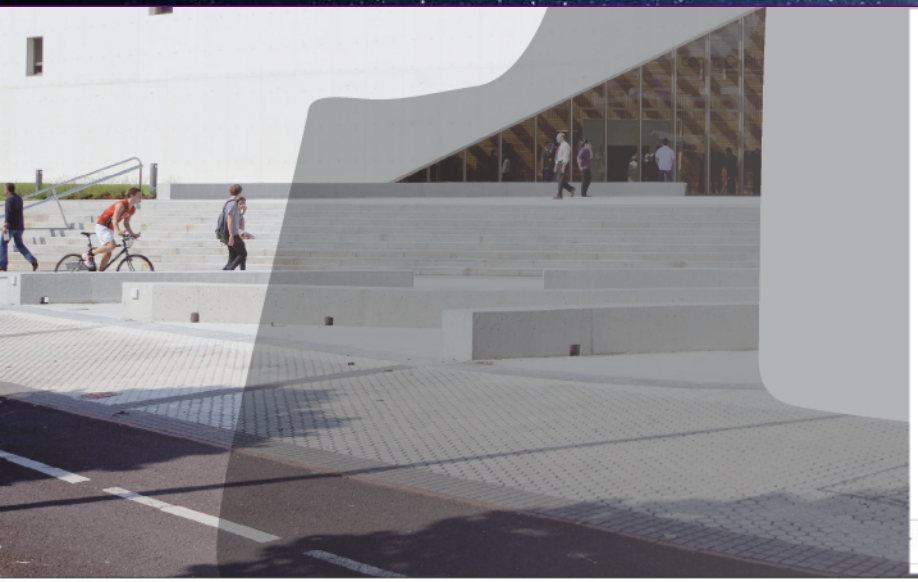
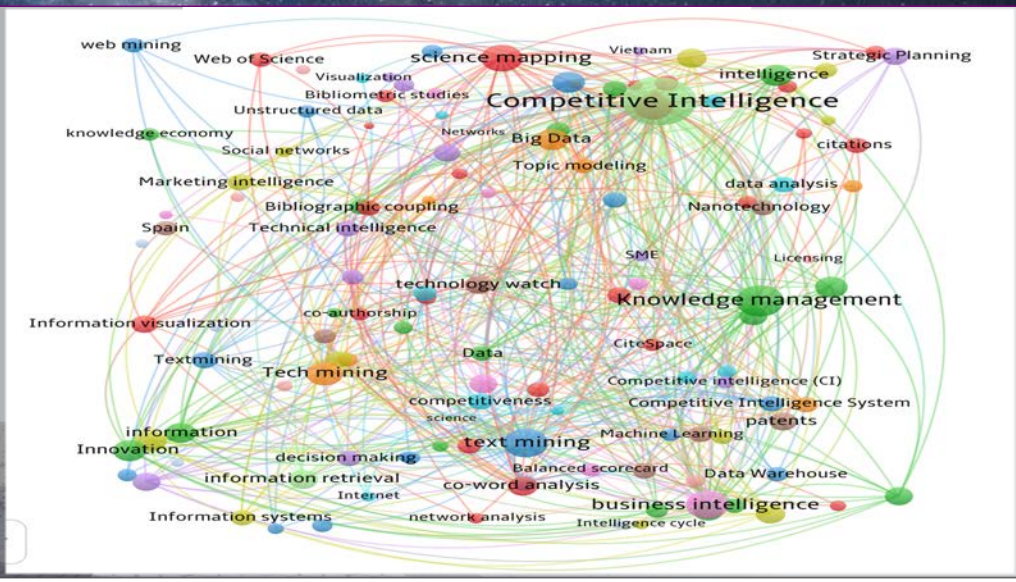
Technology, Foresight and Management

Research Group

Departamento de Organización de Empresas de la UPV/EHU

https://sites.google.com/site/tfmresearch/





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CAMPUS OF INTERNATIONAL EXCELLENCE

Applying Tech-Mining to the Analysis of Technological Evolution

COMPETITIVE INTELLIGENCE INPUTS FOR ORGANIZATIONS:

- Chapter 1. **Tekno-MAP**
- Chapter 2. **Tekno-Barometer**
- Chapter 3. **Tekno-Roadmaps**
- Chapter 4. **Web-indicators**

Future work

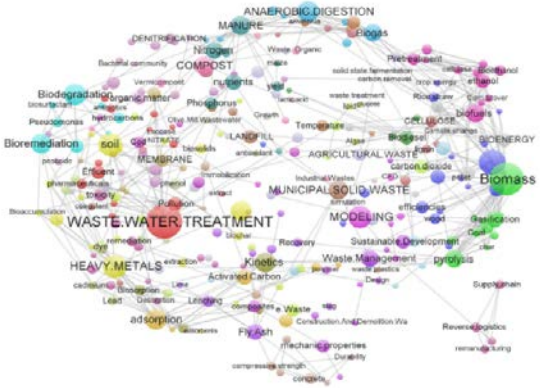
T.F.M. RESEARCH group from UPV/EHU is

specialized in the processing and analysis of scientific and technological data, applied to the detection, assessment and incorporation of new technologies in the industry.

Technology Management; Tech-mining; Technology maps; Foresight; Roadmaps; Knowledge management; Innovation; Competitive Intelligence

Our research lines are the following:

Technology. – We use tech-mining tools in order to analyze scientific-technological information data sources. Our skills range from statistical analysis techniques to the utilization of machine-learning solutions that allow us to characterize the behavior of science/technology fields. We are specialized in the automated analysis of textual data and the building of advanced visualizations to feed decision-making processes.



