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**Faculty of Applied Science and Engineering**
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***Final Project***

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# Part 1: Data-Driven Analysis of Canada's Innovation Performance

## 1. Introduction

As a consulting team engaged by the University of Toronto, we have been tasked with evaluating Canada's innovation performance in a global context. In today's rapidly evolving economic landscape, innovation is a key driver of national competitiveness, resilience, and sustainable growth. Our report begins with a comprehensive analysis of Canada's innovation standing, using the Global Innovation Index (GII) and other international benchmarks to identify strengths and weaknesses. Building on these insights, we propose targeted strategies and outline practical solutions to enhance Canada's innovation ecosystem. We also design and present a prototype of an LLM-powered chatbot to demonstrate how AI can support innovation-related decision-making and communication.

## 2. Data-Driven Analysis of Canada's Innovation Performance

### 2.1 Analysis benchmark: Global Innovation Index (GII) & Measurement Framework

The Global Innovation Index (GII) serves as our primary benchmark for assessing national innovation performance. It is structured around seven innovation pillars, grouped into two sub-indices: the Innovation Input Sub-Index (covering institutions, human capital & research, infrastructure, market sophistication, and business sophistication) and the Innovation Output Sub-Index (covering knowledge & technology outputs and creative outputs). Together, these pillars form the basis of each country's overall GII score, enabling meaningful international comparisons.

### 2.2 Data Collection

In order to make a data-driven analysis of Canada's innovation performance, we collected data directly from the official Global Innovation Index (GII) website. The GII provides publicly accessible datasets in PDF reports with detailed innovation metrics for over 130 economies worldwide.

The data used in this project includes historical GII scores and rankings across all seven innovation pillars. GII provides original datasets in excel for 2021 to 2024. For 2014 to 2020, these data points were extracted from GII annual reports (PDFs from 2014 to 2020).

To ensure accuracy and reproducibility, we developed a custom Jupyter Notebook script to parse GII datasets and summary tables for all countries, structure the data into the same format as GII provided datasets for further analysis, cleans and organizes key indicators under the GII measurement framework.

### 2.3 GII Canada: Past Ten Years Overview

First, let's have a quick overview about Canada's innovation performance according to the Global Innovation Index from 2014 to 2024. According to Figure 1, Canada's overall GII ranking fluctuated around 12-18, relatively consistent. After a brief decline to 18th place in 2017–2018, it gradually improved to 14th in 2024, reflecting resilience and recovery in innovation performance after the pandemic period. When splitting the overall ranking to separate 7 pillars, the situation becomes different. According to Figure 2, we can find Canada performs notably better in some factors than others. The red line of market sophistication and blue line of institutions are clearly above the other five pillars. While some pillars like creative outputs fluctuated violently, some factors like business sophistication maintain at a stable level.

### 2.4 GII Canada 2024: Comparative Analysis

In this section, we focus on the 2024 Global Innovation Index (GII) report to conduct a detailed comparative analysis. We first identify the top 15 innovation drivers globally, based on their strong correlation with overall innovation performance. Canada's performance in these key areas is then benchmarked against leading innovation economies to assess how well it measures up. This analysis helps us clearly identify Canada's strengths and weaknesses across the most critical dimensions of innovation.

#### 2.4.1 Data Cleaning

Firstly, the two columns 'Innovation Inputs' and 'Innovation Outputs' are dropped from the dataset, because they are composite scores derived from the detailed small pillars, including them would cause information leakage since they are direct contributors to the target variable. Then, to deal with missing values, for the columns with missingness over 50%, we simply drop them. For the columns with less than 50% missingness, we fill the remaining missing values with median. Next,

we apply one-hot encoding to non-numerical and categorical features to indicate the country's income level and region group. Finally, from the heatmap, we can find a very high negative correlation between GII_OverallScore and GII_OverallRanking, which is -0.97. That means these two variables are nearly perfectly negatively correlated, because the rank is directly derived from the score. Including both in modeling would lead to redundancy and potential information leakage. To avoid this, we retain only GII_OverallScore as the primary target for data analysis.

### 2.4.2 Top 15 Factors Driving Innovation

Using a Random Forest model, we identify the top 15 global innovation drivers—features that most strongly influence a country's overall GII score. Referring to Figure 3, these drivers span areas such as business R&D investment, knowledge outputs, human capital, and institutional support. The feature importance values derived from the model highlight which factors are most predictive of innovation performance at the global level and form the foundation for our subsequent comparative analysis of Canada.

### 2.4.3 Canada vs. Top 10 Countries on Top 15 Innovation Drivers

Figure 4 shows how Canada stands on these important innovation drivers on the global level. The red line represents the global average. While Canada consistently performs above the global average across all top innovation drivers, a comparison with the top 10 most innovative countries reveals a more nuanced picture. Canada has its innovation strengths and weaknesses.

Strengths :

1. Human Capital, Research and Education Related Factors :
   Among the global leading countries, Canada does very well in Human Capital & Research, R&D Efforts, Researchers per Capita and Knowledge Workers
2. Infrastructure :
   Canada do well in Logistics Performance, Information and Communication Technologies (ICT) and Market Sophistication of supportive financial system
3. Institutional & Innovation Ecosystem :
   Canada benefits from an effective government and a supportive innovation ecosystem. Business Sophistication captures the capacity of firms to absorb knowledge, invest in innovation, and engage in global collaboration. Canada's strong performance in this area highlights the ability of its private sector to support and apply innovation, even though total financial investment in R&D remains limited

Weaknesses:

1. Innovation Investment & Capital Market :
   Canada lags in financial investment in innovation. Both total and business R&D expenditures as a share of GDP are relatively low, and venture capital activity—measured by VC deals per GDP—also falls behind leading innovation economies
2. Innovation Outputs & Commercialization :
   Canada underperforms in converting research into patents and high-tech outcomes, and also lags behind in cultural and creative exports. This suggests a gap in turning innovation efforts into globalized, marketable outputs.

### 2.4.4 Canada's Standardized Position on Top Innovation Drivers

To gain a more intuitive and comparable understanding, we standardized the data and used a Z-score bar chart to measure Canada's innovation performance relative to other countries in terms of standard deviations.

According to figure 5, compared to the global average, Canada performs exceptionally well across multiple innovation drivers — scoring between 0.54 and 2.08 standard deviations above the mean. Notably, Market Sophistication stands out: even when compared to the Top 10 innovation economies, Canada still scores 0.32 standard deviations higher, indicating a strong market environment characterized by scale, openness, and accessible financing for innovative firms.

Canada also excels in education related factors like Human Capital & Research and R&D infrastructure, with both areas exceeding the global average by more than 1.7 standard deviations. Furthermore, Logistics Performance is another standout: Canada slightly outperforms even the Top 3 innovation leaders, reflecting a highly efficient infrastructure for innovation flows.

However, despite these strengths, Canada significantly underperforms in Innovation Investment & Capital Market indicators. While marginally above the global average (~0.5 SD), both Total R&D Expenditure and Business-performed R&D (% GDP) trail far behind top innovation economies. The latter lags almost 2 standard deviations below the Top 3 average, suggesting a substantial investment gap.

In addition, Innovation Outputs & Commercialization represent a major weakness. Metrics like Knowledge & Technology Outputs, Creative Outputs, and Patent Families per GDP are only slightly above the global average but fall sharply when benchmarked against top performers. For instance, Canada's score on Knowledge & Tech Outputs is nearly 1.5 standard deviations below the Top 3 average — indicating challenges in translating research and innovation inputs into impactful outcomes.

For figure 6, This radar chart conveys the same insights as the Z-score bar chart. The shaded shape at the center resembles a maple leaf — a symbolic representation of Canada. In the first subplot, each tip of the leaf extends beyond the dotted border, indicating that Canada performs well across various innovation dimensions compared to the global average. However, in the second and third subplots, when compared to the top 10 and top 3 global innovation leaders, the leaf is mostly enclosed within the dotted boundaries, suggesting that Canada still has room to grow to match the performance of leading innovation nations — except in areas like Market Sophistication and Logistics, where Canada slightly outperforms.

### 3. Refer to External Data Source: What Other Official Rankings Say?

#### 3.1 Bloomberg Innovation Index

In the previous analysis, we primarily relied on insights from the GII report. To enhance the objectivity and robustness of our evaluation, we now turn to other reputable sources to assess Canada's innovation performance from different perspectives. As shown in Figure 7, the Bloomberg Innovation Index ranks Canada consistently around 20th globally from 2016 to 2021 — a trend that closely aligns with the GII rankings. In Figure 8, when examining specific innovation pillars, Canada demonstrates strong performance in areas related to R&D, research, and education. However, its ranking in manufacturing value-added is much lower — around 40th globally — highlighting a notable weakness in innovation outputs and commercialization. These insights further validate the conclusions drawn from the GII analysis.

#### 3.2 Innovation Investment in OECD Countries

According to figure 9, The OECD data further reinforces the conclusions drawn earlier from the GII report: Canada performs poorly in innovation factors related to innovation investment and financial inputs. For instance, as shown in the chart, R&D expenditure as a percentage of GDP and financial support received by the R&D sector — whether in total (GERD) or from business enterprises (BERD & GERD Financed by Business) or government spending (GOVERD & GERD Financed by Government) individually — all rank relatively low. Specifically, Government Intramural Expenditure on R&D (represented by the green line) ranks below 35th place, highlighting Canada's weakness in public R&D funding and investment.

