Innovation at scale: Establishing Canada as a global leader

Deloitte.

In our first *Catalyst* report, *A vision for a thriving Canada in 2030*, Deloitte envisioned a new future for Canada—one in which our country becomes a more resilient, inclusive, and prosperous place for all Canadians over the next decade. We know that innovation and scale-up companies will be a critical piece of this journey; they have an outsized impact on job creation, GDP growth, and international competitiveness. *Our ambition is for Canada to become a destination for technology scale-ups and a global innovation leader by 2030.*

Canada has many of the right components for a successful scale-up ecosystem: entrepreneurial drive, a strong technology environment, and world-class universities that develop leading research and a highly educated workforce. But while our innovation ecosystem has grown and matured significantly in recent years, we still lag behind leaders like the United States, United Kingdom, and Israel in our ability to create globally successful scale-ups.[1]

And that needs to change, since Canada depends on high-growth tech companies to drive future economic growth and employment gains. Through the *Technology Fast 50™ program*, we heard directly from the leaders of Canada's fastest growing scale-ups about their key growth challenges: talent, product development and commercialization, and international expansion.

In this policy brief, we outline targeted government actions to create a winning strategy that would help technology companies expand into leading enterprises. By acting today, Canada can set itself on the path to becoming a global scale-up hub and innovation leader by 2030.

Our research approach

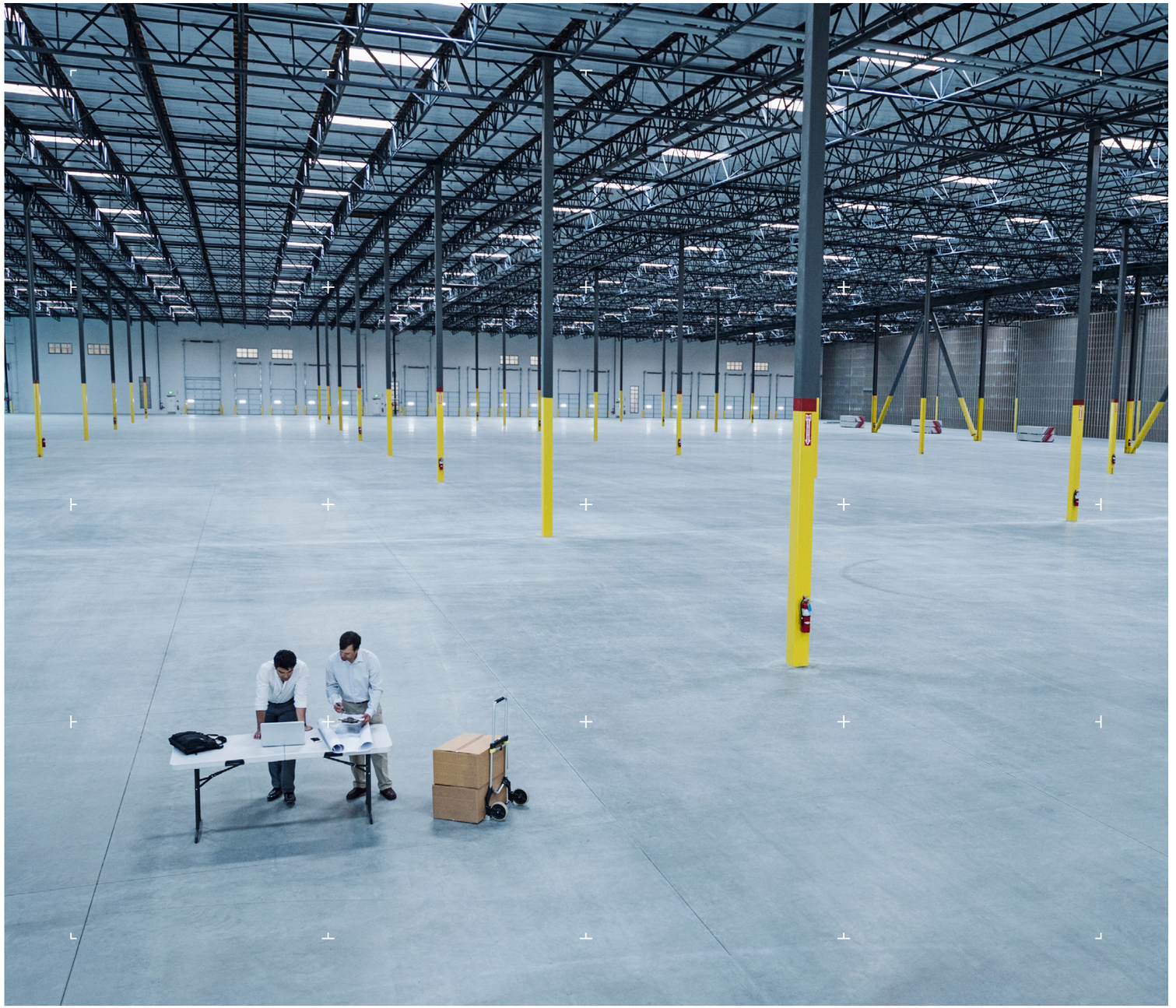
- ***Proprietary data analysis*** *from the past four years of Deloitte Canada's Technology Fast 50™ program. (*See "About the Technology Fast 50™ program" on page 05 for more information.*) For this brief, our team analyzed applicant data from 2018 to 2021, focusing specifically on the more than 250 companies that were in the process of scaling up.*

- ***Literature review*** *of academic and policy research, including analysis of international best practices, to determine which policies Canada could implement to become a global destination for scale-ups.*

- ***Specialist consultations*** *with Deloitte leaders who have extensive knowledge and experience in technology, government, tax, and data.*

For more detail on our analysis approach, refer to the appendix.