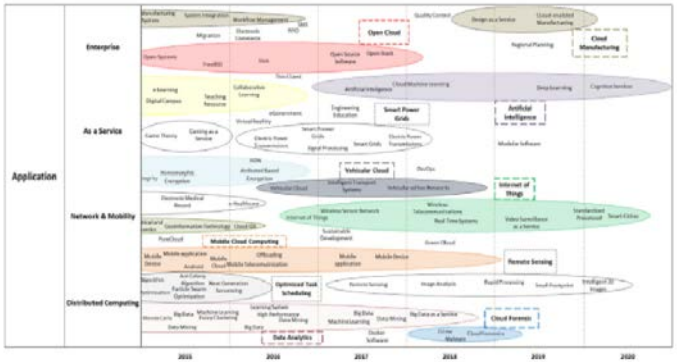


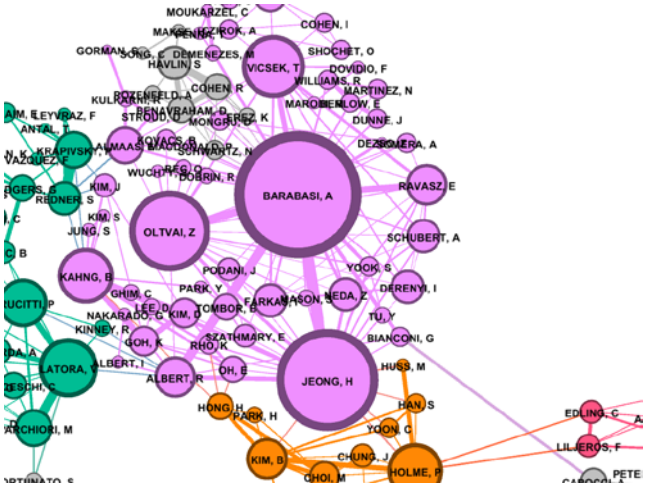
Fig 9. Zoom of the TRM which represents the period 2015–2020 for the application layer.

Foresight. – We are excel at developing data-based Technology Roadmaps in order to identify the most promising technological and scientific fields. The technology roadmaps are further complemented by tools aimed at identifying the position of a technology in the technology life cycle (Gompertz curves ,TRL levels)

Technology Management. – We develop advanced Competitive Intelligence systems based on the tools described above combined with our own expertise on the field.

Evolution of technologies and scientific areas can be **characterized** by automating the analysis of textual information where scientific and technology advances are being described (scientific journal articles, patents…). Similar principles can be used to build conduct analyses about:

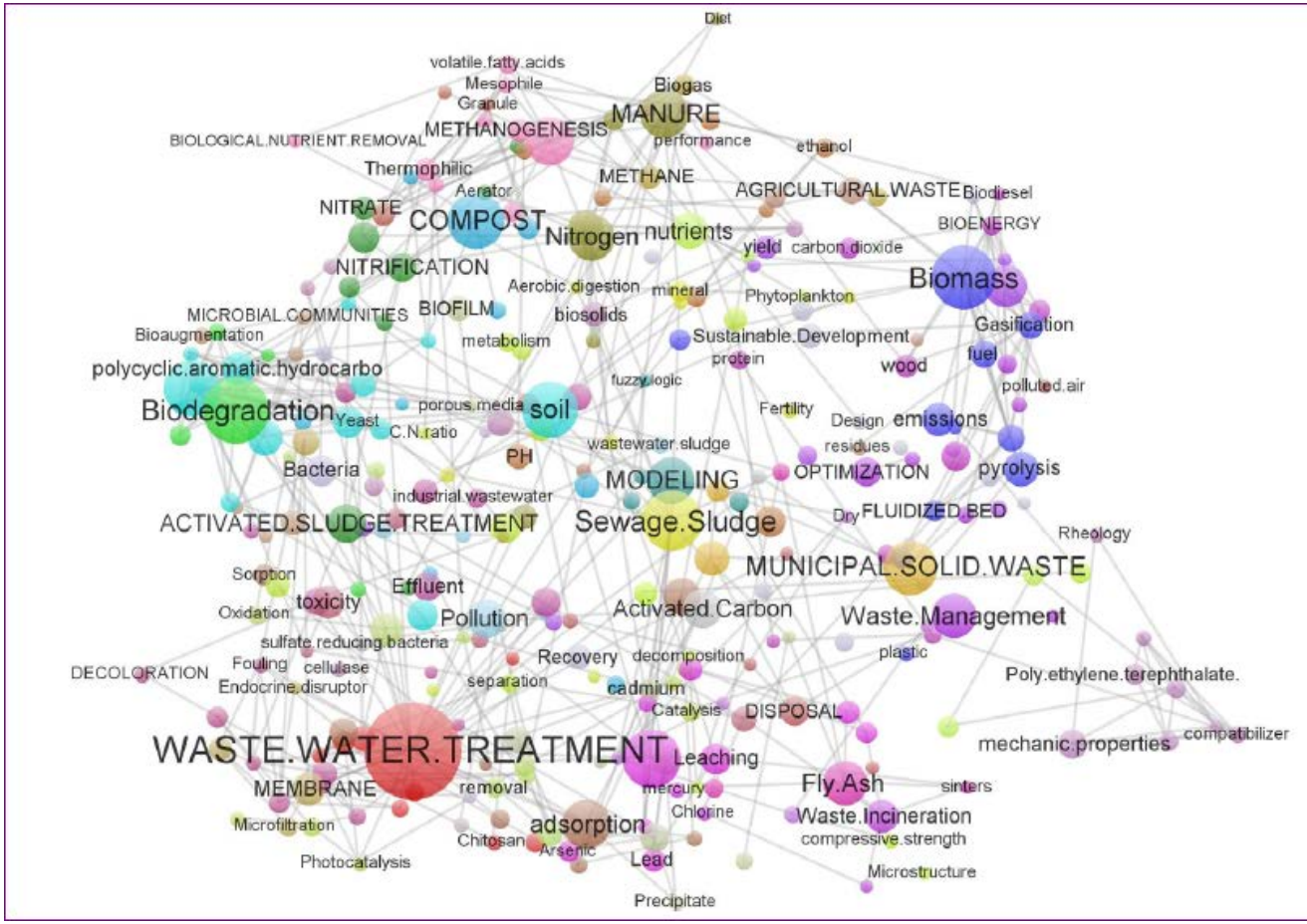
- **Networks** of **organizations** dealing with a research/technology area
- Collaboration **networks** between **researchers**
- Evaluation of the **interdisciplinarity** of a certain sci-tech area.
- **Dynamics** of science and technology: Detection of emergent areas and **multidisciplinary interactions** between different sci-tech specialties.