### 4. A New Tailored and Streamlined Innovation Index

After analyzing the innovation drivers across countries, we created a Custom Innovation Index based on 15 top-performing innovation drivers identified through Random Forest analysis. For each of the 15 factors, we standardize them using Z-scores to normalize across different units and scales, ensuring comparability. The custom index for each country is the average of its 15 Z-scores, assuming equal importance across all selected factors. Finally, countries are ranked in descending order based on their index score — higher scores indicate stronger overall innovation performance. From figure 10, the new ranking for Canada is 16, very similar to the GII ranking of 14.

## Part 2: Proposed Strategies for Canada: Inspired by Global Innovation Leaders

### 2.1 Strategic Priorities: Where Canada Must Lead Next

Based on the strengths and weaknesses mentioned above, Canada's innovation ecosystem strategy should focus on three interrelated strategic priorities — namely, addressing weaknesses in innovation investment and financial input; closing the gap in innovation output and commercialization; and sustaining Canada's strong performance in human capital, research, and education **[1]**.

### 2.2 Strengthening Innovation Investment & Capital Markets

The Canadian investment in innovation development and capital markets shows continuous trouble. Business-performed R&D (BERD) spending shows lower percentages compared to innovation leader countries, Singapore spends 1.94% and Switzerland spends 3.37% along with Israel using 5.44% of GDP in this sector **[2]**. The level of venture capital activity in Canada has increased but still remains lower than the intensity observed in both America and Israel. The development of Canadian high-potential startups requires sufficient growth capital funding to position the country as a global innovation leader.

Singapore's policy approach to innovation investment and capital markets offers a valuable reference for Canada. The successful innovation framework of Singapore structures a moneyed partnership of government initiatives with private sector resources to achieve its goals. The Research Innovation and Enterprise (RIE) 2025 Plan of Singapore invests SGD 25 billion (CAD 24 billion) in strategic sector development through deep tech, AI, biotech and sustainability initiatives **[2]**. Through its Startup SG Equity Program Singapore collaborates with private investors for promising high-tech startups thus enabling the growth of innovation ventures through additional funding. Through its ventures Enterprise Singapore (ESG) facilitates strategic monetary partnerships among investors and corporations and research institutions to develop a cohesive innovation system.

Canada can take courses from Singapore's strategic investment model to form its own innovation funding ecosystem. Canada must strengthen its BERD incentives through an upgrade of the Scientific Research & Experimental Development (SR&ED) tax credit system to add special tax benefits specifically targeted at AI, quantum computing and biotech industries. Singapore's sector-specific investment strategy serves as inspiration for Canada to enhance R&D teamwork between the private sector through these initiatives **[1]**. Tax incentives should be provided to venture funds by the government to expand the VC ecosystem and boost capital market liquidity while enhancing efficiency in financial markets. These reforms will enhance the way Canada funds innovation while speeding up the process of commercializing frontier technologies.

### 2.3 Enhancing Knowledge Commercialization Capacity

Canadian strength in human capital and research facilities but it fails to transform this advantage into innovation outputs and commercialization exports. The nation shows weakness when it comes to producing patents together with creative industry exports which indicates ongoing difficulties between research successes and market outcomes. For Canada to realize impactful global market competition from its intellectual property it needs improved capabilities to transform institutional knowledge into commercial products, services and start-up businesses **[1]**.

Switzerland holds an outstanding position as one of the world's most innovative nations because it maintains a perfect system for knowledge commercialization and technology transfer processes. The Swiss Innovation Agency known as Innosuisse stimulates academic-industrial partnerships by helping researchers and entrepreneurs access funding as well as support. Innosuisse uses the Bridge Discovery Program and Flagship Initiatives as well as financial aid and mentorship services to facilitate quick scientific discovery commercialization. The Technology Transfer Offices in Switzerland manage industry partnerships by operating through structured intellectual property frameworks which license valuable research results into market-ready solutions **[2]**.

Switzerland offers another valuable model Canada should look to. National IP Commercialization Hubs need to be founded by the government following the Innosuisse ecosystem from Switzerland in order to strengthen Canada's knowledge of commercialization capabilities. The hubs would deliver extensive technology transfer services that combine IP defence support with financial guidance and commercialization guidance for both startup and academic teams. The Canadian R&D-Industry Partnership Platform should function similarly to Switzerland's Bridge Program through its goal of enabling academic-industry collaboration for the advancement of high-impact innovative technologies. Startups should receive special funding through IP Commercialization Grants to help them convert patented inventions into profitable marketable products **[1]**. The strategic method allows Canada to improve the commercialization process for research developments while growing its economy.

### 2.4 Sustaining Canada's Human Capital Advantage and Research Leadership

The innovation success of Canada depends fundamentally on its high-standing performance in Human Capital & Research. STEM education quality combined with researcher density and knowledge workforce participation numbers consistently positions Canada as one of the global technology leadership groups **[1]**. The competitive advantage of Canada depends on maintaining alignment between its workforce and emerging technology developments and retaining global top talent. For

Canada to keep its competitive advantage the nation must enhance its STEM education system from early to advanced levels and bring in premier researchers and maintain continuous technology-based education for its talent pool.

Germany offers a mature model for Skills Development and Talent Retention. German companies excel in workforce development and employee retention because they use the Dual Education System and Future Skills Initiative to teach workplace-specific technical knowledge to their staff. The German Research Foundation (DFG) maintains strong relationships with industry to position doctoral candidates along with postdoctoral researchers within practical research facilities thus advancing academic-industry information-sharing processes. High-skilled professionals seeking employment in Germany can easily apply through the Blue Card Program which streamlines their immigration process to become part of the innovation ecosystem. Through its powerful educational-industry connections Germany enables its staff members to develop essential technological capabilities which drive innovation **[2]**.

Learning from Germany, the Canadian government should implement a Future Skills Accelerator Program which provides continuous education about AI and quantum computing along with biotech domains for people in the country. The proposed program ensures that Canadian workers undergo modern training that suits an upcoming economy based on continuous innovation. Canada should create a Global Innovation Talent Visa which functions like Germany's Blue Card Program to obtain highly qualified international experts in AI along with biotech and emerging technology fields by making immigration and residency processes more efficient **[2]**. The Research-Industry Fellowship Program should be established by the government to place graduate students and postdoctoral researchers directly into industrial projects where they can exchange knowledge between academic research and Canadian business operations.

## Part 3 Practical Implementation Steps

### 3.1 Upgrading SR&ED and Venture Incentives

To address the challenges of the SR&ED, where approval currently takes over 180 days and participation remains low at approximately 12% of firms [3], a series of target policy actions are proposed. First, the SR&ED refundable tax credit for Small and Medium-sized Enterprises (SMEs) should be increased from 35% to 50% to enhance R&D incentives. Additionally, the approval process should be streamlined to a 90-day fast track, ensuring that firms receive timely support. Recognizing the importance of emerging sectors, sector-specific enhancements should be introduced for AI, biotechnology, and quantum technology to align with Canada's strategic innovation priorities. To further stimulate early-stage innovation, a Venture Capital (VC) tax deduction should be launched to encourage investments in high-risk, high-growth startups. A useful benchmark for these initiatives is Singapore's RIE2025 and Startup SG Equity program, which offer co-investment incentives and accelerated approval, demonstrating successful strategies in fostering innovation. Implementing these measures is estimated to unlock up to $500M in additional annual SME R&D investment, stimulate early-stage VC activity, and diversify the innovation funding pipeline—strengthening Canada's position as a global leader in innovation (see Appendix B).

### 3.2 Building Canada's Commercialization Engine

Canada faces a significant challenge in patent commercialization, with only 13% of Canadian patents successfully licensed [4]. To bridge this gap, a National IP & Technology Transfer Agency should be established to coordinate licensing and aggregate publicly funded intellectual property, ensuring that innovations developed in research institutions reach the market. Additionally, IP Commercialization Grants of up to $100,000 per project should be introduced to support early-stage ventures in transforming research into commercially viable products. To transfer industry-academic collaboration, a Public-Private Innovation Exchange should be created to connect research institutions with firms for joint development efforts. Benchmarking successful international models, the U.S. The Bayh-Dole Act has led to over 30% licensing success, while the Netherlands' Technology Transfer Offices (TTOs) have achieved a 28% success rate under a nationally coordinated framework [5]. By implementing these measures, Canada aims to increase its patent commercialization rate to 25% by 2030—up from the current 13%—benchmarking the Netherlands (28%) and the U.S. Bayh-Dole system (30%), strengthening its innovation ecosystem and global competitiveness (see Appendix C).

### 3.3 Scaling Talent Programs for Future Skills

Canada ranks among the top 10 globally in Human Capital & Research, demonstrating its strong foundation in innovation and education [6]. However, the country faces risks from intensifying global competition for innovation talent and a domestic tech-skill mismatch, which could hinder growth in key industries. To address these challenges, a Future Skills

Accelerator should be launched, aimed at equipping 100,000 Canadians over five years with expertise focusing on AI, biotechnology, and quantum technologies. Delivered through partnerships with top universities such as the University of Toronto, UBC, and Waterloo, and collaborating with leading Canadian tech companies like Shopify. Additionally, a Global Innovation Talent Visa, modeled after Germany's Blue Card, should be introduced to attract top-tier international researchers and professionals, targeting 10,000 high-skilled researchers and professionals in strategic innovation sectors within three years. To further strengthen industry-academic collaboration, Research-Industry Fellowships should be created, embedding graduate talent within Canadian firms to drive innovation and commercialization. Benchmarking global best practices, Germany's Future Skills Framework and DFG industry placement initiatives provide successful models for aligning national talent pipelines with economic priorities. Initiative goal is to embed 5,000 graduate students and postdoctoral researchers into Canadian firms by 2030. Implementing these measures will ensure that Canada's workforce remains competitive, fostering a stronger innovation ecosystem and enhancing the country's ability to attract and retain top innovators on the global stage (see Appendix D).