1. UNDERSTANDING CANADA'S SCALE-UP CHALLENGE

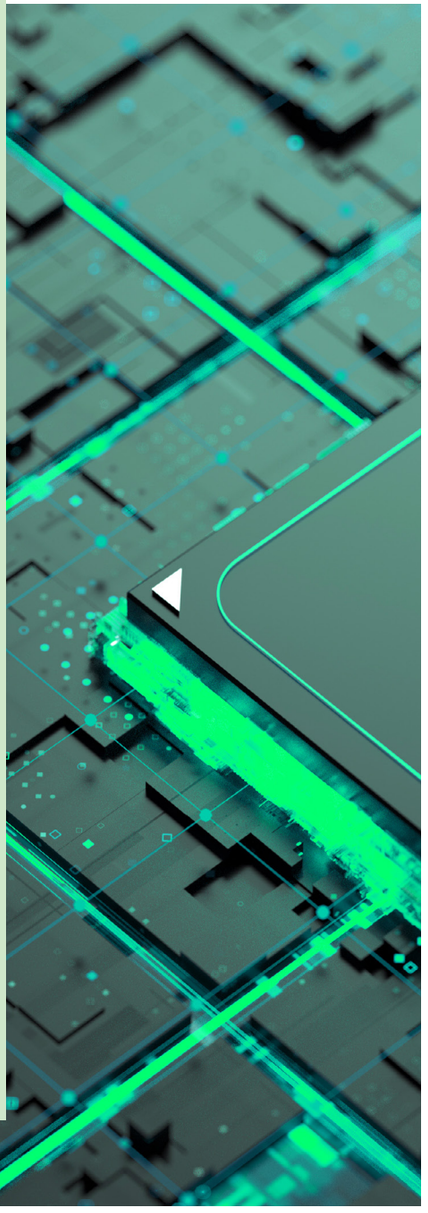


Scaling up is not a linear process; each company follows a unique path depending on a range of factors and characteristics. To understand the different types of scale-up firms in the Canadian ecosystem, and therefore better understand the growth challenges each faces, we used statistical techniques to group Fast 50 participants by shared characteristics.

About the Technology Fast 50™ program

Launched in 1997, the Fast 50 recognizes the fastest-growing technology, media, and telecommunications (TMT) companies in Canada. Awards are made in several categories. Past winners include Shopify, PointClickCare, Magnet Forensics, and Geotab.

To qualify, organizations must have been in business for at least four years, demonstrate minimum revenues of $50,000 in 2017 and $5 million in 2020, and have invested a minimum of 5% of gross revenues in research and development.[2]



Our analysis revealed four main clusters of organizations:

1. ***Early expanders:*** *Smaller, high-growth firms with relatively high international sales distribution*

2. ***Domestic developers:*** *Smaller, high-growth firms with the majority of their sales in Canada*

3. ***Global scalers:*** *Larger, moderate-growth firms with the highest proportion of international sales and the highest participation in accelerator programs*

4. ***Maturing growers:*** *Medium-sized, moderate-growth firms with high international sales and the lowest participation in accelerator programs*

Each cluster has unique characteristics, from size to capital sources to geographic footprint. However, all four consistently list the same top challenges:

- Attracting, upskilling, and retaining talent
- Developing and commercializing new products and services
- Expanding internationally

A key insight for policymakers is that removing these barriers to growth will have the biggest impact for the broadest range of companies. And, while Fast 50 participants did not list raising capital as a top-tier challenge, capital *is* needed to enable scale-ups to address their key challenges, and so must be embedded into any strategy to support their growth.

1. EARLY EXPANDERS
45 total firms

Net Sales	~$10M	280% growth
Employees	~60	51% growth
International sales	US: 58%	Other: 24%
Equity Financing	~$11M	

2. DOMESTIC DEVELOPERS
60 total firms

Net Sales	~$13.5M	108% growth
Employees	~80	37% growth
International sales	US: 13%	Other: 1%
Equity Financing	~$200M	

3. GLOBAL SCALERS
30 total firms

Net Sales	~$61M	35% growth
Employees	~329	27% growth
International sales	US: 67%	Other: 21%
Equity Financing	~$67M	

4. MATURING GROWERS
116 total firms

Net Sales	~$23M	46% growth
Employees	~100	24% growth
International sales	US: 62%	Other: 22%
Equity Financing	~$14M	

2.
BUILDING A LEADING SCALE-UP ECOSYSTEM

Pillar 1

Attracting, upskilling, and retaining talent

Talent is a key component of a strong, flourishing scale-up ecosystem. The number of tech workers in Canada increased by 22.5% from 2014 to 2019, adding 165,300 jobs to the economy at a pace more than three times the national average.[3] But attracting, hiring, and retaining the top talent that a high-growth company needs is challenging. Pandemic-related trends, including reduced immigration and increased international brain drain due to remote work,[4] have further exacerbated the problem.

What we heard from Fast 50 participants

- ***Talent challenges are multifaceted***
  Over the last three years, 40% of CEOs of Fast 50 participants have struggled with availability of the talent they need; 27% find it hard to attract the right people to their company.

- ***Remote work did not make attracting top talent easier***
  29% of participants struggled to find the right talent throughout 2020, compared to 28% before the pandemic.