Tekno-MAPS are visualizations that provide new knowledge about the behavior of the scientific, technological and/or market environment.

Development of concept maps and knowledge.

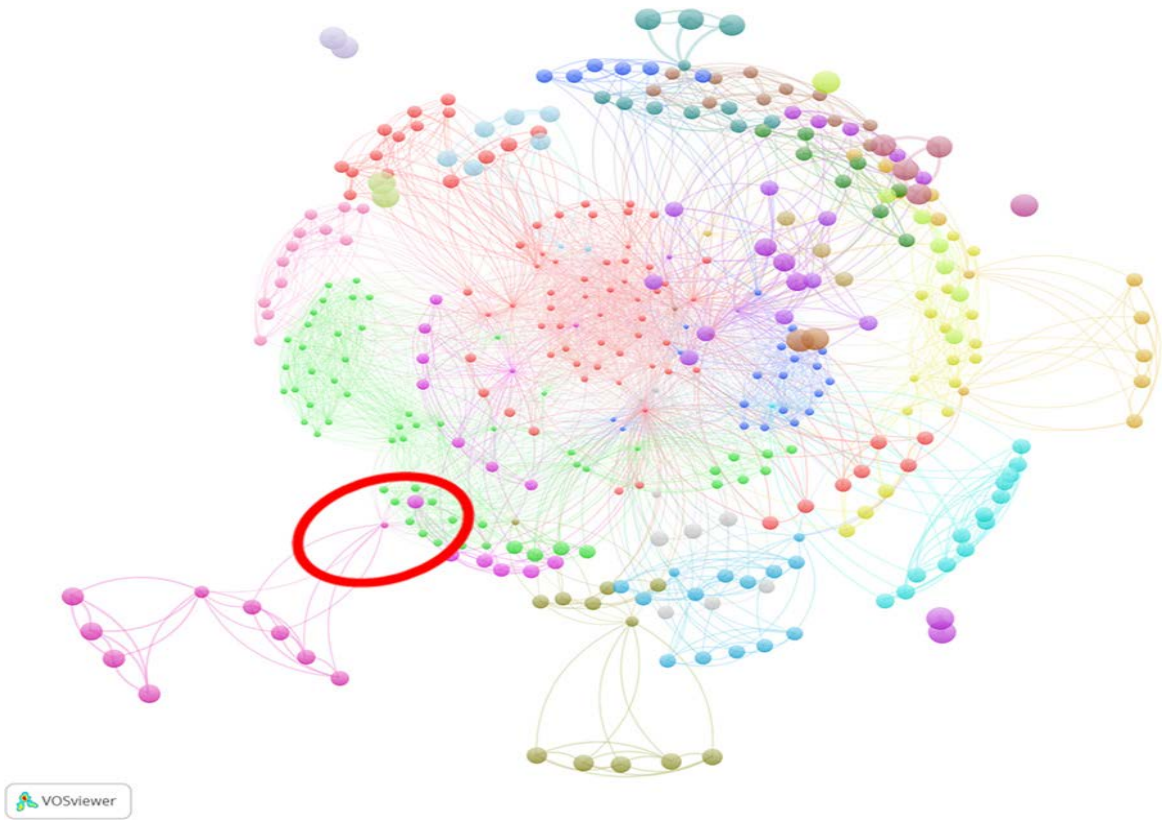
Example: Mapping the evolution of the main **concepts** dealing with waste recycling science (WRS), **built using text mining tools on scientific articles** dealing with WRS. The nodes reflect **research fronts** in this area, uncovered by hierarchical clustering análisis and **mapped** according to their **similarity**, measured by normalizing concept co-occurrence data. The color of noes indicates similar groupings of research fronts



Clusterization and mapping of waste recycling science. Evolution of research from 2002 to 2012. Garechana et al. Journal of the Association for the Information Science and Technology JASIST, 66(7): 1431-1446, (2015)

The data about the **collaborations** and **topics** regarding **European Framework research programs** can also be sucesfully analyzed using **network analysis** tools in order to extract relevant technology intelligence information.

Example: **structural hole** detected in the “Sea” organizational network



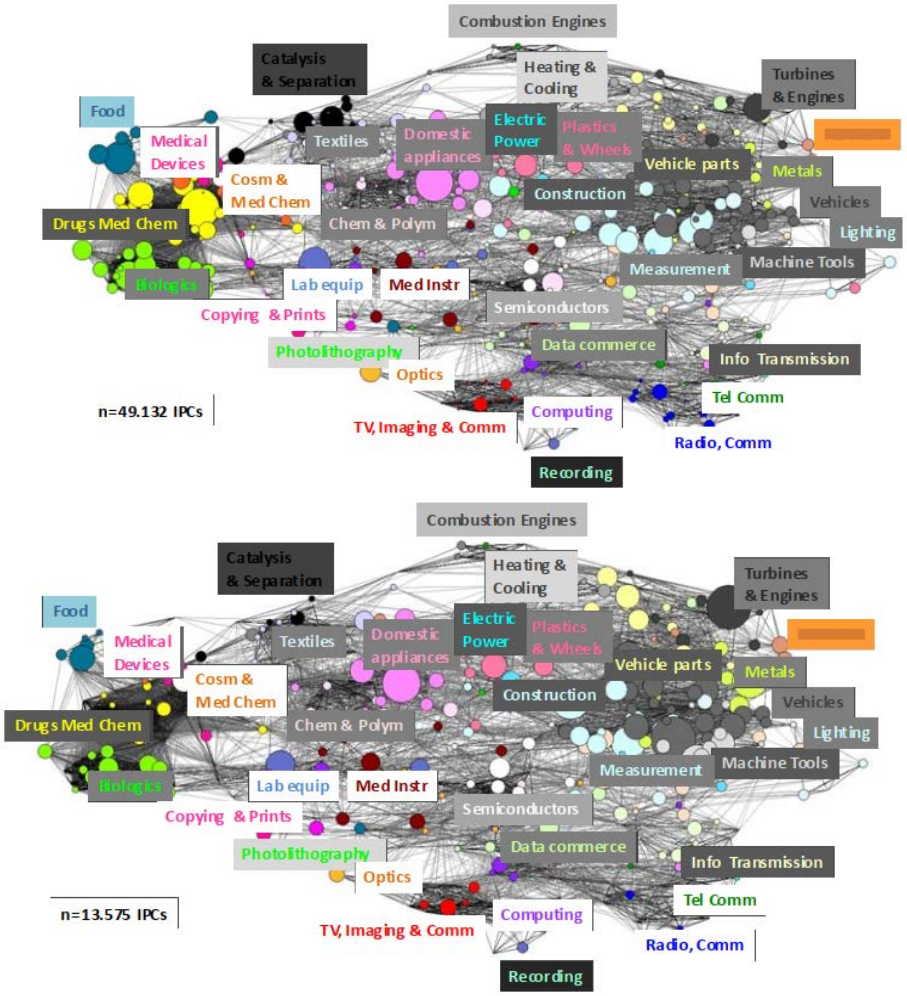
Efficiency in knowledge transmission in R&D project networks: European renewable energy sector. Journal of Renewable and Sustainable Energy 9, 065908 (2017);

