Mapping Canada's strategic technology opportunities for increased industry partnerships

AI-Driven Bibliometrics for Research Impact

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Strategic Technologies Are Now an R&I Priority

Canada's strategic challenge is to turn evidence on emerging technologies into future research and innovation action

Global Competition

Key technologies are tied to economic growth and resilience

Strategic Focus

Identify emerging opportunities where industry partnerships could help realize Canada's technology potential

Policy Relevance

These signals can help inform R&I strategy, technology policy, and industry engagement priorities

The goal is not only to describe Canada's research position, but to identify where strategic action could shape future advantage

Goal: Move from CCA's broad-field STI positioning to an AI-driven KTA-level strategic analysis

Strategic use: Identify technology opportunities where stronger industry engagement could advance Canada's innovation capacity and global competitiveness

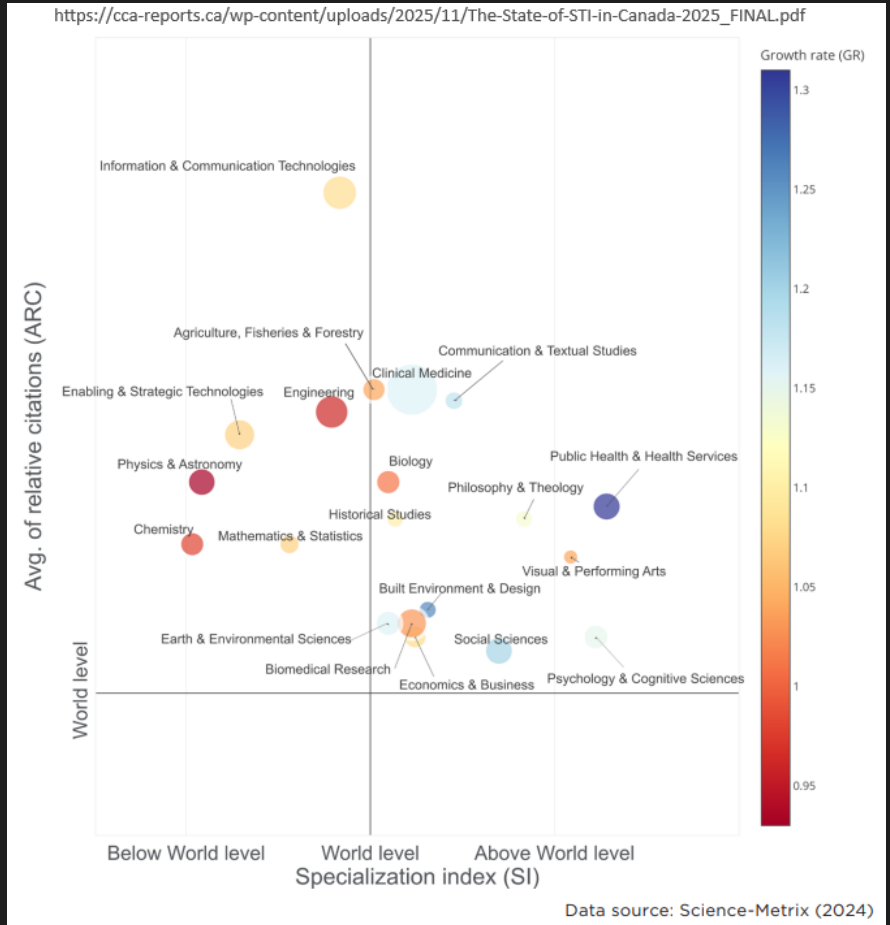


Figure 6.2 Positional analysis of Canada's fields of research, 2012–2023

What evidence base underpins the KTA analysis?

A consistent evidence base for positioning Canada across key technology areas

Source

Scopus

Peer-reviewed publications indexed in the global Scopus database

Study Period

2017-2024

Recent publication activity with enough runway to assess growth

Technology Scope

312 KTAs

Key technology areas organized across 15 higher-level domains

Geographic Frame

Canada, US and world

Canadian outputs benchmarked against US and global research activity

Counting Basis

Indicator-specific counting

Indicators use full or fractional counting as appropriate

Analytical Use

Positioning to strategy

Supports KTA mapping, SWOT, and industry engagement benchmarking

How were publications mapped to key technology areas?