- ***Diversity and inclusivity are a priority***
  For 80% of Fast 50 CEOs, creating and maintaining a diverse and inclusive workplace is vital to business success.

Recommendations

Build a pipeline of diverse talent through upskilling and reskilling programs

In 2020, young workers, visible minorities, Indigenous workers, and workers in sectors hit the hardest by lockdowns were more likely to have received the Canada Emergency Response Benefit (CERB).[5] At the same time, the job-search portal Indeed Canada showed job postings for tech roles were up 30% from pre-pandemic levels.[6] It's clear there's an opportunity, and an urgency, to train Canadians to close existing talent gaps.

To support a diverse, tech-talent pipeline, a good first step would be for the federal, provincial, and territorial governments to work together to develop a comprehensive innovation skills plan to prepare youth, under-represented groups, and displaced workers for careers in the innovation economy. International best practices—such as setting ambitious goals—can be applied here. One such example is the European Union's recent Pact for Skills program, which identifies specific industries where job displacement has been high and sets reskilling targets for them.[7]

More programs that train members of under-represented communities for specific jobs are also needed. Ones like the recent $5.8 million investment by FedDev Ontario and Elevate—a non-profit that aims to reskill 5,300 job seekers from communities including Black, Indigenous, racialized, 2SLGBTQ+, and Francophone professionals—are a step in the right direction.[8]

To succeed, the credentials earned in such programs would need to be viewed as valid and acceptable by both government and industry. For example, Google considers its own affordable, proprietary training certificates the equivalent of a four-year degree. Government could offer to cover initial costs for scale-ups to hire reskilled talent with non-traditional credentials and build confidence in such programs while limiting the financial downsides.

Clear the backlog of pandemic-related immigration/work visas and build a system that's resilient to shock

Canada has several immigration and work pathways, through both federal and provincial governments, that have successfully benefitted scale-ups looking for tech talent. As of 2020, for instance, nearly 40,000 tech workers had been recruited by Canadian companies using the Global Talent Stream program introduced in 2018.[9] However, the pandemic has caused delays and backlogs in visa processing, which make it difficult for scale-ups to acquire the people they need.[10] These delays will also disadvantage Canadian companies as they compete for international talent with countries like the United States.

It's not just the pandemic that's caused the backlog: outdated digital infrastructure, lengthy administrative processes, and lack of integration between federal and provincial systems also contribute.[11] The federal and provincial governments can start collaborating on a streamlined digital system to facilitate application processing.

While the 2021 federal budget provides for a long-term solution in the form of a completely digitalized application platform by 2023, more could be done in the near term.[12] An emergency plan is needed clear the backlogs by early 2022, one that would identify procedural bottlenecks, assess whether any processes can be temporarily adjusted to ease the backlogs, and allocate the resources to do so. Canada has already instituted temporary interview and biometric waivers for certain applicants from countries affected by pandemic-related consular closures,[13] but some visa application streams still don't offer basic video interview options that could, in the short term, reduce delays.[14]

Create programs that help scale-ups access and retain managerial talent

Finding and retaining qualified managerial talent, which is essential for growing a company, remains a major challenge.[15] First, it's difficult to find. Canada's innovation ecosystem is relatively young and therefore has a smaller pool of talent that has the knowledge and experience needed to grow a company. The challenge has been exacerbated by the rise in remote work, which makes it easier for US-based firms to hire top Canadian talent.

Second, acquiring good managerial talent is costly. Government can play an important role in bridging the affordability gap, and some have already begun to act: for example, the Ontario Exporters Fund helps scale-ups cover the cost of hiring an experienced export manager. Meanwhile, private-sector pilot programs have demonstrated that relevant training for workers with managerial skills trying to break into the tech industry enables them to successfully transition.[16]

Data from the Fast 50 analysis suggests that accelerators can be effective delivery partners for upskilling and reskilling programs. The government could support talent needs by backing these programs through the federal Canada Accelerator and Incubator Program (CAIP), an initiative that helps accelerators and incubators improve their service offerings.[17]

Pillar 2

Developing and commercializing new products and services

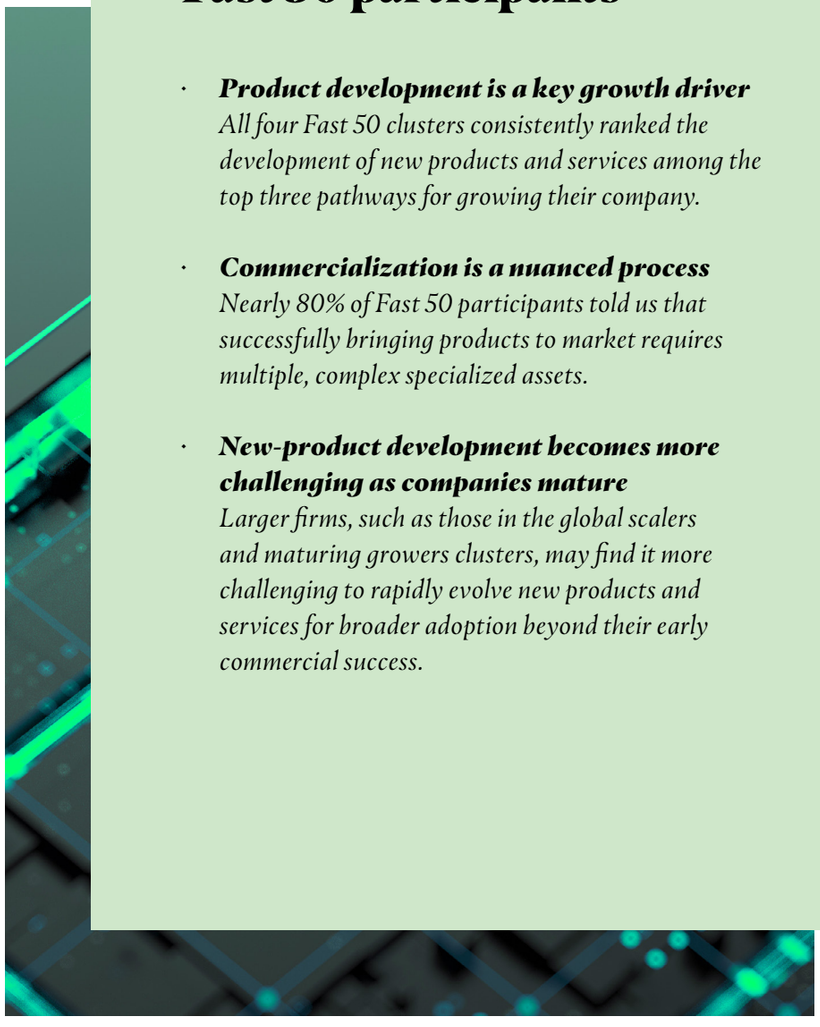
The business model of a scale-up revolves around innovative, differentiated products and services. But simply developing such an offering is not enough—the business must be able to commercialize it. Access to the customers and capital required to bring a product to market and drive adoption is critical.