# Part4 Visualizations, storytelling, recommendations

## 4.1 Overview and Key Takeaways

### 4.1.1 Canada's Projected GII Score(2024-2030):

From Figure 11, we can see that Canada's score starts at 52.91 in 2024, Canada's GII Score will steadily rise to 59.66 by 2030 – an overall increase of ~6.75 points. The steep initial rise (2024-2026) shows the immediate impact of the increased R&D incentives and expanded SR&ED approval rates. Beyond 2026, the line's continuous climb up shows the compounding effect of three strategies mixed together. By 2030, Canada will reach 59.66, placing it closely to other top-tier innovative nations. This improvement reflects the cumulative effects of the implementations in Part 3 which enhanced SR&ED, new commercialization pathways, and expanded talent programs) plus a modest baseline growth assumed for other countries.

### 4.1.2 Canada's Projected GII Rank(2024-2030):

Canada's rank improves from #14 in 2024 to around #10 by 2030. While this is a significant climb, it also underscores that other countries are investing continuously in innovation, so Canada must implement these policies consistently over five years to maintain momentum. The year-by-year improvement shows that results do not happen overnight, consistent, incremental policy actions drive steady progress.

## 4.2 Visualizations

Figure 13 shows an infographic example for social media publicity. And below are some Tweet posts examples:

- "Canada's 5-year roadmap to innovation success sets us on a course to break into the top 10 globally by 2030. By doubling down on R&D, IP commercialization, and talent development, we're fueling sustained economic resilience. #Innovation #Canada #Research"
- "VC community, keep an eye on Canada's momentum in #BusinessSophistication. Rising valuations and better exits await in our booming innovation scene! #VentureCapital #CanadaStartups"
- "Profs & students: Bring your ideas out of the lab! Government fellowships can help you launch real-world solutions, fueling Canada's GII climb post-2026. #AcademicResearch #TechTransfer"

# Part5 Chatbot

## 5.1 Introduction

The Chatbot is a RAG-based application. This technology retrieves relevant information from external knowledge bases and inputs it as a prompt into large language models (LLMs) to enhance their ability to handle knowledge intensive tasks, thereby enabling meaningful conversations with users about Canada's innovation strategy.

## 5.2 Build Vector Database (External Knowledge Library)

The source is from the PDF documents we've done in previous tasks (e.g., Part 1, Part 2... Part 4). Then, split the text content from the PDFs into smaller chunks, convert these chunks into vectors using the NV-Embed-QA text embedding model, and store these vectors in the Astra vector database. (Figure 5.1)

## 5.3 Context

When a user inputs a question, convert the question into a vector using the same text embedding model. Then, retrieve information related to the user's question by calculating the similarity between vectors. This information will subsequently serve as data support for the LLM. (Figure 5.2)

### 5.4 LLM Model

We used two different LLMs—GPT-4o mini and Deepseek-r1-distill-llama-8b (with 4-bit quantization)—to generate responses based on the contextual information described above, enabling conversations with users. (Figure 5.3 & Figure 5.4) The Deepseek-r1-distill-llama model features Chain-of-Thought (CoT) prompting, and in testing, it produced superior content compared to GPT-4o mini. However, since Deepseek-r1-distill-llama runs locally, inference speed is limited by physical hardware performance, resulting in longer processing times. Therefore, during offline presentation demonstrations, we opted to use the GPT-4o mini model due to its faster inference speed compared to our locally run model. We have provided three different Langflow workflows to pair these two models, offering quality-oriented, speed-oriented, and balanced versions, allowing users to select according to their specific requirements.

## Reference List

[1] Innovation, Science and Economic Development Canada, *Building a Nation of Innovators: Canada's Innovation and Skills Plan*, 2019. [Online]. Available: https://ised-isde.canada.ca/site/innovation/en

[2] World Intellectual Property Organization, *Global Innovation Index Dataset*, 2024. [Online]. Available: https://www.wipo.int/global_innovation_index

[3] Organisation for Economic Co-operation and Development (OECD), Canada Science, Technology and Innovation Outlook, 2023. [Online]. Available: https://www.oecd.org/sti/

[4] World Intellectual Property Organization (WIPO), *Global Innovation Index Dataset,* 2024. [Online]. Available: https://www.wipo.int/global_innovation_index

[5] Innovation, Science and Economic Development Canada (ISED), *Building a Nation of Innovators,* 2023. [Online]. Available: https://ised-isde.canada.ca/site/innovation/en

[6] World Intellectual Property Organization (WIPO), *Global Innovation Index* 2024, 2024. [Online]. Available: https://www.wipo.int/global_innovation_index

