Next Generation Manufacturing Canada
Advanced Manufacturing Supercluster
Five-Year Strategy

Canada's Advanced Manufacturing Supercluster will work to position Canada as a world leader in advanced manufacturing for the benefit of Canadians.

The Supercluster is founded on the principle that the transformation to advanced manufacturing will enrich the lives of all Canadians, delivering better products and good jobs while generating the economic growth that is essential to building a better world.

The Supercluster will leverage Canada's technology and industrial strengths to accelerate the development, adoption, and scale-up of world-leading capabilities in Canadian manufacturing.

Its aim is to strengthen the competitiveness of Canada's manufacturing sector, drive more innovation and investment in advanced manufacturing technologies in Canada, generate new commercial opportunities for Canadian companies in global markets, grow more large-scale world-leading Canadian enterprises, and develop a modern and inclusive workforce with the skills required to excel in advanced manufacturing today and in the future. By combining Canada's manufacturing and technology strengths, and facilitating access to supporting infrastructure and services, the Supercluster aims to achieve exponential benefits for Canadian industry and the Canadian economy as a whole.

Adding Value to Support Advanced Manufacturing in Canada

Canada's Advanced Manufacturing Supercluster has an ambitious brand promise to fulfill. It will play a unique value-adding role in Canada's advanced manufacturing ecosystem by providing:

- **Leadership** in identifying the challenges, opportunities, trends, and innovation priorities shaping advanced manufacturing in Canada and around the world;
- **Connections** among manufacturers and technology providers large and small, academic and research institutions, business support services, and government funding agencies to enhance awareness of and strengthen Canada's advanced manufacturing ecosystem;
- **Collaboration** and partnership opportunities for Canadian companies, both within the country and internationally, that facilitate innovation, technology adoption and scale-up, and the commercialization of new technology and manufacturing capabilities in global markets, especially for small-and-medium-sized enterprises (SMEs);
- **Funding** for transformative innovation initiatives that apply advanced technologies in manufacturing; and,

- **Facilitated access** to the services, tools, testbeds, and training programs that can help de-risk technology adoption and scale-up for smaller companies.
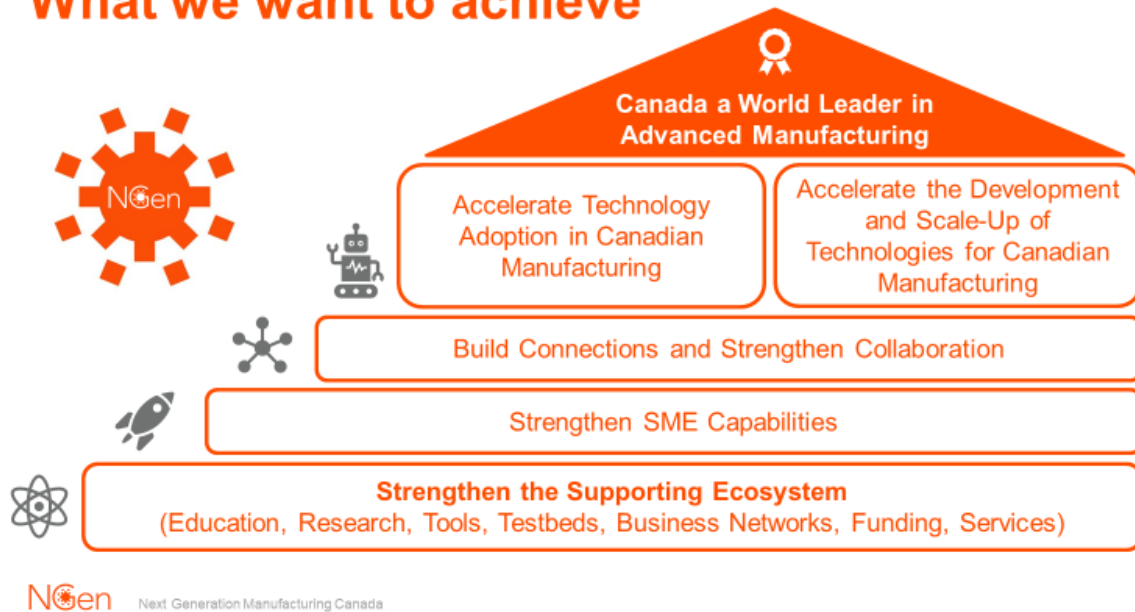
A New Industrial Revolution

