State-of-the-Art Tool

Introduction

State-of-the-Art: Main Process

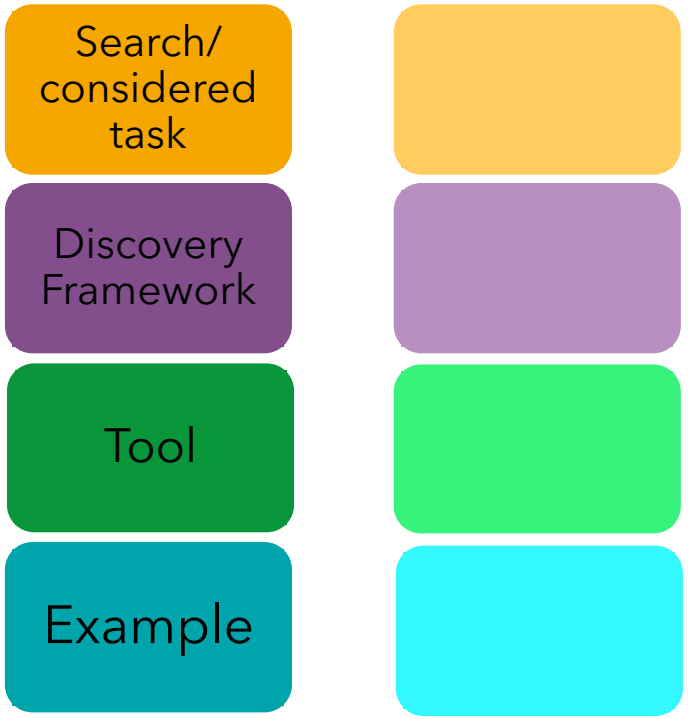
The **State-of-the-Art Tool** provides a structured process to identify cutting-edge technologies and industry trends. It combines quantitative analysis and qualitative expert insights that leverage public data for patents, publications, and academic citations together with trending data from professional databases in a process augmented with standard AI technologies.

This tool offers a comprehensive framework for:

- **Trend and Technology Search**: A systematic approach to explore industry trends and pinpoint potential technologies using both high-level and low-level searches.
- **Technology Status Overview**: Insights into the features, market penetration, and applications of identified technologies, enabling informed decision-making.
- **Technology Diffusion**: A step-by-step guide to exploring patents and academic publications to understand how technologies are evolving and where innovation is happening.

Introduction

Color diagram:



List of the helpful links:

Academic Publication: Wiley, ScienceDirect, IEEE Xplore, WebOfScience, Google Scholar

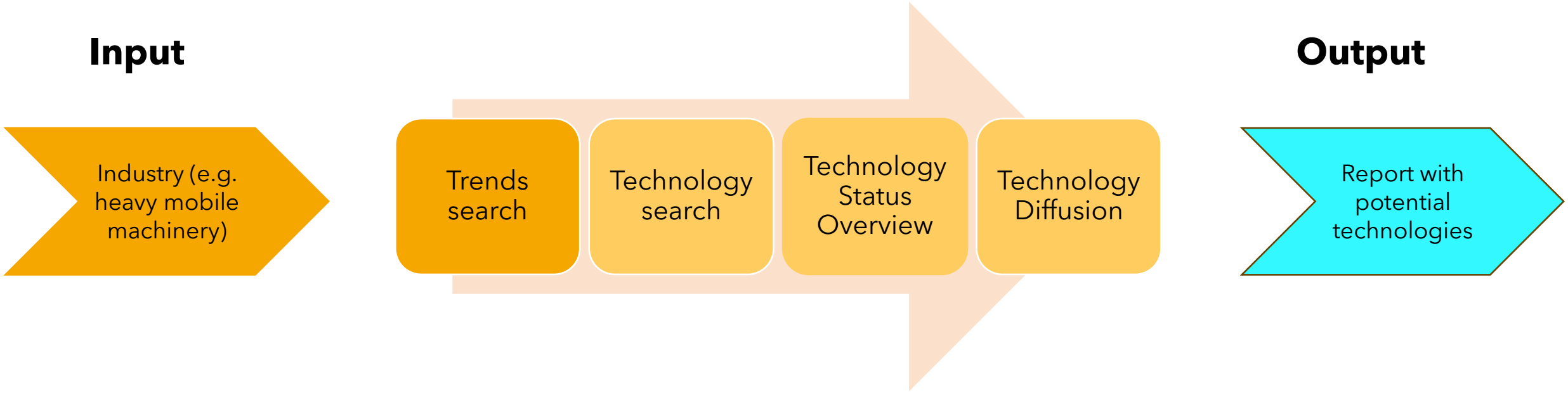
Professional Databases: ResearchGate, ASME, LinkedIn, IVT International

Generative & Generalization tools: ChatGPT, Connected Papers

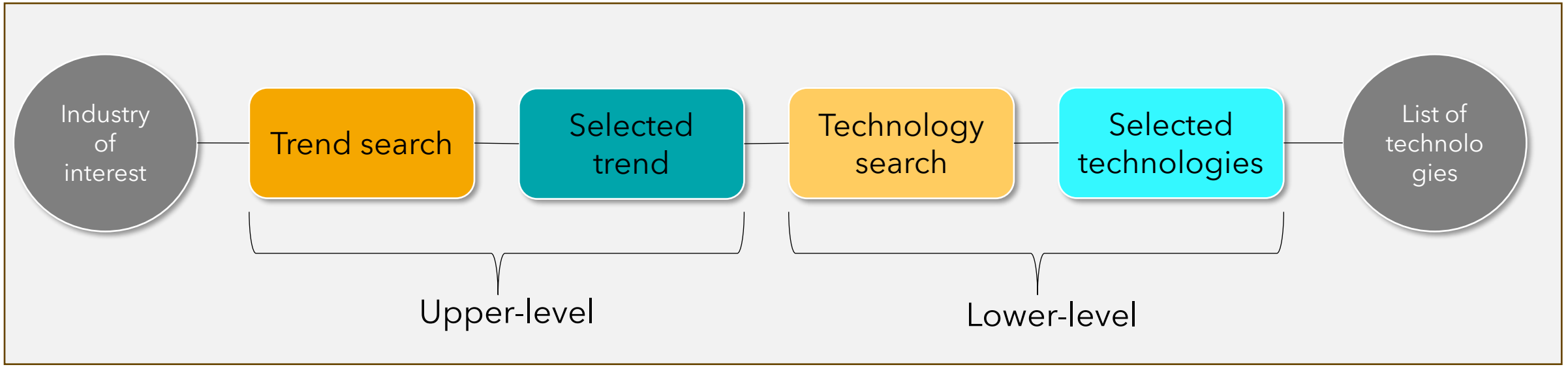
Market Search: Statista, Precedence Research, StraightResearch, Fortune Business Insights, Roots Analysis, Markets and Markets, Mordor Intelligence