A multi-step agentic classification workflow translates KTA definitions into reviewable publication sets, with quality targets above 95% precision and 75% recall

1 KTA Definition
Start with working definition, setting the boundary for classification

2 Agentic Classification
Multi-step workflow evaluates titles and abstracts for relevance to one or more KTAs

3 Reviewable Evidence
Validation samples and recall checks support transparency and interpretation

Designed for >95% precision and >75% recall, with expected variation across technology areas

Example: Quantum Information Theory

DEFINITION

Mathematical and theoretical foundations describing quantum information processing, including quantum error correction, entanglement theory, and quantum algorithms.

JOURNALS TO ESTIMATE RECALL

Journal	Pubs	Recall
Quantum Information Processing	2,068	92.1%
npj Quantum Information	664	77.1%
Quantum Information and Computation	167	92.8%

VALIDATION SAMPLE

- Fundamental Limits of Quantum-Secure Covert Communication over Bosonic Channels
- …

Canada in the KTA landscape

Canada's KTA output spans all 15 higher-level domains, with nearly two-thirds of publication activity concentrated in five broad technology areas

Molecular & Biomed Biotechnology

Data Mgmt, Analysis & Cybersecurity

Computing & Semiconductor Tech

Healthcare Tech

Environmental Tech

Adv Materials

AI & Machine Learning

Adv Manufacturing

Climate & Disaster Prev & Mitigation

Adv Energy & Efficiency

Transportation & Aerospace

Urban Tech & Smart Cities

Adv Comm

Robotics & Automation

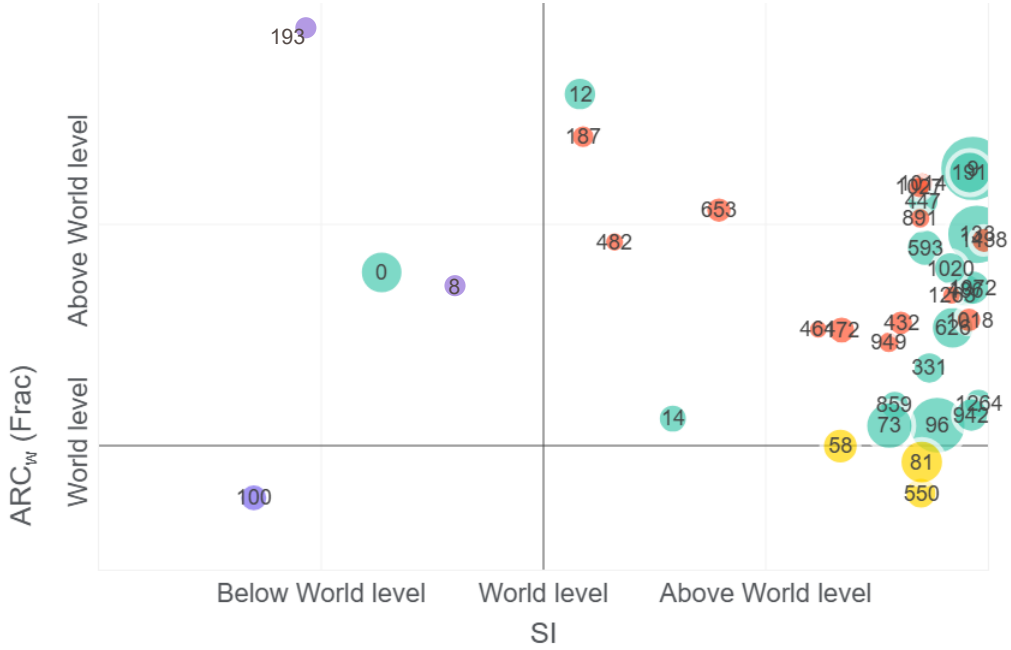
Quantum Information Science

How do we move from KTA mapping to identifying opportunities?