The business of manufacturing is rapidly changing around the world. Customers, governments, and stakeholders are more demanding than ever. They want customized solutions they can manage on demand and at low cost. Political and market risks are running high. The competition is intense. Cost pressures are rising. Innovation is the key to competitive success, and technologies are advancing at a rapid pace. Business models, supply chains, and entire industries are being disrupted by digital and other advanced technologies. However, those same technologies are offering manufacturers new opportunities to improve competitiveness, generate value for customers, and grow their business.

Advanced digital, production, and materials technologies are enabling manufacturers to address critical business challenges. They are revolutionizing the business of manufacturing by:

- Enabling the development of new, connected, and intelligent products, processes, production and business systems;
- Transforming products and processes into data platforms that in turn enable greater connectivity, monitoring, machine learning, and new human-device interfaces;
- Allowing for virtual design, simulation, and testing of products, processes, and production systems;
- Enabling the rapid development, prototyping, and production of new and enhanced products, processes, and services;

- Significantly increasing operating efficiencies and customer satisfaction;
- Speeding up business response, manufacturing, and delivery times;
- Increasing flexibility, agility, and customization on the part of manufacturers, their partners and suppliers;
- Allowing for improved life-cycle management of both materials and products;
- Improving quality, precision, reliability, and maintenance of products and processes;
- Improving the health, safety, and environmental sustainability of manufacturing operations and workplaces;
- Connecting products, processes, customers, suppliers, and partners across extended and reconfigurable value chains; and,
- Creating new business models and revenue streams based on data driven services.

Companies that are able to take advantage of the potential offered by advanced technologies will be in a strong position to compete and grow. Failure to adopt advanced technologies, on the other hand, threatens the competitiveness and long-term survival of manufacturers in Canada and around the world.

The Opportunity for Canada

Canada should be a leader in advanced manufacturing. There are outstanding strengths in research, technology, and manufacturing, well developed innovation infrastructures, and highly talented workers to be found across the country, and especially in southern Ontario and Quebec. Canada can rightly boast of its:
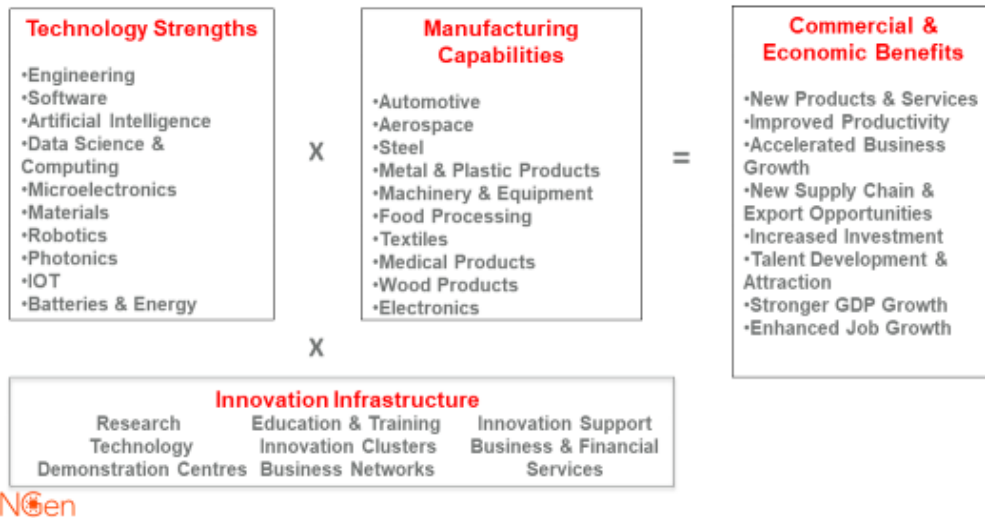
- **Highly diversified manufacturing sector** encompassing industries from resource, food, chemicals and materials processing to high-value automotive, aerospace, equipment, and device production. Founding members of the Advanced Supercluster, for instance, include Honda, Linamar, Magna, Stackpole, Toyota, and Woodbridge (automotive), Algoma, ArcleorMittal Dofasco, and Brannon (steel), Xerox (advanced materials), Crestmold, Laval, and voestAlpine (molds and other metal products), Magellan and MDA (aerospace), Maple Leaf and Maple Lodge (food processing), Celestica and Christie Digital (electronic equipment manufacturing), Danby, GDLS, and Husky (equipment manufacturers), Barrick Gold and Komatsu (mining machinery), and members of the Bluewater Wood Alliance (wood products).