Technology Analysis: Statista, Dimensions, Google Patents

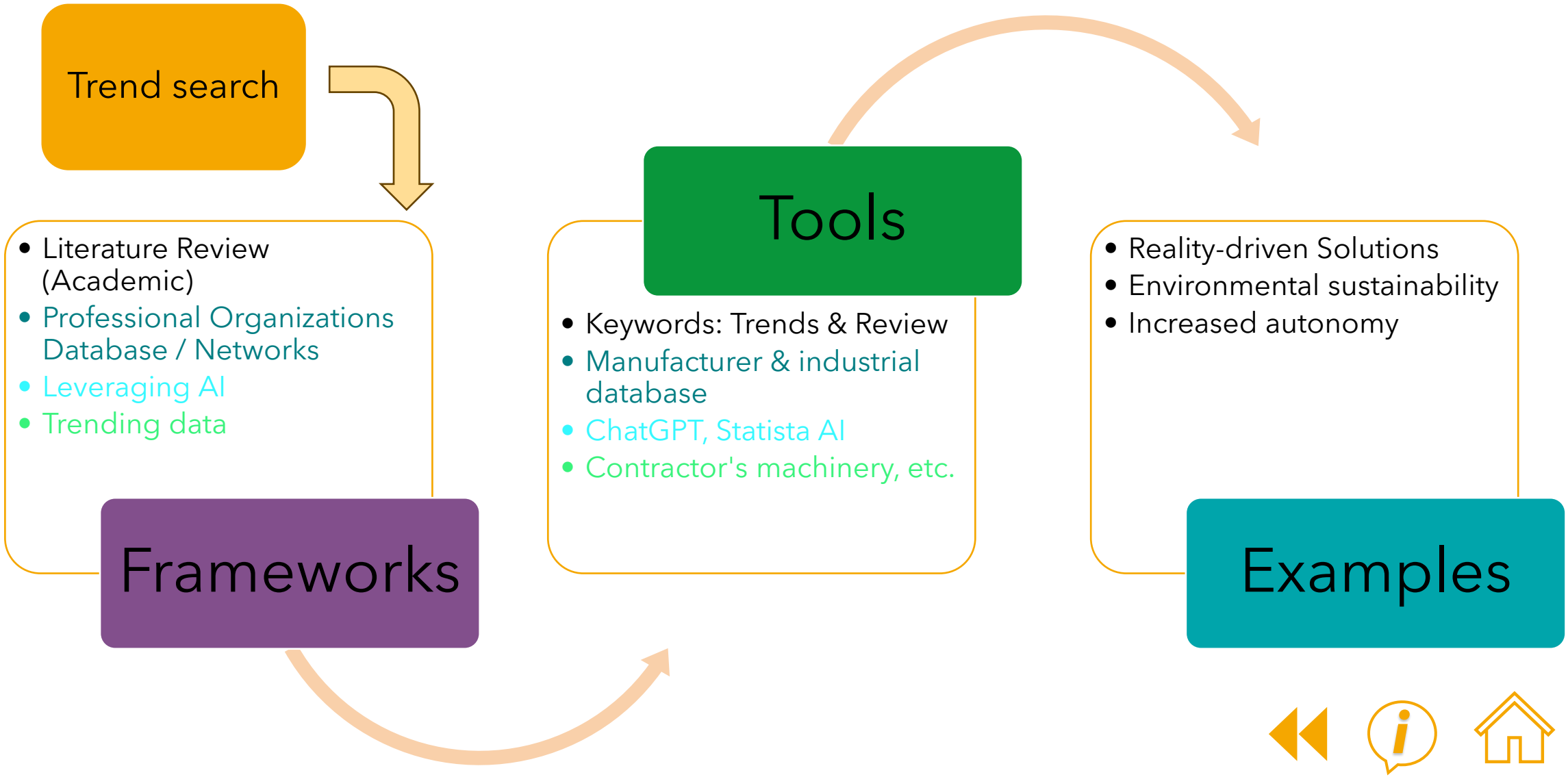
State-of-the-Art: Main Process



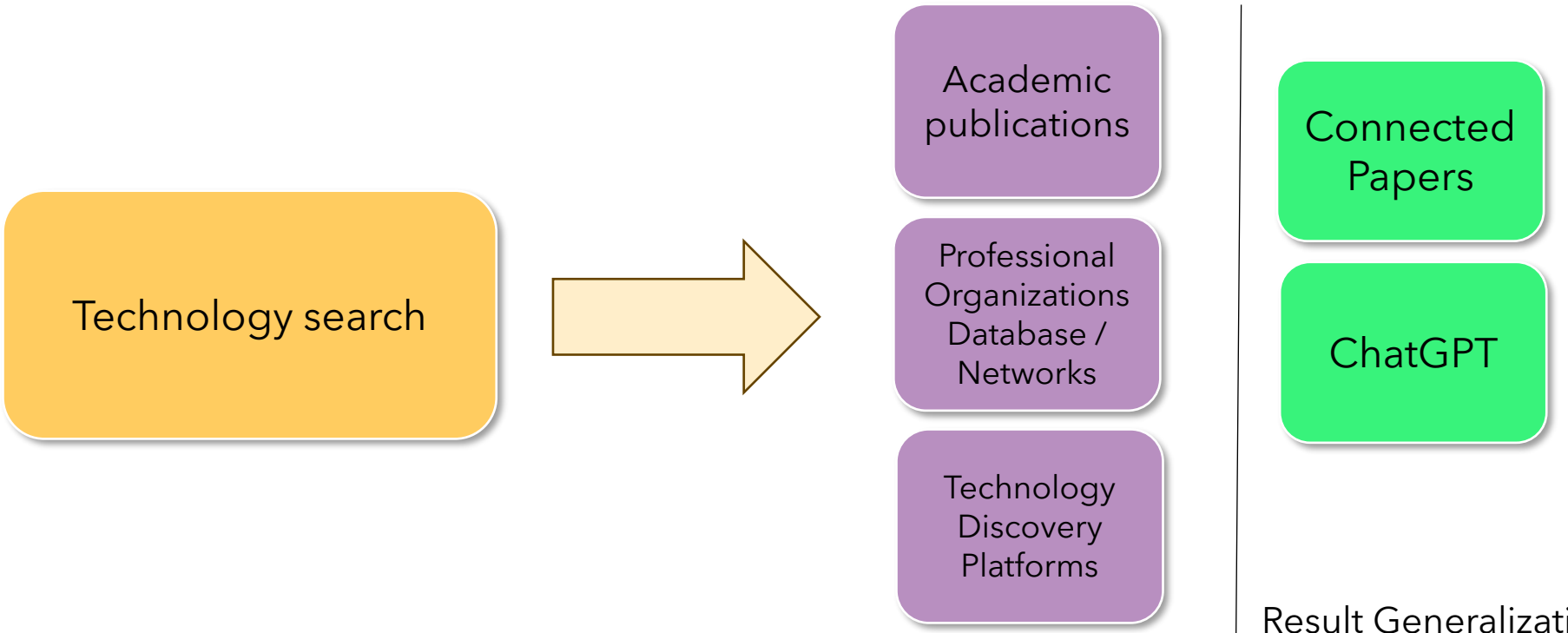
Process Flow Map: Trends and Technologies Identification



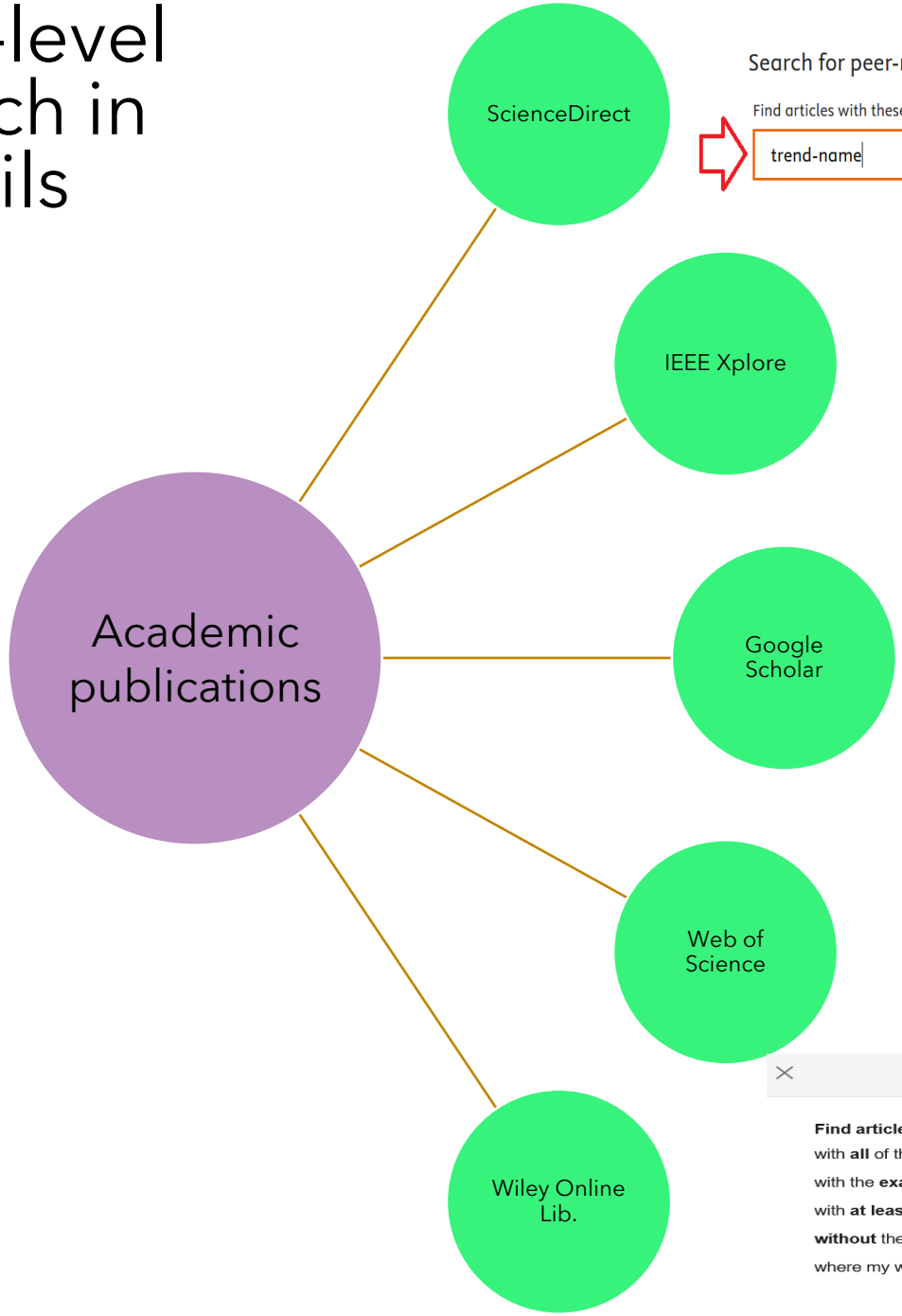
Upper-level search (trend)