Opportunity shortlisting looks for emerging KTAs where Canada has a plausible path to future strategic strength

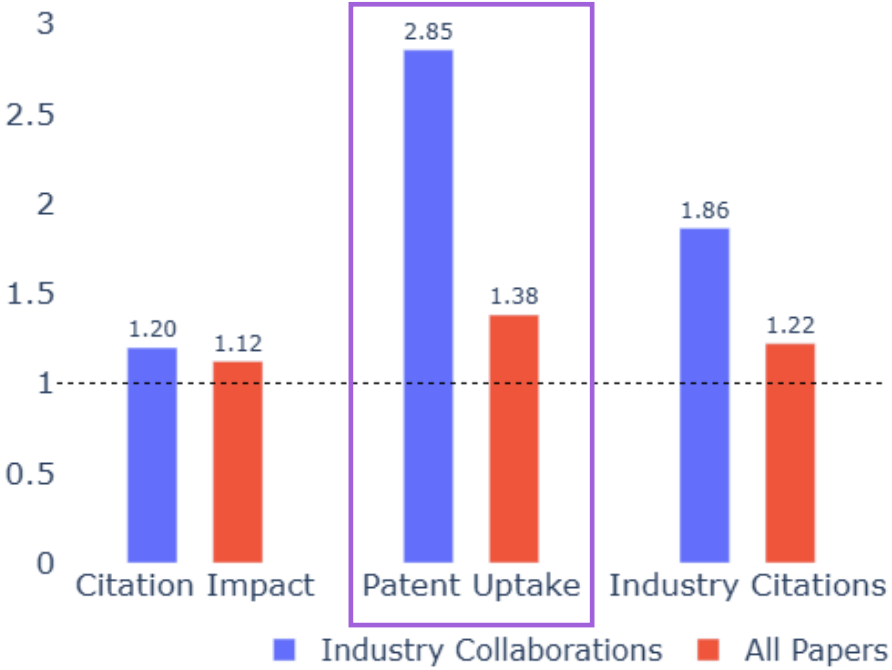
Range of opportunity signals

- CA is under-specialized with high-impact potential and adjacent capabilities to grow
- CA has small output but good impact and adjacent capabilities to grow
- CA shows high impact and interdisciplinary activity
- CA weaknesses with improvement potential through collaboration and adjacent capabilities



Why and how do we identify opportunities and threats with industry partnership gaps?

Industry collaboration is strongly correlated with research translation to innovation in Canada