- **Leading-edge technology providers.** Founding members of the Advanced Manufacturing Supercluster include multinational technology companies like ABB, Autodesk, Cisco, Festo, IBM, Intel, Kuka, Microsoft, Rockwell, Siemens, and Xerox, as well as companies offering unique technologies developed in Canada like Kinova, Clearpath, and MDA (robotics), Memex, Majik, and Timereaction (manufacturing and workflow software systems), Open Text and Yetiware (data analytics), ATS (automation systems), Javelin and the members of Canada Makes (additive manufacturing), Myant and the members of Intelliflex (flexible electronics and smart materials), Teledyne DALSA, Fibos, and Sheba Microsystems (vision systems), Morgan Solar, NIX and the

members of ReMAP (microelectronics and sensors), Escript (cybersecurity), Sightline Innovation and Canvass Analytics (Machine Learning), Miovision and Eleven X (Internet of Things infrastructure), and Thalmic/North, Chipcare, Be Wear, 2020 Armor, Peytec, and Inventing Future Technology (Devices).

- **Four globally ranked technology start-up ecosystems** in the Toronto-Waterloo Corridor, Montreal, Ottawa, and Vancouver.

- **World-leading research** in artificial intelligence, computing, materials, robotics, lasers, optics, information and communications, energy, and sustainable technologies that can be applied in manufacturing. Founding members of the Supercluster include 14 universities and 12 research networks in the fields of artificial intelligence, optics, flexible electronics, advanced materials, computing, digital media, blockchain, microelectronics, mining, automated vehicles, alternative energy and clean tech in both Ontario and Quebec.

- **Rich asset base of technology and innovation service and scale-up centres**. The Centre de recherche industrielle du Québec and Xerox Research Centre of Canada are both founding members of the Supercluster.

- **Skilled and inclusive workforce** in technology and manufacturing.

- **High-quality advanced skills training and education sector**. Founding members of the Supercluster include fifteen colleges and polytechnics across Canada.

- **Rich variety of clusters, networks, and business services** supporting innovation, investment, and business development. Founding members of the Supercluster include ten local and regional chambers of commerce; industry associations including Canadian Manufacturers & Exporters, the Excellence in Manufacturing Consortium, Manufacturing Innovation Network, the Auto Parts Manufacturers' Association, Advanced Technology for Food Processing cluster, Ontario Aerospace Council and Downsview Aerospace Cluster, Blue Water Wood Alliance, and Canadian Mold Makers' Association; innovation networks including MITACS, ReMAP (microelectronics), Canada Makes (additive manufacturing), Intelliflex (flexible electronics and smart materials), Automate Canada (automation and robotics), SOSCIP (advanced computing), and the Digital Media Network (IOT); as well as innovation and start-up centres like Communitech, MaRS, ventureLAB, Innovation Factory, and Green Centre Canada.