What we heard from Fast 50 participants

- ***Product development is a key growth driver***
  All four Fast 50 clusters consistently ranked the development of new products and services among the top three pathways for growing their company.

- ***Commercialization is a nuanced process***
  Nearly 80% of Fast 50 participants told us that successfully bringing products to market requires multiple, complex specialized assets.

- ***New-product development becomes more challenging as companies mature***
  Larger firms, such as those in the global scalers and maturing growers clusters, may find it more challenging to rapidly evolve new products and services for broader adoption beyond their early commercial success.



Recommendations

Work with industry to expand the mission-based approach to supporting innovation

Many government programs, like the federal Scientific Research and Experimental Development (SR&ED) tax incentive, promote made-in-Canada innovation. However, the industry specialists we spoke to described the need to embrace a more demand-side, mission-driven approach to innovation policy; they cited as an example the successes of the US Defense Advanced Research Projects Agency (DARPA). While Canada does have a challenge-based program, called Innovative Solutions Canada (ISC), its budget and scope are limited in comparison to DARPA. Grand Challenges Canada is a similar program, with a specific focus on social impact.

The federal government can work with industry leaders and innovation experts to identify opportunities to grow the impact of ISC and Grand Challenges Canada. For example, some research suggests that DARPA's success is tied to the fact that the US Department of Defense acts as a long-term anchor client with deep pockets. Another consideration is that the benefits of such programs take a long time to accrue—investment in innovation requires effective, time-consuming due diligence to ensure the new technology works.[18] In other words, a successful mission-based innovation policy is a long-term investment underpinned by consistent support and funding. Such a policy can be designed and delivered in collaboration with the private sector.

Explore innovative procurement options

Governments play a key role as a first customer for scale-ups, allowing them to build the market credentials necessary for gaining further business. Public procurement processes tend to require companies to demonstrate success on previous projects, which is an appropriate approach for mitigating risk and responsibly managing taxpayer dollars. However, these requirements can be prohibitive to scale-ups which, by their very nature, often have limited experience to demonstrate, and limited time and resources to navigate the procurement process. We heard from one such company that chose to forgo bidding on a government contract because the associated legal fees and regulatory requirements would be prohibitive, particularly if the company didn't win the contract.

Wider adoption of procurement models that better integrate scale-ups, while continuing to minimize risk, is therefore needed. For example, requests for proposals (RFPs) can continue to target larger, established firms, but with an explicit requirement: to engage with a Canadian scale-up to deliver a portion of the work. While the government has begun to use this approach in isolated instances—for example, including requirements in RFPs for Canadian innovation—it could be scaled up to maximize its impact.

Such an approach to procurement would be most effective if developed and refined in consultation with industry leaders representing both the large, established firms and the scale-up community. This would ensure the requirement is not so onerous as to disincentivize large firms from bidding on the contracts while also making sure it's genuinely helpful to the scale-up bidding partners. Here, the government could apply lessons learned from the Innovation Superclusters Initiative on the importance of balancing competing priorities. Deloitte innovation specialists told us about power imbalances that occurred there between the participating larger firms and scale-ups, where the more established companies "pulled rank;" for example, by structuring patent ownership to favour themselves.

Streamline government programs under a single, user-friendly web portal

The federal government can also play a role in improving access to the support and funding required to commercialize products. Fast 50 participants told us that, while access to capital has improved over the last five years, the various government programs are difficult to navigate due to their diverse offerings and eligibility criteria. The same is true for programs meant to support scale-ups.

One solution is a web portal that serves as a single point of entry to all government programs for scale-ups. The portal could include a concierge service to help leaders understand which funding and support programs are suited to their business's needs and how to apply for them. For example, the portal could include a one-stop-shop trade commissioner service that gathers all government export facilitation services, currently delivered by various agencies and departments, into one interface. This concierge service could also connect scale-ups with a range of non-government funding providers, like Amazon Web Services credits, and take inspiration from private-sector tools like the RBCx platform for entrepreneurs.