Patent overlay maps: A tool for the detection of technology transference opportunities and characterization of regional specialization strategies.

- The Patent Overlay Map is a visualization that shows the existing **connections** between different technological areas.

- These maps can be built using the cited-citing relationships between IPC categories: We can infer that a **technological relatedness** exists between IPC's that cite each other heavily.

- Once the similarity calculations have been normalized and the global map has been built, the **technological production of a firm/region/nation** can be reflected in the global map, thus allowing the detection of **gaps**, **multidisciplinary** niches and the **comparation** of technology production profiles.



Patent overlay maps: Spain and the Basque Country

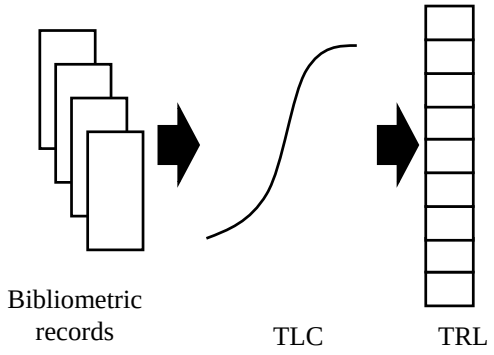
International Journal of Technology Management (IJTM). Vol 69, Nº ¾ (2015)

Tekno-Barometro is a quantitative tool that characterizes the state of technology development.

We developed a quantitative method for the characterization of the TRL stage of technologies.

Bibliometric Model for Assessing Technological Maturity

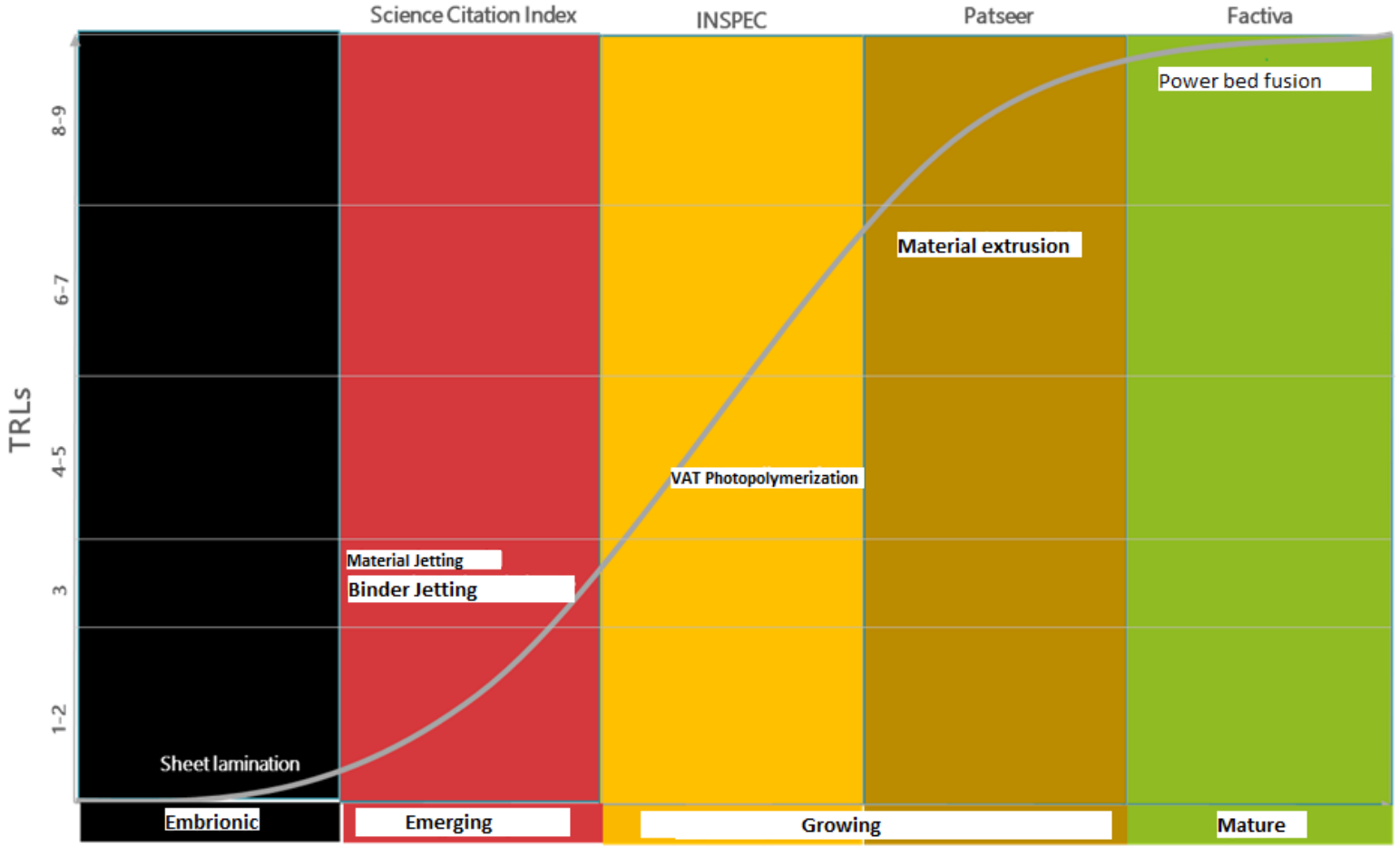
- Several **databases** were selected, considering the **scope** of each database on basic/applied **research**, **development** or **commercialization**.
- We fit the scientific publication/patent/news & business record data to **"S" curve models** or **Hype type** evolution models, depending on the TRL stage we are trying to characterize.
- We determine the TRL stage depending on the **goodness of fit** between the real publication/patenting/news data and the "S" and Hype type curves.