- **Preferential access to international markets** with over 1.5 billion consumers and a combined GDP of $50 trillion thanks to its strategic trade and economic agreements with the United States, Mexico, European Union, and Asia Pacific economies.

Imagine the exponential economic and commercial benefits that would result if these assets could be combined together in a more connected, collaborative, and coordinated ecosystem! That is what NGen aims to achieve in building Canada's Advanced Manufacturing Supercluster.

The Opportunity for Canada

Technology Strengths		Manufacturing Capabilities		Commercial & Economic Benefits
•Engineering •Software •Artificial Intelligence •Data Science & Computing •Microelectronics •Materials •Robotics •Photonics •IOT •Batteries & Energy	X	•Automotive •Aerospace •Steel •Metal & Plastic Products •Machinery & Equipment •Food Processing •Textiles •Medical Products •Wood Products •Electronics	=	•New Products & Services •Improved Productivity •Accelerated Business Growth •New Supply Chain & Export Opportunities •Increased Investment •Talent Development & Attraction •Stronger GDP Growth •Enhanced Job Growth

X

Innovation Infrastructure

Research	Education & Training	Innovation Support
Technology	Innovation Clusters	Business & Financial
Demonstration Centres	Business Networks	Services

NGen

Canada's Advanced Manufacturing Challenge

In spite of Canada's manufacturing and technology strengths and the transformative role that advanced technologies are playing in improving competitiveness, enabling innovation, and driving business growth for manufacturers around the world, Canada is falling behind as an advanced manufacturing economy.

The future of manufacturing matters for Canadians. Manufacturing is a vitally important sector of Canada's economy. It directly accounts for 12% of the country's GDP, employs more than 1.7 million Canadians, and generates over 60% of Canada's merchandise export earnings. Every dollar of manufacturing output creates $3.20 in total private and public sector economic activity by way of the goods and services that Canada's manufacturers purchase and the taxes they pay.

Manufacturing is also the ultimate integrator of technology. The Internet of Things, sensors and microelectronics, next generation networks, cybersecurity, supercomputing, artificial intelligence, virtual modeling, simulation, and testing, robotics, automation, and advanced tooling, additive manufacturing, and advanced materials all have applications in developing, producing, and connecting products, processes, and business and production systems across a wide variety of manufacturing sectors – from wood products, steel, and fabricated metals, to food and chemical processing, to automotive, aerospace, machinery and equipment.

Canadian manufacturers have no choice but to integrate transformative technologies in new and improved products, processes, and business models in order to compete and grow in global markets.

However, Canada is underperforming when it comes to the competitiveness and growth performance of its manufacturing and technology sectors.

After adjusting for price changes, the value of goods produced by Canadian manufacturers is running just slightly higher than in 2002. Canada's manufacturing sector lags behind in developing new products and adopting advanced technologies. R&D spending is down 10 % while investments in technology acquisition have fallen by 24% over the past ten years. As a result, Canada's productivity gap with the United States, not to mention with other advanced manufacturing powerhouses like Germany, Japan, and South Korea, has widened.

In 2000, the United Nations ranked Canada fourth in the world in terms of manufacturing competitiveness. Since then, Canadian manufacturing has tumbled to fifteenth spot in overall global rankings. With other countries investing heavily to support the transformation of their manufacturing industries, Canada runs the risk of falling further behind.

For smaller manufacturers in particular, the risks, opportunities, and business requirements involved in developing and applying new technologies are difficult to identify and to manage. Smaller companies, including scale-ups, often lack the skills, expertise, facilities, and dedicated resources to do it all themselves. Meanwhile, manufacturers struggle to attract the qualified people, capital, product mandates, and the customers they need to make the business case for adopting advanced technologies.