The federal government's Business Benefits Finder is a positive step in the right direction.[19] To maximize its impact, and that of similar tools, improving awareness and driving more users to the website would be a good investment of energy; social media campaigns or investments in webpage discoverability and search rankings would be useful here. →

Improve the commercialization of academic research and innovation

Protecting the innovation underpinning products is also critical. Scale-ups with intellectual property (IP) are almost twice as likely to have experienced high growth (more than 20% per year) compared with companies that don't.[20] Yet, only 10% of Canadian startups and scale-ups hold patents, and only 9% have a formal IP strategy.[21]

A significant portion of Canadian IP and innovation is generated by universities, where technology transfer offices (TTOs) are responsible for supporting their commercialization. However, Canadian universities earn only about 27% as much as their US counterparts from patent licensing.[22] In 2018, the former generated a 1.3% return on their research and development investment, whereas the latter generated 4.6%.[23]

Although TTO practices in Canada vary between universities, most focus on rights retention rather than more open collaboration.[24] Specialists we spoke to told us that universities lack the right incentive structures for patenting, licensing, and commercializing research. Further, commercializing IP is a complex process. Relatively few people in Canada have the specialized expertise required to support technology transfer offices.

Revising best practices for TTOs, therefore, could help improve the commercialization of academic research and innovation. National representative and advocacy bodies like Universities Canada have called for greater government investment.[25] This funding could be tied to the adoption of best practices or new business models for TTOs; for example, performance metrics could be less focused on short-term cost recovery, or licensing policies could be simplified to attract industry partners, particularly smaller firms.[26] Another option would be to centralize patenting and licensing activities within a single group of experts that would be shared by multiple universities and research institutes, as Quebec has begun to do.[27] This approach mitigates the challenge of limited IP expertise in Canada by pooling resources.

Continue to support the protection and commercialization of IP

Given the country's risk of losing IP to foreign ownership, initiatives to improve IP rights and protection—like patent pools—are critical. In a patent pool, participants agree to cross-license patents to one another or to third parties, allowing them to benefit from shared resources, expertise, and protection.

In 2021, the federal government launched Canada's first patent pool: the non-profit Innovation Asset Collective (IAC), for data-driven small and medium-sized businesses in the cleantech sector.[28] Global case studies suggest that initiatives like this one are most successful when both government and industry are involved. (*See "Case study: Promoting an open innovation society with Japan's IP Bridge" on page 16.*)

Government monitoring of the group's performance over the next four years[29] provides an opportunity to identify best practices and to implement similar initiatives to protect Canadian IP in sectors beyond cleantech.

Case study: Promoting an open innovation society with Japan's IP Bridge

In 2013, the Japanese government partnered with private-sector players to establish an IP fund of three billion yen (approximately C$3.5 billion) intended to enhance Japan's competitiveness and promote innovation. The fund, called IP Bridge, supports monetization and commercialization and defends against infringement. Its business model centres on buying and licensing patents from Japanese and international companies in order to generate returns for investors. Since its inception, IP Bridge has obtained more than 3,500 global patents[30] from companies such as Panasonic, NEC, Fujitsu, and Hitachi.[31]

The fund plays an important role as a convener in the innovation ecosystem. For instance, it has partnered with universities and research institutes for technology development, standing at the ready to support the licensing or commercialization of any resulting IP.[32] To promote more distributed benefits of innovation, it also participates in a number of patent pools that are aligned with its major portfolio areas.[33] IP Bridge focuses on Southeast Asia, where its regional proximity allows the fund to quickly respond to local needs and to work with strategic Japanese trading partners. For example, it has worked with the Intellectual Property Intermediary of Singapore to provide access to Japanese IP, and with the Malaysia Digital Economy Corporation to fast-track technology development between the two countries.[34]

With its cross-industry, multi-national portfolio, IP Bridge is working to improve consensus among different industries as to how to handle and value different types of patents—often an obstacle to successful commercialization.[35]

Pillar 3

Expanding internationally

Canada's domestic market is small, with long sales cycles and consumers who tend to buy products from established international companies. To successfully compete, Canadian scale-ups would be well served by a national export strategy that would enable them to expand into other countries.

What we heard from Fast 50 participants

- ***Accessing global markets becomes more challenging as companies grow***
  Fast 50 firms in the global scalers and maturing growers clusters—the largest by revenue—rank international expansion as a greater challenge than their smaller counterparts in the early expanders and domestic developers clusters.

- ***Market expansion is top of mind, particularly for smaller companies***
  While all Fast 50 companies consistently ranked geographic expansion as one of the top three ways their company is likely to grow, the early expanders and domestic developers clusters—where firms have lower revenues on average—emphasized it more than their larger counterparts did.

- ***International sales are highly concentrated***
  On average, sales of Fast 50 participants are 48% in the United States, 8% in the European Union, 3% in Asia, and 6% throughout the rest of the world.

Recommendations

Build the "made-in-Canada" brand into a world-renowned innovation brand
Specialists told us that the made-in-Canada brand has the potential to be a real differentiator in increasing the global competitiveness of scale-ups and attracting world-class talent.

Globally, Canada is known primarily as a resource and manufacturing exporter. Expanding into international markets requires a reputational shift that highlights the sectors that are rapidly growing. Building on the work of Export Development Canada (EDC), this could be achieved through a national branding strategy that aims to link the made-in-Canada brand with innovation, diversity, sustainability, and trust.

This could take the form of a year-long, globally coordinated campaign that builds on the work of Canada's embassies and consulates, as well as members of the cross-departmental Business, Economic and Trade Recovery Team like Global Affairs Canada, Invest in Canada, Export Development Canada, and the Business Development Bank of Canada, to promote the country abroad.

