report**: "Characterisation of preliminary priority areas for smart specialisation in Moldova".
2. A set of **interactive data visualisation tools** allowing a free exploration of the science and innovation ecosystems in Moldova, with S3 preliminary priority and regional lenses.
3. **A list of organisations and individuals connected to the S3 priorities** at the national level and in each region, to support the design and implementation of the Entrepreneurial Discovery Process (EDP)

The approach and methodology of the project are presented in the following chapter.

2. Methodology

2.1. Methodological challenges and trends

When establishing or monitoring smart specialisation strategies, and specially when selecting and characterising priority areas, most European regions face technical difficulties that become strategic challenges:

1. A **lack of granular data on science and innovation activities and results**, sufficiently detailed, recent and updated.
2. A **difficulty to classify R&D activities and results in newly defined specialisation areas**, which do not tally well with existing scientific, technological and sectoral classifications and taxonomies.
3. A **partial and segmented view of the innovation process and of the overlapping public policies**, due to a lack of integrated or interoperable (open, closed and proprietary) data which belong to a diversity of private, regional, national European and international actors.
4. A **gap between experts and stakeholders, between users and providers of data and analysis**, due to different vocabularies, knowledge and experiences, which jeopardise the participatory public-private decision-making processes of the S3 model.

At the same time, several transformational trends, mostly technological but not only, are opening lines of opportunity:

1. **Open government data, the Open science and innovation paradigm and Semantic web technologies** are making more (reusable and interoperable) data available in the science and innovation domain.
2. **Data science, artificial intelligence and natural language processing techniques** facilitate a deeper analysis of large amounts of quantitative and text data, allowing for the extraction and development of ad-hoc taxonomies across regions, data sources and traditional classification systems.
3. The use of **interactive and exploratory visualisation tools** provide experts, policy makers and stakeholders an entry-point to the complex and highly-intertwined data-sources that track or result from science and innovation endeavours.
4. **Learning by monitoring,** an important feature of the S3 model, gives the opportunity to learn from tracking data, developing indicators and analysing past and current information in an **open and participatory exchange** gathering public, intermediary and private actors.

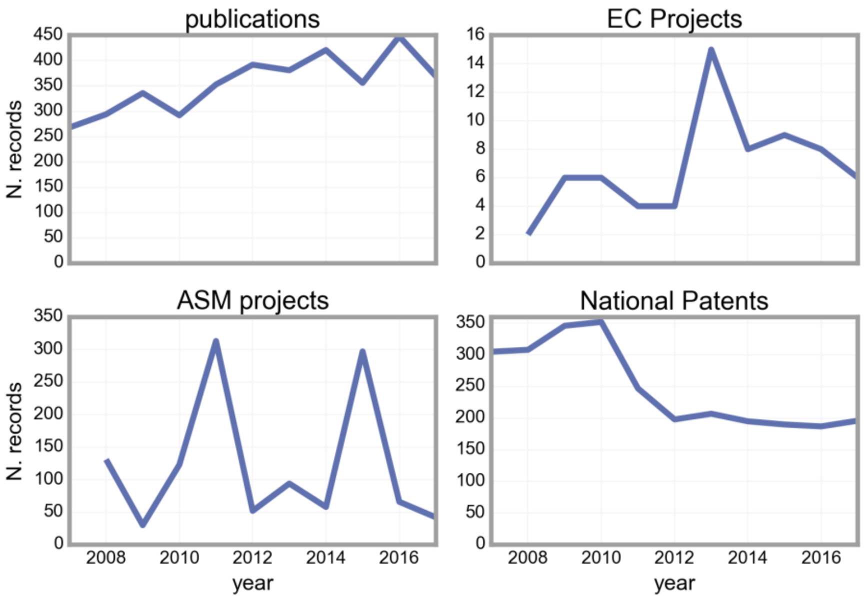
These challenges, trends and opportunities are integrated in the current project with the objective of supporting Moldova in its policy-making process, particularly, bringing data to better design the Entrepreneurial Discovery Process (EDP).

2.2. Data sources and time frame

Records have been gathered for the 2007-2017 eleven-year period from the following data sources:

Scope	Selection criteria	Source	Number of records (2007-2017)
Scientific publications in internationally indexed journals	Publications with at least one author with a Moldovan affiliation.	Scopus (Elsevier)	3925
European projects	FP7 and H2020 projects with at least one Moldovan partner	CORDIS - Community Research and Development Information Service	71
Competitive **national projects**	Awarded by the Moldovan Academy of Sciences	EXPERT On-line – Moldovan S&T Proposal Submission and Evaluation System	1204
National **patent applications**	At least one Moldovan inventor or applicant	AGEPI - Moldovan State Agency on Intellectual Property	2815

As presented in the following line charts, the number of international publications has grown significantly in the period, while the number of national patents has almost halved. The projects financed by the Academy of Sciences cluster in the calls of the years 2011 and 2015, and the number of projects in European peaked in 2013, the closing year of FP7 where a large number of calls accumulated.



Number of records per year (2007-2017) divided by source

2.3. Process

As presented in the previous section, the current project gathers, processes and analyses science and innovation records. All aggregates and indicators, particularly those conforming S3 priorities or geographical areas, have been constructed ad-hoc. This allows for a more precise and detailed description of the perimeters of interest and for the generation of new analysis or categorisations answering specific questions.

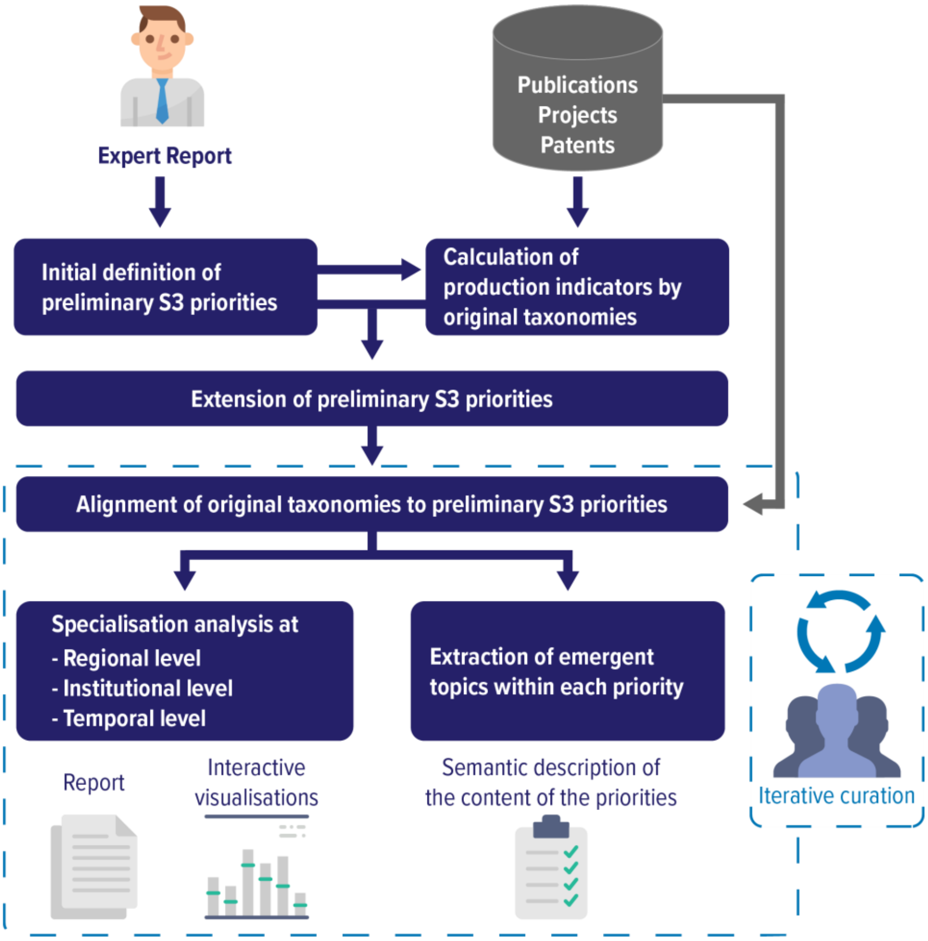
Two main data analysis approaches have been pursued:

1. ***First approach:*** The first approaches consists in **manually aligning the preliminary priority domains with the classification system of the data sources.**

2. ***Second approach:*** Independently from the preliminary domains, the second approach **identifies emergent specialisation topics from the text abstracts or descriptions of the records** (Moldovan publications, EU Projects and patents). After a natural language preprocess, Topic modelling, a machine learning technique, is implemented through the Latent Dirichlet Allocation algorithm, returning a collection of topics that emerge from the textual content of the analysed documents. The topics are, in practice, a collection of keywords that tend to appear together in different documents.

2.3.1. First approach: Mapping of S3 preliminary priority areas to the data source's original taxonomies

In Table 25 (page 53) of the report, Hollanders presents the list of preliminary priority domains[1], expressed in NACE sector codes, scientific publication categories and patent technology fields. This initial priority characterisation has been widened and detailed to define a perimeter for each preliminary priority in the original data source classification system. Within these perimeters, exploiting the full granular records of the data sources, indicators and analysis are developed and presented for each preliminary priority.


Expert Report
Publications
Projects
Patents
Initial definition of preliminary S3 priorities
Calculation of production indicators by original taxonomies
Extension of preliminary S3 priorities
Alignment of original taxonomies to preliminary S3 priorities
Specialisation analysis at
- Regional level
- Institutional level
- Temporal level
Extraction of emergent topics within each priority
Report
Interactive visualisations
Semantic description of the content of the priorities
Iterative curation

Methodology schema of Mapping of S3 preliminary priority areas to the data source's original taxonomies

The records have been mapped to the Moldovan S3 preliminary priority areas using the following methods:

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[1] The summary table can be found in this document's Annex.

Scope	Method	Pivot
Scientific publications in internationally indexed journals	Through the data source original taxonomy	The S3 preliminary priority areas have been mapped to the Scopus' classification of journals in **Subject areas and Subject fields**
European projects	Manual	The limited number of EU projects has allowed for the manual classification of each project in the preliminary priority areas
Competitive **national projects**	Through the data source original taxonomy	The S3 preliminary priority areas have been mapped to the Moldovan **Strategic Directions**[2] (Direcţia strategică)
National **patent applications**	Through the data source original taxonomy	The S3 preliminary priority areas have been mapped to the **International Patent Classification** (IPC).

The concordance tables between the source taxonomies and the preliminary priority areas can be found in annex.

2.3.2. Second approach: Topic modelling

In the second approach, specialisation topics are automatically extracted from the text fields of the records describing science and innovation activities and result, with no reference to the preliminary priority areas. "Topic Modelling", a machine learning text mining technique, is implemented in this work through the Latent Dirichlet Allocation (LDA) algorithm. The number of topics is chosen by minimising the Bayesian Information Criterion, a standard approach in statistics for optimal model selection. Each publication, project and patent is linked with a certain weight to any given topic, so that, by aggregation, priorities, institutions, individuals and regions may be more or less related with any specific topic.

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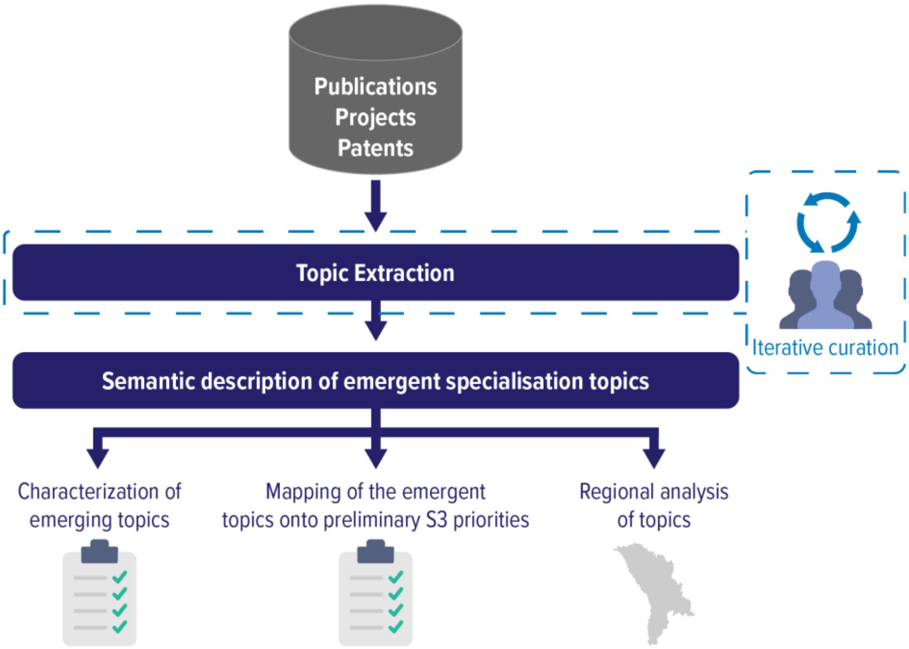
[2] Strategic Directions are established by law (Parliamentary decision). A first set was approved for the timeframe 2006-2010 and extended until 2013. Replacing those, a second set was approved for the timeframe 2013-2020 establishing the current strategic directions for science and innovation of the Republic of Moldova. Government, not Parliament, will establish new priorities from 2019.


Publications
Projects
Patents
Topic Extraction
Iterative curation
Semantic description of emergent specialisation topics
Characterization of emerging topics
Mapping of the emergent topics onto preliminary S3 priorities
Regional analysis of topics

Methodology schema of the extraction of specialisation topics

The results of both approaches are presented along this report, although only the first one, based on the preliminary priority domains, is shown in the interactive visualisation tools.

2.4. Limitations and considerations

A series of issues regarding the data sources and their treatment limit the width and depth of the current analysis:

- **Regionalisation of the analysis in a centralised country:** Moldovan science and innovation actors are very centralised, all institutes of the ASM, but one, as well as the top universities, are located in the capital Chisinau. Hollanders, in page 18 of the report, advanced "There is no real need for a breakdown of scientific publications into the five regions, as knowledge has a public nature and can be more easily accessed across regional borders. Education institutions, in particular in tertiary education, also serve the whole country, not just the region in which they are located." Nevertheless:

    - Regional ecosystems and priorities, outside of the capital, will appear weak and not diversified when mapped from science and innovation data sources. In this sense, **the Moldovan knowledge base should be understood as national and available for all regions: all S3 should make use of that knowledge base regardless of where the actors and assets are located.**

  - This is specially relevant when looking for collaboration networks in the regions. Although some activities and results can be found at the regional level, it is harder to identify bilateral or multilateral (clustered) partnerships. The EDP process design and implementation should specifically address this limitation.

  It must be noted, though, that **universities situated in the regions are building up their research capacity** (as observed in the recent growth in the number of publications in internationally indexed journals) and **increasingly cooperating with their industrial environment**, in a process to establish collaborative ecosystems in education, research and innovation.

- **Low number of records hindering a deeper characterisation of some preliminary priority areas:** The low number of records in some preliminary priority areas prevents a richer characterisation and can provide unreliable indicators. It wouldn't be advisable to derive strong conclusions for areas such as "Textiles" or "Furnitures", weakly represented in the data sources.

- **Bias against non-technological innovation:** Most records compiled belong to the natural sciences and to technological innovation, partly due the nature of the sources of information used, partly due to the specialisation of the Moldovan ecosystem and the country's science and innovation policies. The relative absence of non-technological research and innovation activities (i.e. design or experience-based industries), which can have an important role in regional specialisation strategies, has to be taken into account. Only recently creative and experience-based industries started to be supported mainly by donors-driven programmes.

  The relative absence of non-technological research and innovation activities (such as design based industries or tourism) shouldn't be taken as fact, and a more holistic view of regional capacities and opportunities for innovation should be obtained by the EDP Process. **Creative and experience-based industries, and more generally, the value of non-technological innovation in all sectors, could have an important role in Moldovan regional specialisation strategies.**

- **The alignment between original sources' taxonomies and S3 priorities is not always evident or one to one:** Aligning classical taxonomies to ad-hoc S3 priorities is a problematic process. In occasions there appear overlaps or too-wide taxons that prevent a fine-grained distribution of items in different priorities. Such issues will be presented and dealt with in the following chapters, the main ones being:

  - The bibliometric categories related to computer science applications, nanotechnology, electronics and advanced instrumentation present significant overlaps. This leads to the presence of redundant/similar topics under several S3 priorities.

  - Moldovan Strategic Directions are rather broadly defined, hindering a fine-grained attribution of projects to the S3 priorities. In particular, the following two Strategic Directions are very wide and cut across diverse preliminary priorities:
    - (2006) Nanotechnology, industrial engineering, new products and materials
    - (2010) New materials, technology and innovative products

- **Bias in the coverage of Moldovan scientific publications in Scopus:** There is an important difference in coverage between the Moldovan National Bibliometric Instrument (IBN), which indexes a large number of articles published in national scientific journals, and Scopus, which indexes a small selection Moldovan journals and the main international academic journals. By comparison, IBN offers a much larger representation of publications in law, social sciences and the humanities. At the same time, publications in internationally indexed journals have passed, on aggregate, a higher quality threshold[3]. For this reason, the data set of international publications from Scopus is deemed representative and sufficient to support S3 priorisation decisions, for all but some very specific domains where the social sciences and the humanities have an important role, such as tourism or the cultural industries. More generally, the bias towards the natural sciences, technology and engineering in the used data sources would recommend further work, with expert and qualitative contributions, to analyse and propose specialisation priorities in these domains.

- **Limitations to text mining techniques due to language differences:** It has not been possible to semantically analyse the description of national projects alongside the rest of the datasets, since they don't have an abstract or description in English. In a subsequent project, the abstracts (around 1200) could be translated and incorporated into the topic modelling process.

- **Most European projects are focused on international cooperation and capacity building[4] and respond to external priorities:** Looking at the 69 EU projects with at least a Moldovan partner, 53 (77%) correspond to cooperation and capacity building and only 16 (23%) to actual research, development or innovation projects. They respond to higher-level priorities, such as "Fostering Dialogue and Cooperation between the EU and EECA in the HORIZON 2020 perspective" and provide very weak signals of national or regional specialisation. There is however an influx of financial resources coming in from this venue that might have an impact on the structure of the RDI ecosystem. To capture some of these effects, for 32 projects, more than half of those classified as cooperation and capacity building, have actual domain-specific content and have thus been classified in the preliminary S3 categories. The follow three examples present this categorisation process:

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[3] For a summary of the disciplinary distributions of publications indexed by IBN, see Hollander's report.

[4] This classification of projects is ad-hoc.

Example selection (non-exhaustive)

Project title	Type of project	Preliminary priority
Waste Heat to Electrical Energy via Sustainable Organic Thermoelectric Devices	RDI	Energy
ENER2I (ENErgy Research to Innovation): Reinforcing cooperation with ENP countries on bridging the gap between energy research and energy innovation	Cooperation and capacity building	Energy
Set-up a EURAXESS Services Network in Moldova	Cooperation and capacity building	No S3 preliminary priority

- **Impossibility of mapping collaboration from national RDI projects:** The policy instruments established by the Republic of Moldova and implemented by the Academy of Sciences to support research, development and innovation do not support collaboration. Only 4 out of the 1223 projects funded by ASM calls in the period are executed by more than one beneficiary (2 beneficiaries in 4 projects for young researchers). Thus, it is not possible to identify collaboration and map networks from the records of national projects. Beyond this particular mapping and characterisation exercise, it would be advisable to assess the establishment of policy instruments supporting collaboration and networking in the regional and national science and innovation ecosystems.

- **Difficulty to disentangle the institutes of the ASM:** The scientific specialisation of ASM institutes would be useful to support specialisation decision-making. Unfortunately, in international data sources and in AGEPI, the ASM is presented as a single institutions. Only in national projects ASM institutes are presented separately.

2.5. Interactive data visualisation tools

Science and innovation communities are complex and move fast. To grasp networks, specialisation and emergencies at the level of detail relevant for EDP and priority, predefined tables and aggregates are not enough. There is a need for granular, flexible analysis within changing ad-hoc perimeters (geographic, disciplinary, sectoral), allowing technicians, experts and policy-makers a fine-grained exploration of the ecosystem and a fast analysis of different scenarios.

In this context, a significant part of the data treated and analysis developed during the current project have been made available in a web application with the following features:

- **Presents data** on:
    - internationally-indexed publications
    - EU projects
    - ASM projects
    - national patents
- **Provides a series of filtering tools allowing the definition of fine-grained disciplinary, sectoral and geographic analysis.**
- **Maps collaboration networks** for each of these datasets, with institutions as nodes and collaboration links as edges (co-authorship in publications, project consortia and patent co-applications).
    - The **network is fully interactive, acting also as a filtering tool** where nodes, branches and communities can be selected and analysed.
    - The **size of the nodes depends on the volume of contribution** of each actor (number of publications, aggregate funding in projects, number of patent applications).
    - The **layout of the network can be modified** according to categorical variables of the data, such as the region where the institution is located.
- **Depicts two specialisation indicators in a map of Moldova and its regions**, i) distribution of the specialisation in each region within the nation, ii) intensity of specialisation in each region.
- Several **modules present information at the bottom of the web application**, providing lists and indicators on:
    - Specialisation:
        - Within the preliminary S3 priority areas
        - In the original data source's taxonomies
    - Regional distribution of the activities
    - Top Moldovan organisations
    - Top foreign partners

3. Specialisation Analysis

3.1. Definition of the preliminary priority areas and main figures

3.1.1. Definition of the preliminary priority areas following the Expert's report

As presented in the "Background and presentation" chapter, the previous report "Mapping of economic, innovative and scientific potential in the Republic of Moldova" aimed at mapping preliminary priority areas of specialisation for Moldova and its regions.