TLC stages	Bibliometric sources	Databases	TRL
Emerging	N/A	N/A	1
			2
	Scientific papers	Science Citation Index (Clarivate Analytics, 2017)	3
	Engineering papers	EiCompendex (Elsevier, 2017)/INSPEC (Clarivate Analytics, 2017)/MEDLINE* (Clarivate Analytics, 2017)	4
			5
Growing	Patents	PATENTSCOPE (WIPO, 2017c)/USPTO (USPTO, 2017)/Espacenet (EPO, 2017)/Patseer (Gridlogics Technologies, 2017)	6
			7
Mature	News and business records	Factiva (Dow Jones, 2017)	8
			9

	LOGISTIC GROWTH FIT			HYPE-TYPE EVOLUTION FIT
DATABASES	Science Citation Index (TRL 3)	INSPEC (TRL 4-5)	Patseer (TRL 6-7)	Factiva (TRL 8-9)
TECHNOLOGIES	AR^2			
Cloud computing	0.87	0.96	0.98	0.61
Datamining	0.93	0.93	0.72	0.98
Location-Aware Technology	0.58	0.90	0.73	0.73
Microelectromechanical systems (MEMS)	0.93	0.96	0.86	0.80
Organic light emitting diode	0.97	0.98	0.87	0.98
Radio Frequency Identification (RFID)	0.74	0.74	0.75	0.70
Smartphone	0.98	0.97	0.83	0.50
Speech recognition	0.94	0.92	0.85	0.90
Text to speech	0.67	0.70	0.75	0.78
Wireless Local Area Network (WiFi)	0.93	0.92	0.68	0.84
AR^2 Average	0.85	0.90	0.80	0.78
$ATAR^2$	0.75	0.82	0.74	0.67

10 mature technologies adapted by (Fenn, 2014) and defined by Gartner Inc. (2017)



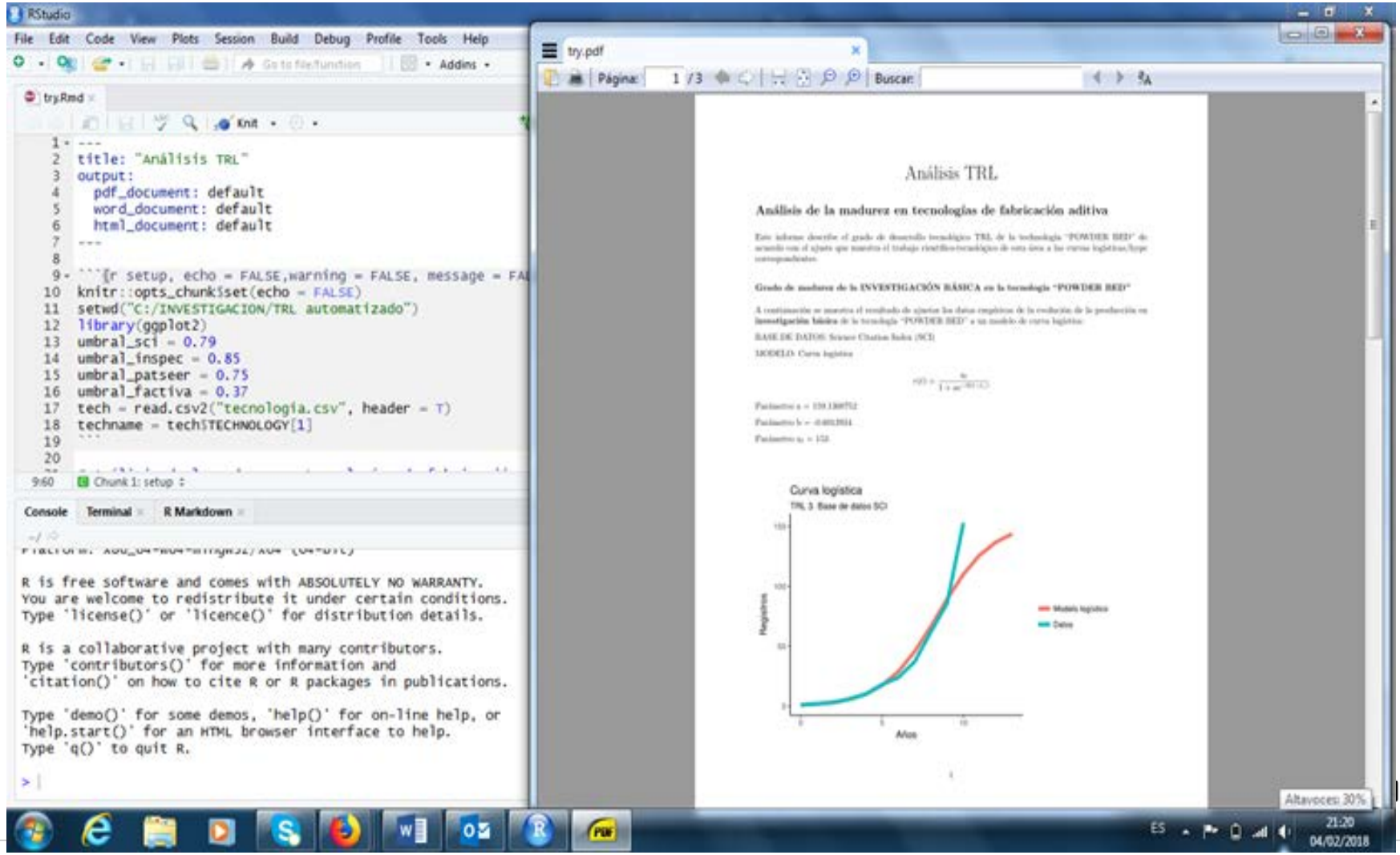
Additive Manufacturing technologies classified on a TRL scale