# Appendix A:

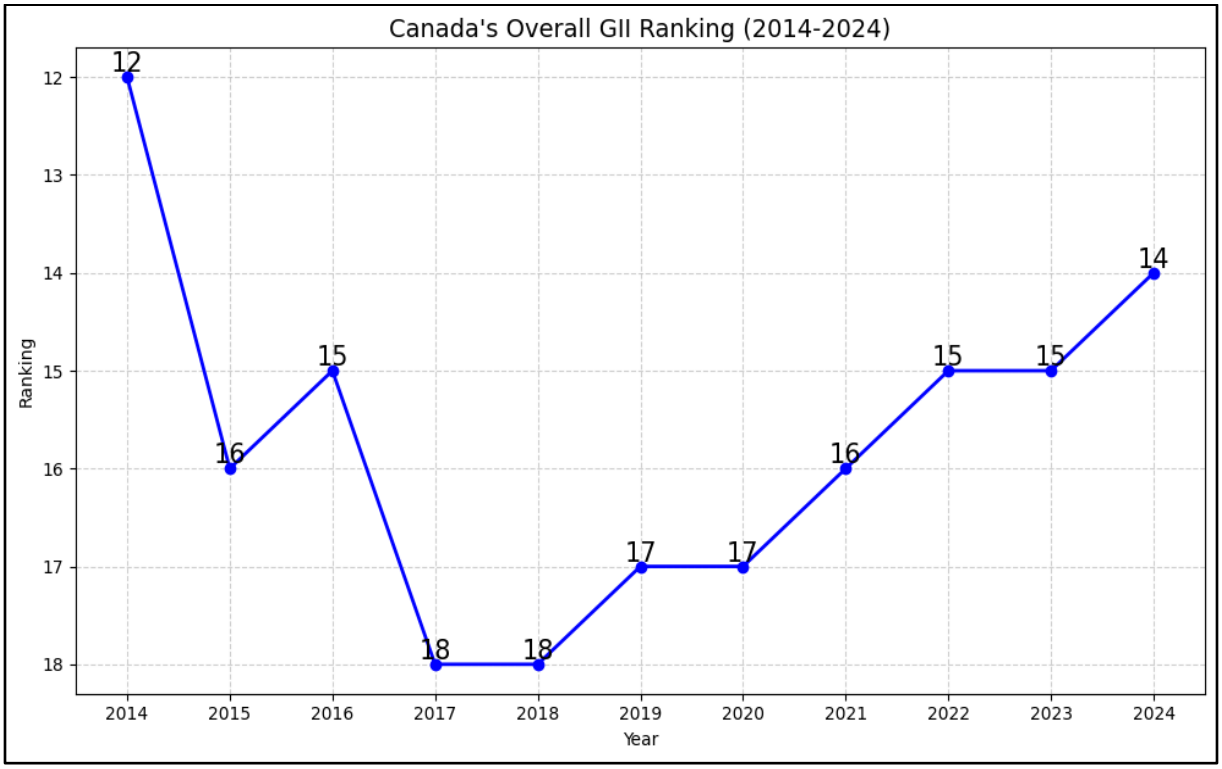



**Figure 1.** Canada's Overall GII Ranking (2014–2024)

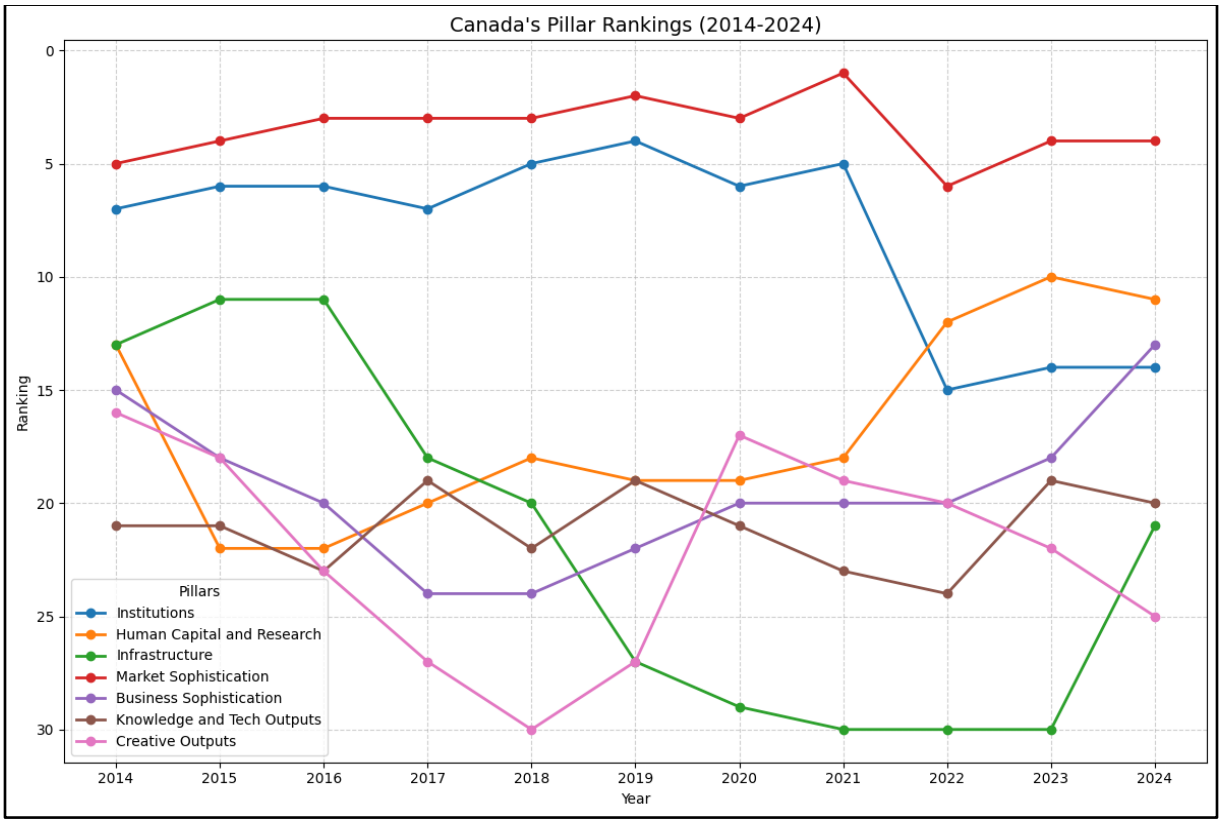



**Figure 2.** Canada's Ranking in 7 Innovation Pillars (2014–2024)

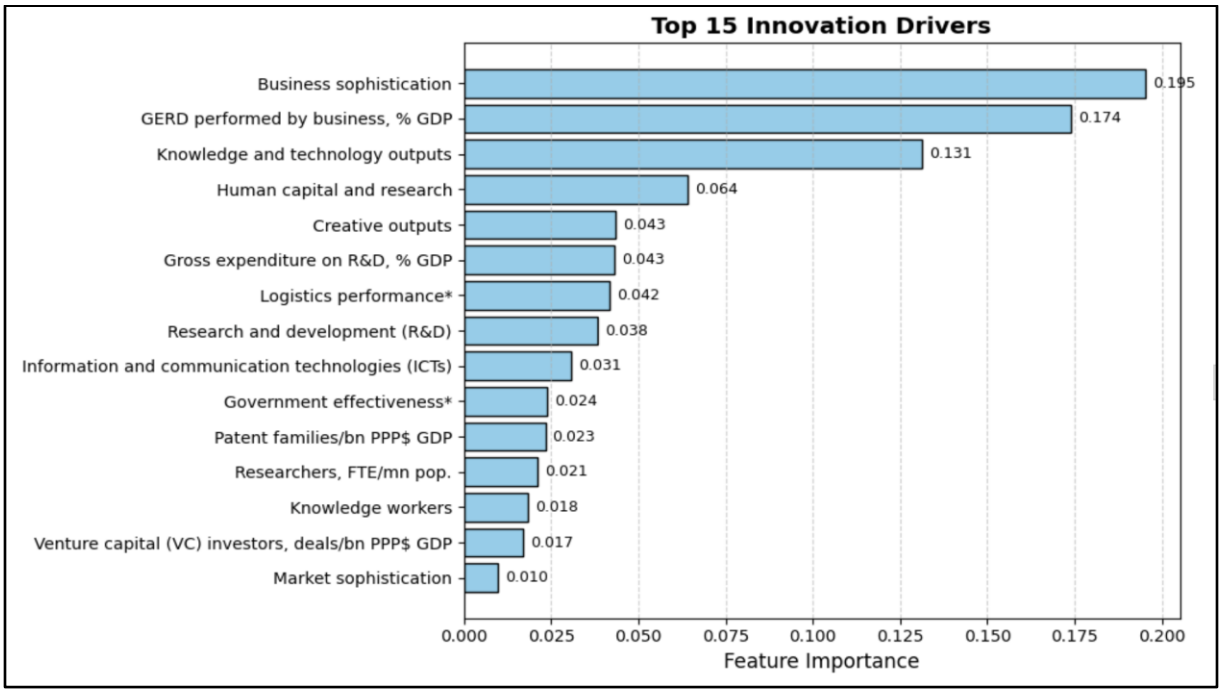



**Figure 3.** Top 15 Innovation Drivers

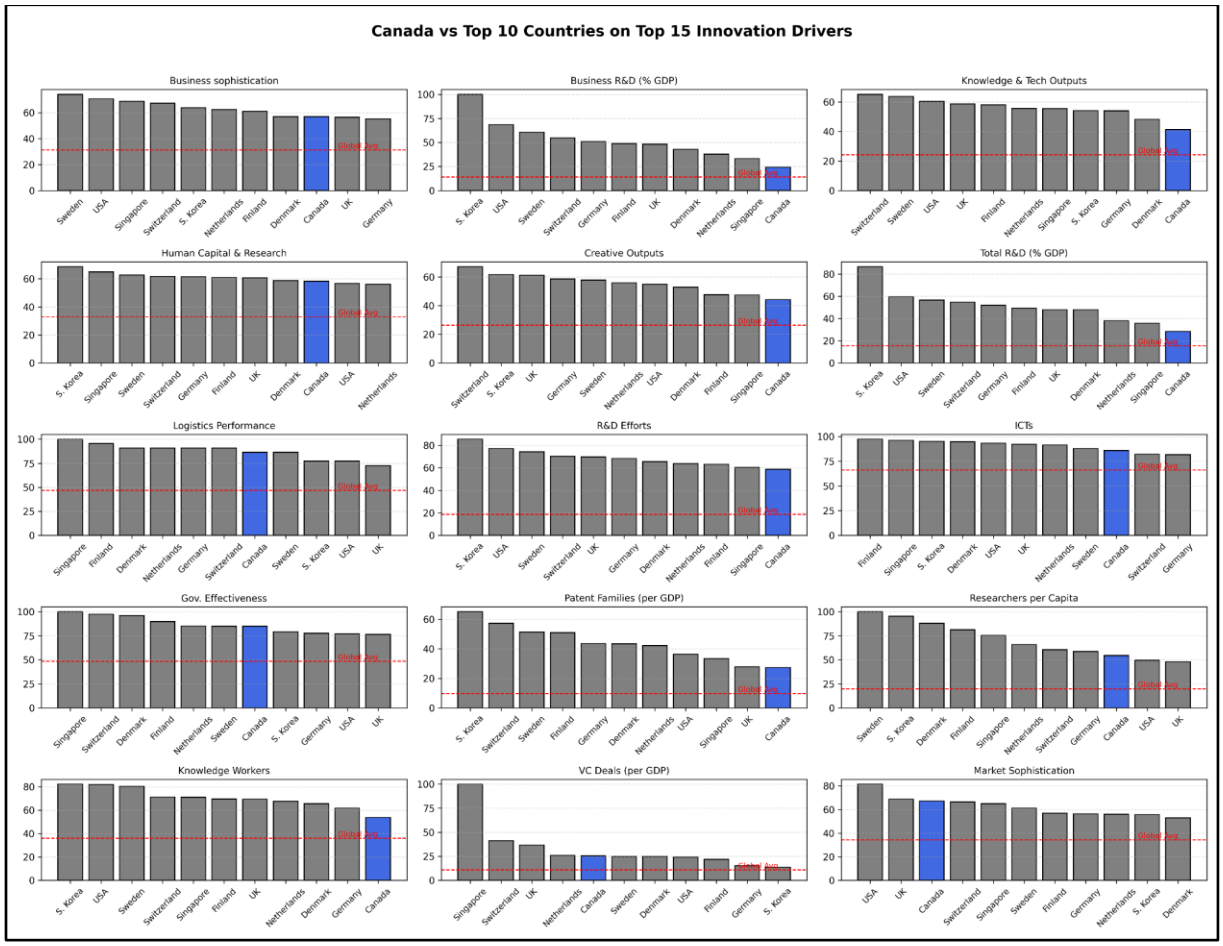



**Figure 4.** Canada vs Top 10 Countries on 15 Innovation Drivers

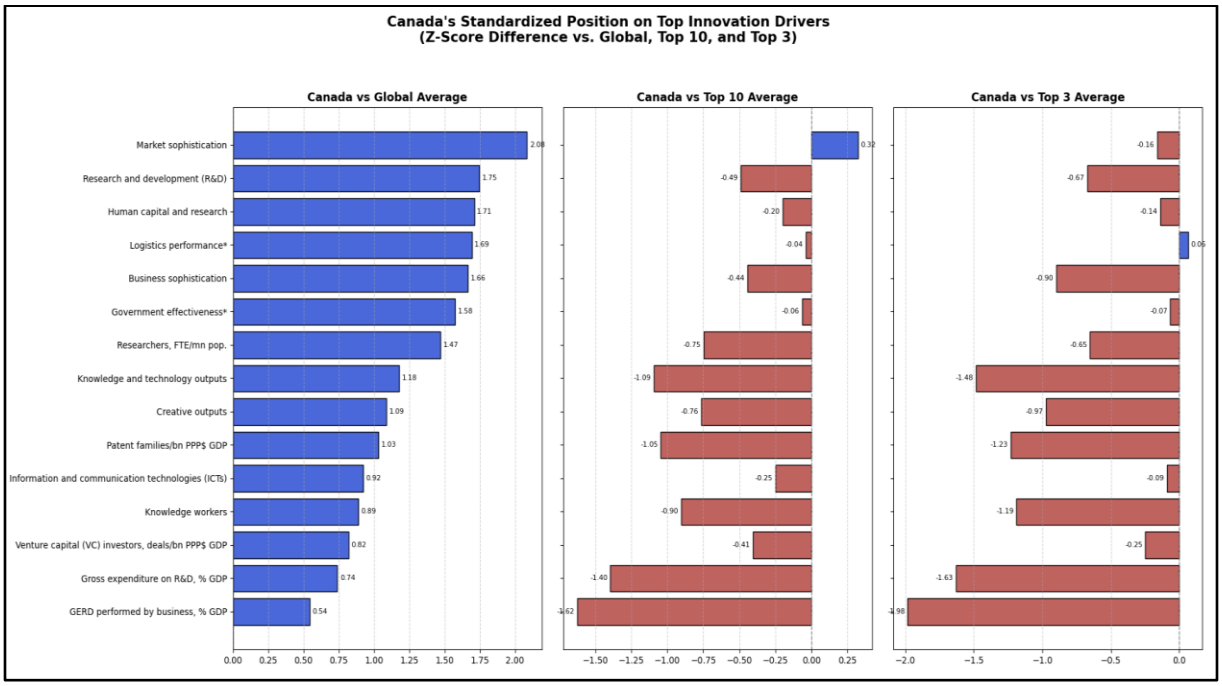



**Figure 5.** Canada's Standardized Position on Innovation Drivers (Z-Score Difference vs. Global Average, Top 10, and Top 3)