Linking SWOT diagnostics to practical industry partnership roadmaps

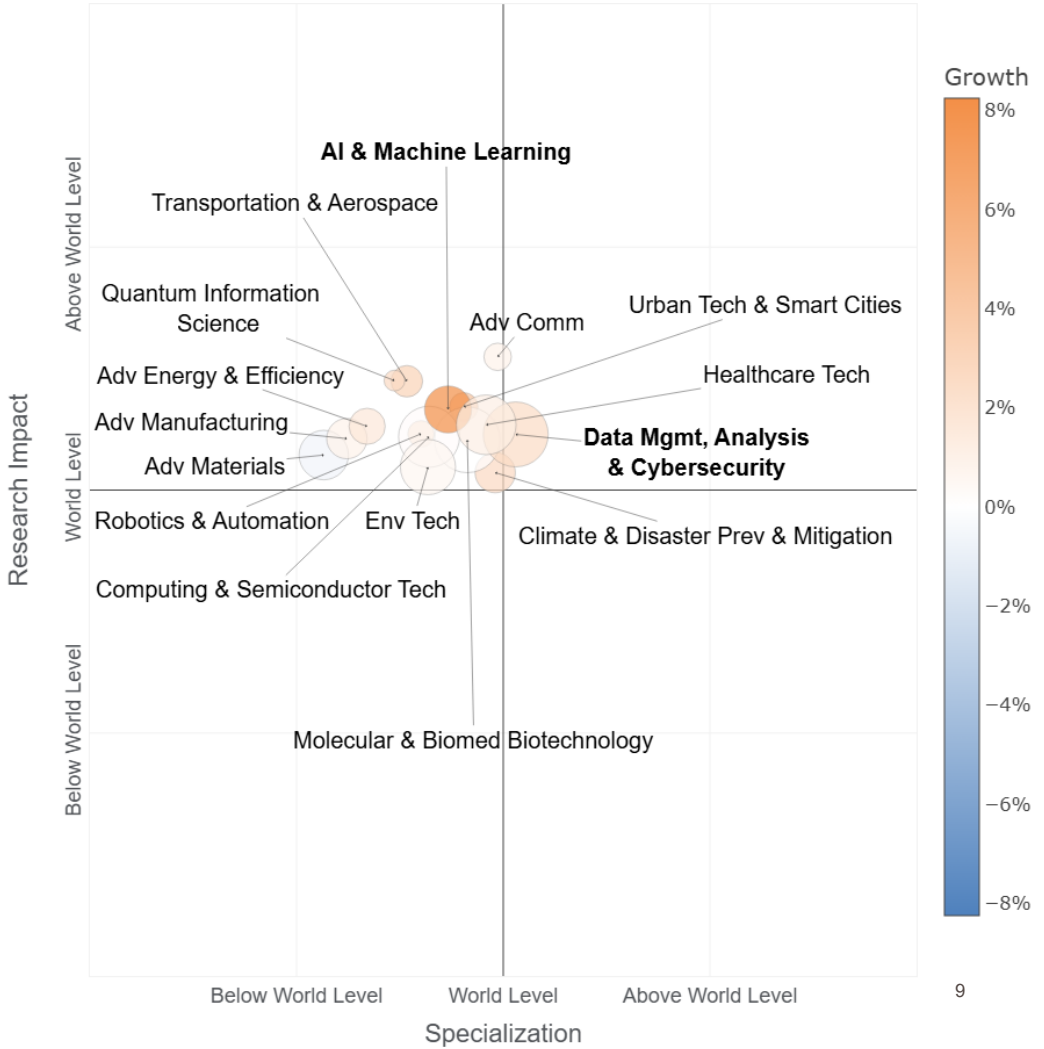
1. Start with opportunity candidates

2. Assess Canada's academic-private collaboration relative to US

3. Identify KTAs where stronger industry engagement could help realize opportunities

Canada performs well across KTA domains, but momentum and specialization vary

- Canada achieves above-world research impact across all 15 KTA domains, despite limited specialization
- Data Management, Analysis & Cybersecurity stands out: 2nd in volume, 1st in specialization, and 12% above world impact
- AI & ML shows high impact (18% above world; 5th) and Canada's strongest momentum (8.2% CAGR), though still below global growth (13.5%)
- These two domains frame several opportunity areas where industry engagement gaps are examined next