A bibliometric method for assessing technological maturity: the case of additive manufacturing

Scientometrics 2018 . R. Lezama, M. Rodriguez, R. Rio, I. Bildosola

This process was partially automated in R programming language by PhD Gaizka Garechana T.F.M. Research Group.

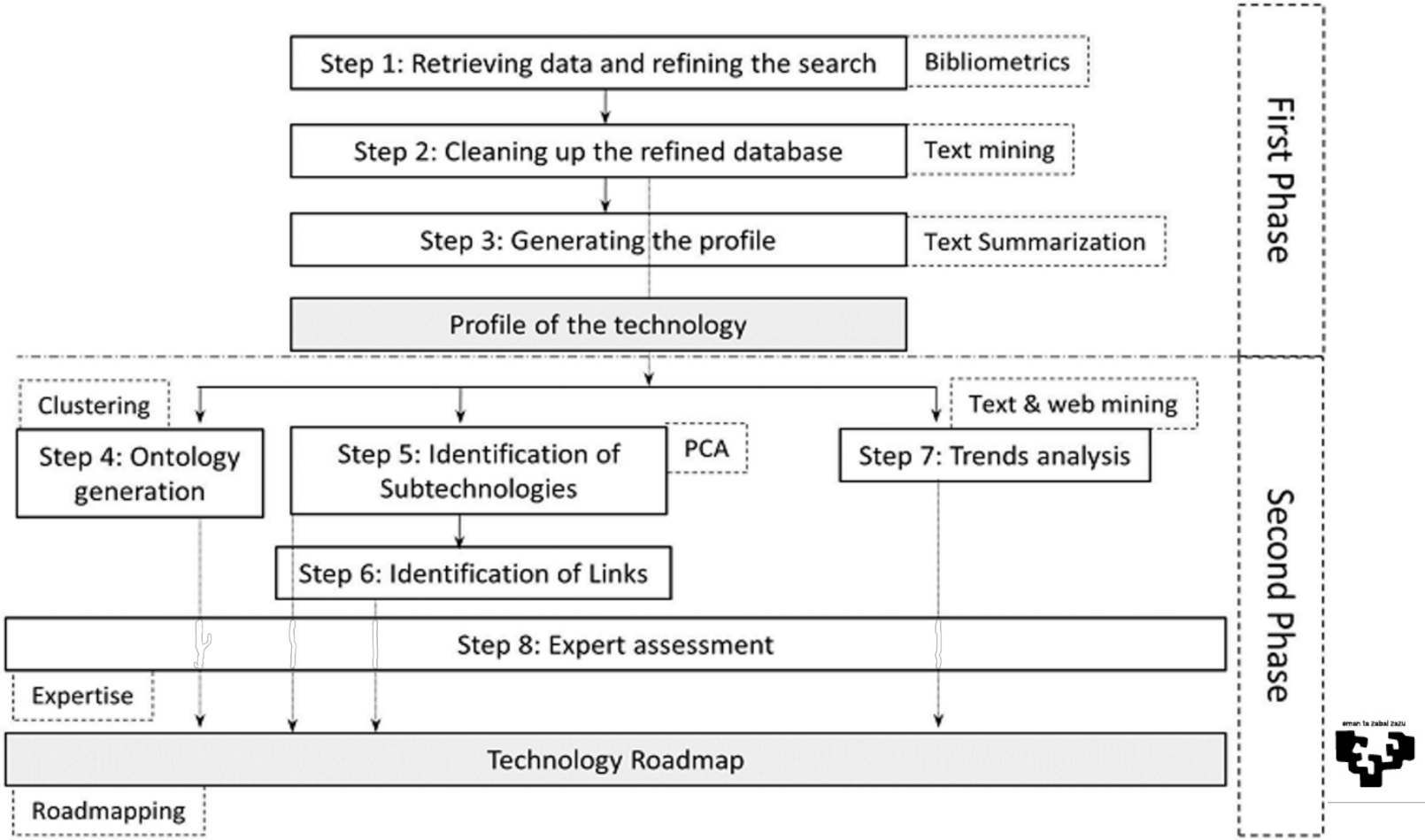
We are currently developing a sectorial application that will work via web.