Canada's emerging technology companies also find it difficult to acquire the customers, capital, talent, and manufacturing capabilities they need for rapid scale-up and growth. In spite of having a high density of technology start-ups, Canada's start-up ecosystems lag behind those in other countries in terms of their ability to create successful sustainable businesses, build them into big companies, develop global connections, and attract capital investment.

Ecosystem Weaknesses

Canada's manufacturers and technology firms both have much to gain by working collaboratively together. Manufacturers would benefit by deploying advanced technologies to boost competitiveness, improve operating efficiencies, and develop new ways of delivering customer value. Smaller technology companies would benefit by identifying applications for their technologies in manufacturing, requirements for manufacturability, and potential partners with manufacturing capabilities that could help them develop new products and scale up production. More manufacturing customers in Canada would help Canada's technology firms keep more of their intellectual property, develop and attract more talent, and raise more investment and working capital in Canada. Both manufacturing and technology companies would benefit from readier access to supporting research, education and training, technology testing, capital, and business services.

But, a well-functioning ecosystem must be created first. Canada's advanced manufacturing assets are currently well hidden to industry, let alone the general public, making it difficult for even large companies

to connect with local manufacturers, technology providers, or research capabilities. With low levels of awareness, there is not enough interaction between manufacturers looking for technology solutions and technology start-ups with applications of potential value.

There are gaps in Canada's supporting research, education, and training infrastructure as well. Not enough students, and not enough female or First Nations students in particular, are pursuing post-secondary programs that will prepare them with the science, technology, engineering, and mathematics skills required to pursue careers in advanced manufacturing. Few post-secondary institutions offer combined engineering and business programs that focus on advanced manufacturing strategy and management. And, few work integrated learning programs exist that effectively combine education in digital technologies with practical trades and manufacturing skills outside the classroom, on the "shop floor".

Facilities do exist where companies can test, validate, and scale up new technology applications, but there are gaps in this infrastructure as well, especially with respect to cutting-edge technologies involving advanced sensors, advanced materials, additive manufacturing, virtual and augmented reality, digital twinning and design, machine learning, and Factory of the Future connectivity and automation systems. Utilization of the technology testing and pilot facilities that do exist often falls short of potential. There is a lack of awareness, even on the part of larger companies, about the support services these facilities can provide. Access to facilities is not always easy for smaller companies to navigate.

Current institutional and funding structures also make it difficult for companies to undertake collaborative innovation projects that are meaningful for their business, carried out on industry terms and timelines, and that allow them to draw on the researchers and resources they need from across the ecosystem. Firms that want to work with experts drawn from across universities and other research centres must negotiate a complex variety of intellectual property protocols and competing institutional interests. Industry projects may not fit nicely within the funding envelopes of government agencies or within the risk profile of Canada's financing institutions. And, although many organizations provide services and run initiatives aimed at helping companies adopt or scale-up technologies, there is little coordination, integration, or common focus on strategic objectives.

Responding to Industry Priorities

In 2018, Canada's Advanced Manufacturing Economic Strategy Table laid out an actionable roadmap for addressing innovation challenges and leveraging rapid technological change in advanced manufacturing to strengthen Canada's manufacturing sector. The Strategy Table's recommendations aim to attract more international investment and global mandates to Canada, leverage Canada's diverse and inclusive talent advantage, help manufacturers de-risk technology adoption, and support the rapid scale-up and growth of smaller companies.

The objectives of Canada's Advanced Manufacturing Supercluster are closely aligned with those of the Advanced Manufacturing Economic Strategy Table. Supercluster initiatives will help deliver on those goals by strengthening connections and collaboration across Canada's advanced manufacturing ecosystem and

identifying priorities for research, education, business services, and funding based on the projects in which industry wants to invest.