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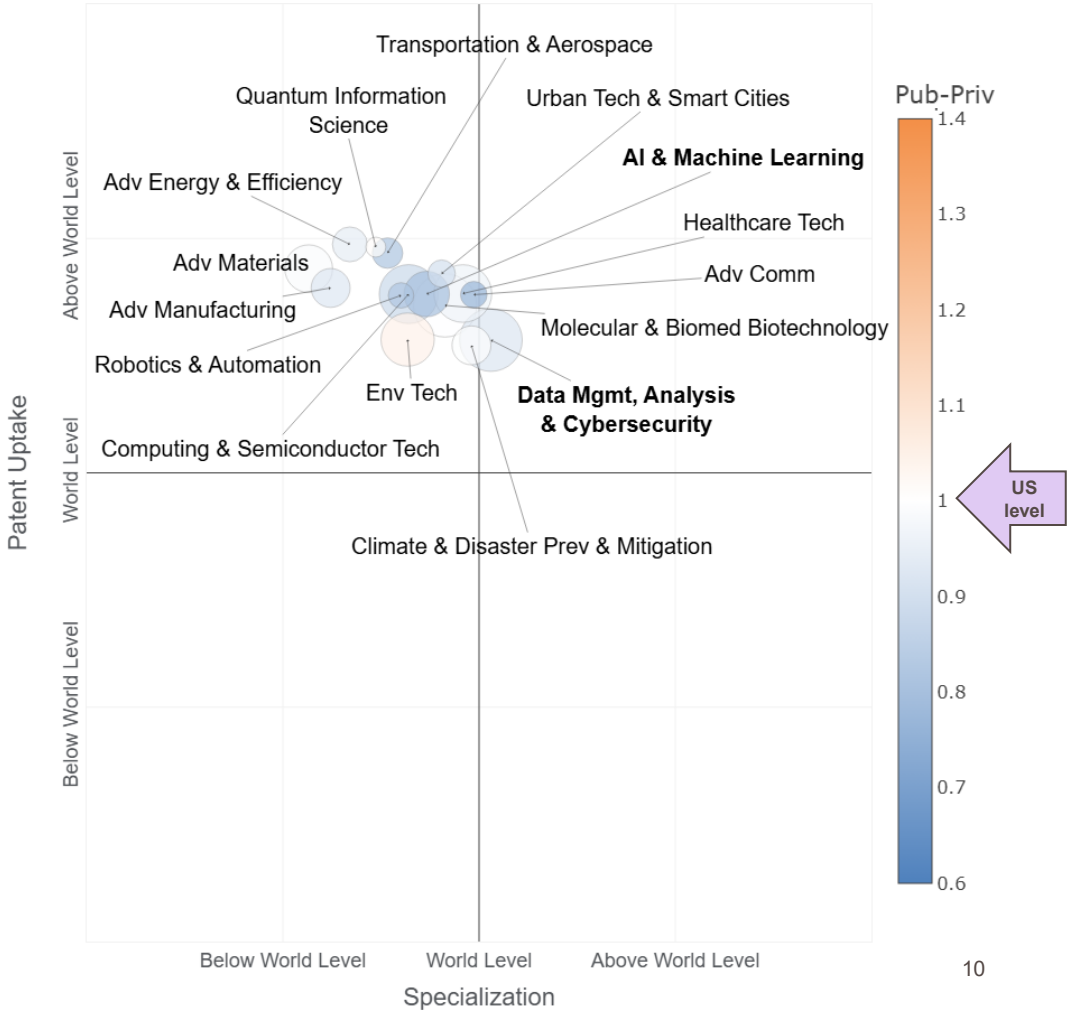
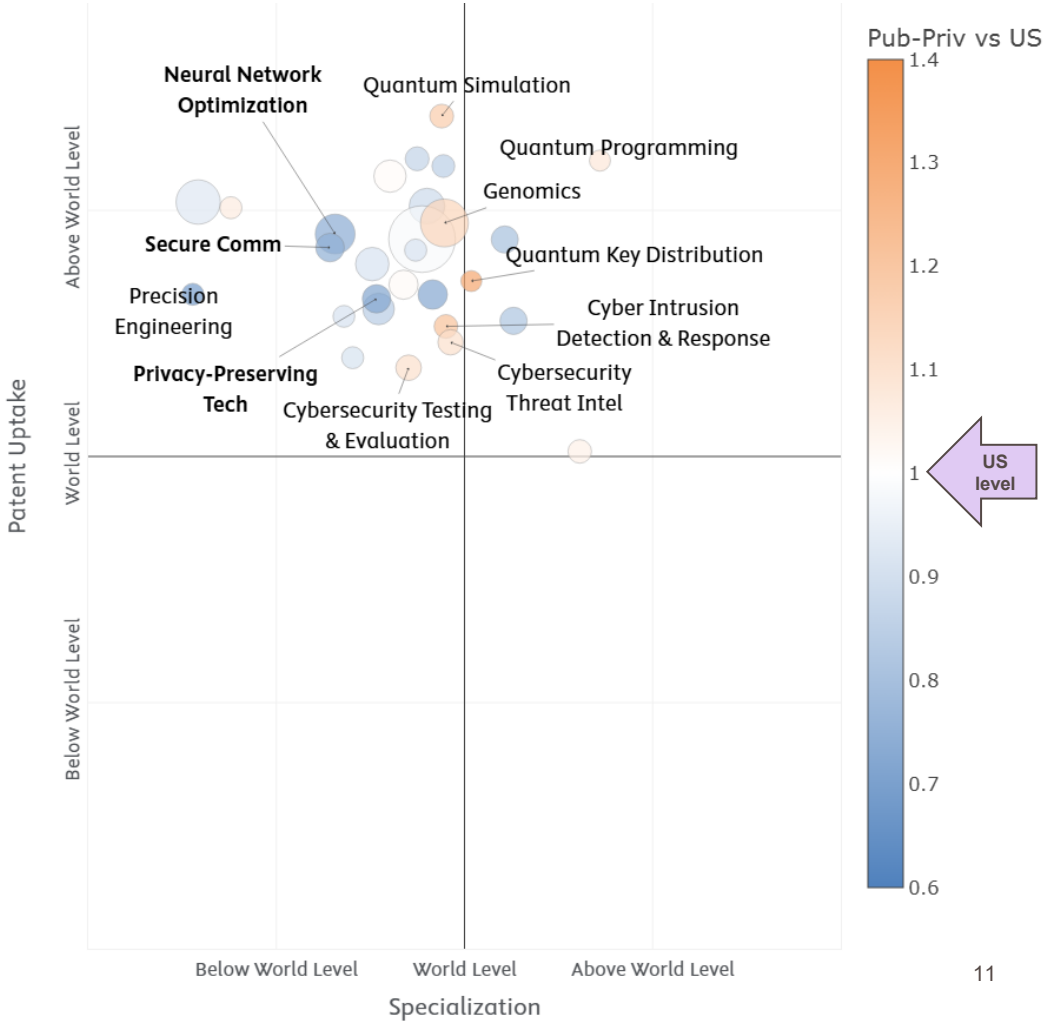
Moving from research to technological impact and from growth to acad-private engagement