Hollanders identified four main domains of potential specialisation and a series of additional domains under the label "Other" (see details in Annex A):

1. Agriculture and Food processing
2. Textile, Apparel, Footwear and Leather goods (TAFL)
3. ICT
4. Renewable energy
5. Other

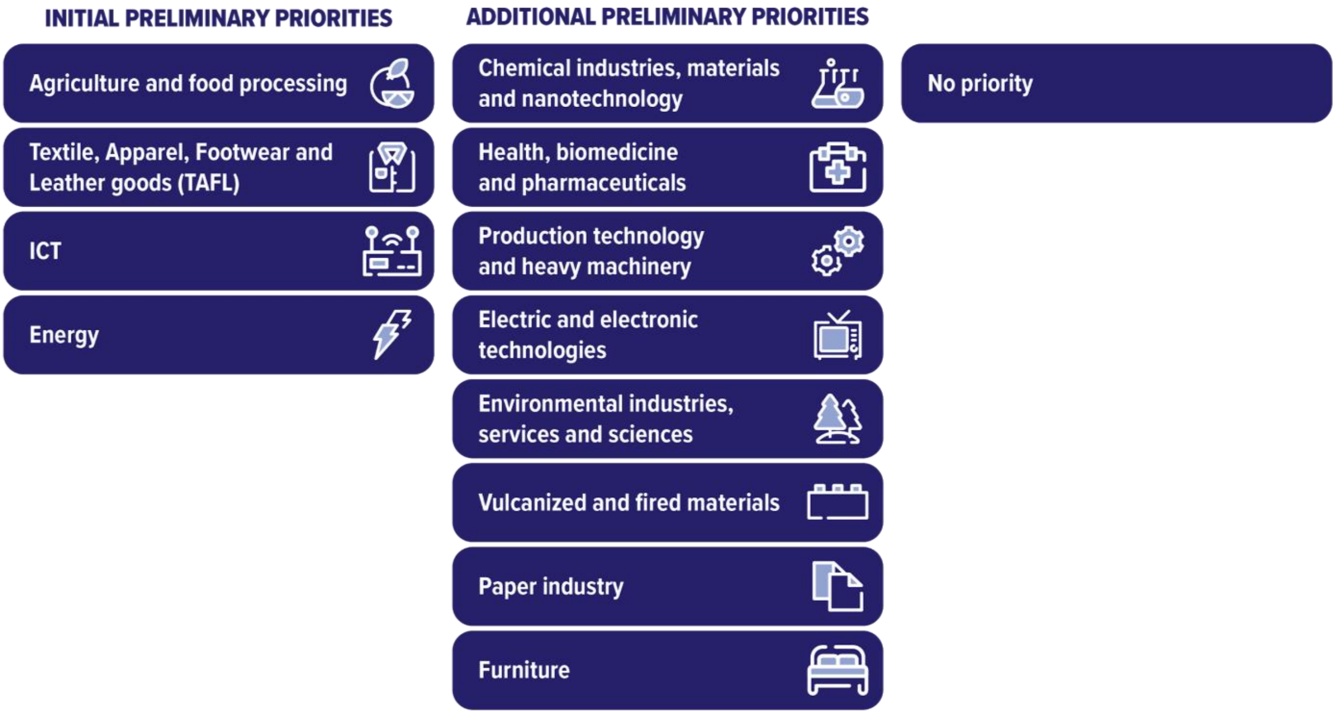
Given the transversality of the data sources gathered for this report, it has been decided to specify most of the "Other" domains in a set of new labels, loosely based on the European Cluster Observatory labels. Also, one of the four main preliminary priority domains, "Renewable energy", has been renamed to allow for a wider characterisation. The following table presents the rationale by which preliminary priority areas have been relabeled or extended:

New or renamed preliminary priority labels	Expert report preliminary priority domain	Identified NACE sectors	Observations
Energy	Renewable energy	Manufacture of coke and refined petroleum products	"Renewable energy" relabeled to "Energy" since it includes "D352 manufacture of gas" and it can accomodate the oil industry.
Chemical industries, materials and nanotechnology	Other	Manufacture of chemicals and chemical products	Gathers the important industrial and knowledge capacity around **physical chemistry and materials**, and the newer research areas that evolve from it such as **surface and nanotechnology**. It includes the **metal and plastic industries.**
Health, biomedicine and pharmaceuticals	Other	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Gathers clinical and biomedicine research, pharmaceuticals and medical devices.

Production technology and heavy machinery	Other	Manufacture of machinery and equipment not elsewhere classified.	
Electrical and electronic technologies	Other	Manufacture of electrical equipment	
Environmental industries, services and sciences	Not identified in the previous report	--	New preliminary priority label proposed due to the several EU projects on conservation and water industry and the important number of publications in the environmental sciences subject areas.
Vulcanized and fired materials	Other	Manufacture of other non-metallic mineral products	
Paper industry	Other	Manufacture of paper and paper products	
Furniture	Other	Manufacture of furniture	
No priority			Finally, all records not classified in a S3 preliminary priority are bundled under a "No priority" label.

Extension of the preliminary priority domains identified in the Expert report

So, the preliminary priority areas analysed in the current project are:



INITIAL PRELIMINARY PRIORITIES

- Agriculture and food processing
- Textile, Apparel, Footwear and Leather goods (TAFL)
- ICT
- Energy

ADDITIONAL PRELIMINARY PRIORITIES

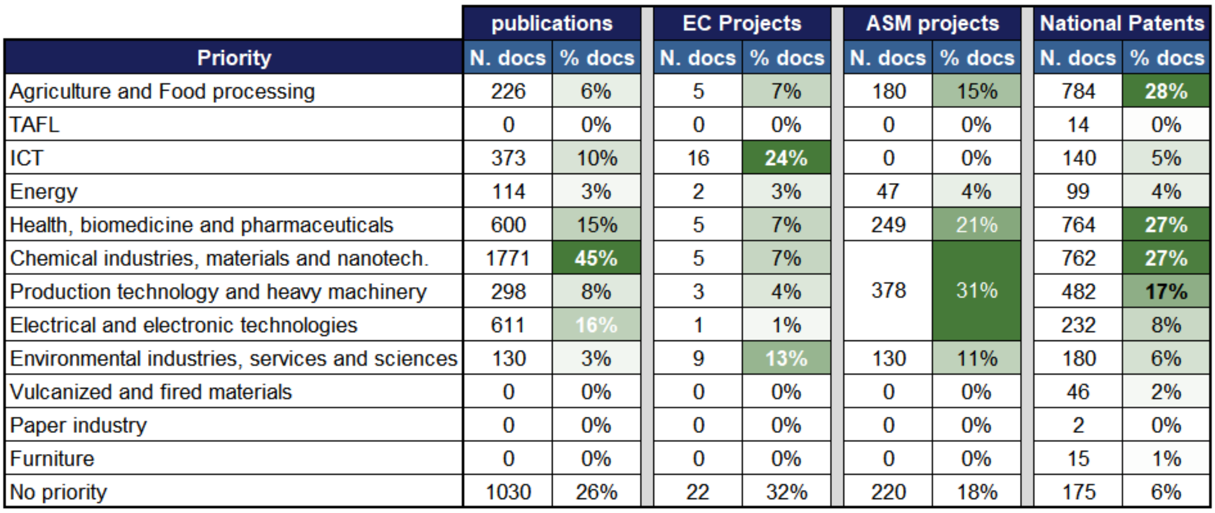
- Chemical industries, materials and nanotechnology
- Health, biomedicine and pharmaceuticals
- Production technology and heavy machinery
- Electric and electronic technologies
- Environmental industries, services and sciences
- Vulcanized and fired materials
- Paper industry
- Furniture

- No priority

Moldova S3 preliminary priority areas

3.1.2. Contribution of each preliminary priority in the data sources

The following table presents the number of records classified under each preliminary priority, and the percentage of contribution of each preliminary priority in the data sources:



	publications		EC Projects		ASM projects		National Patents	
Priority	**N. docs**	**% docs**	**N. docs**	**% docs**	**N. docs**	**% docs**	**N. docs**	**% docs**
Agriculture and Food processing	226	6%	5	7%	180	15%	784	28%
TAFL	0	0%	0	0%	0	0%	14	0%
ICT	373	10%	16	24%	0	0%	140	5%
Energy	114	3%	2	3%	47	4%	99	4%
Health, biomedicine and pharmaceuticals	600	15%	5	7%	249	21%	764	27%
Chemical industries, materials and nanotech.	1771	45%	5	7%	378	31%	762	27%
Production technology and heavy machinery	298	8%	3	4%			482	17%
Electrical and electronic technologies	611	16%	1	1%			232	8%
Environmental industries, services and sciences	130	3%	9	13%	130	11%	180	6%
Vulcanized and fired materials	0	0%	0	0%	0	0%	46	2%
Paper industry	0	0%	0	0%	0	0%	2	0%
Furniture	0	0%	0	0%	0	0%	15	1%
No priority	1030	26%	22	32%	220	18%	175	6%

Document distribution by preliminary priority

Out of the **four preliminarily identified priorities**, two are very present in the data sources ("Agriculture and food processing", "ICT"), one is moderately present ("Energy") and one is almost non-existent (TAFL).[5]

Some of the preliminary priorities listed as "Other" present significant figures in the data sources ("Chemical industries, materials and nanotechnology", "Health, biomedicine and pharmaceuticals", "Production technology and heavy machinery", "Electric and electronic technologies", "Environmental industries, services and sciences") and thus should be considered in any specialisation analysis.

On the contrary, **three priorities listed as "Other"** ("Vulcanized and fired materials", "Paper industry", "Furniture") are nearly absent of the data sources, in similar fashion as

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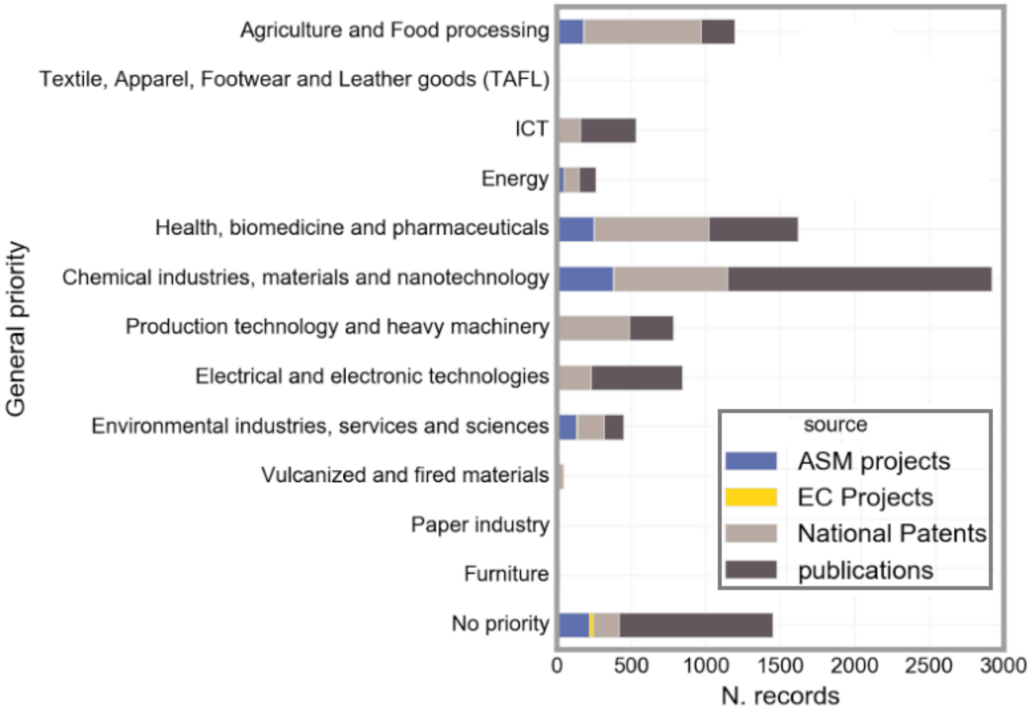
[5] As explained earlier, Strategic directions are rather broadly defined, which makes it difficult to distribute the projects granularly across the S3 priorities. This can be observed in the concentration of projects in just 5 priorities. Consequently, it is possible to extract conclusions for those priorities which better map with the ASM Strategic directions ("Agriculture and food processing", "Energy" and "Health, biomedicine and pharmaceuticals"), but not for the others. It would be fruitful to manually classify ASM projects in the preliminary S3 priorities to obtain a more reliable and detailed image.

TAFL. This fact is most probably due to three main factors:

- Impossibility to directly align bibliometric categories to these priorities: Indeed, there aren't Scopus subject fields that specifically identify journals in these areas. Nevertheless, after a direct querying of scopus (with keywords such as "textile" or "furniture"), less than 10 related publications were found for the whole period, so the missing data doesn't seem significant.
- Lower presence of the activities of these traditional sectors in science and innovation records.
- Lack of research capacity and activity both in the public sector, rather specialised in the natural sciences, and the private sector, rather traditional.

The results of the first Moldovan innovation survey will provide information on the innovative health of these sectors, which will also serve as a test of the reliability of the S&I data sources used in these project for those specific priorities

The precedent information can be visualised in the following chart. It is noteworthy that some priorities are conformed of a larger number of publications (dark grey) than patents (light grey), or the opposite, witnessing **an orientation towards scientific research** (such as "Electrical and electronic technologies") **or towards technological innovation** (such as "Agriculture and food processing").



Number of documents per preliminary priority divided by source

Summarising, the preliminary S3 priorities can be ordered in importance as follows:

Top priorities in the science and innovation data sources

- Chemical industries, materials and nanotechnology (slightly science-oriented)
- Health, biomedicine and pharmaceuticals (balanced preliminary priority)
- Agriculture and food processing (clearly technological-innovation-oriented)

Intermediate priorities in the science and innovation data sources

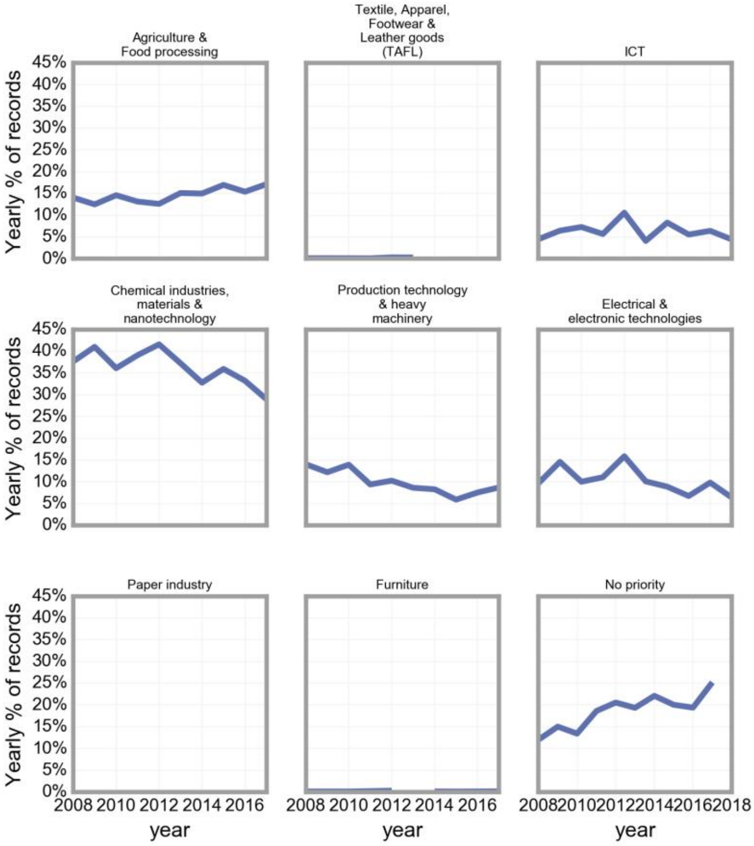
- Electric and electronic technologies (science-oriented)
- Production technology and heavy machinery (technological-innovation-oriented)
- ICT (slightly science-oriented)
- Environmental industries, services and sciences (slightly technological-innovation-oriented)
- Energy (balanced preliminary priority)

Lower priorities in the science and innovation data sources

- Vulcanized and fired materials
- Textile, Apparel, Footwear and Leather goods (TAFL)
- Paper industry
- Furniture

3.2. Temporal evolution of the preliminary S3 priorities

The following line charts present the temporal evolution of the share of contributions in the three datasets rich enough to provide a sizeable and frequently updated sample. Please note that ASM projects are only classified in 5 S3 priorities[6].



Yearly distribution of documents per preliminary priority

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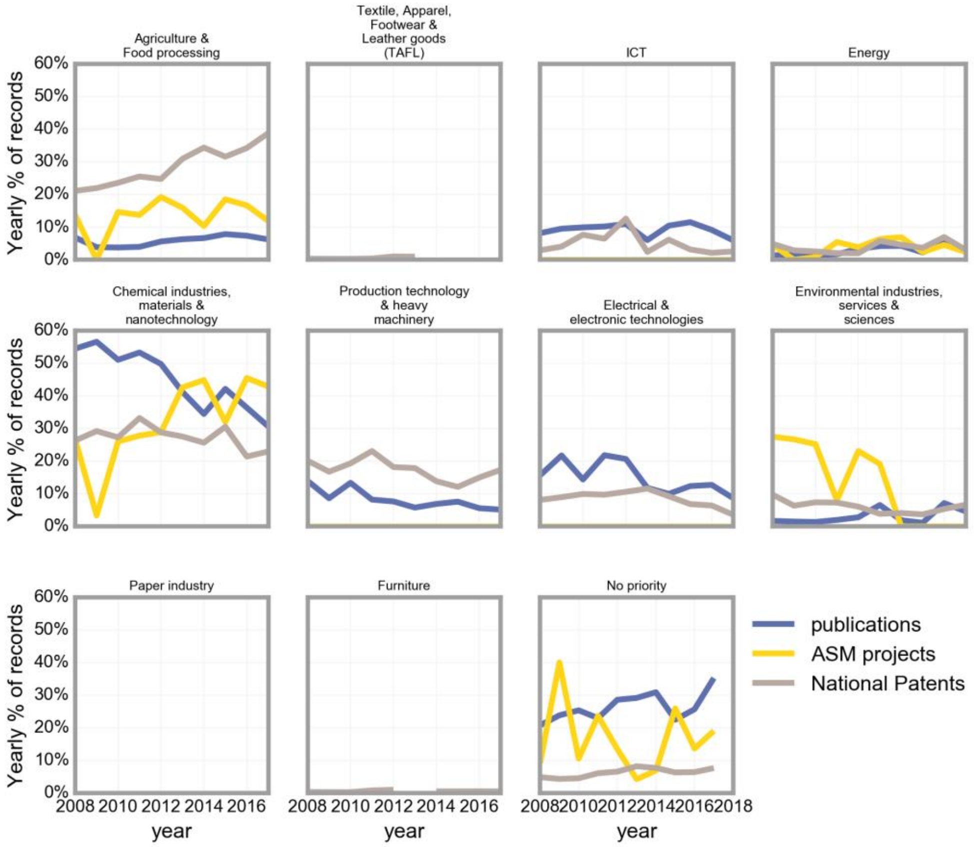
[6] The Strategic direction related to "Environmental industries, services and sciences" disappeared in 2013 and its activities cannot be tracked separately afterwards.



Yearly distribution of documents per preliminary priority divided by source

The most notable changes are:

- A steady rise in the share of patenting activity in “Agriculture and food processing”.
- The rise in publications in “Health, biomedicine and pharmaceuticals”.
- A significant rise in ASM projects in “Chemical industries, materials and nanotechnology” not (yet?) resulting in a rise in publications, which are in fact decreasing.
- A modest decrease in the importance of publications and patents in "Production technology and heavy machinery” and “Electric and electronic technologies”.
- A moderate rise in the number of publications not classified in any preliminary priority.

3.3. Characterisation of the preliminary priority areas through emergent topics

Traditional **classification systems, and the S3 preliminary priority labels, are insufficient** to obtain an expressive description of the actual content of the science and innovation activities and results they include. **To improve the grasp on the preliminary S3 priorities, all the records classified under each preliminary**

priority have been integrated, and, for those with abstracts or descriptions in English (Publications: Title, abstract, keywords; European projects: Title, keywords, description, Patents: Summary) **topics have been extracted** with a semi-automatic text mining algorithm, Latent-Dirichlet Allocation. This algorithm returns a collection of topics that emerge from the textual content of the analysed documents. The topics are, in practice, a collection of keywords that tend to appear together in different documents.

Unfortunately, not all priorities contain enough records in the data sources to provide reliable topic statistics; **a semantic description of the content of the priorities is only provided for**:

- Agriculture and Food processing
- ICT
- Energy
- Health, biomedicine and pharmaceuticals
- Chemical industries, materials and nanotechnology
- Production technology and heavy machinery
- Electric and electronic technologies
- Environmental industries, services and sciences

Each topic is represented by its top keywords. Also, the sources (publications, patents, projects) contributing the most to each topic are identified.

Generally, the thematic and semantic[7] difference between the data sources is represented in the **topics**, which generally have an over-representation of one of the sources, that is, **they are either publication-intense (science oriented) or patent-intense (technological innovation oriented)**. European projects are weakly-represented in the topics, due to their relative lower number; certainly the incorporation of the translated text corpus of national RDI projects to this exercise would be extremely fruitful.

As an example, the following chart presents the topics extracted from the records classified under the "Health, biomedicine and pharmaceuticals" preliminary priority:

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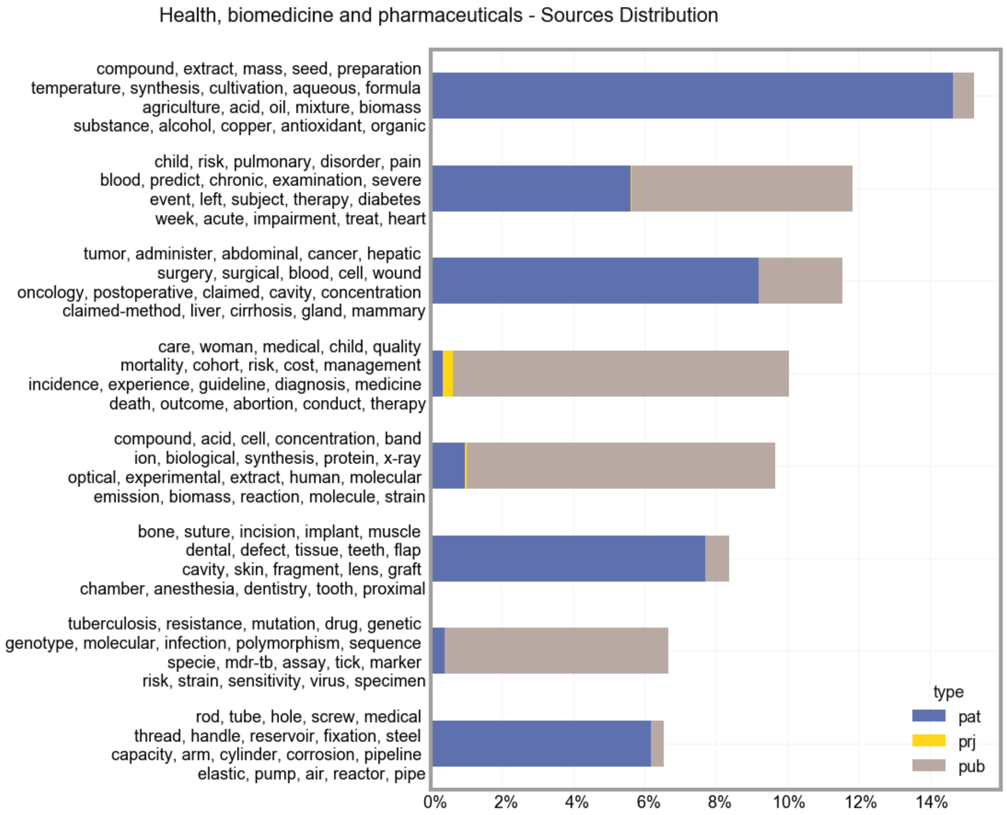
[7] Patents and European projects, specially, contain a large proportion of "domain-jargon" words. Several content-light words have been black-listed (such as geometric terms, very frequent in patents), but it is expectable that the topics do express a certain compartmentalisation which does exist in reality.



Example of topics extracted within the documents related to a preliminary priority, ranked by their relative presence. The different colors represent the distribution by source (patents, projects publications) of the keywords, through the texts most related to each topic.

Agriculture and food processing

Agriculture and food processing is a technological-innovation-oriented area, featuring an important contribution from patents but also significant publication records. It must be noted that the share of patents, witnessing technological innovation, is growing.

Six of the topics are patent intensive, focusing on **farming, food processing, alcohol production and food industry machinery**. Two of the topics are publication intense, focusing on **biotechnology and genetics**. European projects are mostly connected to the latter field.

ICT

ICT is a slightly science-oriented area, with a moderately higher contribution from publications than patents.

Three topics within the domain are patent intensive, related to the development of **mobile devices and applications, super/semi conductive materials and circuitry**. European projects are mainly devoted to building **e-infrastructure** for research and innovation activities. Publication-intensive topics are instead more focused on **frequency modulators and switches, photonics (both at the theoretical and experimental level), algorithmic complexity and parallel computing**. The implementation of e-infrastructures topic, already highlighted in the case of European projects, also features noticeable contribution from publications.