Supercluster Objectives

Canada's Advanced Manufacturing Supercluster aims to accelerate the development, adoption, and scale-up of transformative technologies in Canadian manufacturing by:

1. **Building out and strengthening Canada's advanced manufacturing ecosystem.** The Supercluster will:
   - ➤ Raise awareness about the importance of advanced manufacturing for Canada's economic prosperity and about the world-leading technologies, skills, and manufacturing capabilities that Canada has to offer;
   - ➤ Enhance connectivity and strengthen collaboration among manufacturers, technology providers, researchers, educators, government organizations, business networks, and supporting business and financial services across Canada and internationally;
   - ➤ Help coordinate and align services and capacity building initiatives across the ecosystem, especially for SMEs;
   - ➤ Facilitate access to existing public and private sector funding, expertise, resources, tools, and testbeds;
   - ➤ Identify gaps in Canada's supporting advanced manufacturing infrastructure based on needs and interests identified by Supercluster members; and,
   - ➤ Support the development of new workforce programs, tools, and testbeds that support technology development, adoption, and scale-up in manufacturing, including the development of a more integrated and coordinated network of advanced manufacturing technology adoption centres as recommended by the Advanced Manufacturing Economic Strategy Table.

2. **Encouraging industry investment in manufacturing innovation in Canada.** The Supercluster will:
   - ➤ Leverage government funding to increase industry investments in applied research, development, and technology applications in Canadian manufacturing;
   - ➤ Facilitate collaborative partnerships and facilitate access to supporting infrastructure and services to help companies, and SMEs in particular, de-risk investments in advanced technologies;
   - ➤ Coordinate access to private and public sources of financing for industry innovation initiatives; and,
   - ➤ Promote and attract international interest, participation, and investment in Canada's advanced manufacturing ecosystem.

3. **Supporting the development of Canada's advanced manufacturing workforce.** The Supercluster will:
   - ➤ Heighten the appeal of advanced manufacturing for young people and showcase innovation leadership and careers in advanced manufacturing;
   - ➤ Support initiatives to engage women, First Nations, and other under-represented communities in Canada's advanced manufacturing workforce;
   - ➤ Identify education and training priorities related to advanced manufacturing;

- Encourage and support the development of workplace training programs related to the deployment and management of advanced technologies, including work-integrated, on-line, and shop-floor learning initiatives;
- Encourage the development of education programs in advanced manufacturing leadership and management for both students and business managers;
- Encourage the development of training programs in digital skills and other advanced technologies for trades and manufacturing workers, and,
- Help SMEs attract top-level talent to enable their own growth and commercialization strategies.

4. **Improving the capacity of Canada's manufacturers and technology companies to manage successful technology development, adoption, and scale-up for manufacturing in Canada.** The Supercluster will:
- Define world-leading advanced manufacturing capabilities to guide companies and allow them to assess performance against commonly acknowledged benchmarks;
- Raise awareness on the part of small and medium-sized companies about the potential that advanced technologies offer manufacturers to improve competitiveness, business requirements for successful technology adoption and scale-up, and best practices in actual deployment;
- Enhance the growth potential of SMEs by helping them scale up and develop new market opportunities for IP created as a result of collaborations brokered by NGen;
- Facilitate access to resources, expertise, tools, training, and testbeds that will help manufacturers de-risk technology adoption and technology firms de-risk the development and scale-up of their technologies for manufacturing; and,
- Support peer-to-peer learning and mentoring with respect to best practices related to technology adoption and scale-up.

5. **Providing new commercialization opportunities for manufacturers and technology companies within Canada and internationally.** The Supercluster will:
- Support transformative technology and ecosystem development initiatives that will provide Canadian manufacturers unique competitive advantages in global markets;
- Facilitate partnerships between manufacturers and technology companies to develop world-leading advanced manufacturing capabilities;
- Leverage funding from larger companies to invest in and procure technologies from smaller firms;
- Support the development of integrated technology solutions that can be commercialized through the international supply chains of larger companies and in manufacturing applications in Canada and in global markets;
- Maximize opportunities for commercializing intellectual property arising in collaborative advanced manufacturing projects, especially on the part of SMEs;
- Enhance IP literacy and expertise throughout Canada's advanced manufacturing ecosystem, enabling small and medium-sized firms in particular to improve their competitiveness and develop and exploit commercial opportunities in global markets; and,
- Facilitate advanced manufacturing partnerships between companies and clusters both within Canada and internationally.