Low-level search (Technologies)



Low-level search in details



Search for peer-reviewed journal articles and book chapters (including open access content)

Find articles with these terms: trend-name

In this journal or book title

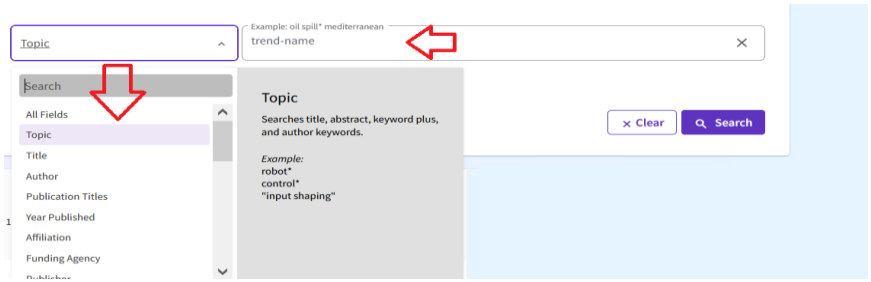
Author(s)

Search | Advanced search

Enter keywords and select fields.

Search Term: Trend / sub-trend — in — All Metadata

AND — Search Term: sub-trend — in — All Metadata



Advanced search

Find articles

with **all** of the words: trend name

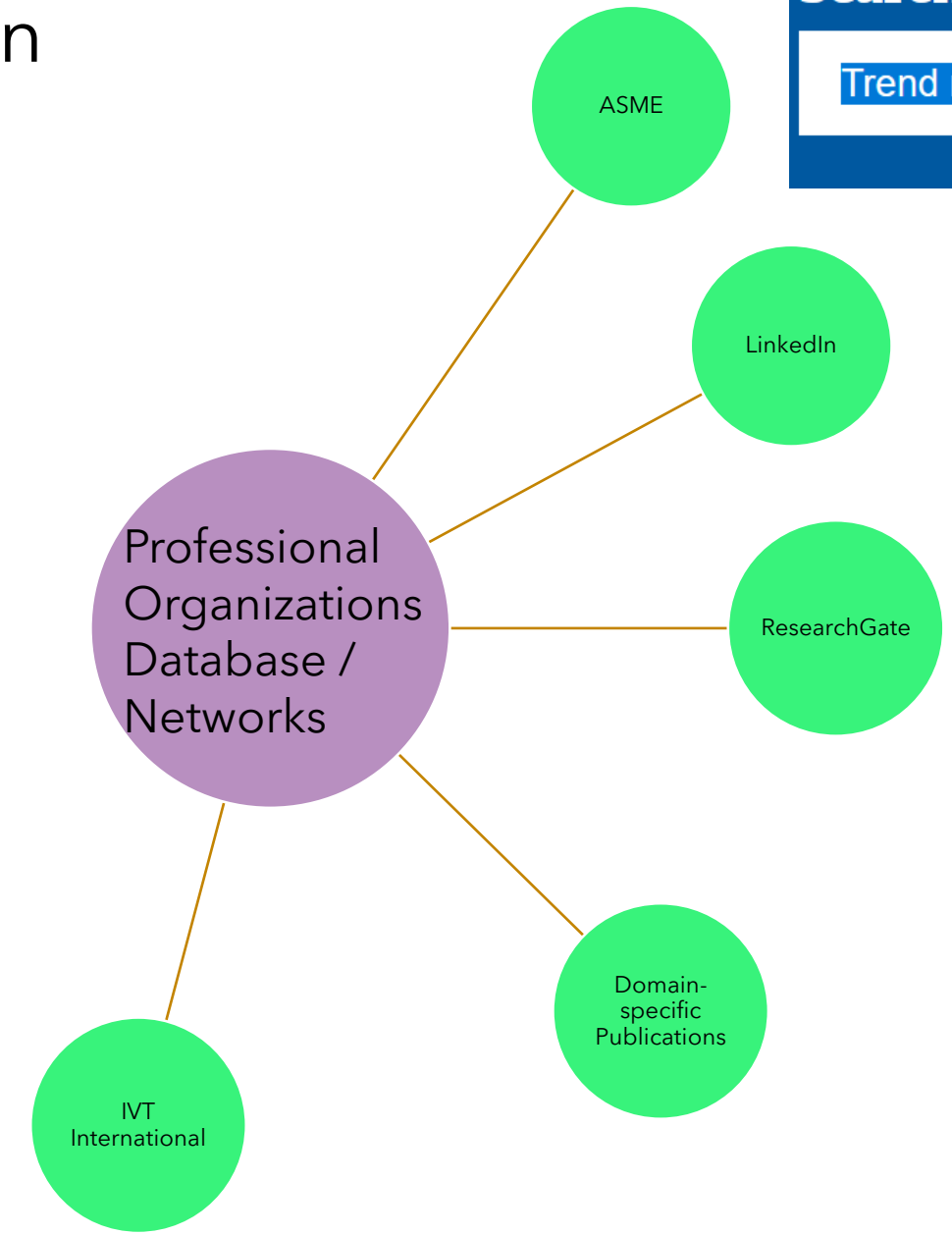
with the **exact phrase**: sub-trend

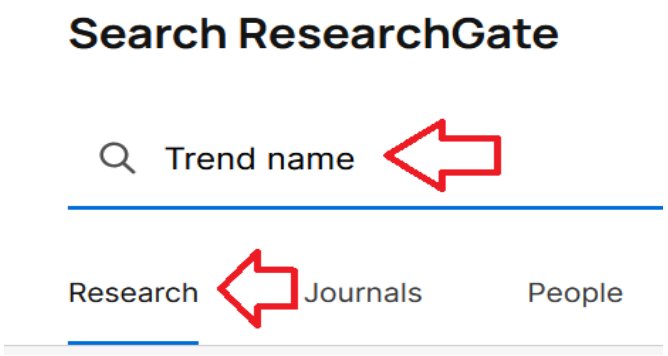
with **at least one** of the words:

without the words:

where my words occur: anywhere in the article / in the title of the article

Low-level search in details

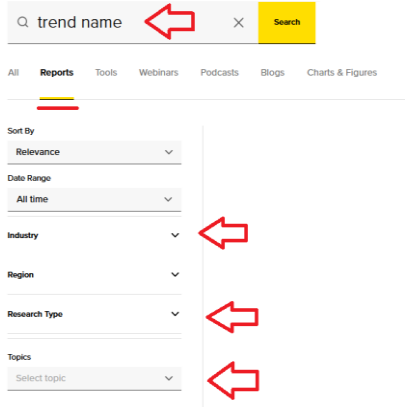


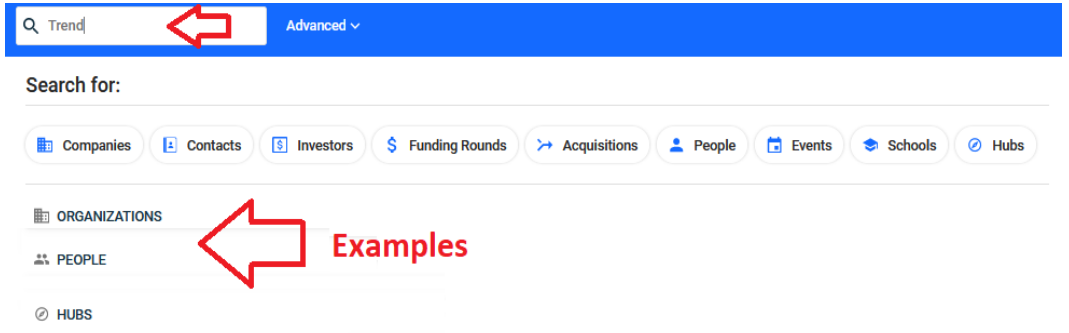


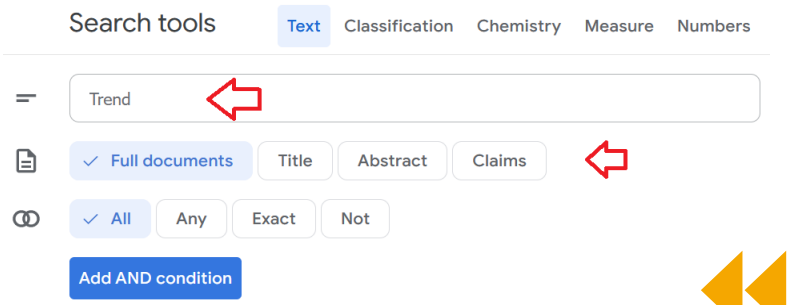
Low-level search in details

Technology Discovery Platforms

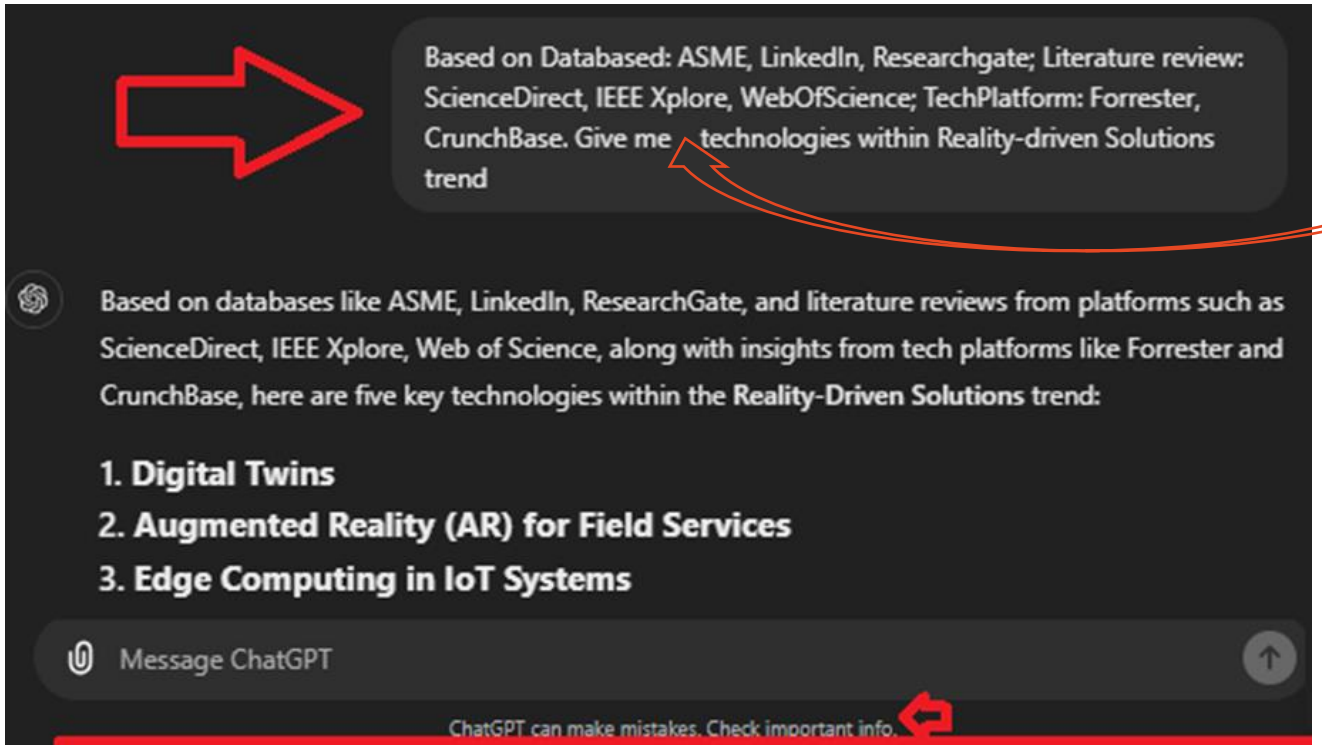
- Forrester
- Crunchbase
- Google Patents