Energy

The emergent topics found for the Energy preliminary priority are almost fully aligned with either publications or patents, albeit the overall contribution from those datasets is almost equivalent, with roughly four topics per source.

The four patent-intense topics focus on **electrotechnical equipment, biofuels, electricity generation and electronics**. The four publication-intense topics are focusing on **quantum- and nano- technology, spectrometry, biomass-based energy production and electric motors.**

Health, biomedicine and pharmaceuticals

Health, biomedicine and pharmaceuticals is a balanced preliminary priority, with a similar contribution from publications and patents.

Four of the topics are patent-intense, focusing on **pharmaceutical products and processes, postoperative medical treatments, surgery, prosthetics and hospital equipment.** Three of the topics are publication-intense, focusing on **health policy and quality, biotechnology and pathology.** One topic mixes publications and patents almost perfectly, focusing on **pathology and medical treatments**.

Chemical industries, materials and nanotechnology

Chemical industries, materials and nanotechnology is a moderately science-oriented preliminary priority.

One of the topics is patent-intense, focusing on the development of **equipment for the process industries and on batteries.** Four of the topics are publication-intense, focusing on **semiconductors, surface chemistry, nanotechnology and advanced materials,** respectively.

Production technology and heavy machinery
Production technology and heavy machinery is a slightly technological-innovation-oriented topic. Three of the topics are patent-intense, focusing on **industrial and hydraulic equipment, heat exchangers and electrotechnical and power station equipment, process industries equipment and advanced manufacturing processes**. One topic is publication-intense, focusing on **advanced materials and manufacturing processes**.

Electrical and electronic technologies
Electrical and electronic technologies is a slightly science-oriented topic. Two of the topics are patent-intense, focusing on **devices for solar energy production and storage** and on **instrumentation for signal amplification and conversion**, respectively. Four topics are publication-intense, focusing on **nanoparticles manipulation and deposition**, **electronic circuitry**, **advanced optics** and **voltage regulation**, respectively.

Environmental industries, services and sciences
Environmental industries, services and sciences is a slightly technological-innovation-oriented topic. Two of the topics are patent-intense, focusing on **equipment for process bioindustries (including bioreactors), water provision and treatment, processes and technologies for the food industry** (especially wine industry). The last topic also witnesses a relevant contribution of scientific publications**.** Two topics are publication-intense, focusing on **biotechnology, bioprocesses and on environmental protection and policy** (with a relevant contribution from EU projects)**.**

3.4. Regional distribution of science and innovation activities

As explained before, Moldovan **research and innovation activities are strongly centralised** in the capital region, **Chisinau**, where all sectors and disciplines are well represented.

The **most concentrated priorities** are “Chemical industries, materials and nanotechnology”, “Electrical and electronic technologies” and “Environmental industries, services and sciences”.

On the contrary, the **most deconcentrated priorities** are “Health, biomedicine and pharmaceuticals”, “Production technology and heavy machinery”, “Vulcanized and fired materials”.

Although the low number of records outside Chisinau makes it difficult to gather any conclusion, the list below presents the modest insights from the regional distribution of activities:

- In **Centru**, the most significant contributions are from “Agriculture and food processing” and “Health, biomedicine and pharmaceuticals”
- In **Nord**, the most significant contributions are from “Environmental industries, services and sciences”, “Agriculture and Food processing” and “Energy”
- In **Sud**, the number of records is specially small.
- In **Gaugazia**, the most significant contributions are from “Chemical industries, materials and nanotechnology” and “Electrical and electronic technologies”

4. Identification of emergent topics

4.1. Introduction

Following the second approach (see schema in section 2.3.2 of the document), here, specialisation topics are automatically extracted from the text fields of the records describing science and innovation activities and results, with no grounding on the priorities identified in the Expert report.

It is an automatic identification (although manually curated in an iterative improvement process) of emerging topics extracted from the titles, abstracts, project objectives, keywords, etc., which returns, as output, an ordered list of words, most related to each topic. Each publication, project and patent is linked with a certain weight to any given topic, in a continuous space, so there's no categorical classification: a publication can strongly belong to several topics, and weakly to others. All words in the text corpus belong to several topics, with different strengths (from a negligible to strong relationship).

These elements provides significant advantages, to list a few:

- The topics emerge from and are characterised with the language actually used by specialists, not on external classifications systems managed by third parties.
- It allows for the identification of transversal concepts which contribute to several topics.
- It accepts polysemy, as in "solar cell" vs. "tumoral cell", where words have a different meaning in unrelated topics.
- All topics are related to each other with diverse strengths, allowing for partial overlapping, vertical and horizontal relationships as well as the existence of core or fundamental topics.

More importantly, by the aggregation of text corpus perimeters, it is possible to compute the topic distribution of priorities, institutions, individuals and regions; for instance, the topic distribution of all the publications by authors from an institution as affiliation.

Three sources of texts have been used: publications, patents and European projects.[8]. Specifically, the body of text is composed of:

- Publications: Title and abstract
- European projects: Title and objective
- Patents: Invention title and description

4.1.1. Identified emergent topics

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[8] Unfortunately, the Academy of Science projects do not have titles or descriptions in English and have not been incorporated to the analysis.

After several iterations of natural language preprocessing and manual curation, it was found that the optimal number of topics best describing the heterogeneity of the body of texts is 15.

The table below presents the result of the application of the LDA algorithm to the corpus,, where each topic is expressed as the ordered list of most relevant words (top 20) in the topic. Each topic is present in the total body of text with a certain distribution, presented as a percentage in the second column. The topics are ordered according to this distribution, from highest to lowest presence in the corpus.

topic top 20 words	distribution
population specie health genetic quality water identify site potential source care economic human management represent individual reveal public local river	9%
shaft rod hole blade axis frame electric rotor gear bar disk wheel screw building fixation drive motor turbine wind tool	9%
film zno layer surface gas sensor oxide substrate device thin semiconductor nanoparticles deposition response electron x-ray diffraction microscopy optical deposit	9%
quantum spin electron atom exchange magnetization ion wave photon resonance coupling dependence superconducting ground behavior cluster ferromagnetic susceptibility cavity equation	8%
band optical absorption film glass emission light raman photoluminescence luminescence dependence wavelength intensity laser amorphous thin concentration spectral impurity experimental	7%
metal surface compound coating alloy concentration electrolyte hydrogen cell electrochemical steel water layer iron acid corrosion electrode copper ion carbon	7%
wine temperature mass mixture dry product food oil acid extract preparation waste grape alcohol fermentation separation mix vegetable substance food-industry	7%
input converter power signal measure electrode voltage amplifier source impedance terminal contact electric wire circuit generator measurement pulse supply metal	6%
pipe chamber heat liquid air valve pump gas outlet capacity tube inlet supply engine channel discharge cylinder reservoir hole electric	6%
agriculture seed cultivation soil strain plant biotechnology acid fruit nutrient extract biomass feed concentration aqueous root grow bee tree preparation	6%
atom ligand molecule x-ray ion copper reaction metal anion bond synthesize acid cation hydrogen diffraction characterize pwm spectroscopy voltage water	6%
invariant equation finite space algorithm polynomial network prove differential singularity relation configuration periodic real membrane quadratic computational define solve language	5%
patient disease treatment clinical risk child drug age associate diagnosis tuberculosis blood resistance woman mutation therapy assess predict mortality disorder	5%
conductivity thermal wire dependence phonon heat electron graphene thermoelectric surface boundary nanowires transport carrier green concentration quantum formula experimental mobility	5%
bone implant suture tissue treat incision muscle cavity dental wound administer patient surgical tube surgery skin defect claimed anesthesia teeth	4%

List of keywords per extracted topic, ranked by its distribution through the texts

After a manual inspection of the top words per topic, and taking into account the participation of the different sources and original taxonomy's in the topics, a **temptative and certainly partial labelling of these topics** can be found in the table below.

temptative label	topic top 20 words
Transversal, related to diverse public policies	population specie health genetic quality water identify site potential source care economic human management represent individual reveal public local river
Mechanical systems	shaft rod hole blade axis frame electric rotor gear bar disk wheel screw building fixation drive motor turbine wind tool
Surfaces and nanofabrication	film zno layer surface gas sensor oxide substrate device thin semiconductor nanoparticles deposition response electron x-ray diffraction microscopy optical deposit
Quantum and photonics I	quantum spin electron atom exchange magnetization ion wave photon resonance coupling dependence superconducting ground behavior cluster ferromagnetic susceptibility cavity equation
Quantum and photonics II	band optical absorption film glass emission light raman photoluminescence luminescence dependence wavelength intensity laser amorphous thin concentration spectral impurity experimental
New manufacturing processes	metal surface compound coating alloy concentration electrolyte hydrogen cell electrochemical steel water layer iron acid corrosion electrode copper ion carbon
Alcohol and food processing	wine temperature mass mixture dry product food oil acid extract preparation waste grape alcohol fermentation separation mix vegetable substance food-industry
Electrical and electronic equipment	input converter power signal measure electrode voltage amplifier source impedance terminal contact electric wire circuit generator measurement pulse supply metal
Equipment for process industries	pipe chamber heat liquid air valve pump gas outlet capacity tube inlet supply engine channel discharge cylinder reservoir hole electric
Agriculture and biotechnology	agriculture seed cultivation soil strain plant biotechnology acid fruit nutrient extract biomass feed concentration aqueous root grow bee tree preparation
Materials science	atom ligand molecule x-ray ion copper reaction metal anion bond synthesize acid cation hydrogen diffraction characterize pwm spectroscopy voltage water
Formal sciences (including computer science)	invariant equation finite space algorithm polynomial network prove differential singularity relation configuration periodic real membrane quadratic computational define solve language
Medicine and pharmacology	patient disease treatment clinical risk child drug age associate diagnosis tuberculosis blood resistance woman mutation therapy assess predict mortality disorder
Advanced materials	conductivity thermal wire dependence phonon heat electron graphene thermoelectric surface boundary nanowires transport carrier green concentration quantum formula experimental mobility

Prosthetics and medical devices	bone implant suture tissue treat incision muscle cavity dental wound administer patient surgical tube surgery skin defect claimed anesthesia teeth

Some of this topics are quite similar, and respond to domain-specific nuances and segmentations that **could be abstracted at the policy level.** For instance, the "Advanced materials" and the "Materials science" topics, originated mainly from scientific publications, could be merged. The same for "Quantum + photonics" I and II. On the contrary, within the medical and healthcare domain, the division between the topic related to "Medicine and pharmacology" and the topic related to "Prosthetics and medical devices" is expressive and highly valuable.

4.2. Clustering the topics: from science to technological innovation

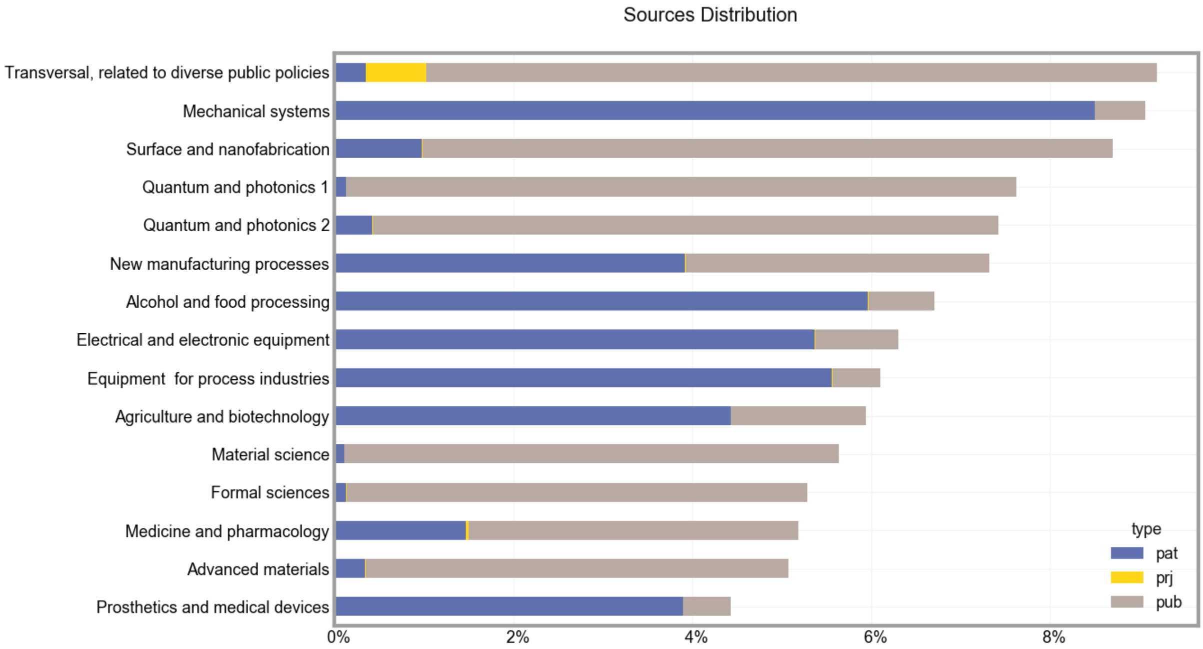
To better grasp the nature of the automatically extracted topics, the following barchart presents the distribution of sources producing each topic.

Generally, the thematic and semantic[9] difference between the data sources is represented in the topics, which generally have an over-representation of one of the sources, that is, they are either publication-intense or patent-intense.

European projects are weakly-represented in the topics due to their relative lower number; certainly the incorporation of the translated text corpus of national RDI projects to this exercise would be extremely fruitful.

---

[9] Patents and European projects, specially, contain a large proportion of "domain-jargon" words. Several content-light words have been black-listed (such as geometric terms, very frequent in patents), but it is expectable that the topics do express a certain compartmentalisation which does exist in reality.



Distribution of sources through the emergent topics. The different colors represent the distribution by source (patents, projects publications) of the keywords, through the texts most related to each topic.

Summarising these patterns, it is possible to cluster the topics as follows:

- **Balanced topics** (science + technological innovation)
  - New manufacturing processes
  - Agriculture and biotechnology
  - Medicine and pharmacology
- **Publication-intense topics** (science oriented):
  - Transversal, related to diverse public policies
  - Surfaces and nanofabrication
  - Quantum and photonics I
  - Quantum and photonics II
  - Materials science
  - Formal sciences
  - Advanced materials
- **Patent-intense topic** (technological innovation oriented)
  - Mechanical systems
  - Alcohol and food processing
  - Electrical and electronic equipment
  - Equipment for process industries
  - Prosthetics and medical devices

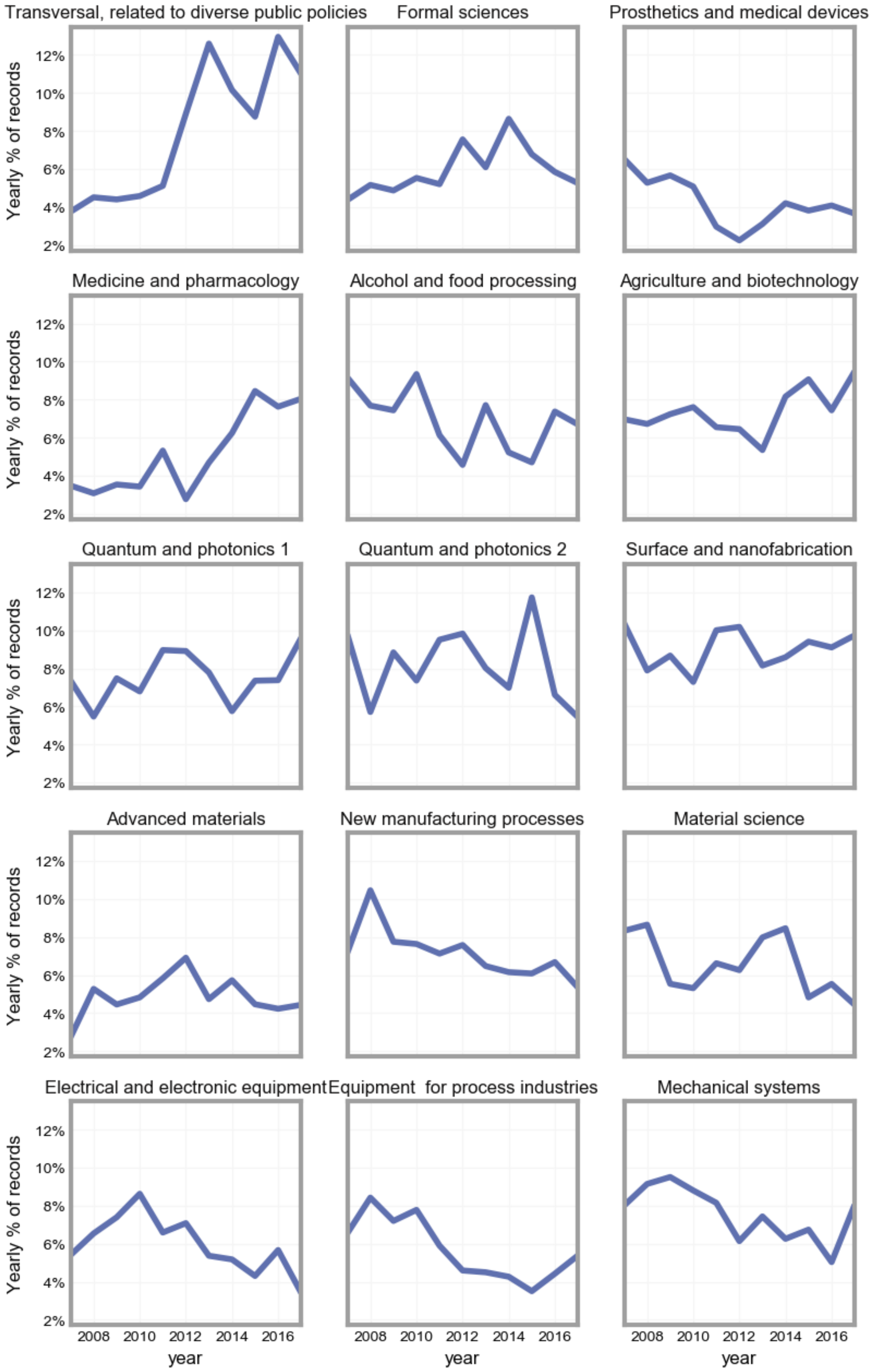
These three clusters of topics could lead to **a differentiated menu of public policies**, with different blends of push, pull, capacity-building, ecosystem-building, advanced education, vocational training, internationalisation, etc. instruments.

The **three Balanced topics** (New manufacturing processes, Agriculture and biotechnology, Medicine and pharmacology) present the richest ecosystem, with a significant contribution of scientific research and technological innovation. These domains could be **a fertile environment for the Entrepreneurial Discovery Process**.

Nevertheless, it must be observed that almost all topics have a non-negligible contribution of both main sources (publications and patents), showing a certain overlap between academic and entrepreneurial or technological innovation activities.

4.3. Temporal evolution of the topics

The following line charts present the change in the presence of topics over time, on the same scale, for the 2007-2017 period.



Yearly distribution of the presence of the topics in the whole body of texts

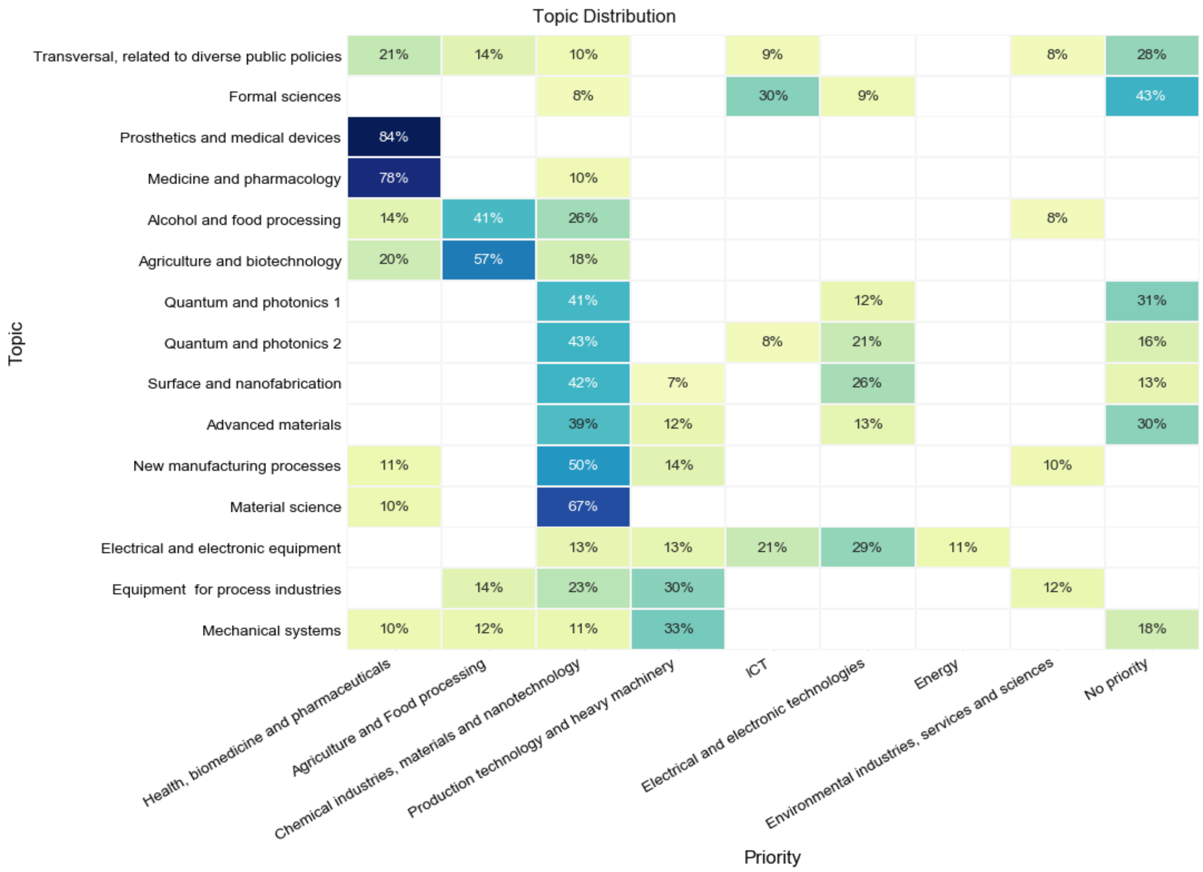
- **Growing topics**
    - Transversal, related to diverse public policies
    - Medicine and pharmacology
    - Agriculture and biotechnology
- **Stable topics**
    - Quantum and photonics I and II
    - Surface and nanofabrication
    - New manufacturing processes
    - Advanced materials
    - Mechanical systems
    - Formal sciences
- **Decreasing topics**
    - Prosthetics and medical devices
    - Electrical and electronic equipment
    - Alcohol and food processing
    - Materials science
    - Equipment for process industries

This evolution is just a rough indication of the health of the topics in the analysed data sources. To have a reliable grasp on the actual evolution of such topics, it would be necessary to include quantitative economic analysis, additional data sources (to control for biases in the current ones) and, most importantly, **expert knowledge** from the science and the industrial sectors.

4.4. Alignment between the emergent topics and the preliminary S3 priorities

An alignment matrix between the emergent topics and the preliminary S3 priorities has been constructed, based on the frequency and strength of a given record belonging to a taxon of both taxonomies.

The matrix provides insights on thematic overlaps, verticality and transversality of the topics and the S3 priorities. Rows add up to 100%, Cells with values below 7% have been hidden for readability.