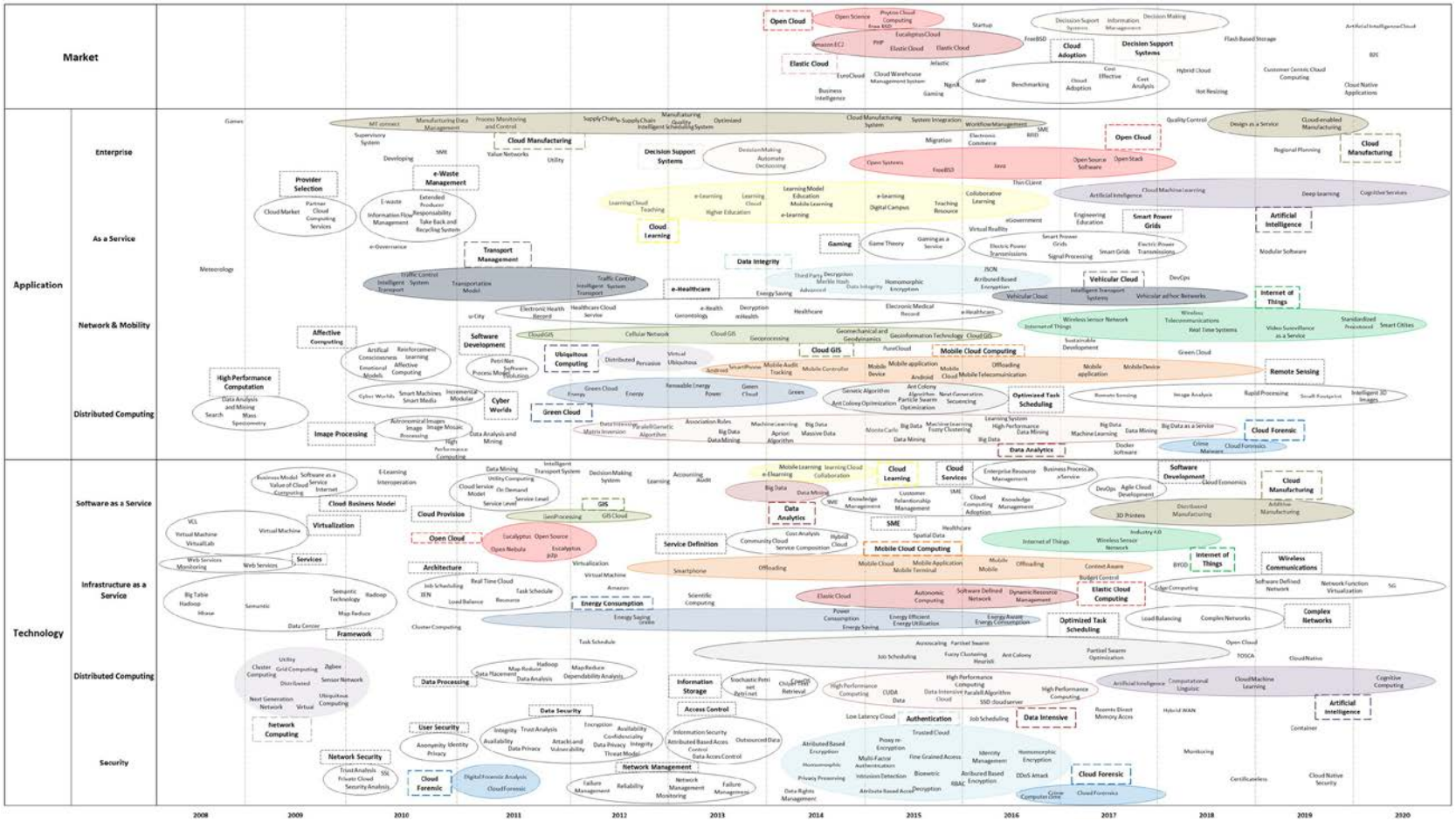
3.Tekno- Roadmap

Tekno-Roadmap is a prediction tool to trace technological itineraries. It is a fundamental tool in the definition of the technological strategy of the organization.

Step by step, breakdown of the process, which combines bibliometrics and technology forecasting methods to depict emerging technologies.



Example. Cloud Computing Tekno-Roadmap

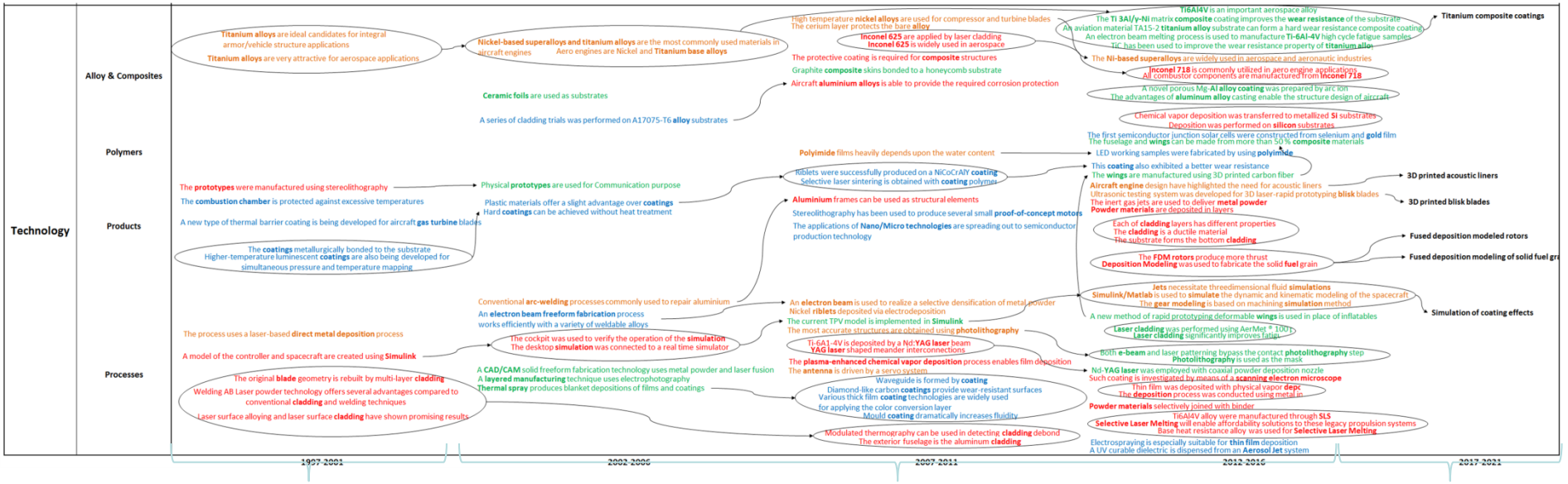


Tekno-Roadmap, an approach for depicting emerging technologies

Technological Forecasting and Social Change 117(2017) 25-37

3.Tekno- Roadmap

Example: Technology Roadmapping of Emerging Technologies: Bibliometrics, **Time Series Analysis and SAO-based Approach**



The TRM shows the initial subfields' developments

The TRM shows the development of the technology. Increasing and decreasing issues.