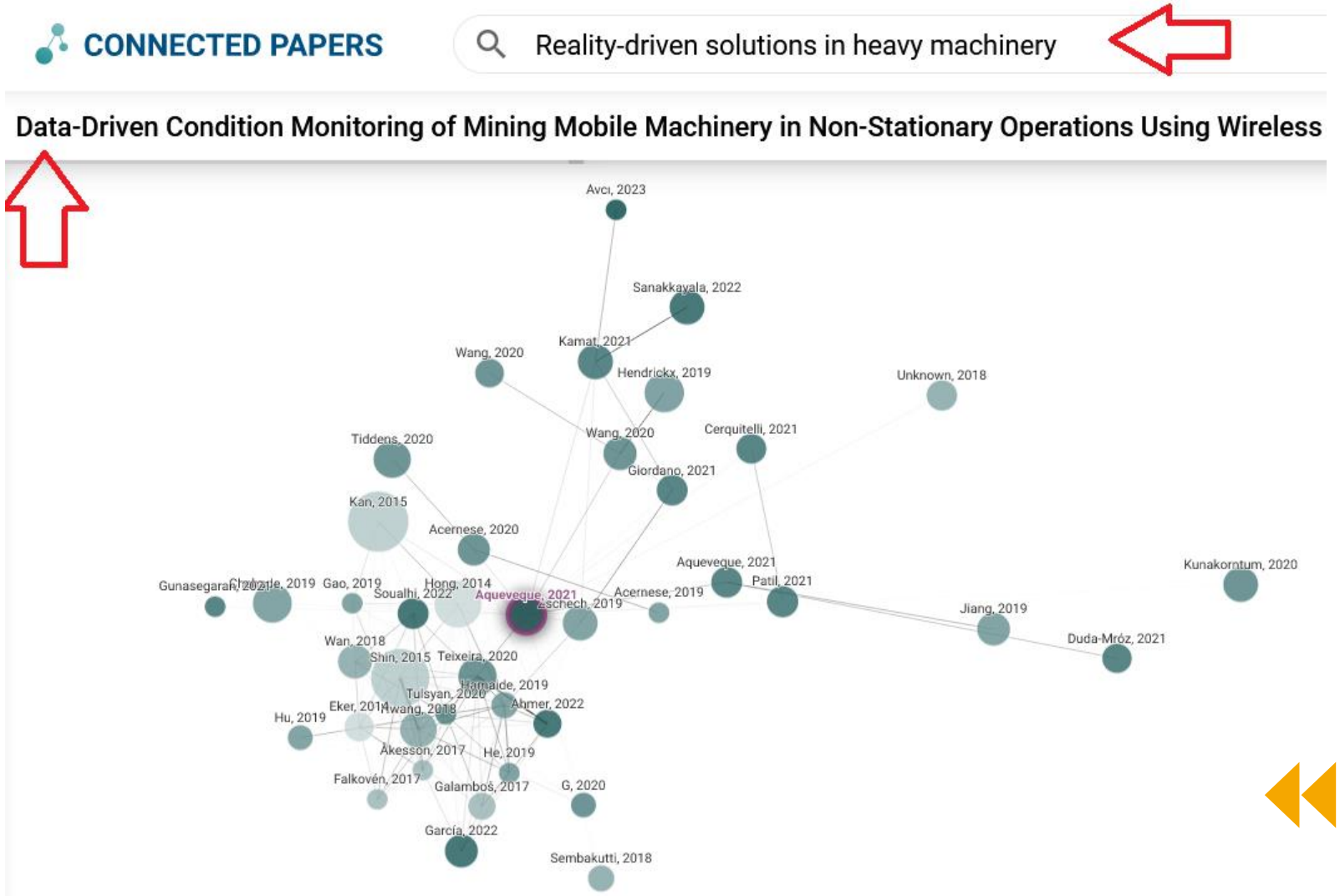


ChatGPT example for Reality-Driven Solutions

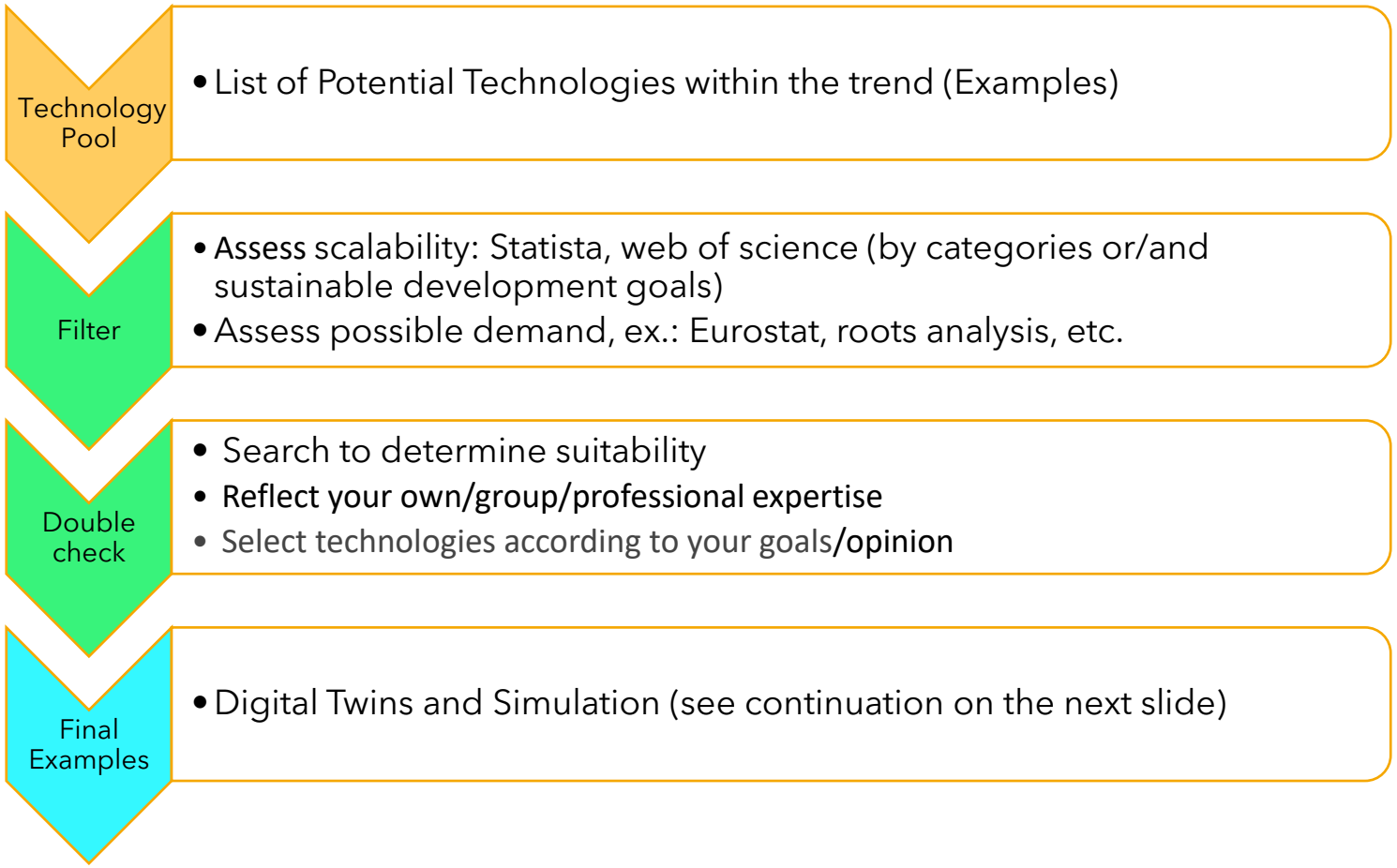


Number of technologies

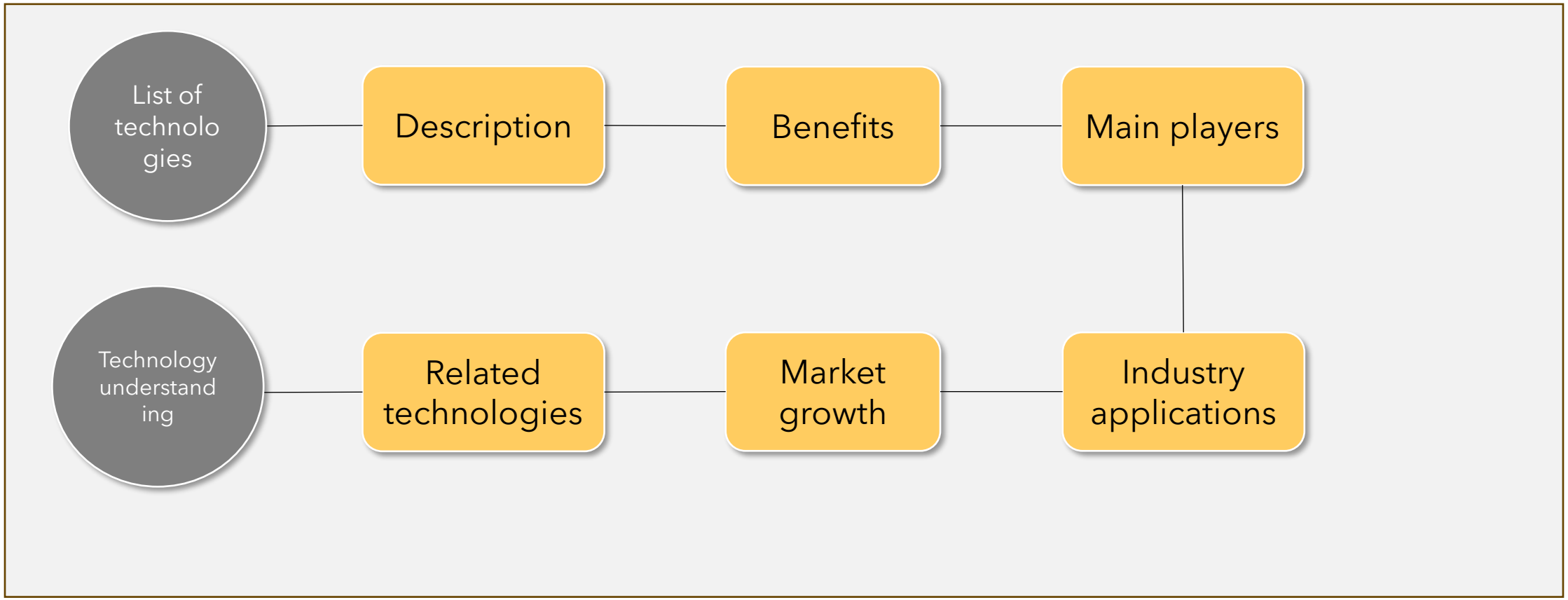
Connected Papers example for Reality-Driven Solutions



Procedure: Select among Potential Technologies



Process Flow Map: Technology Status Overview



Procedure: Technology Description

		Examples
Define Technology	• Briefly describe what the technology does • Explain its core principles and capabilities	A digital twin is a real-time virtual model of a physical machine to monitor and optimize performance.
Components	• Break the technology down into its essential parts • Briefly explain how each part plays a role in the overall function	Digital twins integrate sensors, data transmission systems, simulation models, analytics engine and user interface.
Applications	• Briefly introduce real-world applications in multiple industries • Briefly describe use cases in the analyzed industry	Digital twins are used in mining equipment to allow operators to monitor real-time performance, predict failures, and reduce downtime, improving efficiency.