Topic	Health, biomedicine and pharmaceuticals	Agriculture and Food processing	Chemical industries, materials and nanotechnology	Production technology and heavy machinery	ICT	Electrical and electronic technologies	Energy	Environmental industries, services and sciences	No priority
Transversal, related to diverse public policies	21%	14%	10%		9%			8%	28%
Formal sciences			8%		30%	9%			43%
Prosthetics and medical devices	84%								
Medicine and pharmacology	78%		10%						
Alcohol and food processing	14%	41%	26%					8%	
Agriculture and biotechnology	20%	57%	18%						
Quantum and photonics 1			41%			12%			31%
Quantum and photonics 2			43%		8%	21%			16%
Surface and nanofabrication			42%	7%		26%			13%
Advanced materials			39%	12%		13%			30%
New manufacturing processes	11%		50%	14%				10%	
Material science	10%		67%						
Electrical and electronic equipment			13%	13%	21%	29%	11%		
Equipment for process industries		14%	23%	30%				12%	
Mechanical systems	10%	12%	11%	33%					18%

Alignment between Emergent Topics and preliminary Priorities. Each percentage represents the mean of the distribution of the topic through the documents associated to the specific preliminary priority

Agriculture and Food processing is a quite compact preliminary S3 priority, composed by two topics:

- Agriculture and biotechnology
- Alcohol and food processing, which is a specification of the above

ICT is composed of two main disciplinary hearts:

- Formal sciences (mathematics, computer science, modelisation)
- Electrical and electronic equipment

Energy is connected to the research in the topic "Electrical and electronic equipment.

Health, biomedicine and pharmaceuticals S3 preliminary priority has two complementary core topics, and the smaller contribution of two topics at the margins:

- Medicine and pharmacology
- Prosthetics and medical devices
- Transversal, related to diverse public policies
- Agriculture and biotechnology

Chemical industries, materials and nanotechnology, is, by far, the most diverse and transversal preliminary priority covering science, technology and innovation and being applied in:

- The natural sciences topics:
  - Quantum and photonics I and II
  - Materials science
- The advanced engineering topics:
  - New manufacturing processes
  - Surfaces and nanofabrication
  - Advanced materials
  - Electrical and electronic equipment
- The industrial topics:
  - Mechanical systems
  - Equipment for process industries
- Agriculture and food processing:
  - Alcohol and food processing
  - Agriculture and biotechnology

The **Electrical and electronic technologies** S3 preliminary priority is publication-intense, with weak presence of patents. It is formed mainly by the following topics:

- Quantum and photonics II
- Electrical and electronic equipment
- Surfaces and nanofabrication

The **Production technology and heavy machinery** preliminary priority has topics with a vertical and a transversal role:

- Equipment for process industries, such as water, gas or chemical
- Mechanical systems, transversally for all industrial technologies (as a common language in patents)

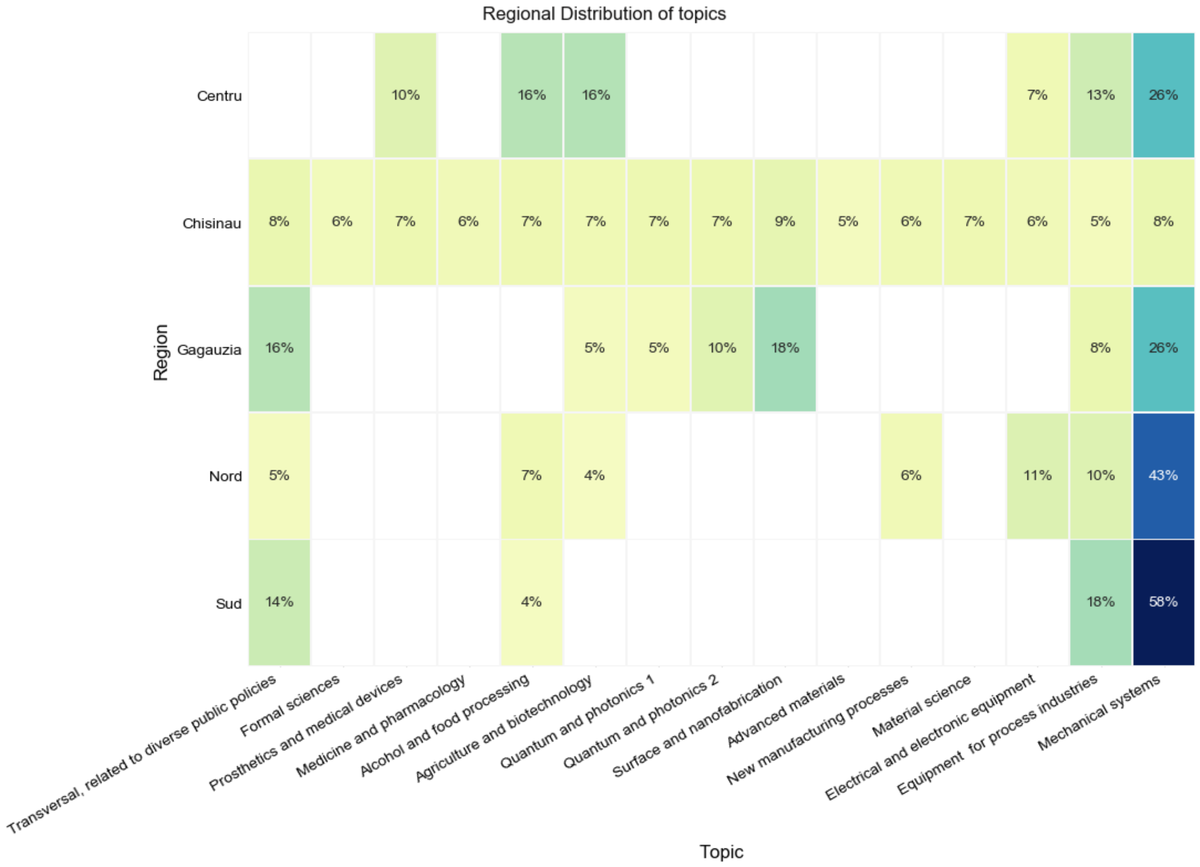
Environmental industries, services and sciences presents a distributed alignment pattern, with relevant connections to the following topics:

- Transversal, related to diverse public policies
- New manufacturing processes
- Alcohol and food processing
- Equipment for process industries

4.5. Regional distribution of the topics

It must be noted again that the number of records from Moldovan regions, outside the capital, is very low. Scientific publications are especially concentrated in Chisinau, while the patents are a bit more distributed. Just a few records can dramatically change the profile of a region. To have a reliable grasp on the actual distribution of such topics, it would be necessary to include quantitative economic analysis, additional data sources (to control for biases in the current ones) and, most importantly, expert knowledge from the science and the industrial sectors.

The following table presents the distribution of the topics in each region. It has to be read in horizontal: the cells in a row add up to 100 (although the lowest values, under 3%, are hidden to improve readability).



Regional distribution of the topics. Each cell represents the weighted presence of each topic in the documents belonging to each region.

Evidently, Chisinau internal topic specialisation is very distributed, since it conforms almost the whole corpus.

Some can be said about the distribution of topics in the nation:

- "Mechanical systems", the topic most connected to patents, is the most important in all non-capital regions. This is due to the decentralisation of patent applicants and inventors.
- Similarly, "Equipment for process industries", "Agriculture and biotechnology" and "Alcohol and food processing", also patent-intense topics, are present in several regions, witnessing the industrial and sectorial decentralisation.
- The "transversal topic, related to diverse public policies", is important in Gaugazia, Nord and Sud.

- Due to the centralisation of the academic and scientific sector in Chisinau, publication-intense topics are almost non-existent in the rest of regions.

6. Key actors and collaboration analysis

This chapter presents the main actors and partnerships identified in the data sources. This information is just a selection and summary of larger datasets made available in the other two project deliverables. In the interactive tool, Moldovan organisations and their collaboration networks can be explored by preliminary priority area and by region.

6.1. Key actors and collaborations at the national level

6.1.1. Top Moldovan actors

The actors most present in the data sources are:

- **Chisinau**
    - *[National organisation]* Academy of Sciences of Moldova (institutional and profile members)
        - Centre of International Projects - Academy of Sciences of Moldova
    - Nicolae Testemiţanu State University of Medicine and Pharmacy
    - Technical University of Moldova
    - Research and Educational Networking Association of Moldova (RENAM)
    - SHS Serviciul Hidrometeorologic de Stat
    - Agricultural State University of Moldova
    - Moldova State University
    - Research Institute for Viticulture and Oenology
    - Centre of Reproductive Health and Medical Genetics
    - IMSP Institute for Emergency Medicine
    - Ion Creangă Pedagogical State University
    - Srl Polivalent-95 Ecosorbent Limited Liability Company
    - Societatea Pentru Metodologia Sondajelor
    - *[National agency]* Agentia Pentru Inovare Si Transfer Tehnologic
- **Centru**
    - ASM profile member - Scientific and Practical Institute of Biotechnologies in Zootechnics and Veterinary Medicine
    - QUEST SRL
    - Vc-Saturn-13 Srl
    - Senipal-V Srl
- **Nord**
    - Alecu Russo State University of Bălţi
    - ASM profile member - Research Institute for Field Crops "Selection"
    - Balti Municipal Hospital
    - Südzucker-Moldova SA
    - Research Institute RIF-ACVAAPARAT Beltsy

    - Institute of Plant Industry „Porumbeni”
    - Moldagrotehnica SA
    - Pantehno-Nord SRL
    - Impexinvesteh. Co Srl
- **Gaugazia**
    - Comrat State University
    - Tomai-Vinex SA
    - Goliat-Vita SRL
    - Vitapharm-Com Srl
- **Sud**
    - Taraclia State University
    - Bogdan Petriceicu Hasdeu State University
    - Cantemir Regional Hospital

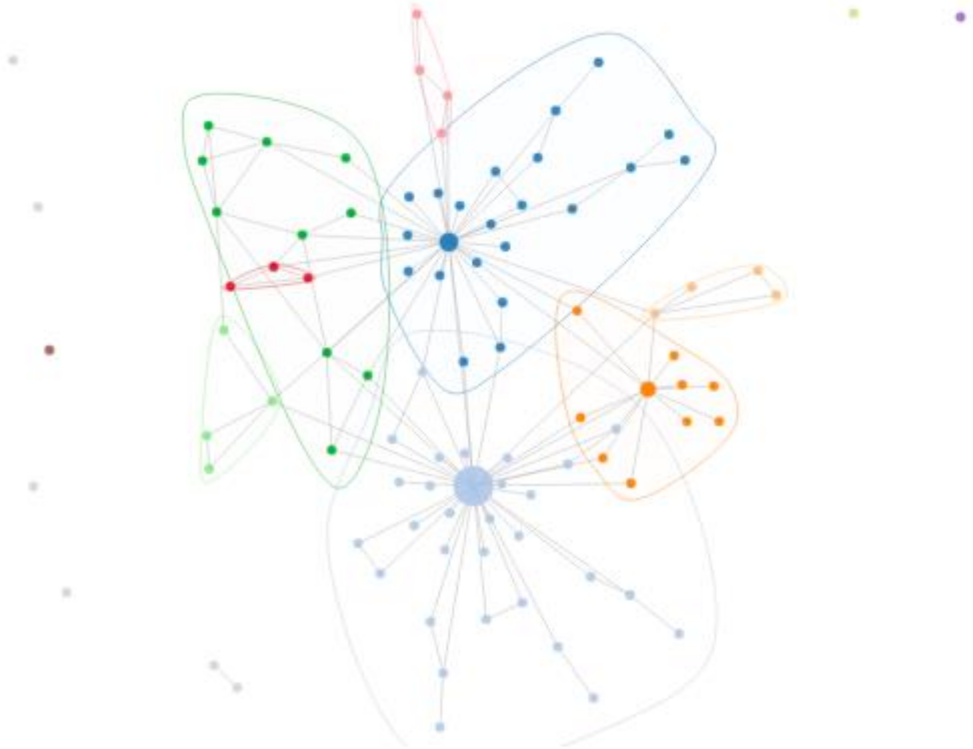
To explore the key actors per preliminary priority and regions, please visit the interactive tool.

6.1.2. National collaboration networks

Co-authorship in scientific publications

Science and innovation actors collaborate in a diversity of formal and informal ways. Some of these collaborations are registered in the data sources, in particular: co-authorship networks, project consortia and patenting co-applications and co-inventions.

The interactive tool visualises these collaboration networks, per region and per preliminary priority. As a relevant example, the image below depicts the national co-authorship network, where the nodes are institutional affiliations and the edges are co-authorship links.



Moldovan co-authorship network
Data source: Scopus (Elsevier). Elaboration: SIRIS Academic

In the previous network, collaboration communities have been automatically identified:

- The largest network, in light blue, is centered around the Moldovan Academy of Sciences and is **pluridisciplinary**.
- The network in dark blue is centered around Nicolae Testemiţanu State University of Medicine and Pharmacy and formed by health research institutes and hospitals, **focusing on Health, biomedicine and pharmaceuticals**.
- The green network is multipolar, formed by ministries and public agencies related to **health policies, safety and the environment**.
- The orange network is centered around the Technical University of Moldova and focused on **engineering and the natural sciences.**
- The smaller networks are generally focused on **Health, biomedicine and pharmaceuticals.**

The **most heterogeneous communities appear in Health, biomedicine and pharmaceuticals**, where a diversity of research and academic institutions collaborate with hospitals and other institutions.

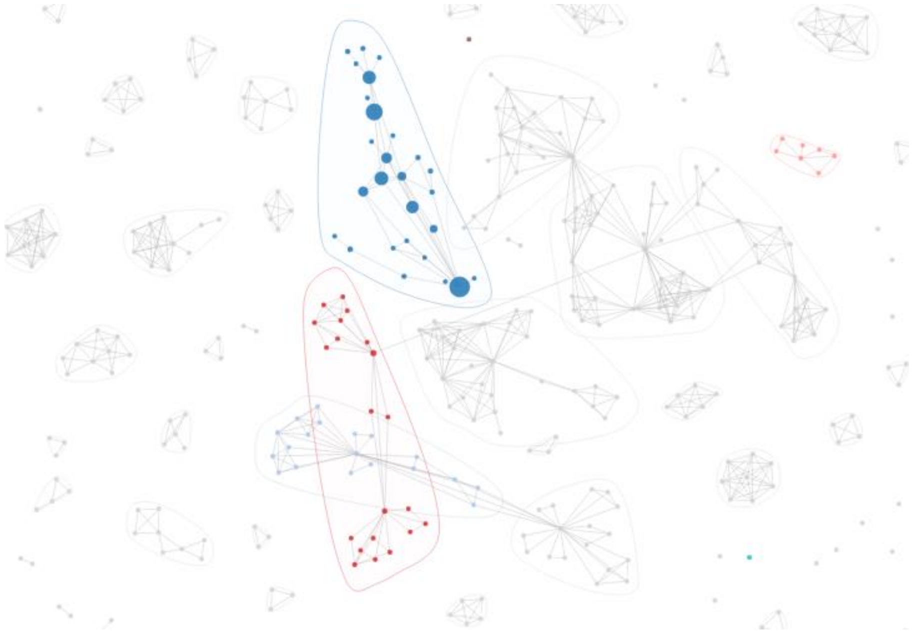
The **rest of the the preliminary priority networks are less rich, centered around the ASM and the main universities.**

Collaboration in competitive projects

Not much information about collaboration can be extracted from competitive projects. The number of EU Projects is too small, and **ASM projects are for the largest part not collaborative.**

Collaboration in patenting activities

Finally, the image below presents the **collaboration network in patent applications**



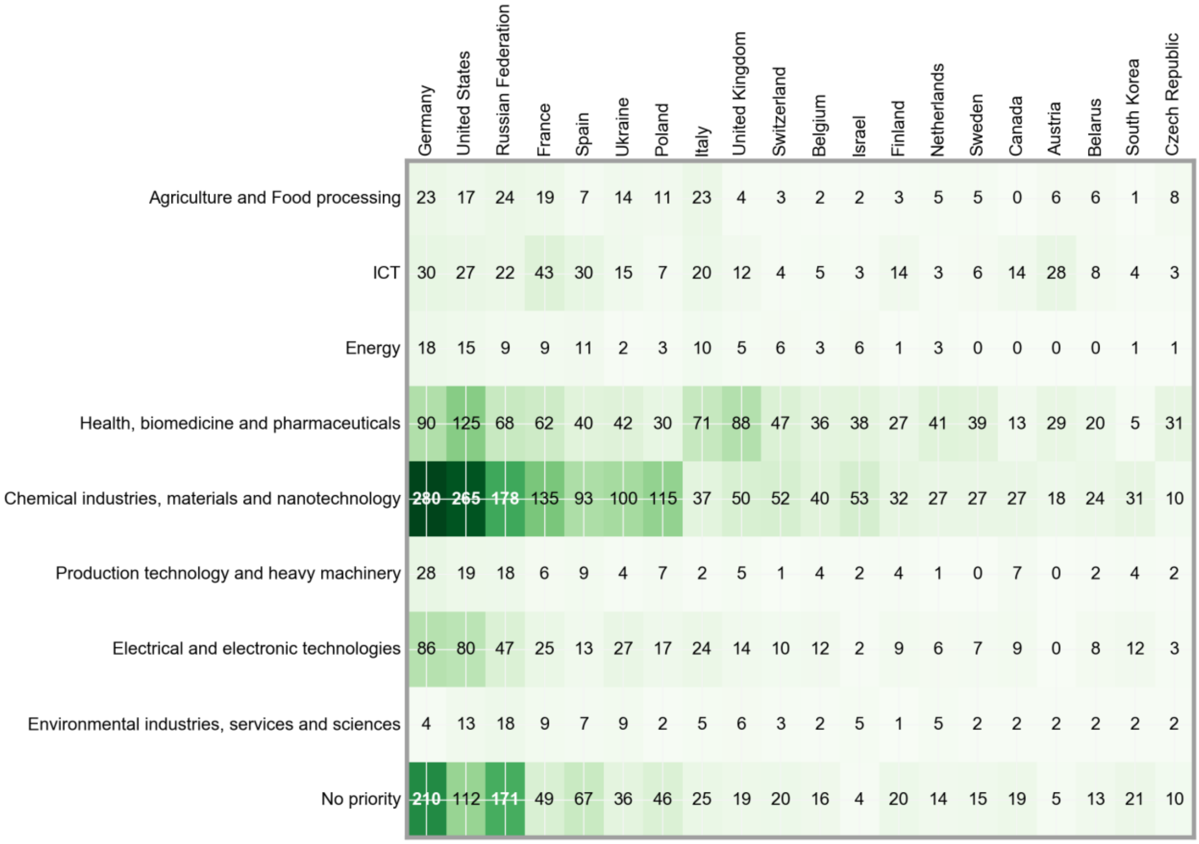
Moldovan co-patenting network
Data source: AGEPI. Elaboration: SIRIS Academic

The blue network with large nodes is formed by academic institutions: ASM institutes and the main universities. The rest of the network, rather disconnected, is formed by individual applicants.

6.2. Key foreign actors and international collaboration

International partnerships are crucial to support excellence in research and internationalisation in the business sector. In the data sources, international collaboration is represented by the publication of scientific papers in co-authorship with foreign affiliated researchers and in EU project consortia.

The following table presents the most frequent co-authorship relationships by country and by preliminary S3 priority.



	Germany	United States	Russian Federation	France	Spain	Ukraine	Poland	Italy	United Kingdom	Switzerland	Belgium	Israel	Finland	Netherlands	Sweden	Canada	Austria	Belarus	South Korea	Czech Republic
Agriculture and Food processing	23	17	24	19	7	14	11	23	4	3	2	2	3	5	5	0	6	6	1	8
ICT	30	27	22	43	30	15	7	20	12	4	5	3	14	3	6	14	28	8	4	3
Energy	18	15	9	9	11	2	3	10	5	6	3	6	1	3	0	0	0	0	1	1
Health, biomedicine and pharmaceuticals	90	125	68	62	40	42	30	71	88	47	36	38	27	41	39	13	29	20	5	31
Chemical industries, materials and nanotechnology	280	265	178	135	93	100	115	37	50	52	40	53	32	27	27	27	18	24	31	10
Production technology and heavy machinery	28	19	18	6	9	4	7	2	5	1	4	2	4	1	0	7	0	2	4	2
Electrical and electronic technologies	86	80	47	25	13	27	17	24	14	10	12	2	9	6	7	9	0	8	12	3
Environmental industries, services and sciences	4	13	18	9	7	9	2	5	6	3	2	5	1	5	2	2	2	2	2	2
No priority	210	112	171	49	67	36	46	25	19	20	16	4	20	14	15	19	5	13	21	10

International co-authorship network
Data source: Scopus (Elsevier). Elaboration: SIRIS Academic

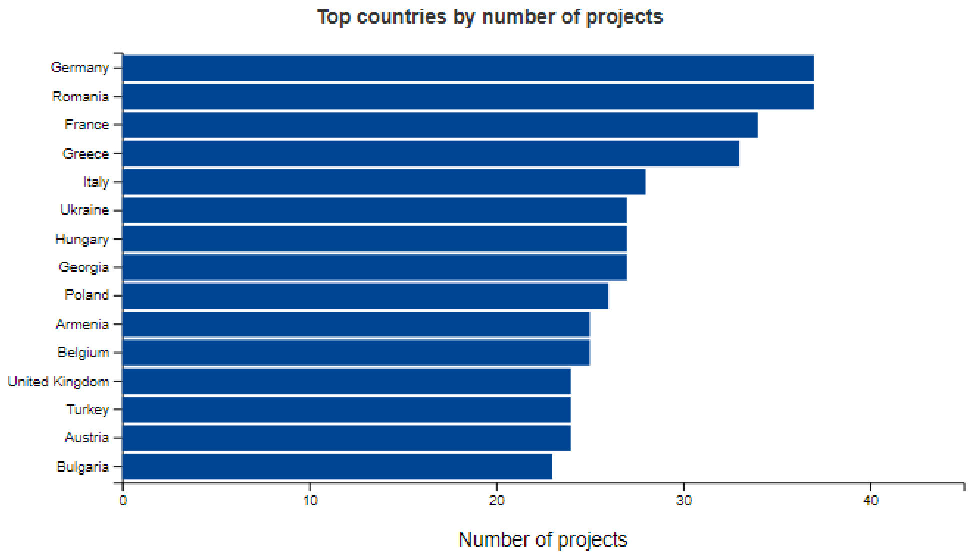
Germany, the United States and Russia are the top international partners of Moldovan research, followed by France, Spain, Poland, Ukraine, Italy and the United Kingdom.