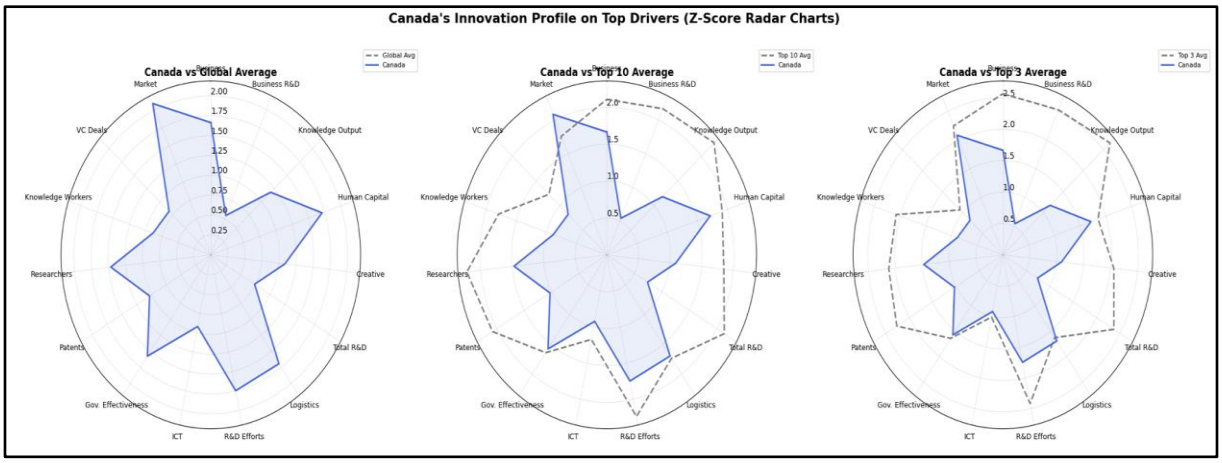



**Figure 6.** Canada's Standardized Position on Top Innovation Drivers (Radar Chart)

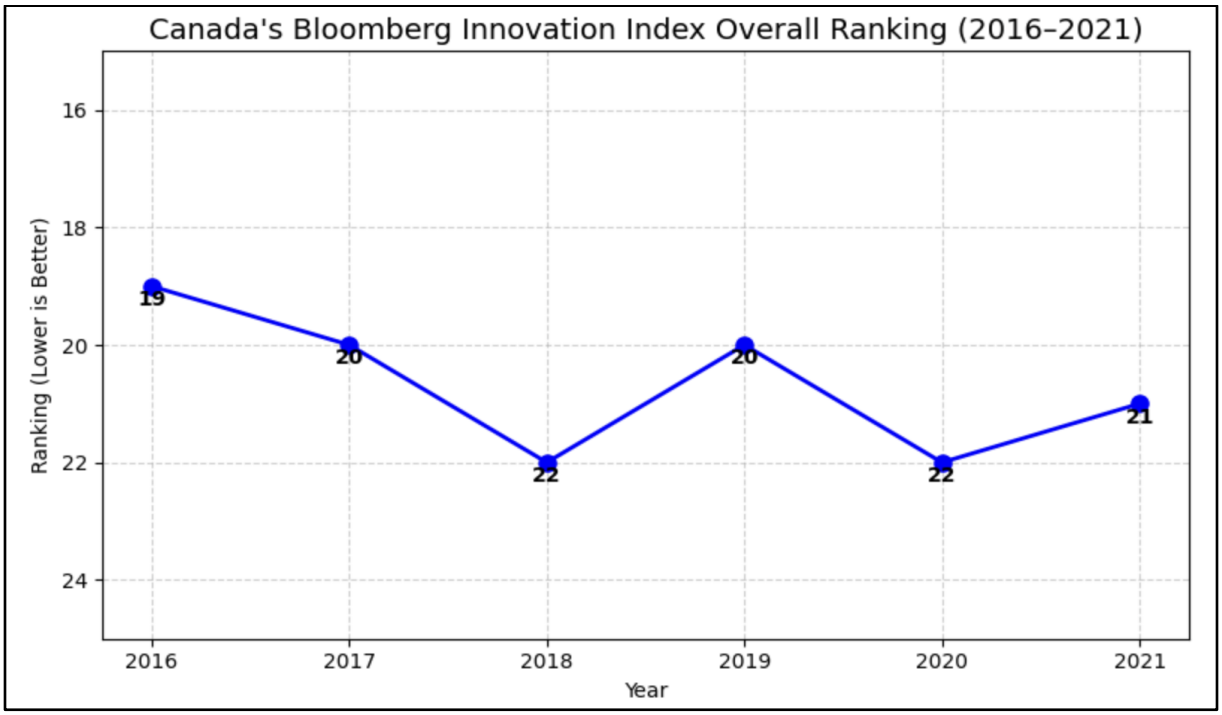



**Figure 7.** Canada's Bloomberg Innovation Index Overall

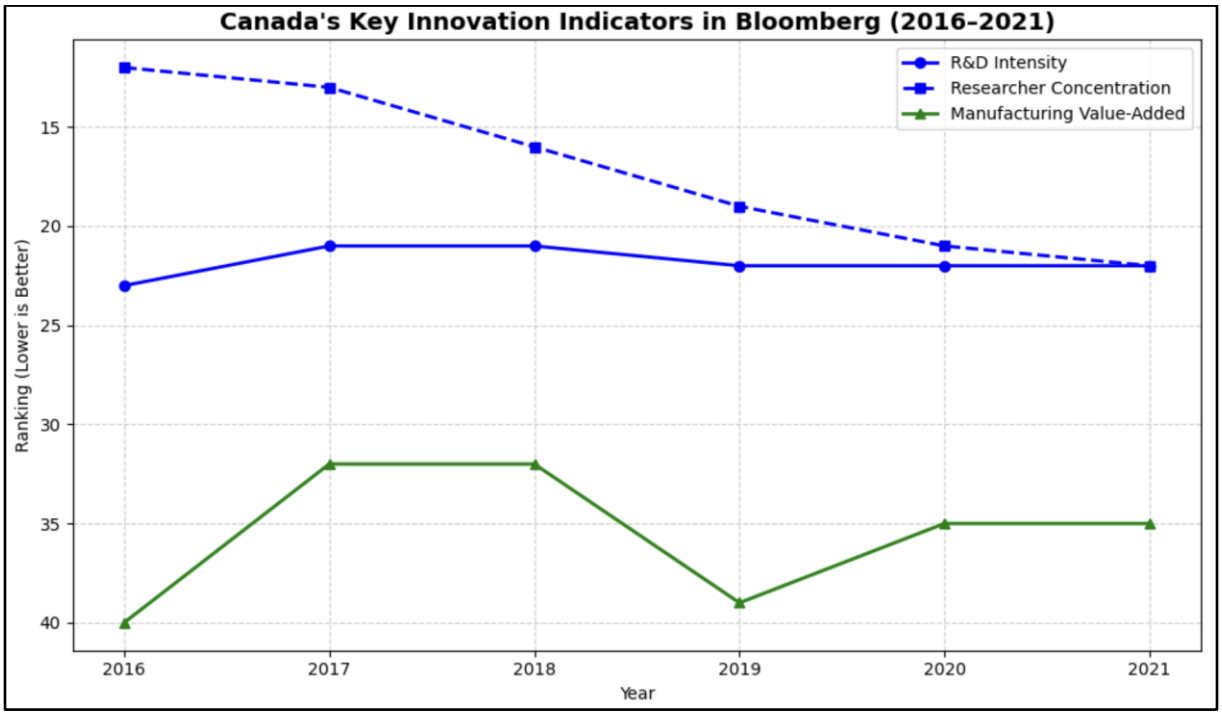