The campaign could include major events in global markets that Canada is targeting and bring together scale-ups, the business ecosystem, and the media to raise the profile of the made-in-Canada brand. A best-in-class digital marketing strategy aimed at key exports targets would be a smart component.

Recommendations *cont'd*

Create an engagement strategy to help scale-ups leverage Canada's international trade infrastructure

A targeted go-global engagement strategy could help companies expand internationally by raising awareness of federal support programs and ensuring they have the necessary tools to structure their export operations. Building on the existing Export Diversification Strategy, the strategy could expand to include:

- *A communications strategy*
  Many scale-ups are not aware of government programs that exist specifically to help them export. An awareness campaign is therefore called for, which would of course include a social media strategy, as well as promotion through partnerships with key stakeholders in the scale-ups ecosystem, such as incubators and capital providers.
- *A mentorship program:*
  Scale-ups could learn a great deal from companies that have successfully expanded internationally, as a New Zealand mentorship program has proven. (*See "Case study: Connecting to global opportunities with World Class New Zealand" on page 20.*) This would enable high-growth tech companies to build global networks and enhance their understanding of their foreign target markets. The government could co-deliver the mentorship program with accelerators in major Canadian tech hubs, capitalizing on their experience in working with scale-ups and their established networks. To complement the mentorship program, the government could integrate an exporter-in-residence service—modelled after entrepreneur-in-residence roles—that offers technical support to help navigate export processes. This would reduce the administrative burden for scale-ups entering international markets. →

Case study: Connecting to global opportunities with World Class New Zealand

World Class New Zealand Awards and Network was established in 2001 by the government to engage its citizens who had moved elsewhere and to create a global network keen to help New Zealand. The annual awards celebrate world-leading expatriates in various fields who contribute positively to the country's image abroad. The network, meanwhile, is a group of more than 400 high-achieving expatriates who offer mentorship and knowledge-sharing sessions to help other New Zealanders succeed on the world stage.[36]

The initiatives are delivered by Kea New Zealand, a public-private partnership funded by the New Zealand government, private sector sponsors, and membership fees. It has offices in major hubs where the New Zealand diaspora is concentrated, such as London, Sydney, New York, and Shanghai, as well as 14 chapters across Europe, North America, and Asia.[37]

Recommendations *cont'd*

Update data residency and privacy rules

Data residency—where data is physically stored—dictates which regulatory requirements apply to the data.[38] These requirements could pose a barrier to Canadian companies looking to expand internationally, because compared to those of other jurisdictions, Canada's laws around data residency are not as robust or as consistent. And where there are significant differences in those laws, businesses are at greater risk of improperly transmitting or storing data outside Canada.[39] This is particularly important for businesses using cloud service providers.[40]

To mitigate this challenge, it's critical to update existing laws around data privacy and residency—such as the Personal Information Protection and Electronic Documents Act—to be more consistent with international standards. This consistency would help businesses reduce their risk of data breaches and non-compliance. Stronger data privacy laws would also provide greater certainty to international businesses that are considering transferring and storing data in Canada.[41]

A THRIVING SCALE-UP ECOSYSTEM FOR A THRIVING CANADA

Canada stands at a pivotal crossroads. We have all the necessary components in place for a thriving scale-up ecosystem, from raw talent to R&D to entrepreneurial spirit. What we do next will determine whether Canada becomes recognized as the global innovation leader it can be or whether it continues to trail its peers.

Deloitte data and analysis reveal that the thorniest obstacles to growth—for every cluster of scale-ups, irrespective of their unique characteristics, growth stage, or size—lie in talent, product commercialization, and international expansion.

Canada relies on its policymakers to initiate the targeted interventions that will address these challenges and enable our innovation ecosystem to realize its potential. To be most effective, this work must include promoting awareness of support programs and encouraging companies to take advantage of them.

By acting today, Canada can set itself on the path to becoming a global scale-up destination and a recognized leader in innovation by 2030.

Summary of recommendations

Pillar 1: Attracting, upskilling, and retaining talent

- Build a pipeline of diverse talent through upskilling and reskilling programs
- Clear the backlog of pandemic-related immigration/work visas and build a system that's resilient to shock
- Create programs that help scale-ups access and retain managerial talent

Pillar 2: Developing and commercializing new products and services

- Work with industry to expand the mission-based approach to supporting innovation
- Explore innovative procurement options
- Streamline government programs under a single, user-friendly web portal
- Improve the commercialization of academic research and innovation
- Continue to support the protection and commercialization of intellectual property

Pillar 3: Expanding internationally

- Build the "made-in-Canada" brand into a world-renowned innovation brand
- Create an engagement strategy to help scale-ups leverage Canada's international trade infrastructure
- Update data residency and privacy rules

Acknowledgements

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It's a follow-up to the Deloitte Future of Canada Centre's first Catalyst report, *A vision for a thriving Canada in 2030*, which charts the country's path from recovery from the COVID-19 pandemic to a prosperous, resilient, and inclusive economy and society in 2030.

The Future of Canada Centre facilitates an exploration of new ideas, viewpoints, and insights about our country's most important national issues, with the aim of helping propel Canada into a new age of growth and competitiveness. It houses a team of Deloitte's most innovative thinkers and experienced leaders, who are valued influencers in their respective fields.

The centre also gratefully acknowledges Ryan Dormer, Hélène Emorine, Farah Huq, Ramya Kunnath-Puliyakodil, Joe Noss, Maya Prager, and Alexandra Wilkinson for their contributions to the research and writing of this policy brief.