Most international collaborations belong to the "Chemical industries, materials and nanotechnology" and "Health, biomedicine and pharmaceuticals". Beyond these two priorities, some bilateral relationship patterns emerge:

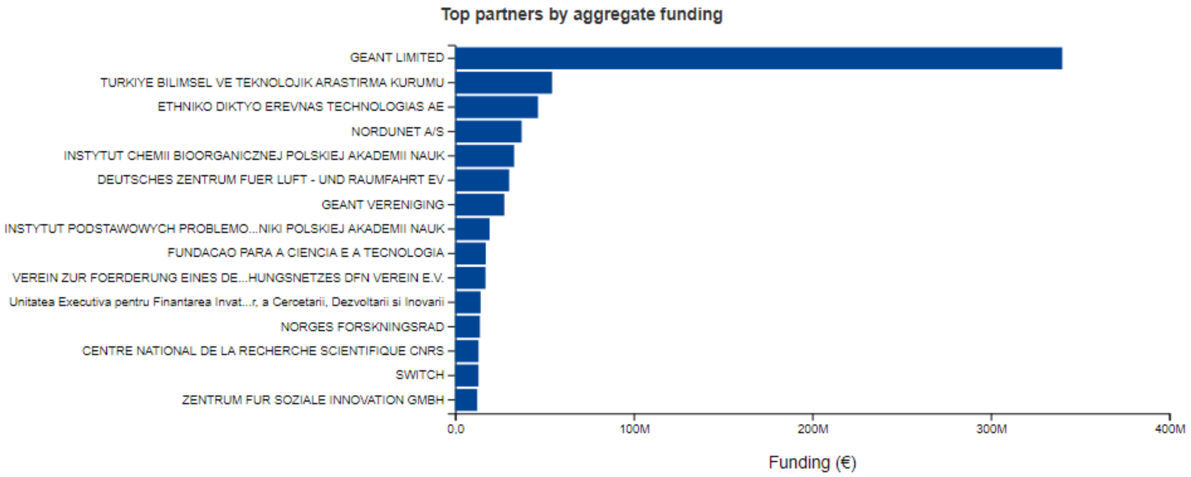
- Agriculture and food processing: Germany, Italy, Russia, France.
- ICT: France, Austria, Spain, Germany, Romania, Italy.
- Energy: Germany and USA.
- Health, biomedicine and pharmaceuticals: United States, United Kingdom, Germany
- Chemical industries, materials and nanotechnology: Germany, the United States and Russia.
- Production technology and heavy machinery: Germany, the United States and Russia
- Electric and electronic technologies: Germany, the United States and Russia
- Environmental industries, services and sciences: diverse pattern lead by Russia.

As can be observed, **collaboration in engineering and the natural sciences is lead by authors in Germany, the United States and Russia, while in the rest of sectors and applications there is a more diverse pattern of collaboration, mainly with European countries.**

In terms of international consortia, **the top partner countries of Moldova in EU projects are:**



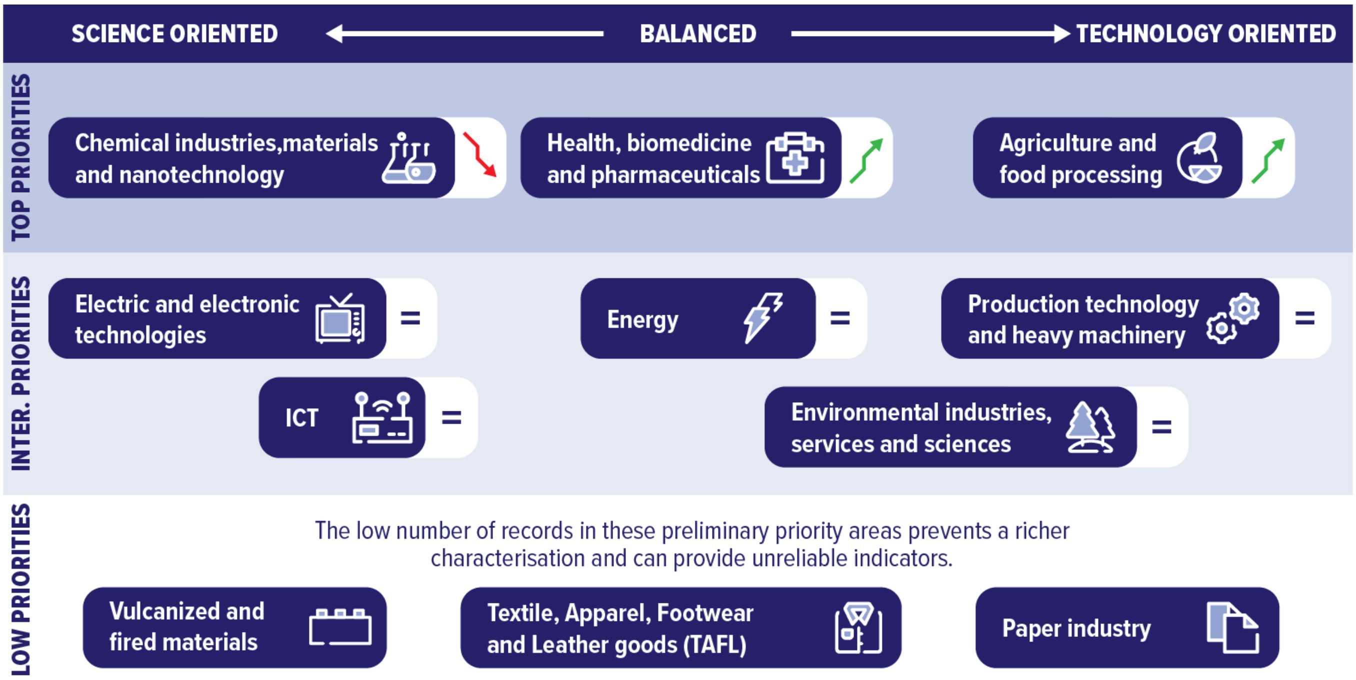
And **the institutions with higher stakes in EU projects with a Moldovan partner are:**



7. Conclusions and recommendations

7.1. Priority-setting

1. **Preliminary priority domains have been adapted and extended from the previous Expert report**. These preliminary priority areas have been aligned to the original data sources' classification systems to affect each record to one or several priorities. As a result, **preliminary priorities can be characterised as follows**:


SCIENCE ORIENTED
BALANCED
TECHNOLOGY ORIENTED
TOP PRIORITIES
Chemical industries,materials and nanotechnology
Health, biomedicine and pharmaceuticals
Agriculture and food processing
INTER. PRIORITIES
Electric and electronic technologies
=
Energy
=
Production technology and heavy machinery
=
ICT
=
Environmental industries, services and sciences
=
LOW PRIORITIES
The low number of records in these preliminary priority areas prevents a richer characterisation and can provide unreliable indicators.
Vulcanized and fired materials
Textile, Apparel, Footwear and Leather goods (TAFL)
Paper industry

2. Disciplines and sectors prone to **non-technological innovation** present a lower number of research and innovation records in the data sources. Thus, potential priority areas such as **design, cultural or experience-based industries**, which can have an important role in regional specialisation strategies, **should be taken into account.**

3. The **topic modelling at the preliminary priority level** enables to have **in-depth insights** about the possible development scenarios of the moldovan research and innovation ecosystem. For instance, the analysis carried out in Section 3.3 enables on to see that:
    a. In **ICT**, there's a significant R&D activity is focused **on superconductors**
    b. In **Energy**, there's a significant R&D activity is focused on **biofuels**
    c. In **Chemistry**, there's a significant R&D activity is focused on batteries and semiconductors

So that, overall, the entire ecosystem expresses an **interesting potential for green energy** technology development, a line to be explored with experts and stakeholders.

4. The **main highlights of the preliminary priority level topic modelling** are:
   a. Agriculture and food processing
      i. Technological innovation topics: farming, food processing, alcohol production and food industry machinery
      ii. Scientific research topics: biotechnology and genetics
   b. ICT
      i. Technological innovation topics: mobile devices and applications, super/semi conductive materials and circuitry, e-infrastructure for research and innovation activities
      ii. Scientific research topics: frequency modulators and switches, photonics (both at the theoretical and experimental level), algorithmic complexity and parallel computing
   c. Energy
      i. Technological innovation topics: electrotechnical equipment, biofuels, electricity generation and electronics
      ii. Scientific research topics: quantum- and nano- technology, spectrometry, biomass-based energy production and electric motors
   d. Health, biomedicine and pharmaceuticals
      i. Technological innovation topics: pharmaceutical products and processes, postoperative medical treatments, surgery, prosthetics and hospital equipment
      ii. Scientific research topics: health policy and quality, biotechnology and pathology
   e. Chemical industries, materials and nanotechnology:
      i. Technological innovation topics: equipment for the process industries and on batteries.
      ii. Scientific research topics: semiconductors, surface chemistry, nanotechnology and advanced materials
   f. Production technology and heavy machinery:
      i. Technological innovation topics: industrial and hydraulic equipment, heat exchangers and electrotechnical and power station equipment, process industries equipment and advanced manufacturing processes
      ii. Scientific research topics: advanced materials and manufacturing processes
   g. Electrical and electronic technologies

        i. Technological innovation topics: devices for solar energy production and storage and on instrumentation for signal amplification and conversion
        ii. Scientific research topics: nanoparticles manipulation and deposition, electronic circuitry, advanced optics and voltage regulation
    h. Environmental industries, services and sciences
        i. Technological innovation topics: equipment for process bioindustries (including bioreactors), water provision and treatment, processes and technologies for the food industry (especially wine industry)
        ii. Scientific research topics: biotechnology, bioprocesses and on environmental protection and policy

5. **Specialisation topics have also been automatically extracted from the text fields of the science and innovation records**, with no reference to the preliminary priority areas. Thus, specialisation topics emerge directly and completely bottom-up. Each publication, project and patent is linked with a certain weight to any given topic, in a continuous space, so there's no categorical classification: a publication can strongly belong to several topics, and weakly to others. All words in the text corpus belong to several topics, with different strengths (from a negligible to strong relationship). These elements provides significant advantages, to list a few:
    - The topics emerge from and are characterised with the language actually used by specialists, not on external classifications systems managed by third parties.
    - It allows for the identification of transversal concepts which contribute to several topics.
    - It accepts polysemy, as in "solar cell" vs. "tumoral cell", where words have a different meaning in unrelated topics.
    - All topics are related to each other with diverse strengths, allowing for partial overlapping, vertical and horizontal relationships as well as the existence of core or fundamental topics.

    The identified emergent topics can be clustered in three main categories, and characterised in the following summary table:

Balanced topics (science + technological innovation)	
	Trend
New manufacturing processes	↔
Agriculture and biotechnology	↑

Medicine and pharmacology	↑
Science oriented topics (publication-intense)	
	Trend
Transversal, related to diverse public policies	↑
Surfaces and nanofabrication	↔
Quantum and photonics	↔
Materials science / advanced materials	↔
Formal sciences (including computer science	↔
Technological innovation oriented topics (patent-intense)*[10]	
	Trend
Mechanical systems	↓*
Alcohol and food processing	↓*
Electrical and electronic equipment	↓*
Equipment for process industries	↓*
Prosthetics and medical devices	↓*

These three clusters of topics could lead to **a differentiated menu of public policies**, with different blends of **push, pull, capacity-building, ecosystem-building, advanced education, vocational training, internationalisation, etc. instruments**.

In any case, it must be observed that almost all topics have a non-negligible contribution of both main sources (publications and patents), showing a certain overlap between academic and entrepreneurial or technological innovation activities.

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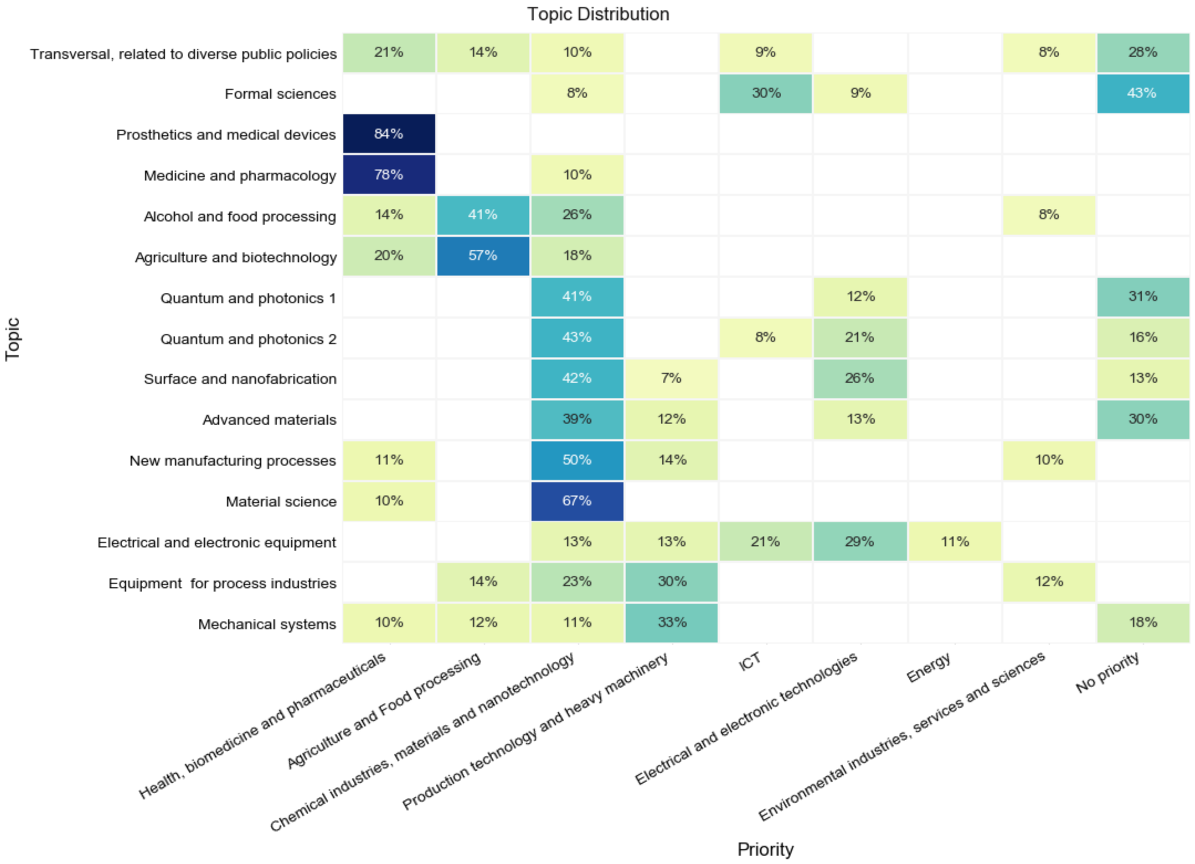
[10] The number of patents per year in the AGEPI database has diminished significantly in the latest years. Thus, topics with an important presence of patents in their text corpus tend to show a decreasing trend in relation to those more based on publications, which have remained more stable. With this caveat, **the insights from the previous table should be assessed and validated from other data sources and with the local experts**.

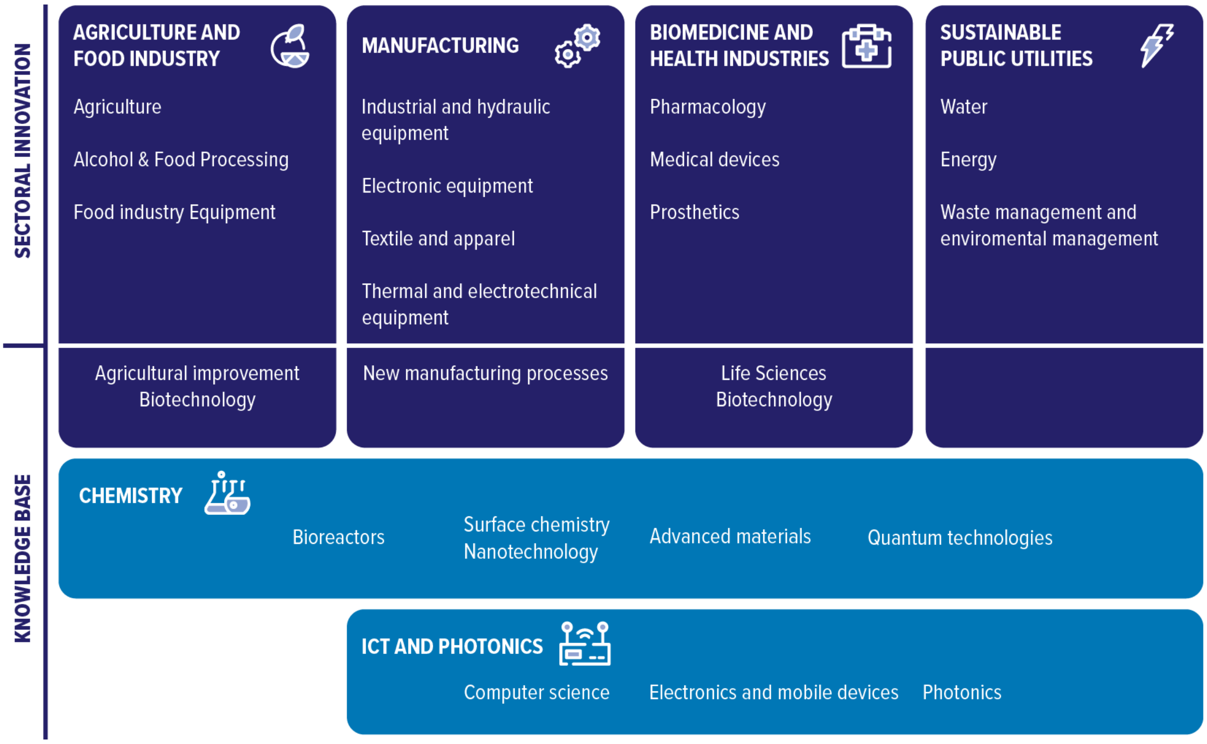
6. **Specialisation topics have been mapped to the preliminary priority areas, as summarised in the following table:**



Topic	Health, biomedicine and pharmaceuticals	Agriculture and Food processing	Chemical industries, materials and nanotechnology	Production technology and heavy machinery	ICT	Electrical and electronic technologies	Energy	Environmental industries, services and sciences	No priority
Transversal, related to diverse public policies	21%	14%	10%		9%			8%	28%
Formal sciences			8%		30%	9%			43%
Prosthetics and medical devices	84%								
Medicine and pharmacology	78%		10%						
Alcohol and food processing	14%	41%	26%					8%	
Agriculture and biotechnology	20%	57%	18%						
Quantum and photonics 1			41%			12%			31%
Quantum and photonics 2			43%		8%	21%			16%
Surface and nanofabrication			42%	7%		26%			13%
Advanced materials			39%	12%		13%			30%
New manufacturing processes	11%		50%	14%				10%	
Material science	10%		67%						
Electrical and electronic equipment			13%	13%	21%	29%	11%		
Equipment for process industries		14%	23%	30%				12%	
Mechanical systems	10%	12%	11%	33%					18%

It is possible then to distinguish the disciplinary topics within each preliminary priority, for instance the fact that **Agriculture and Food processing** is a quite compact preliminary S3 priority, composed by two main topics topics: Agriculture and biotechnology; and Alcohol and food processing, with a component of mechanical and machinery topics. While other priorities such as "Chemical industries, materials and nanotechnology" span many science and technology disciplines, engaging with a diversity of communities.

7. The following schemas present **potential areas for EDP focus integrating both approaches**. It is an initial proposal based on the current work and inspired by the previous expert report, to be complement with local knowledge and exchanges with key stakeholders. The upper side of the schemas present areas of potential innovation in (mainly) tradable sectors. The lower side present knowledge areas with relevant activity, forming a potential knowledge base. Different combinations of these domains provide various options for EDP. Some specific topics have been highlighted for each of these areas, which could guide the identification of experts at a lower level and help structure EDP workshops into thematic sessions:


SECTORAL INNOVATION
KNOWLEDGE BASE
AGRICULTURE AND FOOD INDUSTRY
Agriculture
Alcohol & Food Processing
Food industry Equipment
MANUFACTURING
Industrial and hydraulic equipment
Electronic equipment
Textile and apparel
Thermal and electrotechnical equipment
BIOMEDICINE AND HEALTH INDUSTRIES
Pharmacology
Medical devices
Prosthetics
SUSTAINABLE PUBLIC UTILITIES
Water
Energy
Waste management and enviromental management
Agricultural improvement Biotechnology
New manufacturing processes
Life Sciences Biotechnology
CHEMISTRY
Bioreactors
Surface chemistry Nanotechnology
Advanced materials
Quantum technologies
ICT AND PHOTONICS
Computer science
Electronics and mobile devices
Photonics

7.2. Entrepreneurial Discovery Process

8. Science and innovation communities are complex and move fast. To grasp networks, specialisation and emergencies at the level of detail relevant for EDP and S3 priority-setting, predefined tables and aggregates are not enough. There is a need for granular, flexible analysis within changing ad-hoc perimeters (geographic, disciplinary, sectoral), allowing technicians, experts and policy-makers a fine-grained exploration of the ecosystem and a fast analysis of different scenarios. In this context, **to support the Entrepreneurial Process of Discovery, a web app containing interactive visualisations has been developed.**

9. **Preliminary priority areas and specialisation topics can be rather science-oriented, technological-innovation-oriented or balanced.** As such, actors and experts can interact in more heterogeneous or more compact, centralised or decentralised communities, a fact that could lead to differentiated EDP approaches.

10. The **higher education and research sector in Moldova is extremely centralised and concentrated.** On the one side, this can simplify the initial stages of the EDP process, but, on the other, it reduces diversity and autonomous specialisation processes and can lead to capture and conflict of interest. **Special**

efforts should be made to access new actors, specially outside of capital and in private-sector oriented domains.

11. **International partnerships are crucial to support excellence in research and internationalisation in the business sector.** In the data sources, international collaboration is represented by the publication of scientific papers in co-authorship with foreign affiliated researchers and in EU project consortia. **Germany, the United States and Russia are the top international partners** of Moldovan research, followed by France, Spain, Poland, Ukraine, Italy and the United Kingdom. **Most international collaborations belong to the "Chemical industries, materials and nanotechnology" and "Health, biomedicine and pharmaceuticals"**. Beyond these two priorities, some bilateral relationship patterns emerge:
    - Agriculture and food processing: Germany, Italy, Russia, France.
    - ICT: France, Austria, Spain, Germany, Romania, Italy.
    - Energy: Germany and USA.
    - Health, biomedicine and pharmaceuticals: United States, United Kingdom, Germany
    - Chemical industries, materials and nanotechnology: Germany, the United States and Russia.
    - Production technology and heavy machinery: Germany, the United States and Russia
    - Electric and electronic technologies: Germany, the United States and Russia
    - Environmental industries, services and sciences: diverse pattern lead by Russia.

7.3. Other policy implications

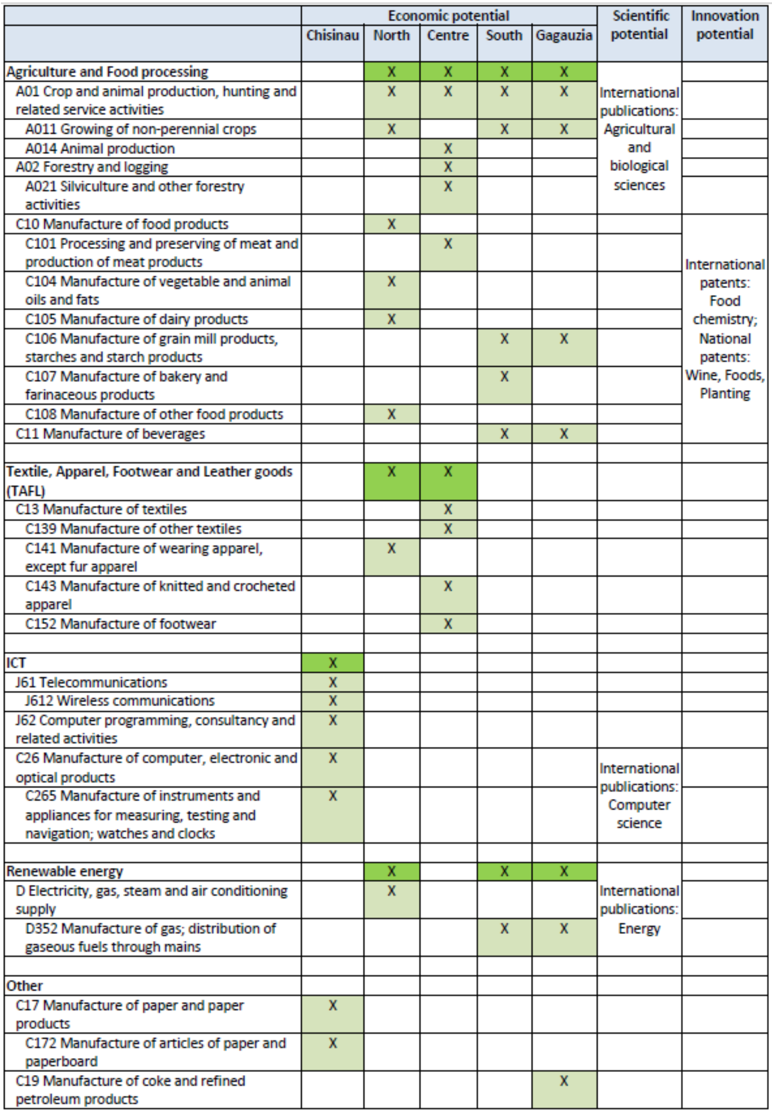
12. **Moldovan science and innovation actors are very centralised**, all institutes of the ASM, but one, as well as the top universities, are located in the capital Chisinau. **The Moldovan knowledge base should be understood as national and available for all regions: all S3 should make use of that knowledge base regardless of where the actors and assets are located.**

13. The **policy instruments established by the Republic of Moldova** and implemented by the Academy of Sciences to support research, development and innovation **do not support collaboration**. Beyond this particular mapping and characterisation exercise, it would be advisable to **assess the establishment of policy instruments supporting collaboration and networking in the regional and national science and innovation ecosystems**.