Defining Success

By strengthening the ecosystem, incenting investment in innovation, supporting workforce development, assisting companies in connecting and in managing technology adoption, and helping smaller companies scale up production and exploit commercial opportunities in new markets, Canada's Advanced Manufacturing Supercluster aims to generate exponential benefits for the Canadian economy. Ultimately, the success of the Supercluster will be measured in terms of the incremental economic impacts it will achieve over the next five to ten years.

Metric	Five-Year Incremental Growth Target	Ten-Year Incremental Growth Target
Value Added (GDP)	$2.5 billion	$13.5 billion
Jobs Created	2,500	13,500
Sales Revenue	$4.5 billion	$25.0 billion
Annual Growth in Labour Productivity	5%	5%
Business Investment in R&D & Technology	$465 million	$750 million

From Ambition to Action: Supercluster Initiatives

Canada's Advanced Manufacturing Supercluster is led by Next Generation Manufacturing Canada (NGen), a private sector not-for-profit corporation dedicated to positioning Canada as a world leader in advanced manufacturing and carrying out the objectives set for the Supercluster.

Between November 9, 2018 and March 31, 2023, NGen will receive just under $230 million in funding from the Canada's Ministry of Innovation, Science, and Economic Development's Innovation Supercluster Initiative (ISI) program that it will deploy to leverage investments by industry, supporting organizations, and other government funders in four types of initiatives aimed at achieving the Advanced Manufacturing Supercluster's objectives:

1. **Leadership initiatives** – knowledge sharing based on industry trends, best practices, and experience, customized data analysis to inform business and policy decisions, and standards setting to guide industry performance and support innovation;
2. **Connections and collaboration** across Canada's advanced manufacturing ecosystem – enabled by an online, searchable capabilities database and interactive collaboration platform;
3. **Transformative technology and ecosystem development projects**; and,
4. **Capacity-building initiatives** aimed at de-risking technology investment decisions, strengthening the management capabilities of smaller companies with respect to technology adoption and scale-up, and facilitating access to supporting services, training, tools, testbeds, and funding.

Supercluster funding is expected to leverage approximately $380 million in cash and in-kind investments in these initiatives, including $325 million from industry and $53 million from supporting organizations and other government agencies.

However, interest on the part of industry is potentially much greater than this. The 140 initial members of the Advanced Manufacturing Supercluster indicated that they would be prepared to invest over $800 million in innovation projects related to advanced manufacturing. More opportunities for industry engagement and investment will develop as Supercluster membership expands.

Membership in the Supercluster will be open to any company, organization, or individual contributing to advanced manufacturing in Canada. All members will have the opportunity to benefit from and participate in Supercluster initiatives. There is no cost involved in becoming a member of the Supercluster. Members are expected simply to register on NGen's website at www.ngen.ca.

A broad membership base will allow NGen to expand the scope of connectivity and collaboration across Canada's advanced manufacturing ecosystem, identify transformative projects on the basis of proposals received from a broad cross-section of Canadian manufacturing and technology firms, build economies of scale that can facilitate the alignment and development of supporting services and infrastructure, and leverage other sources of funding to support innovation and ecosystem development.

Leadership Initiatives

NGen will undertake four leadership initiatives related to advanced manufacturing in Canada.

First, NGen will identify **world-leading capabilities** in advanced manufacturing. These best practices will, for instance, highlight capabilities related to the deployment and management of state-of-the-art technologies, intelligent products, end-to-end engineering, digital and connected operating processes, workforce development, collaborative business networks, environmentally sustainable management practices, agile production systems, and value-adding business strategies. They will set Next Generation Manufacturing benchmarks against which companies will be able to evaluate their capabilities, assess how they can move to higher levels of performance, and identify the supporting services that will help them along the way.