**Figure 8.** Canada's Key Innovation Indicators in Bloomberg

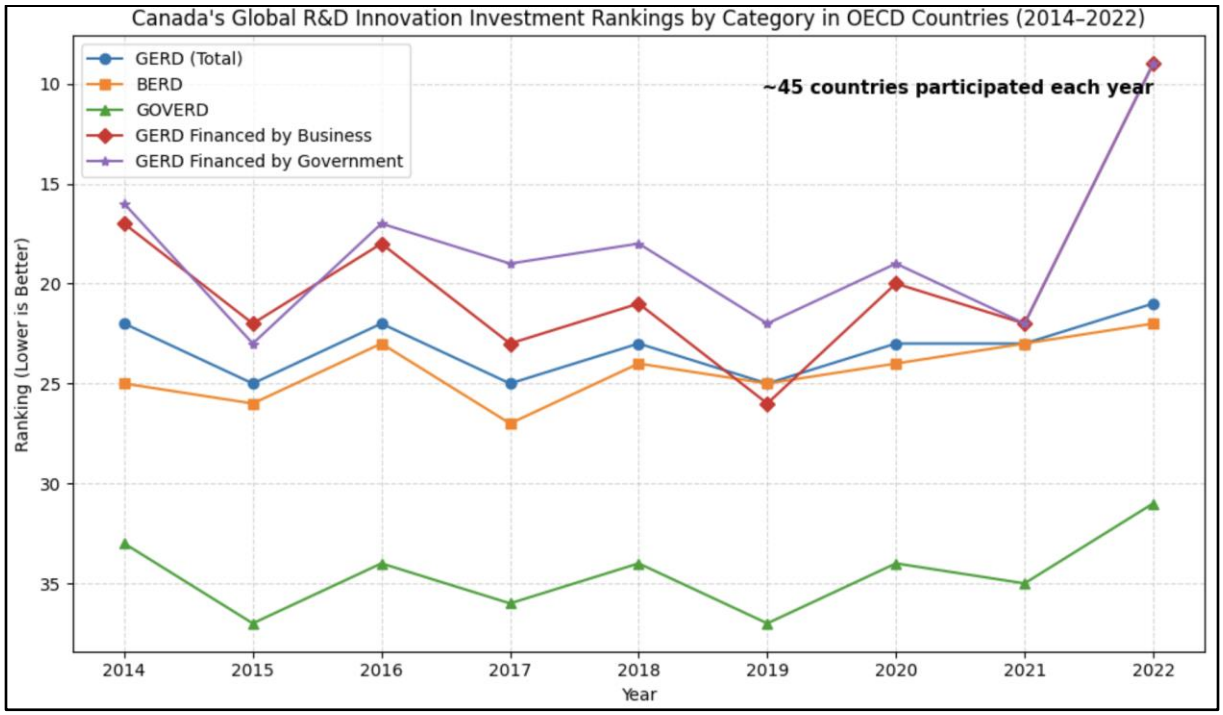



**Figure 9.** Canada's Global R&D Innovation Investment Rankings by Category in OECD Countries (2014–2022)

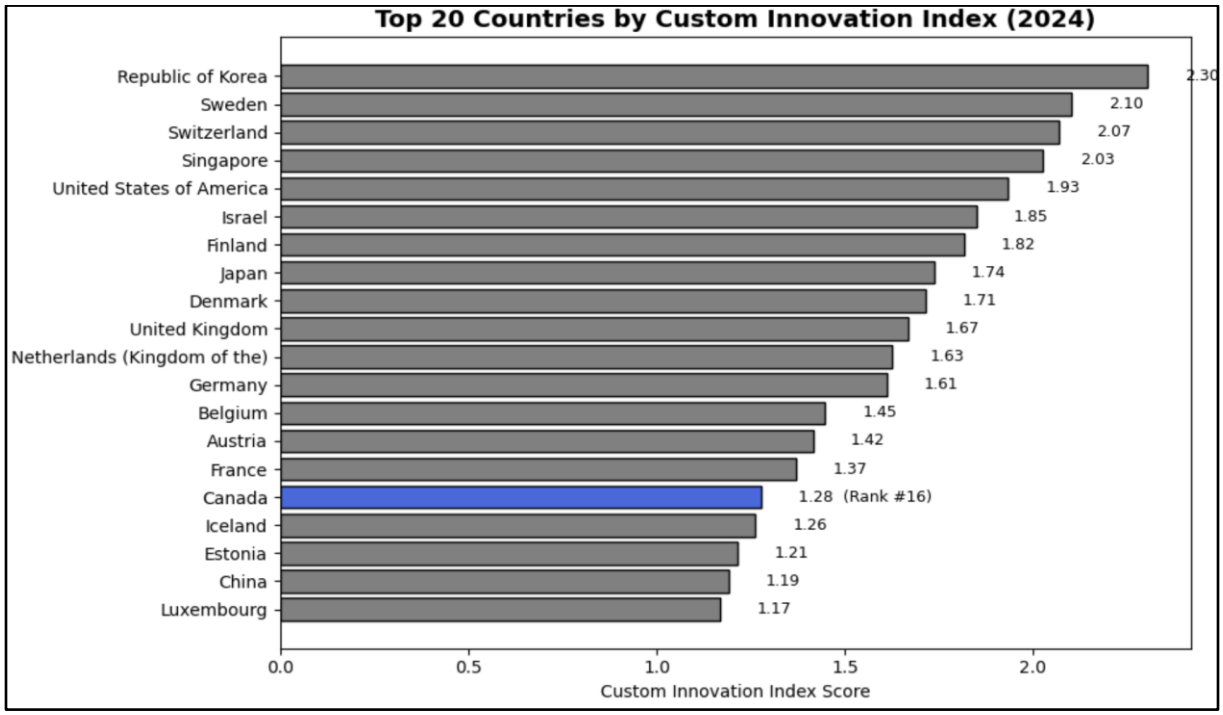



**Figure 10.** Top 20 Countries by Custom Innovation Index (2024)

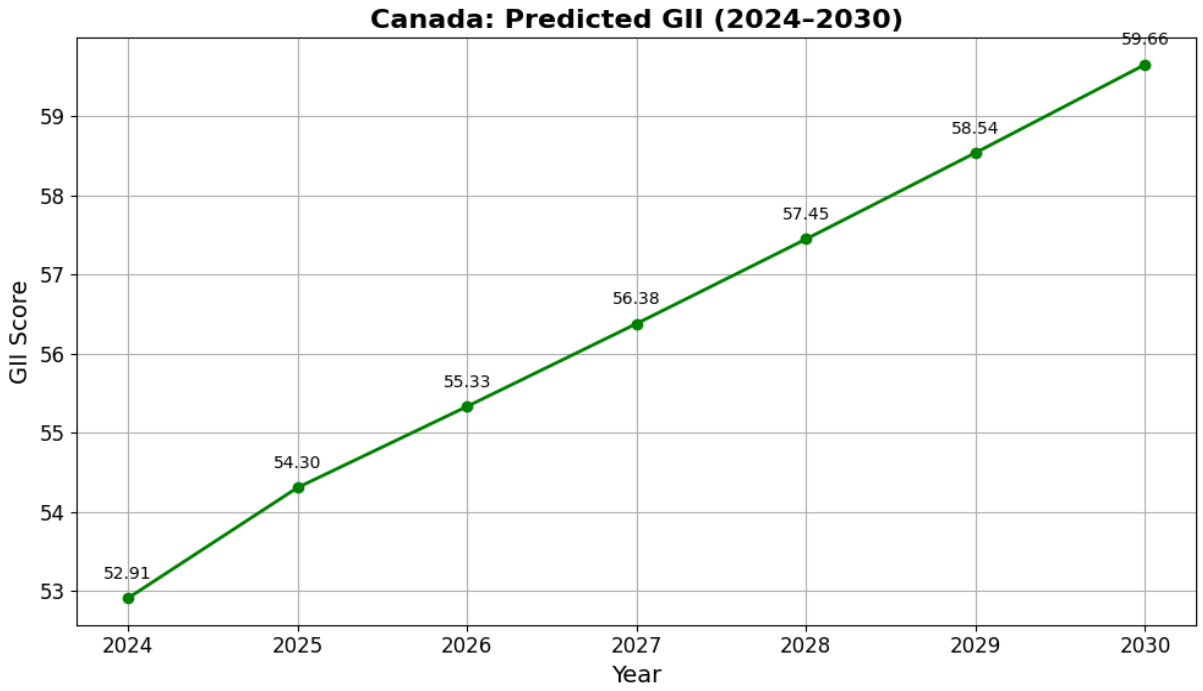