APPENDIX: OVERVIEW OF DATA ANALYSIS AND METHODOLOGY

The technique used in our analysis, k-means clustering, separates data into groups such that the observations in the same cluster are more similar than the observations in different clusters. An algorithm creates clusters by minimizing the Euclidean distance within a cluster and maximizing this distance between different clusters.

Using data from the 2018-2020 applications, 251 Fast 50 applicants were clustered into four groups, all of which on average meet the OECD definition of a scale-up (cumulative average growth rate of at least 20% for employment or revenue over three consecutive years).[42] It should be noted that applications include data for prior years; applications made in 2020, for instance, reflect data from business operations from 2019, and so on.

Due to the large differences in observations, several applicants were treated as key outliers and dropped from the analysis. Outliers included firms with null values, or values dramatically outside the inter-quartile (25-75th percentile) range. In turn, many of the largest firms (in terms of total employees) were excluded from these clusters. Not only does this exclusion let us focus on firms that are in the midst of the scaling-up process, but it also ensures the k-means algorithm is not thrown off by the outliers.

K-means clustering requires all input variables to be continuous—they cannot be binary or categorical. When selecting variables, three considerations were made: the level of correlation between variables; their relevance to the scale-up process; and their ability to make *meaningful* clusters. *Meaningful* in this context means those that have significant similarity within each cluster and disparity between clusters. The final variables included in the clustering model were: percentage of sales in Canada; employee growth; total employees; and percentage of employees in R&D.

Cluster 1 - Early expanders

CHARACTERISTICS:

- Net sales: ~$10M
- Equity financing: ~$11M
- Number of employees: ~60
- Frequency: 45 firms (18%)
- Highest sales growth (280%) and employee growth (51%)
- Relatively high % of sales in the EU, Asia, and other markets
- Second-highest number of firms have been in accelerators (38%)

CHALLENGES:

- Raising capital is a larger challenge than for other clusters.
- International expansion is *not* one of their top three challenges.

Cluster 2 - Domestic developers

CHARACTERISTICS:

- Net sales: ~$13.5M
- Equity financing: ~$200M
- Number of employees: ~80
- Frequency: 60 firms (24%)
- Second-highest sales growth (108%) and employee growth (37%)
- Highest amount of sales in Canada (86%)
- Second-lowest number of firms have been in accelerators (28%)

CHALLENGES:

- Developing Management is a greater challenge for them than any other cluster.

Cluster 3 - Global scalers

CHARACTERISTICS:

- Net sales: ~$61M
- Equity financing: ~$67M
- Number of employees: ~329
- Frequency: 30 firms (12%)
- Lowest sales growth (35%) and second-lowest employee growth (27%)
- Highest number of firms have been in accelerators (57%)

CHALLENGES:

- Finding, hiring, retaining talent is by far their biggest challenge, more than any other cluster.
- International expansion is a bigger challenge than for other clusters.
- Raising capital is their least important challenge, lower than any other cluster.

Cluster 4 - Maturing growers

CHARACTERISTICS:

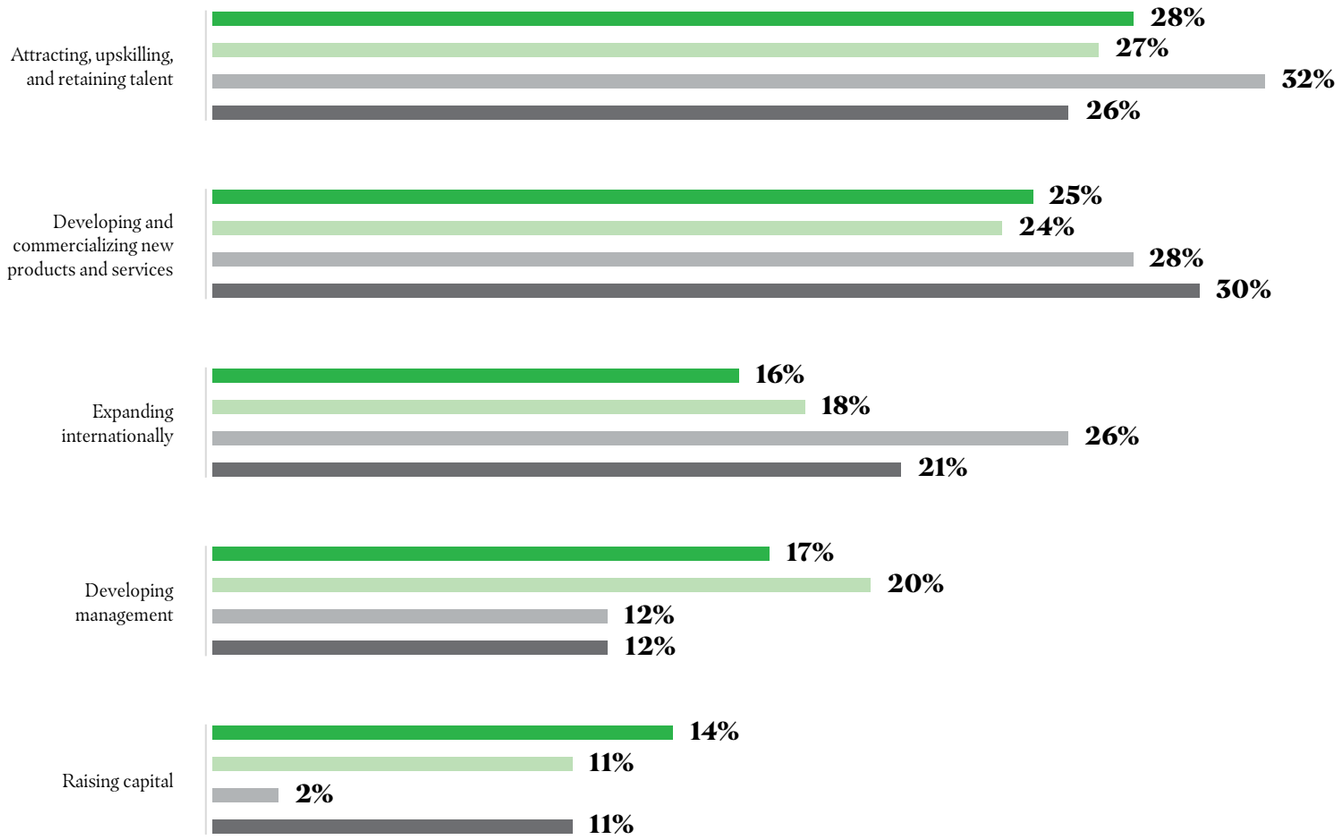
- Net sales: ~$23M
- Equity financing: ~$14M
- Number of employees: ~100
- Frequency: 116 firms (46%)
- Second-lowest sales growth (46%) and lowest employee growth (24%)
- Lowest number of firms have been in accelerators (15%)