8. Annex

a. Preliminary specialisation domains in Hollander's expert report

The following table (page 53 of the report) summarizes Hollander's identification of specialisation potential in Moldovan regions,, based on NACE codes (rows) and providing indications on bibliometric categories and patent technologies in the two final columns:



	Economic potential					Scientific potential	Innovation potential
	Chisinau	North	Centre	South	Gagauzia		
Agriculture and Food processing		X	X	X	X	International publications: Agricultural and biological sciences	
A01 Crop and animal production, hunting and related service activities		X	X	X	X		
A011 Growing of non-perennial crops		X		X	X		
A014 Animal production			X				
A02 Forestry and logging			X				
A021 Silviculture and other forestry activities			X				
C10 Manufacture of food products		X					International patents: Food chemistry; National patents: Wine, Foods, Planting
C101 Processing and preserving of meat and production of meat products			X				
C104 Manufacture of vegetable and animal oils and fats		X					
C105 Manufacture of dairy products		X					
C106 Manufacture of grain mill products, starches and starch products				X	X		
C107 Manufacture of bakery and farinaceous products				X			
C108 Manufacture of other food products		X					
C11 Manufacture of beverages				X	X		
Textile, Apparel, Footwear and Leather goods (TAFL)		X	X				
C13 Manufacture of textiles			X				
C139 Manufacture of other textiles			X				
C141 Manufacture of wearing apparel, except fur apparel		X					
C143 Manufacture of knitted and crocheted apparel			X				
C152 Manufacture of footwear			X				
ICT	X						
J61 Telecommunications	X						
J612 Wireless communications	X						
J62 Computer programming, consultancy and related activities	X						
C26 Manufacture of computer, electronic and optical products	X					International publications: Computer science	
C265 Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks	X						
Renewable energy		X		X	X	International publications: Energy	
D Electricity, gas, steam and air conditioning supply		X					
D352 Manufacture of gas; distribution of gaseous fuels through mains				X	X		
Other							
C17 Manufacture of paper and paper products	X						
C172 Manufacture of articles of paper and paperboard	X						
C19 Manufacture of coke and refined petroleum products					X		

C192 Manufacture of refined petroleum products					X		
C20 Manufacture of chemicals and chemical products	X					International publications: Chemistry, Chemical engineering	
C203 Manufacture of paints, varnishes and similar coatings, printing ink and mastics	X						
C21 Manufacture of basic pharmaceutical products and pharmaceutical preparations			X				International patents: Pharmaceuticals
C212 Manufacture of basic pharmaceutical preparations			X				
C23 Manufacture of other non-metallic mineral products			X				
C231 Manufacture of glass and glass products	X				X		
C235 Manufacture of cement, lime and plaster		X	X				
C27 Manufacture of electrical equipment		X					
C273 Manufacture of wiring and wiring devices		X					
C28 Manufacture of machinery and equipment not elsewhere classified	X						
C31 Manufacture of furniture	X						
C33 Repair of installation of machinery and equipment	X						
C331 Repair of fabricated metal products, machinery and equipment	X						
K662 Activities auxiliary to insurance and pension funding	X						
M Professional, scientific and technical activities	X						

Concordance tables

Patents Concordance Table: ICP to preliminary S3 priorities

General preliminary priority	Code	Description
Agriculture and Food processing	A01	Agriculture; Forestry; Animal Husbandry; Hunting; Trapping; Fishing
Agriculture and Food processing	C12	Biochemistry; Beer; Spirits; Wine; Vinegar; Microbiology; Enzymology; Mutation Or Genetic Engineering
Agriculture and Food processing	A23	Foods Or Foodstuffs; Their Treatment, Not Covered By Other Classes
Agriculture and Food processing	A21	Baking; Equipment For Making Or Processing Doughs; Doughs For Baking
Agriculture and Food processing	A61D	Veterinary Instruments, Implements, Tools, Or Methods
Agriculture and Food processing	C13	Sugar Industry
Chemical industries, materials and nanotechnology	B81	Microstructural Technology
Chemical industries, materials and nanotechnology	F42	Ammunition; Blasting
Chemical industries, materials and nanotechnology	C21	Metallurgy Of Iron
Chemical industries, materials and nanotechnology	B04	Centrifugal Apparatus Or Machines For Carrying-Out Physical Or Chemical Processes
Chemical industries, materials and nanotechnology	B22	Casting; Powder Metallurgy
Chemical industries, materials and nanotechnology	B82	Nanotechnology
Chemical industries, materials and nanotechnology	B29	Working Of Plastics; Working Of Substances In A Plastic State In General
Chemical industries, materials and nanotechnology	C03	Glass; Mineral Or Slag Wool
Chemical industries, materials and nanotechnology	C22	Metallurgy; Ferrous Or Non-Ferrous Alloys; Treatment Of Alloys Or Non-Ferrous Metals
Chemical industries, materials and nanotechnology	C05	Fertilisers; Manufacture Thereof
Chemical industries, materials and nanotechnology	B05	Spraying Or Atomising In General; Applying Liquids Or Other Fluent Materials To Surfaces, In General
Chemical industries, materials and nanotechnology	C30	Crystal Growth
Chemical industries, materials and nanotechnology	C09	Dyes; Paints; Polishes; Natural Resins; Adhesives; Compositions Not Otherwise Provided For; Applications Of Materials Not Otherwise Provided For
Chemical industries, materials and nanotechnology	C08	Organic Macromolecular Compounds; Their Preparation Or Chemical Working-Up; Compositions Based Thereon
Chemical industries, materials and nanotechnology	C07G	Compounds Of Unknown Constitution
Chemical industries, materials and nanotechnology	B01	Physical Or Chemical Processes Or Apparatus In General
Chemical industries, materials and nanotechnology	C01	Inorganic Chemistry
Chemical industries, materials and nanotechnology	C25	Electrolytic Or Electrophoretic Processes; Apparatus Therefor

Chemical industries, materials and nanotechnology	C07F	Acyclic, Carbocyclic, Or Heterocyclic Compounds Containing Elements Other Than Carbon, Hydrogen, Halogen, Oxygen, Nitrogen, Sulphur, Selenium, Or Tellurium
Chemical industries, materials and nanotechnology	C07D	Heterocyclic Compounds
Chemical industries, materials and nanotechnology	C07C	Acyclic Or Carbocyclic Compounds
Chemical industries, materials and nanotechnology	C23	Coating Metallic Material; Coating Material With Metallic Material; Chemical Surface Treatment; Diffusion Treatment Of Metallic Material; Coating By Vacuum Evaporation, By Sputtering, By Ion Implantation Or By Chemical Vapour Deposition, In General; Inhibiting Corrosion Of Metallic Material Or Incrustation In General
Chemical industries, materials and nanotechnology	G01N	Investigating Or Analysing Materials By Determining Their Chemical Or Physical Properties
Chemical industries, materials and nanotechnology	B65	Conveying; Packing; Storing; Handling Thin Or Filamentary Material
Chemical industries, materials and nanotechnology	C07B	General Methods Of Organic Chemistry; Apparatus Therefor
Electrical and electronic technologies	H04	Electric Communication Technique
Electrical and electronic technologies	F21	Lighting
Electrical and electronic technologies	G01R	Measuring Electric Variables; Measuring Magnetic Variables
Electrical and electronic technologies	H01	Basic Electric Elements
Electrical and electronic technologies	H05	Electric Techniques Not Otherwise Provided For
Energy	G21	Nuclear Physics; Nuclear Engineering
Energy	F22	Steam Generation
Energy	C10	Petroleum, Gas Or Coke Industries; Technical Gases Containing Carbon Monoxide; Fuels; Lubricants; Peat
Energy	H02	Generation, Conversion, Or Distribution Of Electric Power
Environmental industries, services and sciences	E03	Water Supply; Sewerage
Environmental industries, services and sciences	B03	Separation Of Solid Materials Using Liquids Or Using Pneumatic Tables Or Jigs; Magnetic Or Electrostatic Separation Of Solid Materials From Solid Materials Or Fluids; Separation By High-Voltage Electric Fields
Environmental industries, services and sciences	C02	Treatment Of Water, Waste Water, Sewage, Or Sludge
Environmental industries, services and sciences	B07	Separating Solids From Solids; Sorting
Environmental industries, services and sciences	F17	Storing Or Distributing Gases Or Liquids
Environmental industries, services and sciences	B09	Disposal Of Solid Waste; Reclamation Of Contaminated Soil
Environmental industries, services and sciences	E02	Hydraulic Engineering; Foundations; Soil-Shifting
Furniture	A47	Furniture; Domestic Articles Or Appliances; Coffee Mills; Spice Mills; Suction Cleaners In General
Health, biomedicine and pharmaceuticals	A61M	Devices For Introducing Media Into Or Onto The Body
Health, biomedicine and pharmaceuticals	A61N	Electrotherapy; Magnetotherapy; Radiation Therapy

Health, biomedicine and pharmaceuticals	A61F	Prostheses; Orthopaedic Or Nursing Appliances; Contraceptive Devices; Fomentation; Treatment Or Protection Of Eyes Or Ears; Bandages
Health, biomedicine and pharmaceuticals	C07K	Peptides; Proteins
Health, biomedicine and pharmaceuticals	C07J	Steroids
Health, biomedicine and pharmaceuticals	A61H	Physical Therapy Apparatus, E.G. Devices For Locating Or Stimulating Reflex Points In The Body; Artificial Respiration; Massage; Baths Or Washing Devices For Special Purposes Or Specific Parts Of The Body
Health, biomedicine and pharmaceuticals	A61P	Specific Therapeutic Activity Of Chemical Compounds Or Medicinal Preparations
Health, biomedicine and pharmaceuticals	A61B	Diagnosis; Surgery; Identification
Health, biomedicine and pharmaceuticals	A61K	Preparations For Medical, Dental, Or Toilet Purposes
Health, biomedicine and pharmaceuticals	A61C	Dentistry; Oral Or Dental Hygiene
Health, biomedicine and pharmaceuticals	A61L	Methods Or Apparatus For Sterilising Materials Or Objects In General; Disinfection, Sterilisation, Or Deodorisation Of Air; Chemical Aspects Of Bandages, Dressings, Or Surgical Articles; Materials For Bandages, Dressings Or Surgical Articles
Health, biomedicine and pharmaceuticals	A61Q	Specific Use Of Cosmetics Or Similar Toilet Preparations
Health, biomedicine and pharmaceuticals	C07H	Sugars; Derivatives Thereof; Nucleosides; Nucleotides; Nucleic Acids
Health, biomedicine and pharmaceuticals	A61J	Containers Specially Adapted For Medical Or Pharmaceutical Purposes; Devices Or Methods Specially Adapted For Bringing Pharmaceutical Products Into Particular Physical Or Administering Forms; Devices For Administering Food Or Medicines Orally; Baby Comforters; Devices For Receiving Spittle
ICT	H03	Basic Electronic Circuitry
ICT	G02	Optics
ICT	G01S	Radio Direction-Finding, Locating, Distance Or Velocity Measuring; Radio Navigation Systems; Analogous Systems Employing Other Waves
ICT	G06	Computing; Calculating; Counting
ICT	G01J	Measurement Of Intensity, Velocity, Spectral Content, Polarisation, Or Phase Of Infra-Red, Visible Or Ultra-Violet Light; Colorimetry; Radiation Pyrometry
ICT	G08	Signalling
ICT	G11	Information Storage
No priority	E06	Doors, Windows, Shutters, Or Roller Blinds, In General; Ladders
No priority	B67	Opening Or Closing Bottles, Jars Or Similar Containers; Liquid Handling
No priority	F41	Weapons
No priority	B25	Hand Tools; Portable Power-Driven Tools; Handles For Hand Implements; Workshop Equipment; Manipulators

No priority	G12	Instrument Details
No priority	A99	Subject Matter Not Otherwise Provided For In This Section
No priority	B42	Bookbinding; Albums; Files; Special Printed Matter
No priority	G01F	Measuring Volume, Volume Flow, Mass Flow, Or Liquid Level; Metering By Volume
No priority	G01G	Weighing
No priority	E04	Building
No priority	A61G	Transport Or Accommodation For Patients; Operating Tables Or Chairs; Chairs For Dentistry; Burial Devices
No priority	G01W	Meteorology
No priority	G01T	Measurement Of Nuclear Or X-Radiation
No priority	G01P	Measuring Linear Or Angular Speed, Acceleration, Deceleration, Or Shock; Indicating Presence, Absence, Or Direction, Of Movement
No priority	G01D	Indicating Or Recording In Connection With Measuring In General; Devices Or Instruments For Measuring Two Or More Variables Not Covered By A Single Other Sub-Class; Tariff Metering Apparatus; Measuring Or Testing Not Otherwise Provided For
No priority	G01K	Measuring Temperature; Measuring Quantity Of Heat; Thermally-Sensitive Elements Not Otherwise Provided For
No priority	G01B	Measuring Length, Thickness, Or Similar Linear Dimensions; Measuring Angles; Measuring Areas; Measuring Irregularities Of Surfaces Or Contours
No priority	A24	Tobacco; Cigars; Cigarettes; Smokers' Requisites
No priority	A46	Brushware
No priority	B41	Printing; Lining Machines; Typewriters; Stamps
No priority	G10	Musical Instruments; Acoustics
No priority	G09	Educating; Cryptography; Display; Advertising; Seals
No priority	B27	Working Or Preserving Wood Or Similar Material; Nailing Or Stapling Machines In General
No priority	B08	Cleaning
No priority	B26	Hand Cutting Tools; Cutting; Severing
No priority	G03	Photography; Cinematography; Analogous Techniques Using Waves Other Than Optical Waves; Electrography; Holography
No priority	B44	Decorative Arts
No priority	B62	Land Vehicles For Travelling Otherwise Than On Rails
No priority	G07	Checking-Devices
No priority	A63	Sports; Games; Amusements
No priority	B43	Writing Or Drawing Implements; Bureau Accessories
No priority	E05	Locks; Keys; Window Or Door Fittings; Safes

No priority	B60	Vehicles In General
No priority	B64	Aircraft; Aviation; Cosmonautics
No priority	E21	Earth Or Rock Drilling; Mining
No priority	C11	Animal Or Vegetable Oils, Fats, Fatty Substances Or Waxes; Fatty Acids Therefrom; Detergents; Candles
No priority	B32	Layered Products
No priority	B63	Ships Or Other Waterborne Vessels; Related Equipment
No priority	A62	Life-Saving; Fire-Fighting
No priority	B21	Mechanical Metal-Working Without Essentially Removing Material; Punching Metal
No priority	E01	Construction Of Roads, Railways, Or Bridges
No priority	B24	Grinding; Polishing
Paper industry	D21	Paper-Making; Production Of Cellulose
Production technology and heavy machinery	F04	Positive-Displacement Machines For Liquids; Pumps For Liquids Or Elastic Fluids
Production technology and heavy machinery	B23	Machine Tools; Metal-Working Not Otherwise Provided For
Production technology and heavy machinery	F25	Refrigeration Or Cooling; Combined Heating And Refrigeration Systems; Heat Pump Systems; Manufacture Or Storage Of Ice; Liquefaction Or Solidification Of Gases
Production technology and heavy machinery	F26	Drying
Production technology and heavy machinery	G01H	Measurement Of Mechanical Vibrations Or Ultrasonic, Sonic Or Infrasonic Waves
Production technology and heavy machinery	G01L	Measuring Force, Stress, Torque, Work, Mechanical Power, Mechanical Efficiency, Or Fluid Pressure
Production technology and heavy machinery	G01M	Testing Static Or Dynamic Balance Of Machines Or Structures; Testing Structures Or Apparatus Not Otherwise Provided For
Production technology and heavy machinery	F03	Machines Or Engines For Liquids; Wind, Spring, Or Weight Motors; Producing Mechanical Power Or A Reactive Propulsive Thrust, Not Otherwise Provided For
Production technology and heavy machinery	B02	Crushing, Pulverising, Or Disintegrating; Preparatory Treatment Of Grain For Milling
Production technology and heavy machinery	B30	Presses
Production technology and heavy machinery	F23	Combustion Apparatus; Combustion Processes
Production technology and heavy machinery	F02	Combustion Engines; Hot-Gas Or Combustion-Product Engine Plants
Production technology and heavy machinery	F27	Furnaces; Kilns; Ovens; Retorts
Production technology and heavy machinery	B06	Generating Or Transmitting Mechanical Vibrations In General
Production technology and heavy machinery	F24	Heating; Ranges; Ventilating
Production technology and heavy machinery	B66	Hoisting; Lifting; Hauling
Production technology and heavy machinery	F15	Fluid-Pressure Actuators; Hydraulics Or Pneumatics In General

Production technology and heavy machinery	F16	Engineering Elements Or Units; General Measures For Producing And Maintaining Effective Functioning Of Machines Or Installations; Thermal Insulation In General
Production technology and heavy machinery	F28	Heat Exchange In General
Production technology and heavy machinery	G05	Controlling; Regulating
Production technology and heavy machinery	F01	Machines Or Engines In General; Engine Plants In General; Steam Engines
Textile, Apparel, Footwear and Leather goods (TAFL)	A43	Footwear
Textile, Apparel, Footwear and Leather goods (TAFL)	A41	Wearing Apparel
Textile, Apparel, Footwear and Leather goods (TAFL)	A44	Haberdashery; Jewellery
Textile, Apparel, Footwear and Leather goods (TAFL)	D05	Sewing; Embroidering; Tufting
Textile, Apparel, Footwear and Leather goods (TAFL)	A45	Hand Or Travelling Articles
Vulcanized and fired materials	C04	Cements; Concrete; Artificial Stone; Ceramics; Refractories
Vulcanized and fired materials	B28	Working Cement, Clay, Or Stone

Publications Concordance Table

General preliminary priority	Area	Description
Agriculture and Food processing	Agricultural and Biological Sciences	Plant Science
Agriculture and Food processing	Agricultural and Biological Sciences	Ecology, Evolution, Behavior and Systematics
Agriculture and Food processing	Agricultural and Biological Sciences	Food Science
Agriculture and Food processing	Agricultural and Biological Sciences	Agronomy and Crop Science
Agriculture and Food processing	Agricultural and Biological Sciences	Horticulture
Agriculture and Food processing	Agricultural and Biological Sciences	General Agricultural and Biological Sciences
Agriculture and Food processing	Agricultural and Biological Sciences	Soil Science
Agriculture and Food processing	Agricultural and Biological Sciences	Aquatic Science
Agriculture and Food processing	Veterinary	General Veterinary
Agriculture and Food processing	Agricultural and Biological Sciences	Insect Science
Agriculture and Food processing	Agricultural and Biological Sciences	Agricultural and Biological Sciences (miscellaneous)
Agriculture and Food processing	Agricultural and Biological Sciences	Animal Science and Zoology
Chemical industries, materials and nanotechnology	Chemical Engineering	Filtration and Separation
Chemical industries, materials and nanotechnology	Materials Science	Metals and Alloys
Chemical industries, materials	Chemical Engineering	Chemical Engineering (miscellaneous)

and nanotechnology		
Chemical industries, materials and nanotechnology	Materials Science	Ceramics and Composites
Chemical industries, materials and nanotechnology	Chemical Engineering	Bioengineering
Chemical industries, materials and nanotechnology	Chemistry	General Chemistry
Chemical industries, materials and nanotechnology	Materials Science	Electronic, Optical and Magnetic Materials
Chemical industries, materials and nanotechnology	Chemical Engineering	Colloid and Surface Chemistry
Chemical industries, materials and nanotechnology	Materials Science	Polymers and Plastics
Chemical industries, materials and nanotechnology	Chemistry	Analytical Chemistry
Chemical industries, materials and nanotechnology	Chemistry	Electrochemistry
Chemical industries, materials and nanotechnology	Engineering	Mechanics of Materials
Chemical industries, materials and nanotechnology	Materials Science	Materials Chemistry
Chemical industries, materials and nanotechnology	Chemical Engineering	Process Chemistry and Technology
Chemical industries, materials and nanotechnology	Chemistry	Organic Chemistry
Chemical industries, materials and nanotechnology	Chemical Engineering	Fluid Flow and Transfer Processes
Chemical industries, materials and nanotechnology	Chemistry	Chemistry (miscellaneous)
Chemical industries, materials and nanotechnology	Chemistry	Physical and Theoretical Chemistry
Chemical industries, materials and nanotechnology	Chemical Engineering	General Chemical Engineering
Chemical industries, materials and nanotechnology	Materials Science	Surfaces, Coatings and Films
Chemical industries, materials and nanotechnology	Chemistry	Spectroscopy
Chemical industries, materials and nanotechnology	Physics and Astronomy	Surfaces and Interfaces
Chemical industries, materials and nanotechnology	Chemistry	Inorganic Chemistry
Chemical industries, materials and nanotechnology	Materials Science	Materials Science (miscellaneous)
Chemical industries, materials and nanotechnology	Chemical Engineering	Catalysis
Electrical and electronic technologies	Engineering	Electrical and Electronic Engineering
Energy	Energy	Nuclear Energy and Engineering
Energy	Energy	Fuel Technology
Energy	Energy	General Energy
Energy	Energy	Renewable Energy, Sustainability and the Environment
Energy	Energy	Energy (miscellaneous)
Energy	Energy	Energy Engineering and Power Technology