**Figure 11** Canada Predicted GII scores (2024 to 2030)

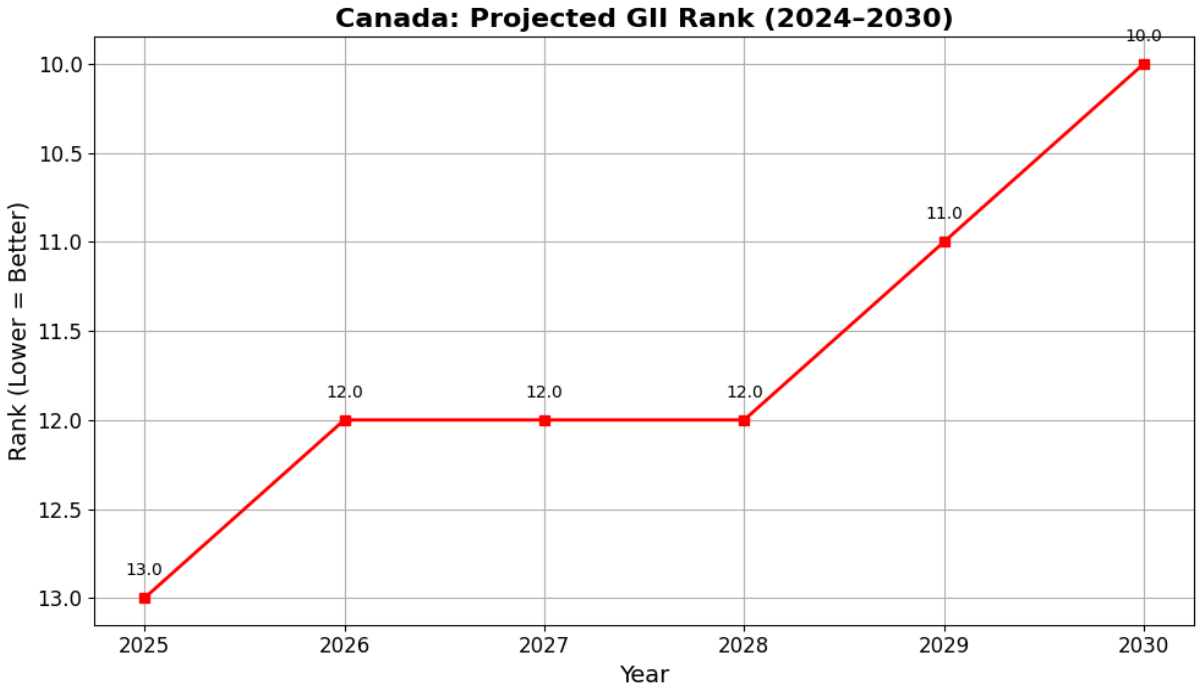



**Figure 12** Canada Projected GII Rank (2025 to 2030)

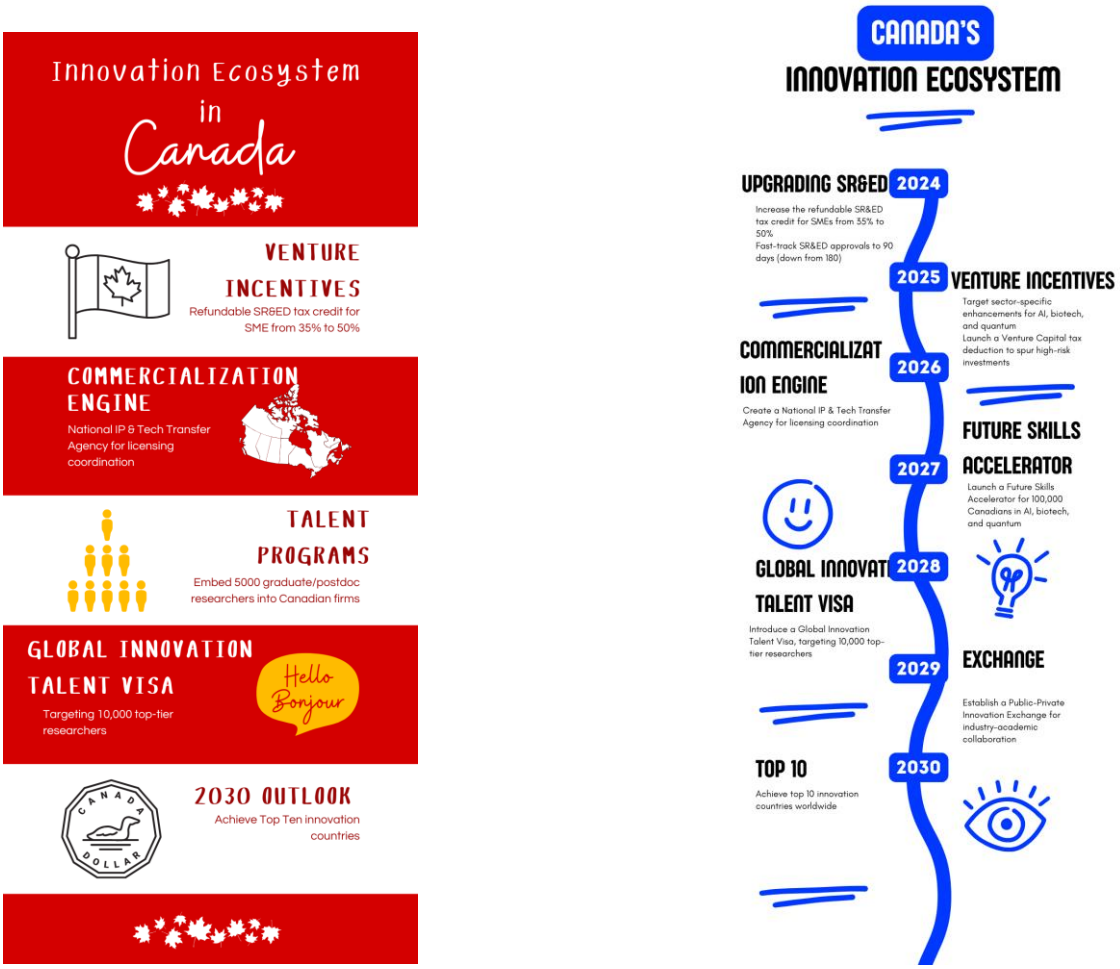
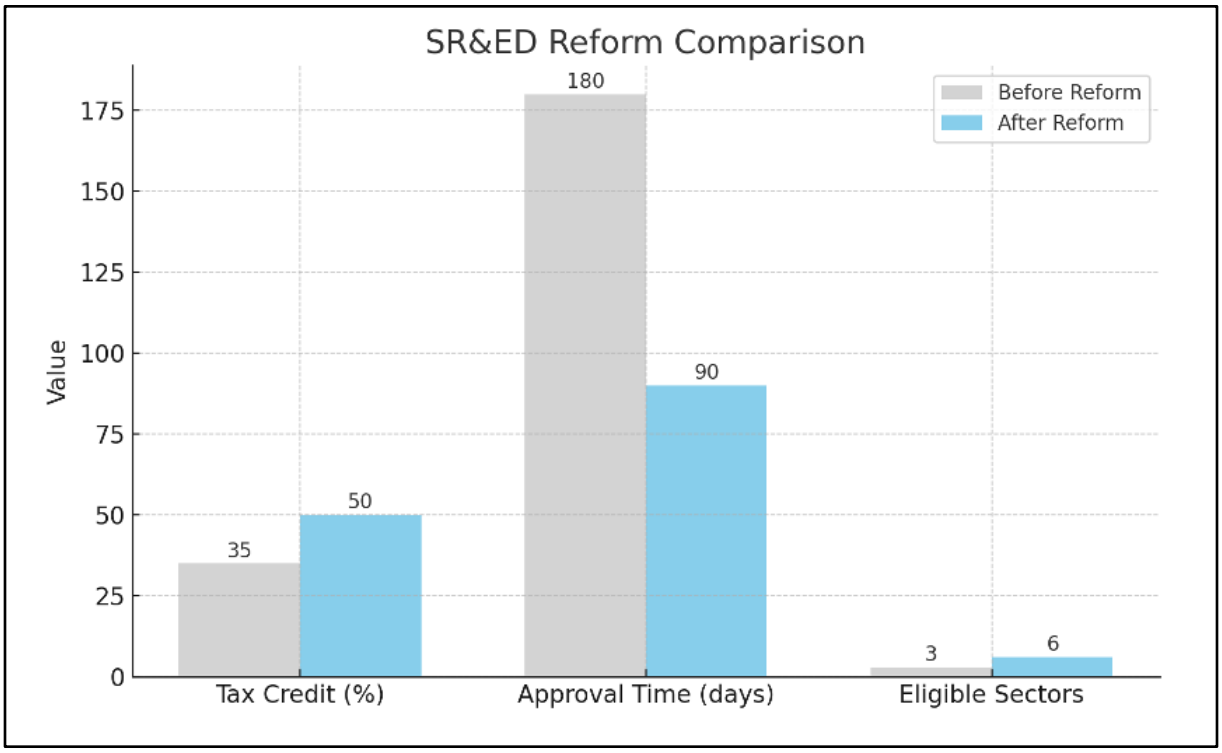
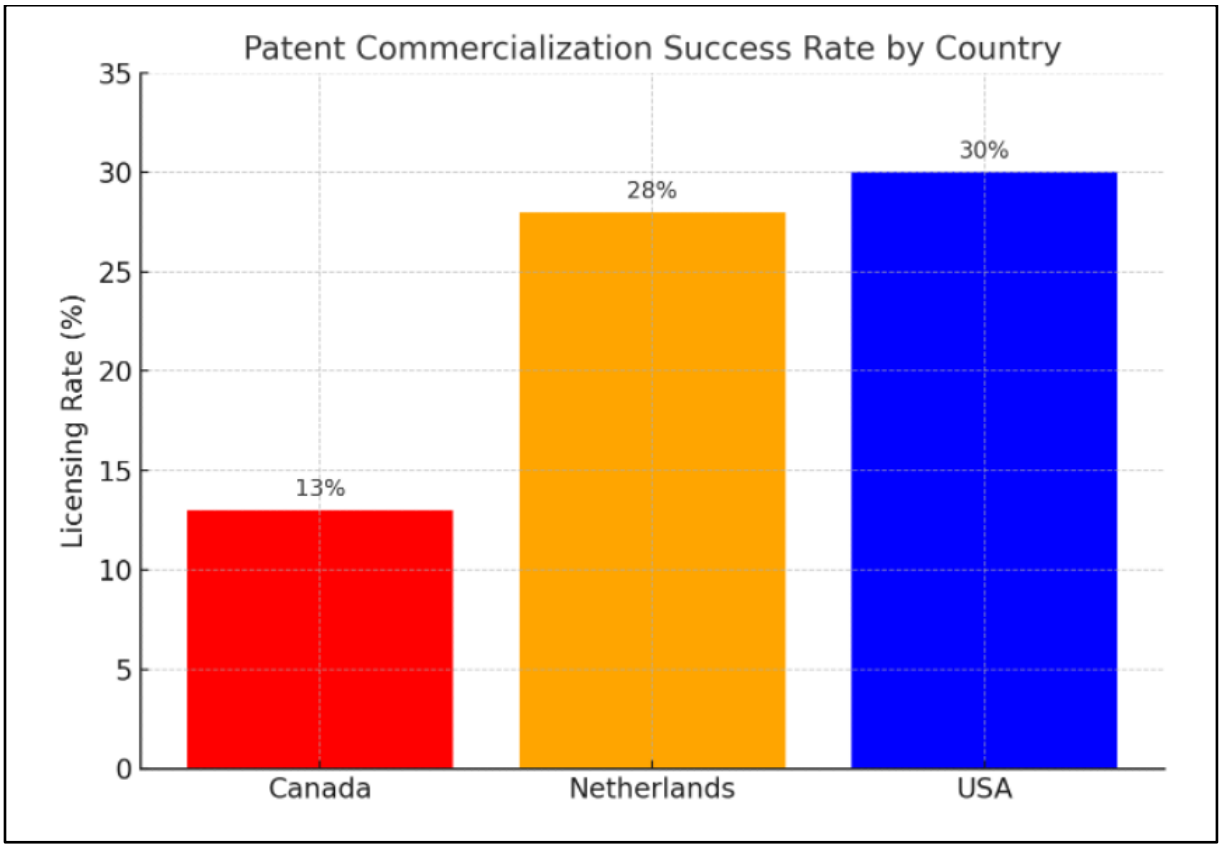