- Patent uptake is generally strong, ranging from 32% to 70% above world, but industry engagement lags the US
- AI & ML remains strong, but drops from 5th to 7th in impact, while ranking 14th for industry engagement
- Data Management, Analysis & Cybersecurity drops from 7th to 14th in impact, with an 8% industry engagement gap vs. the US
- Above the US in industry engagement in: Env. Technologies, Quantum Info. Science, Mol. & Biomed. Biotech, Climate & Env. Disaster Mitigation, and Adv. Materials



Industry engagement gaps reveal where AI opportunities may need targeted partnership roadmaps

- Canada lags the US in industry engagement in nearly 80% of KTAs
- Among 24 shortlisted opportunities, Data Management accounts for the largest share: 8 opportunities (33%)
- The three largest gaps are in Data Management and AI & ML:
  - Privacy-Preserving Technologies
  - Secure Communications
  - Neural Network Optimization



Leading North American companies in Neural Network Optimization

	Companies with Canadian AI publication footprint	Companies with US AI publication footprint
Stronger embeddedness in CA network	Element AI Inc. (26, 2.18, 100%) DarwinAI Corp. (24, 5.91, 100%) Hydro-Quebec (18, 0.58, 94.4%) Thunder Bay Health (9, 1.95, 100%) Lakes Environmental (9, 2.21, 100%)	Alphabet Inc. (215, 7.75, 9.6%) Microsoft USA (119, 2.48, 9.3%) Meta (77, 7.80, 8.4%) NVIDIA (65, 0.67, 10.7%) Adobe (16, 0.55, 6.2%)
Weaker embeddedness in CA network	Huawei Canada (127, 1.20, 78.9%) Samsung (30, 0.10, 73.3%) RBC Borealis AI (20, 0.77, 85.7%) Xanadu (9, 4.81, 55.6%) D-Wave Systems (9, 3.81, 66.7%)	IBM (36, 0.58, 3.0%) Amazon.com (22, 4.41, 3.2%) Intel (17, 1.13, 3.4%) Qualcomm (119, 3.37, 2.8%) Apple (79, 10.25, 2.1%)

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Acquired or relocated to the US

(#,#, #) # publications, Impact, Coll with Canada

Conclusion - From KTA intelligence to strategic action

1. Prioritize where action matters

Bibliometrics can move from broad positioning to specific KTA opportunities where policy, funding, or partnership action could help realize Canada's potential

2. Triangulate with policy priorities

Use desk research to test whether shortlisted KTAs align with policy priorities, such as the Pan-Canadian AI Strategy's commercialization pillar

3. Build place-based partnerships

KTA evidence can identify leading firms with limited Canadian collaboration, creating a pool of targets for industry partnership roadmaps and regional innovation ecosystems

4. Strategic Readiness

AI partnership patterns also reveal vulnerabilities, including reliance on US firms and Canadian AI companies that have been acquired or relocated abroad

From KTA action to 4GU regional innovation analytics

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INTERACTIVE ANALYTICS

4GU Tool

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4GU Consultancy

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