Procedure: Technology Benefits

		Examples
Efficiency improvements	• Explain how the technology improves efficiency, reduces costs, or enhances productivity in relevant processes	Smart sensors can alert operators to potential failures, enabling proactive maintenance, which avoids costly unplanned downtime.
Sustainability benefits	• Highlight the social and environmental sustainability benefits of the technology • Explain how the technology reduces environmental impact and improve people's safety, health and wellbeing	Autonomous systems in mining reduce the need for human presence in hazardous areas, improving safety.
Operational improvements	• Explain how the technology optimizes processes and improve operational resilience (i.e., anticipate and face disruptions)	AI-driven predictive maintenance identify early signs of wear or failure, allowing the addressing of issues before they occur.

Procedure: Technology Main Players

Examples

Key players

- List leading companies or organizations that develop or provide the technology
- Separate large corporations from niche players

Digital Twins
Large players: Siemens and Ansys
Niche players: Mevea and Algorix

Categorization

- Classify main players into technology developers, service providers or end-users

Smart sensors
Developers: Bosch and ABB
Service providers: Consulting and technology integrators

Market leaders

- Highlight organizations that have established themselves as leaders in this technology

Caterpillar is the pioneer and leader of autonomous mining systems.

Procedure: Technology Applications

		Examples
Sector-specific use	• Identify how the technology is applied in various industries	In agriculture, AI-driven robotics are helping optimize harvests and reduce manual labor.
Key benefits	• Highlight what benefits the technology brings to these industries	Autonomous trucks can operate in remote, dangerous environments, reducing the need for human presence.
Applications	• Mention new or emerging applications where the technology is gaining traction • Discuss how the technology is being used differently across regions or countries	Electric machinery adoption might be higher in Europe due to stricter environmental regulations.

Procedure: Technology Market

Market size

- Provide data on the current market size of the technology
- Use market forecasts to show how the technology is expected to grow over the coming years

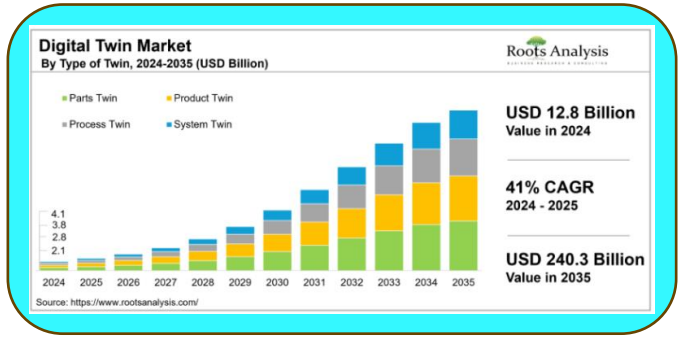
Market segmentation

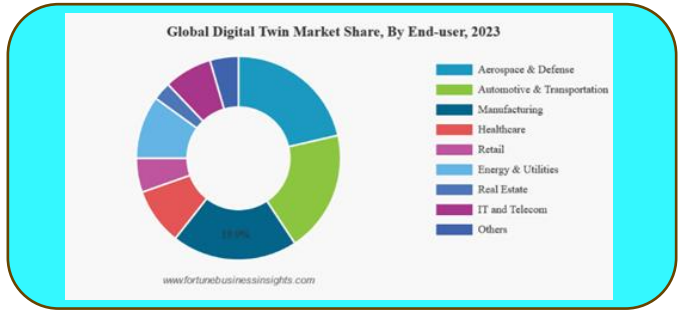
- Break down the market by industry, region, or other segments

Drivers and challenges

- Identify factors driving market growth and barriers or challenges facing the market

Examples



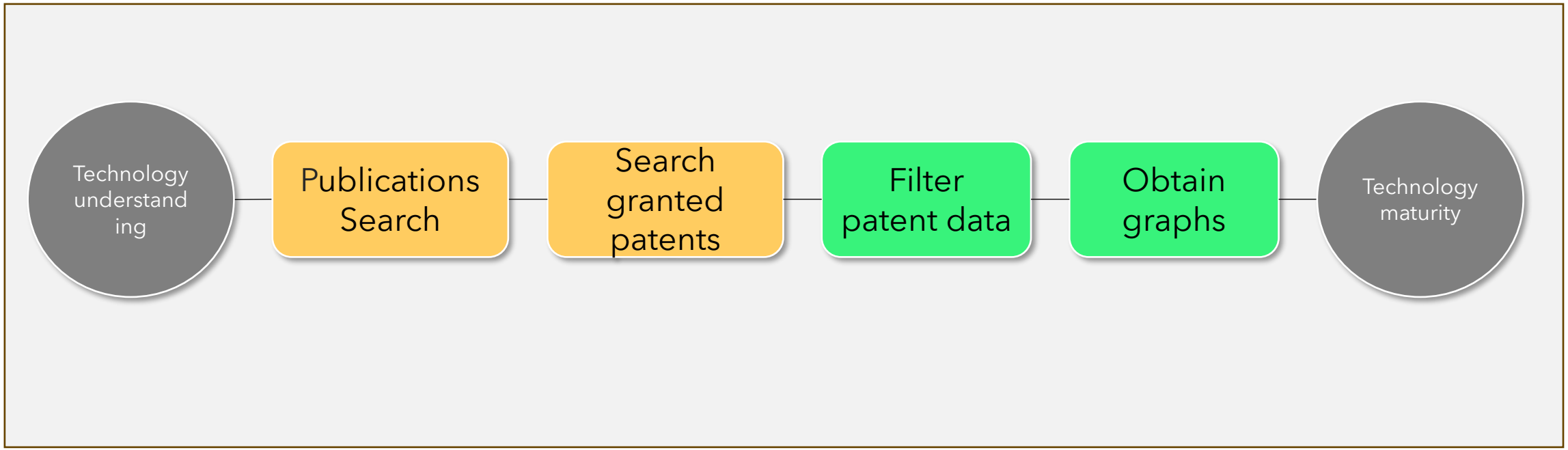


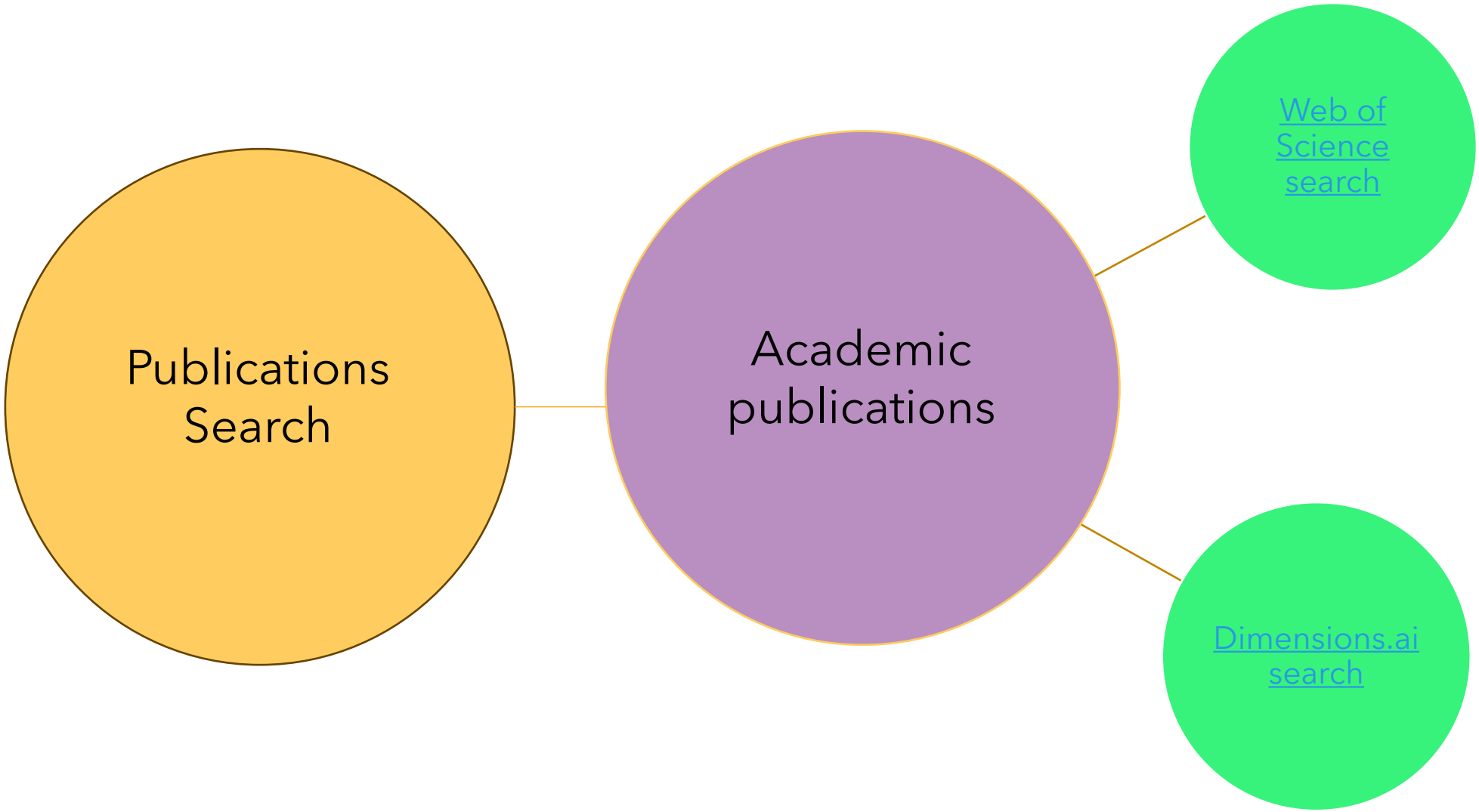
Drivers: Growing demand for automation, increasing focus on sustainability.
Challenges: High initial implementation costs, regulatory hurdles.