**Figure 13** Infographics for social media

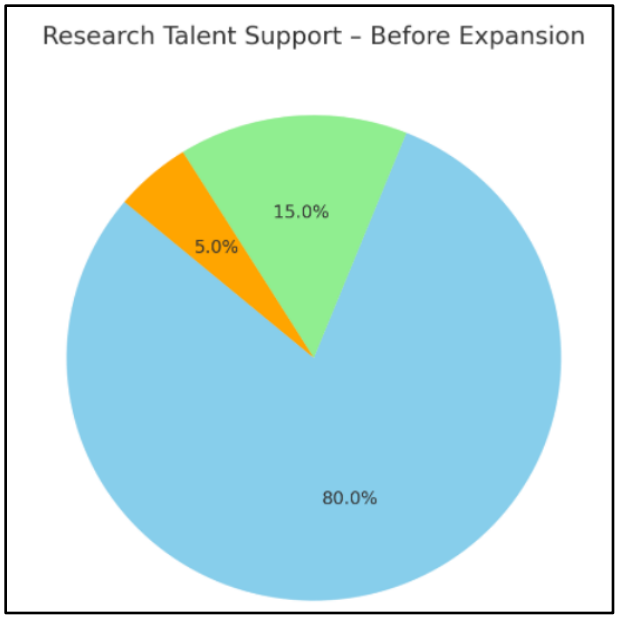
## Appendix B: Comparison of Before and After reform

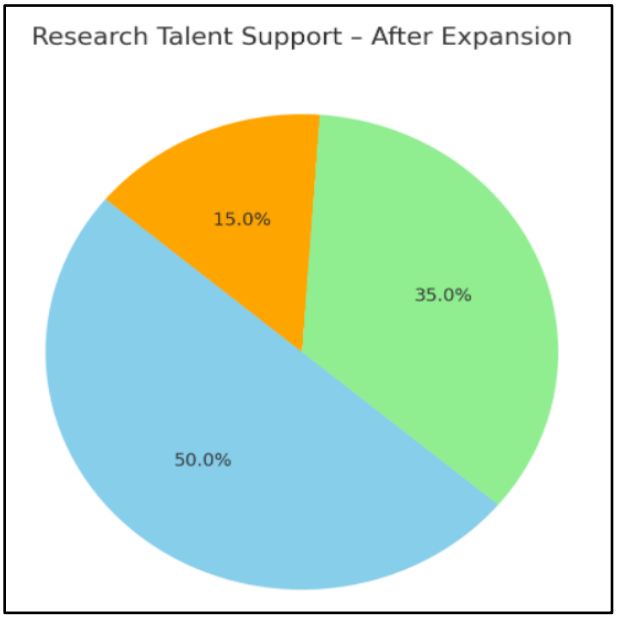



## Appendix C: Patent Commercialization Success Rate in Selected Countries



## Appendix D: Comparison of Research Talent Support Before and After Expansion




University Research: 80%

Industry Embedded Fellowships: 15%

International Talent Programs: 5%

University Research: 50%

Industry Embedded Fellowships: 35%

International Talent Programs: 15%

## Appendix E: Chatbot


**Figure 5.1**

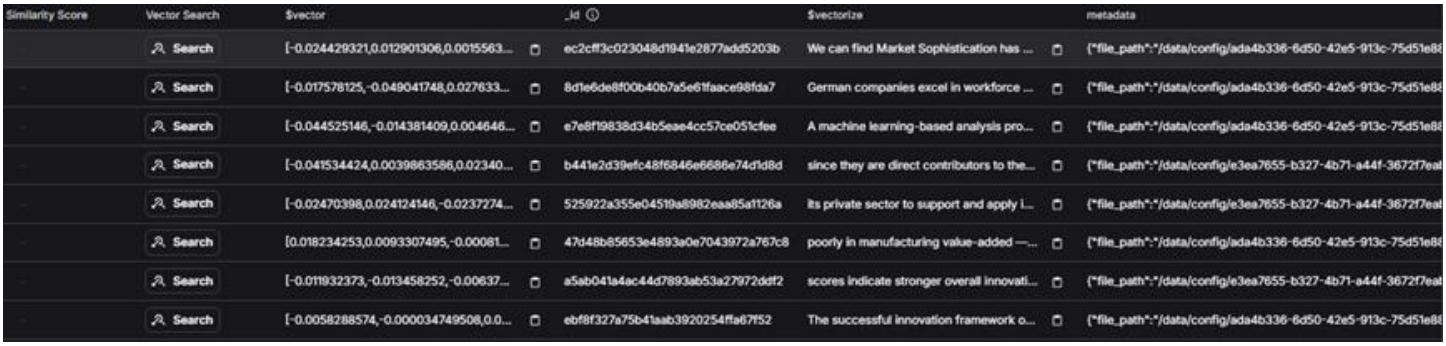



**Figure 5.2**

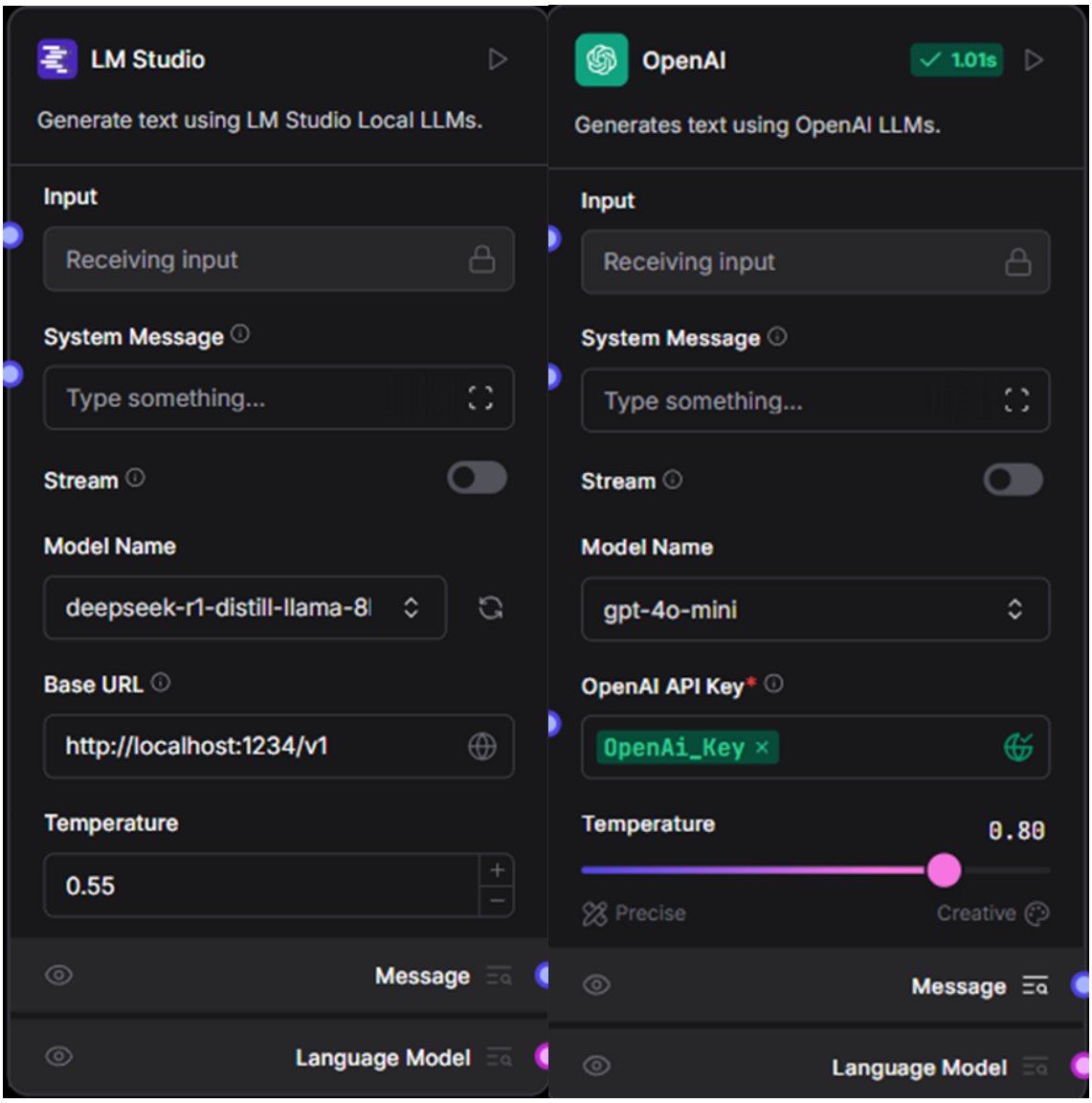



**Figure 5.3**