Environmental industries, services and sciences	Environmental Science	Management, Monitoring, Policy and Law
Environmental industries, services and sciences	Environmental Science	Pollution
Environmental industries, services and sciences	Earth and Planetary Sciences	Atmospheric Science
Environmental industries, services and sciences	Environmental Science	Environmental Chemistry
Environmental industries, services and sciences	Environmental Science	Ecology
Environmental industries, services and sciences	Environmental Science	Water Science and Technology
Environmental industries, services and sciences	Environmental Science	Health, Toxicology and Mutagenesis
Environmental industries, services and sciences	Environmental Science	General Environmental Science
Environmental industries, services and sciences	Environmental Science	Environmental Engineering
Health, biomedicine and pharmaceuticals	Medicine	Otorhinolaryngology
Health, biomedicine and pharmaceuticals	Medicine	Radiology Nuclear Medicine and imaging
Health, biomedicine and pharmaceuticals	Biochemistry, Genetics and Molecular Biology	Cancer Research
Health, biomedicine and pharmaceuticals	Pharmacology, Toxicology and Pharmaceutics	General Pharmacology, Toxicology and Pharmaceutics
Health, biomedicine and pharmaceuticals	Medicine	Health Informatics
Health, biomedicine and pharmaceuticals	Medicine	Complementary and alternative medicine
Health, biomedicine and pharmaceuticals	Neuroscience	Cellular and Molecular Neuroscience
Health, biomedicine and pharmaceuticals	Medicine	Health Policy
Health, biomedicine and pharmaceuticals	Immunology and Microbiology	Parasitology
Health, biomedicine and pharmaceuticals	Medicine	Pathology and Forensic Medicine
Health, biomedicine and pharmaceuticals	Dentistry	Oral Surgery
Health, biomedicine and pharmaceuticals	Medicine	Embryology
Health, biomedicine and pharmaceuticals	Immunology and Microbiology	Virology
Health, biomedicine and pharmaceuticals	Medicine	Endocrinology, Diabetes and Metabolism
Health, biomedicine and pharmaceuticals	Materials Science	Biomaterials
Health, biomedicine and pharmaceuticals	Social Sciences	Health(social science)
Health, biomedicine and pharmaceuticals	Neuroscience	Neurology
Health, biomedicine and pharmaceuticals	Medicine	Psychiatry and Mental health
Health, biomedicine and pharmaceuticals	Medicine	Transplantation

Health, biomedicine and pharmaceuticals	Medicine	Pediatrics, Perinatology, and Child Health
Health, biomedicine and pharmaceuticals	Biochemistry, Genetics and Molecular Biology	Molecular Medicine
Health, biomedicine and pharmaceuticals	Medicine	Cardiology and Cardiovascular Medicine
Health, biomedicine and pharmaceuticals	Medicine	Oncology
Health, biomedicine and pharmaceuticals	Pharmacology, Toxicology and Pharmaceutics	Pharmacology
Health, biomedicine and pharmaceuticals	Medicine	Pharmacology (medical)
Health, biomedicine and pharmaceuticals	Pharmacology, Toxicology and Pharmaceutics	Pharmaceutical Science
Health, biomedicine and pharmaceuticals	Medicine	Microbiology (medical)
Health, biomedicine and pharmaceuticals	Neuroscience	Endocrine and Autonomic Systems
Health, biomedicine and pharmaceuticals	Medicine	Pulmonary and Respiratory Medicine
Health, biomedicine and pharmaceuticals	Medicine	Nephrology
Health, biomedicine and pharmaceuticals	Biochemistry, Genetics and Molecular Biology	General Biochemistry, Genetics and Molecular Biology
Health, biomedicine and pharmaceuticals	Pharmacology, Toxicology and Pharmaceutics	Drug Discovery
Health, biomedicine and pharmaceuticals	Medicine	Infectious Diseases
Health, biomedicine and pharmaceuticals	Biochemistry, Genetics and Molecular Biology	Genetics
Health, biomedicine and pharmaceuticals	Biochemistry, Genetics and Molecular Biology	Biochemistry
Health, biomedicine and pharmaceuticals	Medicine	Physiology (medical)
Health, biomedicine and pharmaceuticals	Medicine	Critical Care and Intensive Care Medicine
Health, biomedicine and pharmaceuticals	Medicine	Rheumatology
Health, biomedicine and pharmaceuticals	Dentistry	Dentistry (miscellaneous)
Health, biomedicine and pharmaceuticals	Medicine	General Medicine
Health, biomedicine and pharmaceuticals	Medicine	Hepatology
Health, biomedicine and pharmaceuticals	Medicine	Internal Medicine
Health, biomedicine and pharmaceuticals	Medicine	Ophthalmology
Health, biomedicine and pharmaceuticals	Medicine	Anatomy
Health, biomedicine and pharmaceuticals	Neuroscience	Behavioral Neuroscience
Health, biomedicine and pharmaceuticals	Pharmacology, Toxicology and Pharmaceutics	Pharmacology, Toxicology and Pharmaceutics (miscellaneous)
Health, biomedicine and pharmaceuticals	Medicine	Epidemiology

Health, biomedicine and pharmaceuticals	Medicine	Family Practice
Health, biomedicine and pharmaceuticals	Medicine	Hematology
Health, biomedicine and pharmaceuticals	Neuroscience	Cognitive Neuroscience
Health, biomedicine and pharmaceuticals	Medicine	Obstetrics and Gynaecology
Health, biomedicine and pharmaceuticals	Medicine	Immunology and Allergy
Health, biomedicine and pharmaceuticals	Medicine	Anesthesiology and Pain Medicine
Health, biomedicine and pharmaceuticals	Neuroscience	General Neuroscience
Health, biomedicine and pharmaceuticals	Neuroscience	Biological Psychiatry
Health, biomedicine and pharmaceuticals	Engineering	Biomedical Engineering
Health, biomedicine and pharmaceuticals	Medicine	Geriatrics and Gerontology
Health, biomedicine and pharmaceuticals	Immunology and Microbiology	Immunology
Health, biomedicine and pharmaceuticals	Medicine	Gastroenterology
Health, biomedicine and pharmaceuticals	Medicine	Clinical Neurology
Health, biomedicine and pharmaceuticals	Medicine	Surgery
Health, biomedicine and pharmaceuticals	Immunology and Microbiology	Applied Microbiology and Biotechnology
Health, biomedicine and pharmaceuticals	Neuroscience	Developmental Neuroscience
Health, biomedicine and pharmaceuticals	Biochemistry, Genetics and Molecular Biology	Biotechnology
Health, biomedicine and pharmaceuticals	Medicine	Dermatology
Health, biomedicine and pharmaceuticals	Medicine	Public Health, Environmental and Occupational Health
Health, biomedicine and pharmaceuticals	Pharmacology, Toxicology and Pharmaceutics	Toxicology
Health, biomedicine and pharmaceuticals	Medicine	Genetics(clinical)
Health, biomedicine and pharmaceuticals	Health Professions	Pharmacy
ICT	Mathematics	Computational Mathematics
ICT	Computer Science	Artificial Intelligence
ICT	Computer Science	Signal Processing
ICT	Computer Science	Information Systems
ICT	Engineering	Media Technology
ICT	Computer Science	Hardware and Architecture
ICT	Computer Science	Software
ICT	Computer Science	Computational Theory and Mathematics
ICT	Computer Science	General Computer Science

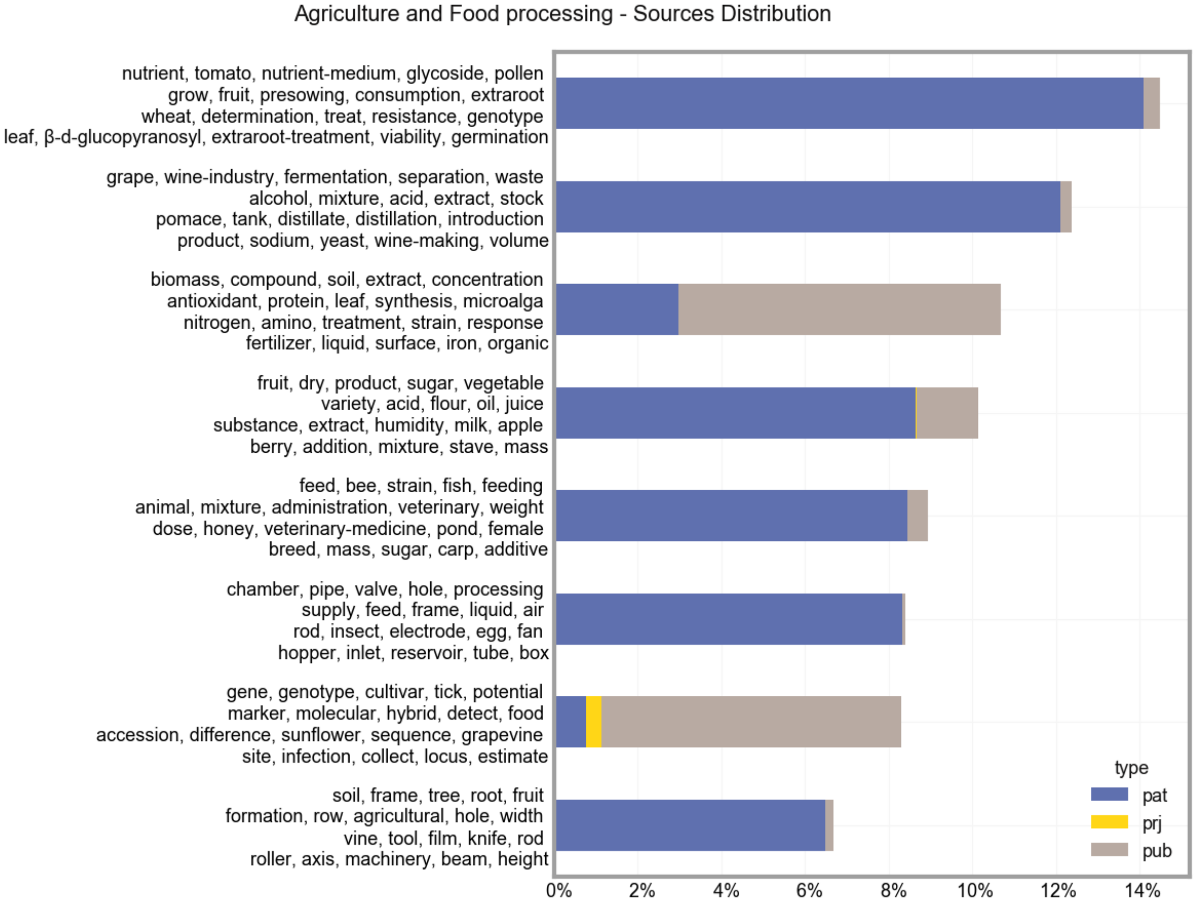
ICT	Computer Science	Computer Science Applications
ICT	Computer Science	Computer Science (miscellaneous)
ICT	Mathematics	Theoretical Computer Science
ICT	Computer Science	Computer Networks and Communications
ICT	Physics and Astronomy	Instrumentation
ICT	Mathematics	Modelling and Simulation
No priority	Physics and Astronomy	Physics and Astronomy (miscellaneous)
No priority	Health Professions	Health Information Management
No priority	Social Sciences	Transportation
No priority	Engineering	General Engineering
No priority	Social Sciences	Archaeology
No priority	Decision Sciences	General Decision Sciences
No priority	Physics and Astronomy	Nuclear and High Energy Physics
No priority	Social Sciences	Safety Research
No priority	Social Sciences	Social Sciences (miscellaneous)
No priority	Economics, Econometrics and Finance	Economics, Econometrics and Finance (miscellaneous)
No priority	Biochemistry, Genetics and Molecular Biology	Physiology
No priority	Earth and Planetary Sciences	Geophysics
No priority	Social Sciences	Linguistics and Language
No priority	Environmental Science	Ecological Modelling
No priority	Psychology	Social Psychology
No priority	Engineering	Safety, Risk, Reliability and Quality
No priority	Arts and Humanities	Visual Arts and Performing Arts
No priority	Mathematics	Mathematical Physics
No priority	Immunology and Microbiology	General Immunology and Microbiology
No priority	Nursing	Nutrition and Dietetics
No priority	Nursing	Issues, ethics and legal aspects
No priority	Biochemistry, Genetics and Molecular Biology	Structural Biology
No priority	Arts and Humanities	Arts and Humanities (miscellaneous)
No priority	Engineering	Civil and Structural Engineering
No priority	Arts and Humanities	Music
No priority	Business, Management and Accounting	Accounting
No priority	Biochemistry, Genetics and Molecular Biology	Developmental Biology
No priority	Materials Science	General Materials Science
No priority	Engineering	Architecture
No priority	Nursing	Gerontology
No priority	Business, Management and Accounting	Organizational Behavior and Human Resource Management
No priority	Nursing	General Nursing
No priority	Physics and Astronomy	General Physics and Astronomy

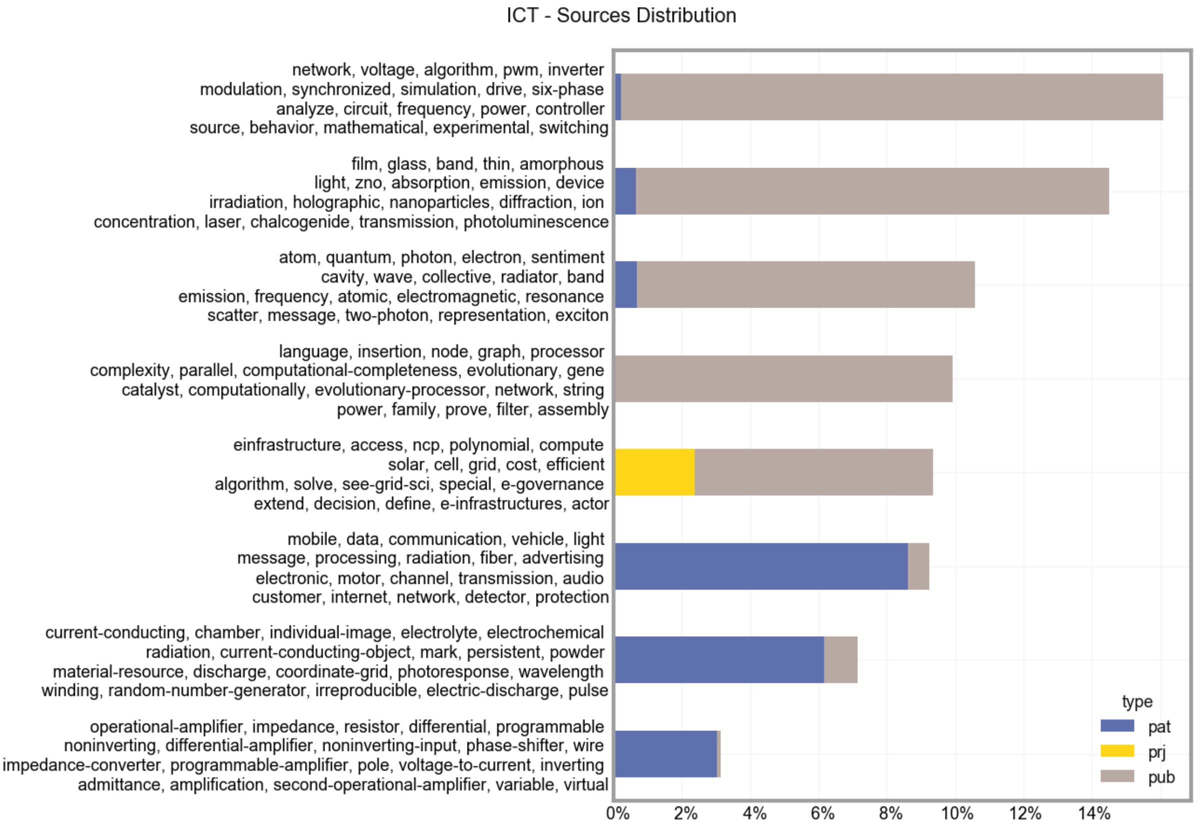
No priority	Mathematics	Applied Mathematics
No priority	Physics and Astronomy	Astronomy and Astrophysics
No priority	Environmental Science	Nature and Landscape Conservation
No priority	Mathematics	General Mathematics
No priority	Physics and Astronomy	Atomic and Molecular Physics, and Optics
No priority	Earth and Planetary Sciences	Oceanography
No priority	Decision Sciences	Information Systems and Management
No priority	Decision Sciences	Statistics, Probability and Uncertainty
No priority	Arts and Humanities	History
No priority	Mathematics	Mathematics (miscellaneous)
No priority	Psychology	Applied Psychology
No priority	Business, Management and Accounting	Business and International Management
No priority	Dentistry	Periodontics
No priority	Social Sciences	Gender Studies
No priority	Social Sciences	General Social Sciences
No priority	Health Professions	Medical Assisting and Transcription
No priority	Engineering	Ocean Engineering
No priority	Arts and Humanities	Museology
No priority	Psychology	Psychology (miscellaneous)
No priority	Multidisciplinary	Multidisciplinary
No priority	Engineering	Control and Systems Engineering
No priority	Social Sciences	Political Science and International Relations
No priority	Engineering	Engineering (miscellaneous)
No priority	Earth and Planetary Sciences	Earth and Planetary Sciences (miscellaneous)
No priority	Mathematics	Control and Optimization
No priority	Physics and Astronomy	Statistical and Nonlinear Physics
No priority	Earth and Planetary Sciences	Geotechnical Engineering and Engineering Geology
No priority	Social Sciences	Cultural Studies
No priority	Mathematics	Analysis
No priority	Arts and Humanities	Archaeology
No priority	Social Sciences	Life-span and Life-course Studies
No priority	Social Sciences	Geography, Planning and Development
No priority	Economics, Econometrics and Finance	General Economics, Econometrics and Finance
No priority	Biochemistry, Genetics and Molecular Biology	Molecular Biology
No priority	Arts and Humanities	General Arts and Humanities
No priority	Physics and Astronomy	Radiation
No priority	Health Professions	Physical Therapy, Sports Therapy and Rehabilitation
No priority	Mathematics	Algebra and Number Theory
No priority	Engineering	Automotive Engineering

No priority	Immunology and Microbiology	Microbiology
No priority	Economics, Econometrics and Finance	Economics and Econometrics
No priority	Social Sciences	Anthropology
No priority	Social Sciences	Communication
No priority	Earth and Planetary Sciences	Geochemistry and Petrology
No priority	Dentistry	General Dentistry
No priority	Mathematics	Statistics and Probability
No priority	Arts and Humanities	Literature and Literary Theory
No priority	Biochemistry, Genetics and Molecular Biology	Endocrinology
No priority	Biochemistry, Genetics and Molecular Biology	Clinical Biochemistry
No priority	Earth and Planetary Sciences	Earth-Surface Processes
No priority	Social Sciences	Law
No priority	Engineering	Building and Construction
No priority	Business, Management and Accounting	Business, Management and Accounting (miscellaneous)
No priority	Arts and Humanities	History and Philosophy of Science
No priority	Social Sciences	Education
No priority	Earth and Planetary Sciences	General Earth and Planetary Sciences
No priority	Social Sciences	Demography
No priority	Mathematics	Logic
No priority	Social Sciences	Urban Studies
No priority	Earth and Planetary Sciences	Space and Planetary Science
No priority	Engineering	Aerospace Engineering
No priority	Biochemistry, Genetics and Molecular Biology	Biochemistry, Genetics and Molecular Biology (miscellaneous)
No priority	Health Professions	Radiological and Ultrasound Technology
No priority	Social Sciences	Sociology and Political Science
No priority	Environmental Science	Waste Management and Disposal
No priority	Economics, Econometrics and Finance	Finance
No priority	Physics and Astronomy	Acoustics and Ultrasonics
No priority	Business, Management and Accounting	General Business, Management and Accounting
No priority	Mathematics	Geometry and Topology
No priority	Arts and Humanities	Philosophy
No priority	Biochemistry, Genetics and Molecular Biology	Cell Biology
No priority	Social Sciences	Development
No priority	Business, Management and Accounting	Strategy and Management
No priority	Biochemistry, Genetics and Molecular Biology	Biophysics
No priority	Earth and Planetary Sciences	Palaeontology
No priority	Decision Sciences	Management Science and Operations Research

No priority	Social Sciences	Library and Information Sciences
No priority	Arts and Humanities	Religious studies
No priority	Mathematics	Discrete Mathematics and Combinatorics
No priority	Physics and Astronomy	Condensed Matter Physics
Production technology and heavy machinery	Engineering	Mechanical Engineering
Production technology and heavy machinery	Engineering	Industrial and Manufacturing Engineering