The TRM shows the potential development of the technology from core and emerging subfields

Competitive Intelligence inputs

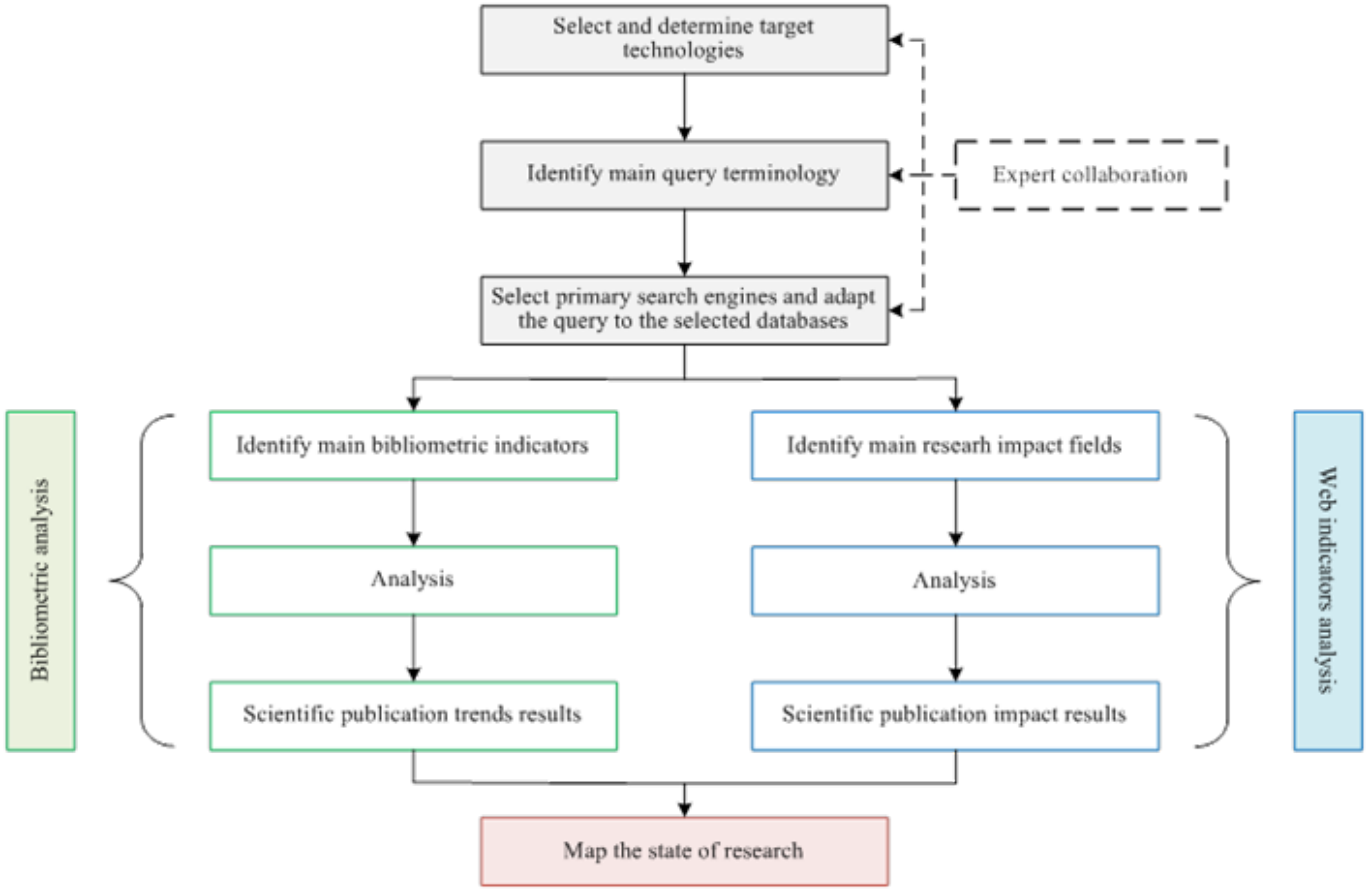
4. Web impact analysis

The objective of the web impact study is the early detection of future impact for the prediction of technological success.

Example:

Additive Manufacturing vs Metal Additive Manufacturing:

Research Trends and Scientific Impact



Workflow of research trends and scientific impact analysis model

Enara Zarrabeitia , Rosa María Rio-Belver , Iñaki Bildosola , Izaskun Álvarez

GIKA 2018

4. Web impact analysis

<table>
<tr><th colspan="2">BIBLIOMETRIC ANALYSIS
Research performance</th><th colspan="2">WEB INDICATOR ANALYSIS
Research impact</th></tr>
<tr><th>Variables</th><th>Bibliometric indicators</th><th>Impact type</th><th>Web data obtained from</th></tr>
<tr><td rowspan="3">– Publication year
– Country
– Institution
– Journal
– Author</td><td rowspan="3">– Number of publications
– Publication outcome: Number of citation counts (quality)</td><td>– Academic impact</td><td>– Citation count indicators
– Mendeley readers
– Wikipedia citations</td></tr>
<tr><td>– Industrial and commercial impact</td><td>– Google Patents citations</td></tr>
<tr><td>– Attention/interest or public engagement impact</td><td>– Blog citations</td></tr>
<tr><td colspan="2">Type of documents and timespan: Articles from 1900 to 2017</td><td colspan="2">Type of documents and timespan: Articles of 2012</td></tr>
<tr><th colspan="2">Software to gather and analyse articles data</th><th colspan="2">Software to gather and analyse web data</th></tr>
<tr><td colspan="2">• VantagePoint</td><td colspan="2">• Webometrics Analyst 2.0</td></tr>
<tr><td colspan="2">A powerful text-mining tool for discovering knowledge in search results from patent and literature databases (VantagePoint, n.d.)</td><td colspan="2">Software designed to conduct automatic web analyses of various types for social science research purposes (Thelwall, 2009a, 2009b)</td></tr>
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Training	Tools
Technology Management Skills	Sci-Tech analysis
Competitive Intelligence Systems	Tekno-MAPS
R&D&i Management systems	Tekno-BAROMETER
	Tekno-Roadmaps

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