## Emerging technology snapshot
Early detection of emerging technologies

The rapidly increasing volume of scientific publications makes early detection of emerging technologies in the resulting vast body of literature more and more challenging. An active field of scientific research is continuously experimenting with new approaches, such as network analysis, topic modelling and machine learning. The effective identification of new technologies is of great significance for countries and organizations to seize strategic development opportunities and form innovation-driven competitiveness.
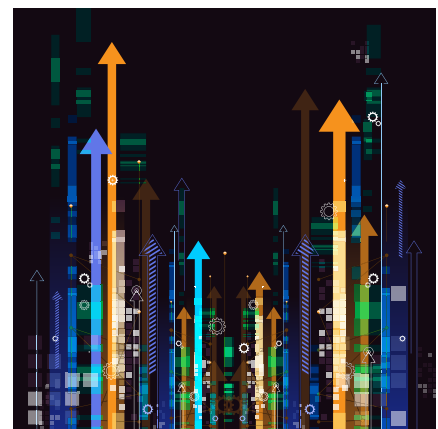
Enabling Science and Technology

Convergence

Convergence looks at novel combinations of distant fields of science and technology which emerge when previously unrelated scientific domains begin to cite each other and collaborate. Convergence provides scientific means to detect new fields of research and emerging technologies.

Link prediction

Link prediction analyzes a network at a set point in time and predicts what links are likely to appear in the future. It can also be used to identify missing links in a static network. To identify emerging technologies, it is applied on different networks, such as keyword co-occurrence networks from scientific articles or co-classification networks from patents.

Bibliometrics

Bibliometric analysis is the quantitative study of bibliographic material. It is often used to provide a comprehensive review of developments in a subject. When combined with other methods, such as topic modelling, co-citation networks, cluster analysis or citation burst detection, a bibliometric analysis can lead to the identification of emerging research and developing key topics.

Topic prediction

Many methods have been developed to predict topics and trends, with several using natural language processing or text-based modelling. To overcome the limits of these more common methods, researchers are exploring machine learning and network analysis to more accurately predict future topics of interest, even before the topics actually materialize in documents.

Topic evolution

Understanding topic evolution in a scientific domain can facilitate the promotion of knowledge transfer and help keep track of innovations and knowledge flows. It reveals how a topic is changing over time; whether it is in the early stages of appearance, gaining importance or maturely developed; how knowledge transfer occurs between topics; or whether a topic has split or converged into other topics.

"… today's white-hot innovations will indeed become tomorrow's legacy applications… our pioneering advances might one day be dismissed by the new generation as "the old way"."

Mike Bechtel, Chief futurist, Deloitte Consulting LLP. Tech Trends 2023. December 6, 2022.

National Research Council Canada

Conseil national de recherches Canada

Canada

Signals

Academic

The University of South Alabama suggests a network-based evolution approach, operating on any datasets, using an algorithm to identify possible common ancestors of future new descendant topics.

Government

The Chinese Academy of Sciences uses correlation analysis to show that the number of international patent classes, of citing patents and of patents in the same family, are indicators of disruptive technologies.

Collaboration

A collaboration between University of Technology Sydney, Australia, and Beijing Institute of Technology, China proposes a bi-layer network analysis to predict emerging general purpose technologies.

Defence

The Seoul National University of Science and Technology analyzed patent applications by the Agency for Defense Development of South Korea to predict technology convergence in the defence field.

Corporate

Search Technologies Inc, USA, an active company in technology mining, has developed an emergence score that identifies emerging technologies based on measures of growth, novelty, persistence and community.

"In a world of continual change, it is necessary to explore and filter, assess, and then invest in emerging technologies to be resilient and adaptive."

Cristy Stone, Lead research for the Emerging Technologies team, Avanade. 3 steps to identifying emerging technologies that create business value. March 10, 2022.

Impact

Social

Combining traditional patent analysis with social media data mining can enhance the detection of emerging technologies and accelerate the identification of changing trends.

Policy

An early understanding of the dynamics of technological change is crucial to help R&D policymakers make better-informed decisions and strategically allocate resources.

Economic

Identifying emerging technologies helps companies to evaluate the commercial viability of the latest technological advances, to test new ideas and to grow revenues.

Environmental

Identification of promising emerging clean technology can have a significant impact on the environment.

Defence

Emerging technologies represent a unique challenge for national security as a lot of the research on these technologies is happening in the commercial sector and have dual-use applications.

"To support … competitiveness, policymakers need to make strategic decisions for defense modernization, including where to invest attention and resources. Whether identifying threats or opportunities, leaders benefit from accurate forecasts about the capabilities and limitations of emerging technologies and industries."

Harisson Durland, National Defense Magazine. Modernizing Defense Through Crowdsourcing. December 15, 2022.

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