Results of the topic modelling in each preliminary priority




ICT - Sources Distribution
network, voltage, algorithm, pwm, inverter
modulation, synchronized, simulation, drive, six-phase
analyze, circuit, frequency, power, controller
source, behavior, mathematical, experimental, switching
film, glass, band, thin, amorphous
light, zno, absorption, emission, device
irradiation, holographic, nanoparticles, diffraction, ion
concentration, laser, chalcogenide, transmission, photoluminescence
atom, quantum, photon, electron, sentiment
cavity, wave, collective, radiator, band
emission, frequency, atomic, electromagnetic, resonance
scatter, message, two-photon, representation, exciton
language, insertion, node, graph, processor
complexity, parallel, computational-completeness, evolutionary, gene
catalyst, computationally, evolutionary-processor, network, string
power, family, prove, filter, assembly
einfrastructure, access, ncp, polynomial, compute
solar, cell, grid, cost, efficient
algorithm, solve, see-grid-sci, special, e-governance
extend, decision, define, e-infrastructures, actor
mobile, data, communication, vehicle, light
message, processing, radiation, fiber, advertising
electronic, motor, channel, transmission, audio
customer, internet, network, detector, protection
current-conducting, chamber, individual-image, electrolyte, electrochemical
radiation, current-conducting-object, mark, persistent, powder
material-resource, discharge, coordinate-grid, photoresponse, wavelength
winding, random-number-generator, irreproducible, electric-discharge, pulse
operational-amplifier, impedance, resistor, differential, programmable
noninverting, differential-amplifier, noninverting-input, phase-shifter, wire
impedance-converter, programmable-amplifier, pole, voltage-to-current, inverting
admittance, amplification, second-operational-amplifier, variable, virtual
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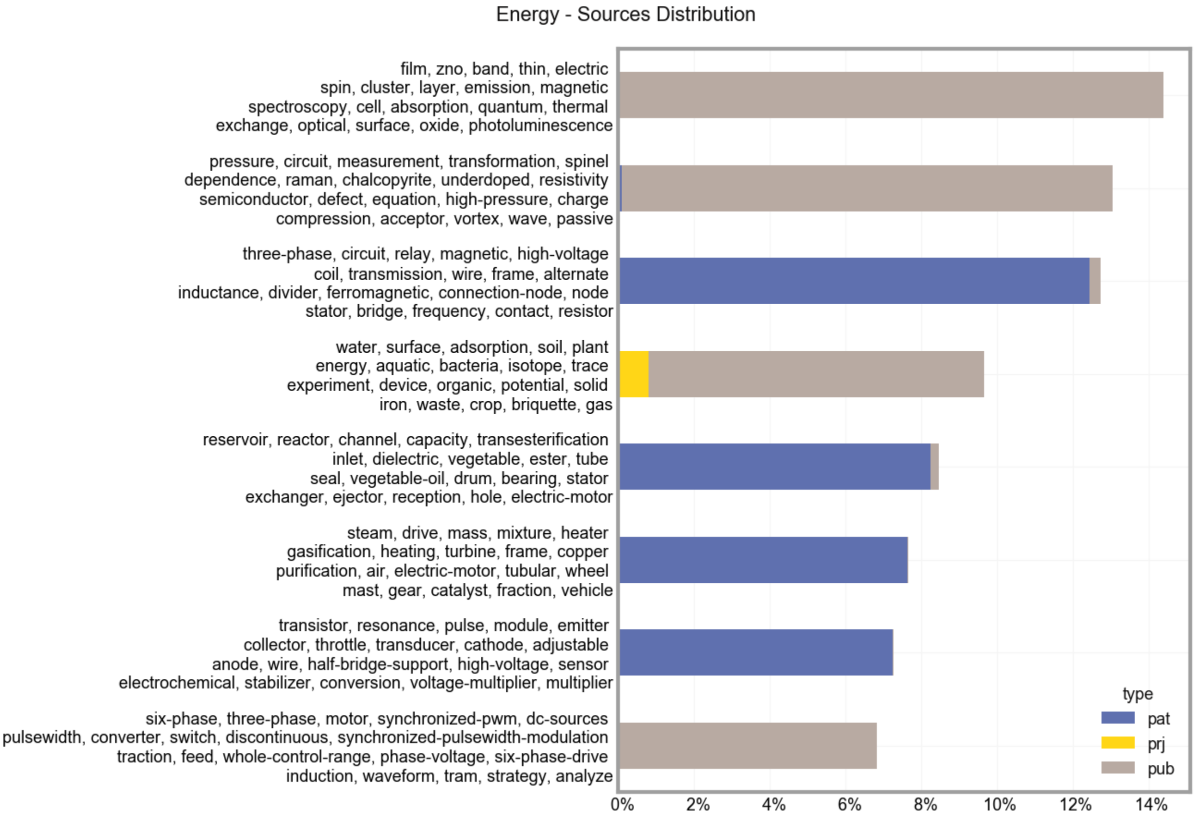
Energy - Sources Distribution
film, zno, band, thin, electric
spin, cluster, layer, emission, magnetic
spectroscopy, cell, absorption, quantum, thermal
exchange, optical, surface, oxide, photoluminescence
pressure, circuit, measurement, transformation, spinel
dependence, raman, chalcopyrite, underdoped, resistivity
semiconductor, defect, equation, high-pressure, charge
compression, acceptor, vortex, wave, passive
three-phase, circuit, relay, magnetic, high-voltage
coil, transmission, wire, frame, alternate
inductance, divider, ferromagnetic, connection-node, node
stator, bridge, frequency, contact, resistor
water, surface, adsorption, soil, plant
energy, aquatic, bacteria, isotope, trace
experiment, device, organic, potential, solid
iron, waste, crop, briquette, gas
reservoir, reactor, channel, capacity, transesterification
inlet, dielectric, vegetable, ester, tube
seal, vegetable-oil, drum, bearing, stator
exchanger, ejector, reception, hole, electric-motor
steam, drive, mass, mixture, heater
gasification, heating, turbine, frame, copper
purification, air, electric-motor, tubular, wheel
mast, gear, catalyst, fraction, vehicle
transistor, resonance, pulse, module, emitter
collector, throttle, transducer, cathode, adjustable
anode, wire, half-bridge-support, high-voltage, sensor
electrochemical, stabilizer, conversion, voltage-multiplier, multiplier
six-phase, three-phase, motor, synchronized-pwm, dc-sources
pulsewidth, converter, switch, discontinuous, synchronized-pulsewidth-modulation
traction, feed, whole-control-range, phase-voltage, six-phase-drive
induction, waveform, tram, strategy, analyze
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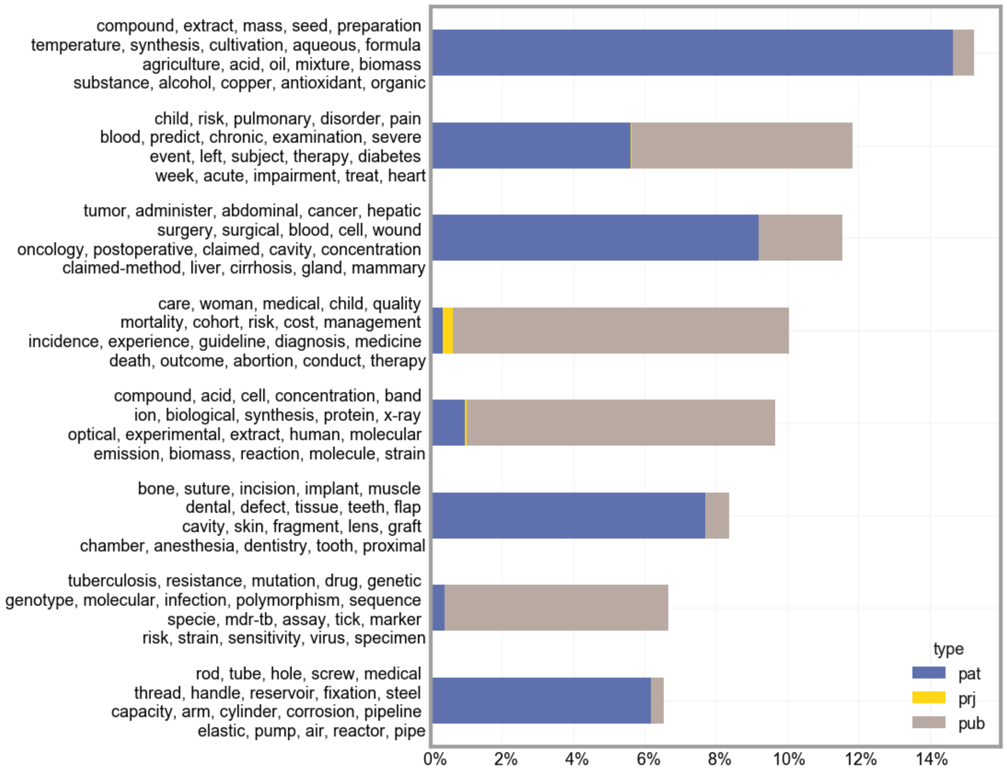
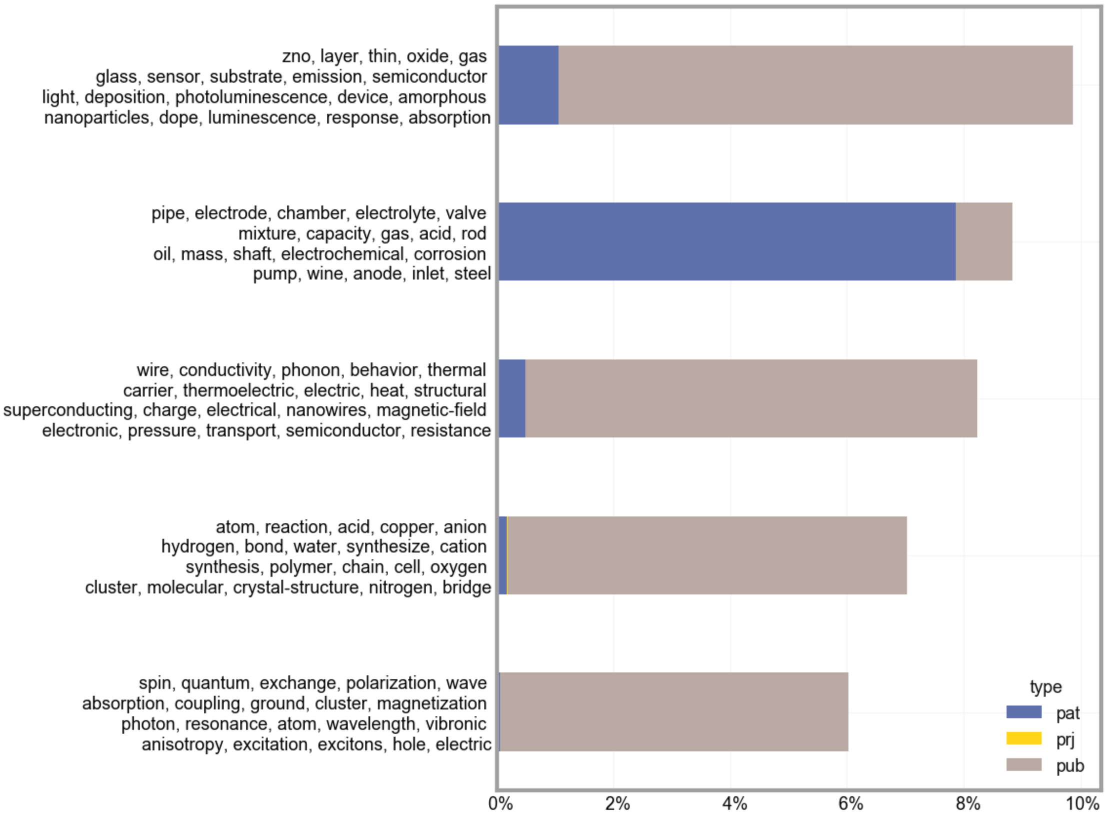
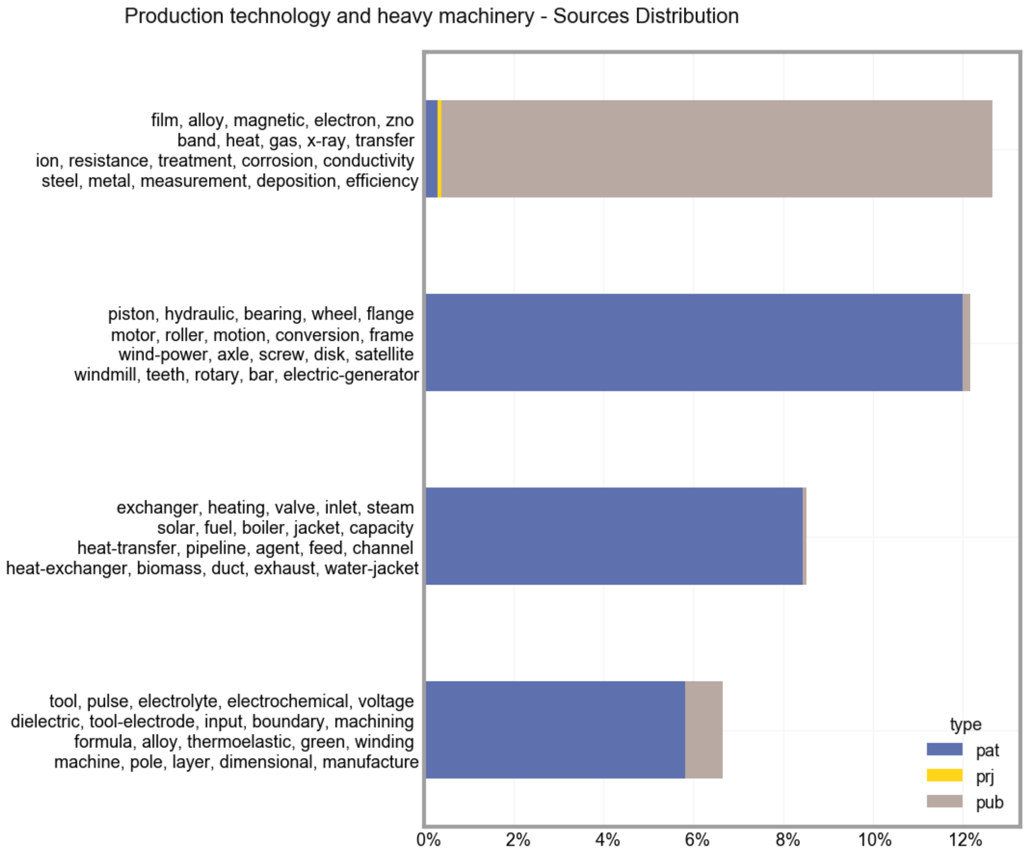

Health, biomedicine and pharmaceuticals - Sources Distribution


Chemical industries, materials and nanotechnology - Sources Distribution


Production technology and heavy machinery - Sources Distribution
film, alloy, magnetic, electron, zno
band, heat, gas, x-ray, transfer
ion, resistance, treatment, corrosion, conductivity
steel, metal, measurement, deposition, efficiency
piston, hydraulic, bearing, wheel, flange
motor, roller, motion, conversion, frame
wind-power, axle, screw, disk, satellite
windmill, teeth, rotary, bar, electric-generator
exchanger, heating, valve, inlet, steam
solar, fuel, boiler, jacket, capacity
heat-transfer, pipeline, agent, feed, channel
heat-exchanger, biomass, duct, exhaust, water-jacket
tool, pulse, electrolyte, electrochemical, voltage
dielectric, tool-electrode, input, boundary, machining
formula, alloy, thermoelastic, green, winding
machine, pole, layer, dimensional, manufacture
type
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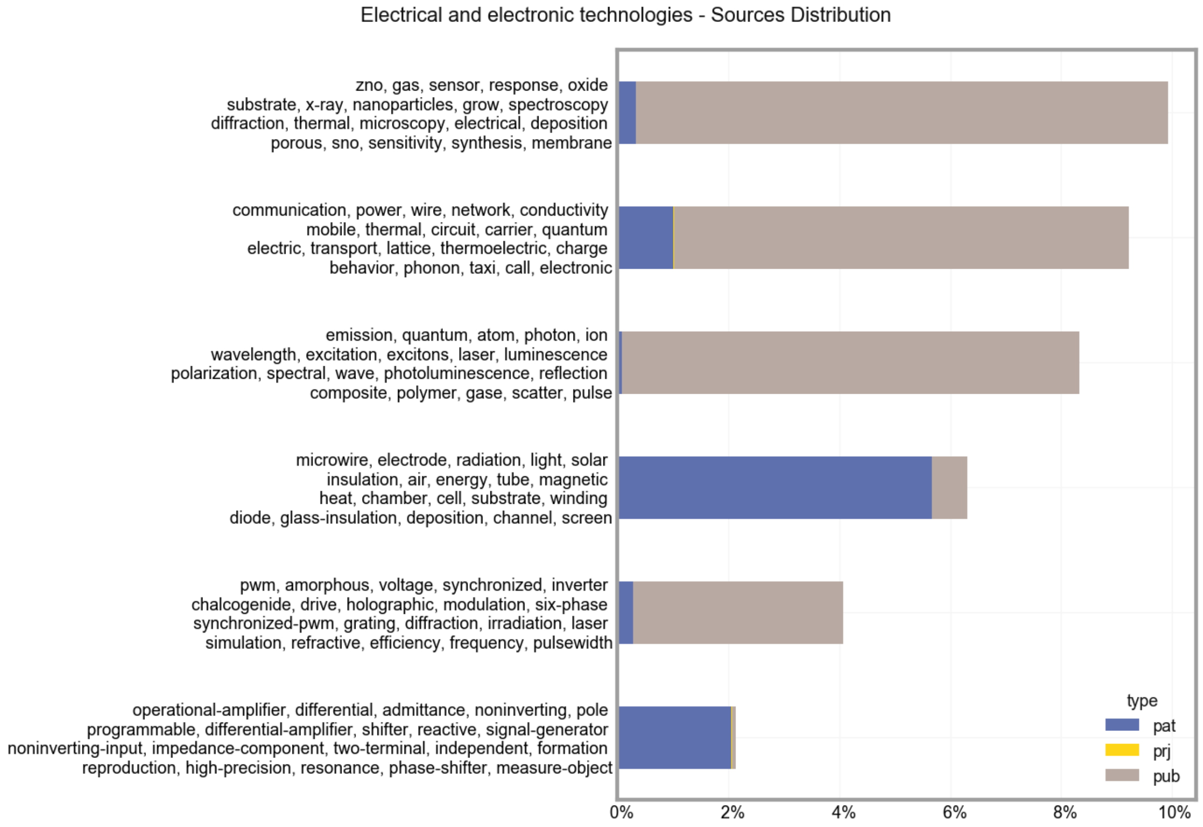
Electrical and electronic technologies - Sources Distribution
zno, gas, sensor, response, oxide
substrate, x-ray, nanoparticles, grow, spectroscopy
diffraction, thermal, microscopy, electrical, deposition
porous, sno, sensitivity, synthesis, membrane
communication, power, wire, network, conductivity
mobile, thermal, circuit, carrier, quantum
electric, transport, lattice, thermoelectric, charge
behavior, phonon, taxi, call, electronic
emission, quantum, atom, photon, ion
wavelength, excitation, excitons, laser, luminescence
polarization, spectral, wave, photoluminescence, reflection
composite, polymer, gase, scatter, pulse
microwire, electrode, radiation, light, solar
insulation, air, energy, tube, magnetic
heat, chamber, cell, substrate, winding
diode, glass-insulation, deposition, channel, screen
pwm, amorphous, voltage, synchronized, inverter
chalcogenide, drive, holographic, modulation, six-phase
synchronized-pwm, grating, diffraction, irradiation, laser
simulation, refractive, efficiency, frequency, pulsewidth
operational-amplifier, differential, admittance, noninverting, pole
programmable, differential-amplifier, shifter, reactive, signal-generator
noninverting-input, impedance-component, two-terminal, independent, formation
reproduction, high-precision, resonance, phase-shifter, measure-object
type
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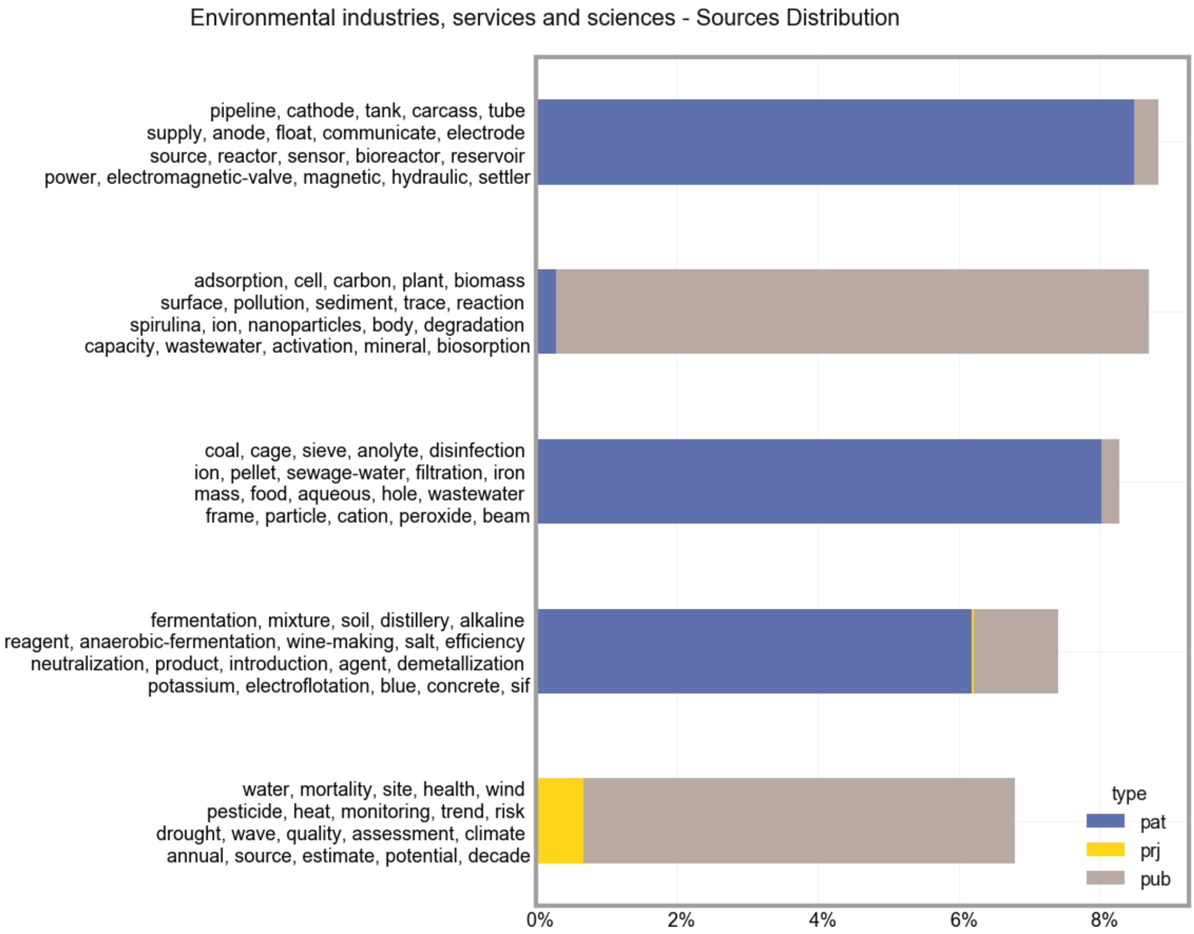
Environmental industries, services and sciences - Sources Distribution
pipeline, cathode, tank, carcass, tube
supply, anode, float, communicate, electrode
source, reactor, sensor, bioreactor, reservoir
power, electromagnetic-valve, magnetic, hydraulic, settler
adsorption, cell, carbon, plant, biomass
surface, pollution, sediment, trace, reaction
spirulina, ion, nanoparticles, body, degradation
capacity, wastewater, activation, mineral, biosorption
coal, cage, sieve, anolyte, disinfection
ion, pellet, sewage-water, filtration, iron
mass, food, aqueous, hole, wastewater
frame, particle, cation, peroxide, beam
fermentation, mixture, soil, distillery, alkaline
reagent, anaerobic-fermentation, wine-making, salt, efficiency
neutralization, product, introduction, agent, demetallization
potassium, electroflotation, blue, concrete, sif
water, mortality, site, health, wind
pesticide, heat, monitoring, trend, risk
drought, wave, quality, assessment, climate
annual, source, estimate, potential, decade
type
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9.

Key actors and collaboration at the regional level

Chisinau

Source	Name	Kind	Num. doc.
Publications	Academy of Sciences of Moldova	ASM	2513
Publications	Nicolae Testemiţanu State University of Medicine and Pharmacy	Universities	784
Publications	Technical University of Moldova	Universities	539
Publications	Institute of Phtisiopneumology "Chiril Draganiuc"	Profile Member - ASM	33
Publications	Practical Scientific Institute of Horticulture and Food Technology	Profile Member - ASM	28
EC Projects	Academy of Sciences of Moldova	ASM	24
EC Projects	Centre of International Projects - Academy of Sciences of Moldova	OTHER	18
EC Projects	Research and Educational Networking Association of Moldova (RENAM)	OTHER	9
EC Projects	Technical University of Moldova	Universities	7
EC Projects	SHS Serviciul Hidrometeorologic de Stat	OTHER	3
ASM projects	Moldova State University	Universities	112
ASM projects	Technical University of Moldova	Universities	92
ASM projects	Nicolae Testemiţanu State University of Medicine and Pharmacy	Universities	91
ASM projects	Institute of Applied Physics	Institutional Member - ASM	89
ASM projects	Institute of Genetics, Physiology and Protection of Plants	Institutional Member - ASM	60
National Patents	Moldova State University	Universities	311
National Patents	Technical University of Moldova	Universities	238
National Patents	Institute of Applied Physics	Institutional Member - ASM	178
National Patents	Nicolae Testemiţanu State University of Medicine and Pharmacy	Universities	168
National Patents	Institute of Genetics, Physiology and Protection of Plants	Institutional Member - ASM	152

Nord, Centru, Gaugazia, Sud

Region	Source	Name	Kind	num. doc.
Centru	publications	Scientific and Practical Institute of Biotechnologies in Zootechnics and Veterinary Medicine	Profile Member - ASM	8
	ASM projects	Scientific and Practical Institute of Biotechnologies in Zootechnics and	Profile Member - ASM	3

		Veterinary Medicine		
	National Patents	Scientific and Practical Institute of Biotechnologies in Zootechnics and Veterinary Medicine	Profile Member - ASM	13
Nord	publications	Alecu Russo State University of Bălţi	Universities	28
	EC Projects	Alecu Russo State University of Bălţi	Universities	1
	ASM projects	Alecu Russo State University of Bălţi	Universities	32
	National Patents	Impexinvesteh. Co Srl	OTHER	1
Gaugazia	publications	Comrat State University	Universities	18
	ASM projects	Tomai-Vinex SA	OTHER	2
	National Patents	Vitapharm-Com Srl	OTHER	1