Procedure: Related Technologies

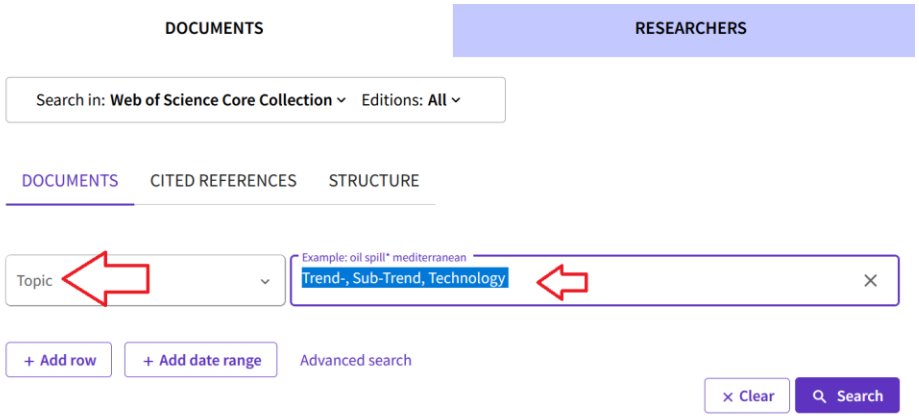
		Examples
Complementary technologies	• List complementary technologies that are commonly used in conjunction with the main technology	Predictive analytics uses data from digital twins to forecast machine failures.
Ecosystem view	• Present the technology in the context of a larger technological ecosystem, showing how it fits into broader industry trends	Autonomous vehicles rely on an ecosystem of technologies like perception systems, AI, LiDAR, and GPS.
Examples	• Include examples of solutions or systems where multiple connected technologies are deployed together	Autonomous mining trucks use AI, perception systems, and smart sensors to navigate complex environments and avoid collisions.

Process Flow Map: Technology Diffusion

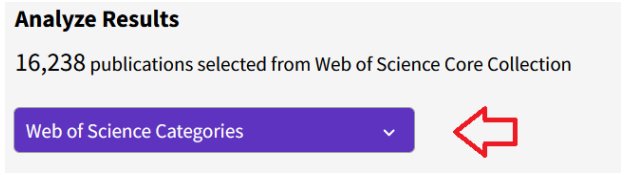


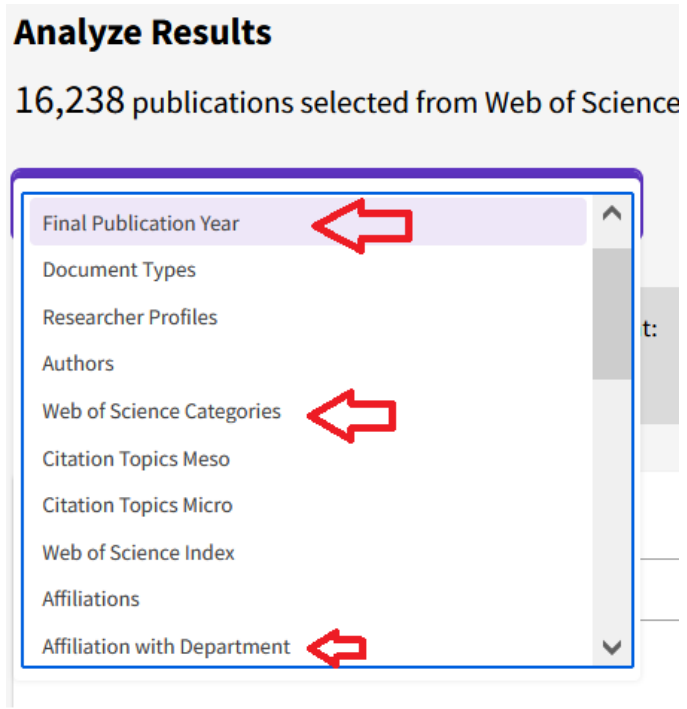

Publications Search
Academic publications
Web of Science search
Dimensions.ai search