CHALLENGES:

- New product/service development is their top-rated challenge.
- Have the highest variation in top challenge of any cluster.

Fast 50 applicant challenges by cluster, 2018–2020 (%)

n=251



ENDNOTES

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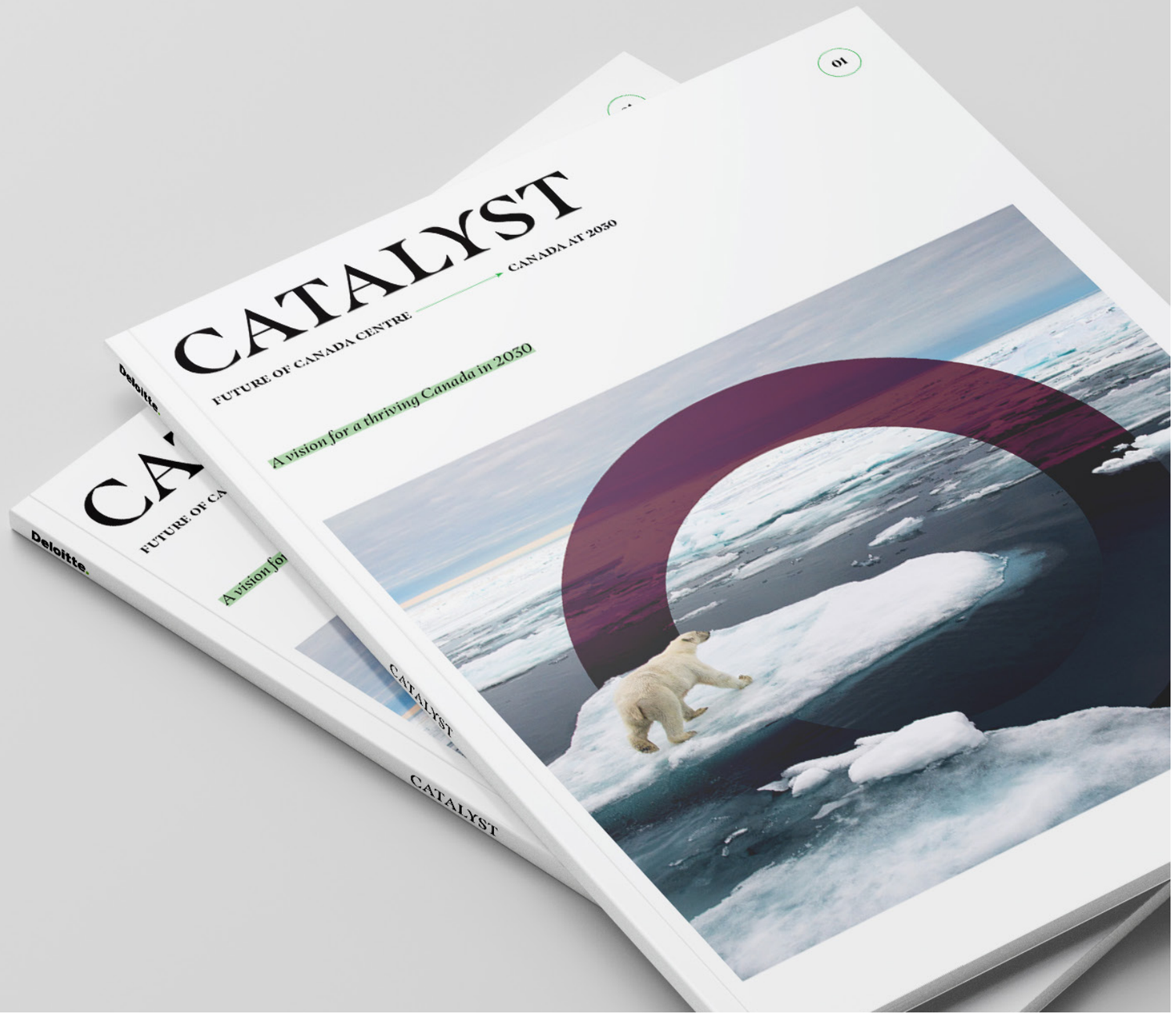

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