Web-of-Science Search

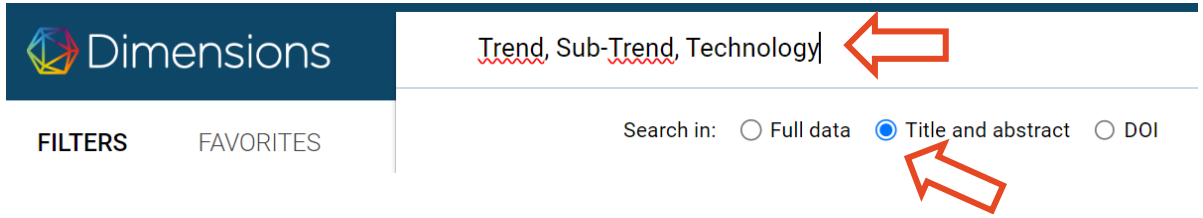


Digital twin example

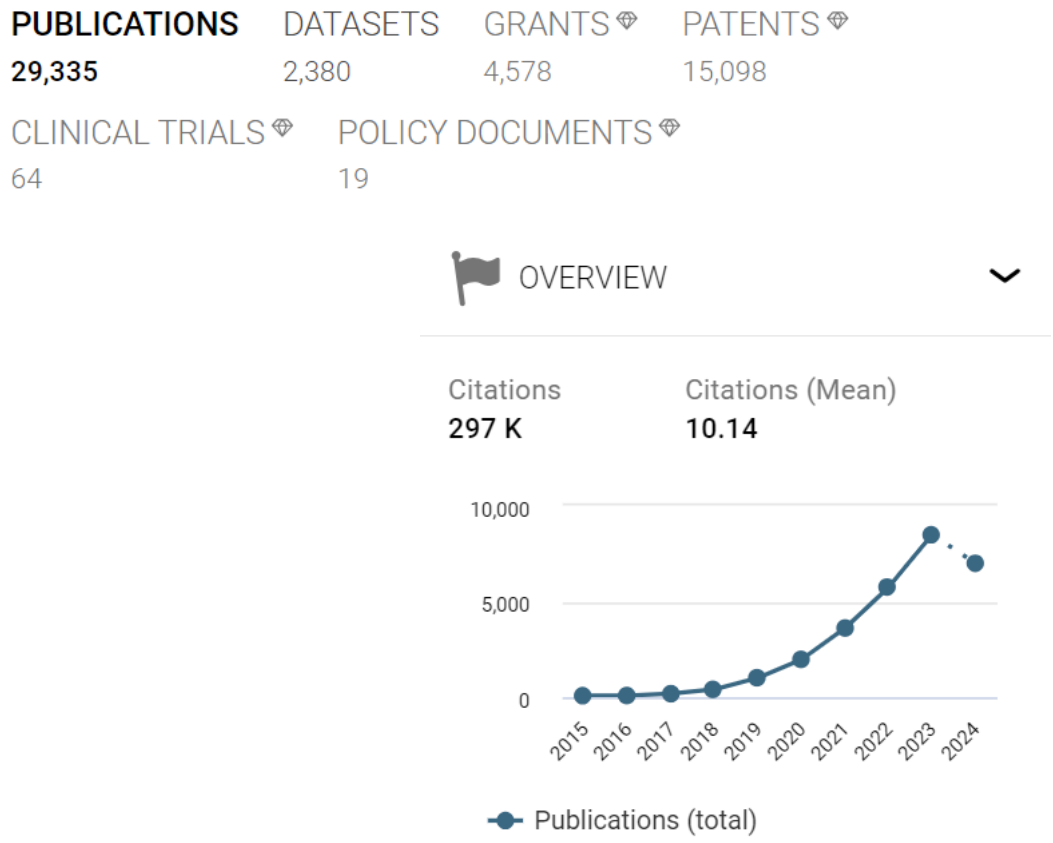




Dimensions.ai Search

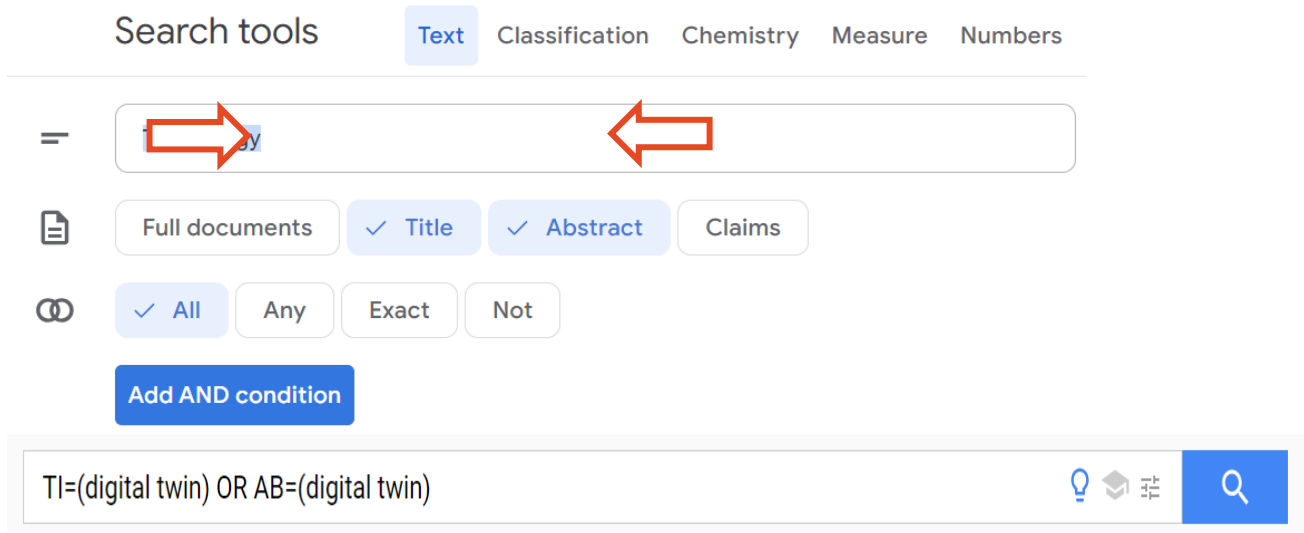


Digital Twin example

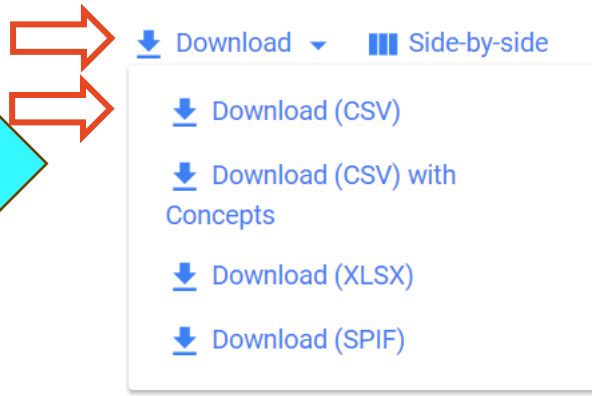


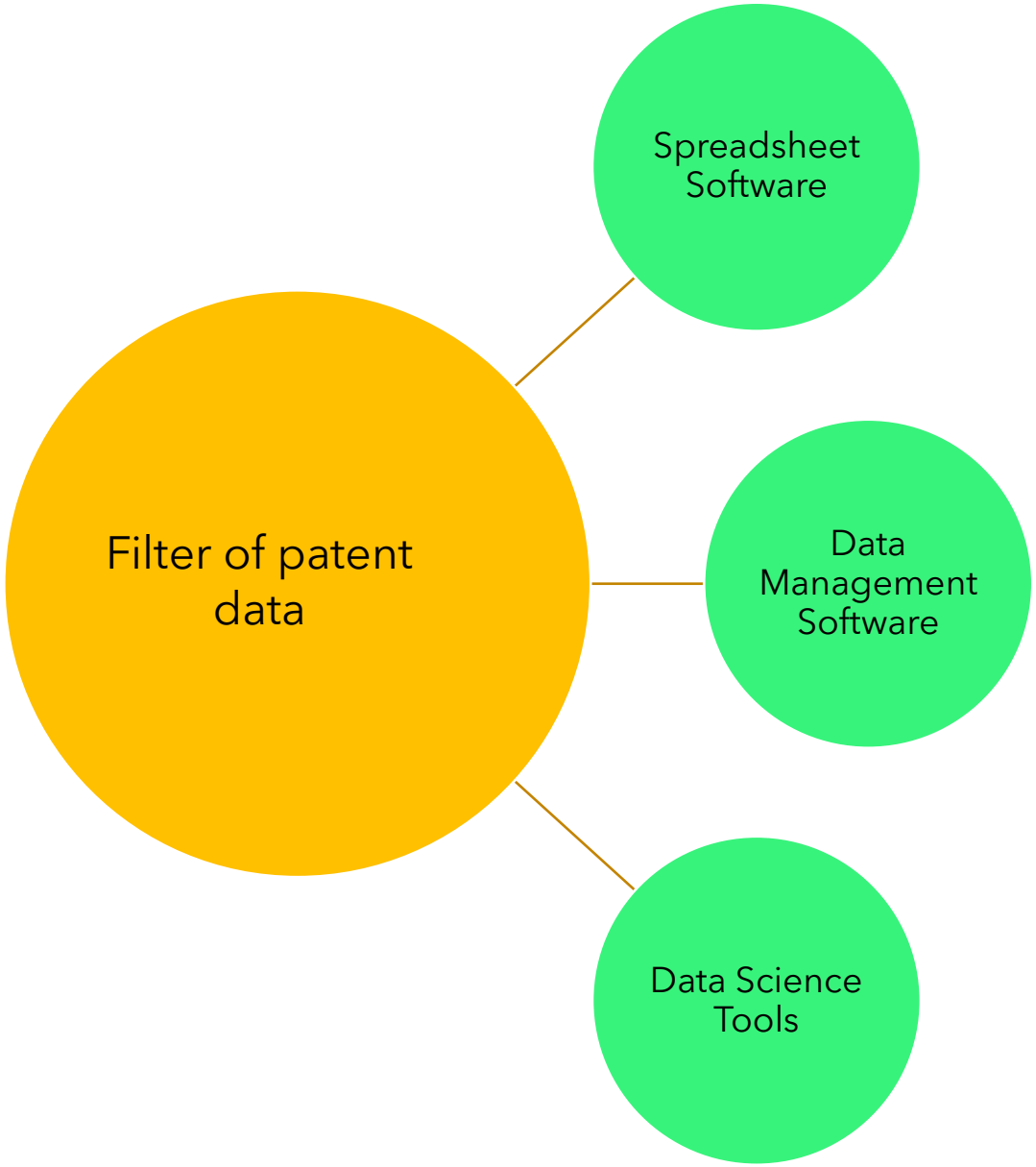
Granted Patents Search – Google Patents

Google patent



Digital Twin example





Filter relevant fields, including patent name, country of application and grant date

Obtain graphs

- Obtain trend and bar charts from the Excel file's filtered data
- Recommended time period – from 2000 to date
- Order the graph of patents by country from highest to lowest

Digital twin example