This initiative will help SMEs identify opportunities for technological investment, scale-up, and growth as well as the business requirements for successful deployment and management of technologies in manufacturing. It will offer companies, and SMEs in particular, a roadmap for implementing best practices in advanced manufacturing and a methodology for assessing their capabilities according to these criteria. It will also help them identify what they need to do to transform their business to meet enhanced levels of capability and competitive performance.

Best-in-class capabilities will inform the evaluation and selection of Supercluster-funded projects as well as NGen's capacity building initiatives which will be designed in order to support SMEs achieve higher

levels of advanced manufacturing capability. The latter will offer SMEs access to diagnostic tools for self-assessment, provide funding for independent capability audits, feasibility studies, and pilots undertaken by SMEs to assess requirements for performance improvement, and facilitate access to the support services, pilot facilities, and sources of funding they need to enhance their advanced manufacturing capabilities. They will also enhance the capabilities of SMEs to engage as partners in Supercluster-funded projects.

By focusing on best-in-class advanced manufacturing capabilities, NGen will work to ensure that the capabilities of Canadian companies are recognized around the world. The initiative will help to promote Canadian capabilities internationally and identify opportunities for technology and commercial partnerships in global markets.

In a second related initiative, NGen will work with partner organizations to convene **industry strategy roundtables** involving technology and industry experts, large and small manufacturing and technology companies, colleges and universities, and other supporting private and public sector organizations (including funding agencies and regulators) to engage in discussions about the challenges and opportunities related to operationalizing advanced manufacturing techniques. Roundtable discussions will focus on actions that can be taken to better inform business strategies, improve education and training, build greater collaboration, and strengthen management decision-making with respect to the protection and commercialization of intellectual property, cybersecurity, technology implementation and manufacturing scale-up. The proceedings of these discussions will be made public and shared among Supercluster members with the intention of informing them and raising general awareness about industry best practices in advanced manufacturing and the resources that companies have at their disposal across Canada.

Third, NGen will facilitate discussions in **industry practice groups** involving business leaders and managers from smaller manufacturing and technology companies with the more specific purpose of sharing best practices related to technology and manufacturing management. The discussions will aim to help smaller manufacturers understand the requirements involved in successful technology deployment on one hand, and assist smaller technology companies understand the requirements for managing successful applications in full scale production and manufacturing scale-up on the other.

NGen's fourth leadership initiative will be founded on its ability to **identify transformative projects** with significant commercial potential in which industry is willing to invest. Not all projects that NGen will receive will meet the specific requirements of Supercluster funding. Yet, project proposals from industry will provide valuable information about industry's interests in innovation and should play an important role in aligning priorities for advanced manufacturing education, training, and research, as well as for private and public sector funding programs, across Canada.

With respect to financing, not all projects in which industry is willing to invest will fit nicely within NGen's eligibility criteria, the funding envelopes of federal or provincial government agencies, or the risk and investment portfolio of private sector financial institutions. NGen will work to develop a more

coordinated, or syndicated, funding approach for promising projects. By facilitating funding from a variety of private and public sector sources, NGen will also be able to leverage more industry investment from Supercluster funding while at the same time reducing risk for other funding partners and expediting greater access to capital for Supercluster members. This will be of greatest benefit to SMEs that need growth capital to undertake technology development, adoption, and scale-up projects, but find it difficult to find the specific funding mechanisms that best fit their intentions and capabilities. (Funding from other government sources would be complementary to Supercluster funding. Project activities funded from other government programs would themselves be ineligible for Supercluster funding).

Connections and Collaboration

Connections and collaboration are defining features of all Superclusters. NGen will develop online tools and facilitate face-to-face meetings in order to identify potential innovation, technology, and manufacturing partnerships both within Canada and internationally. Over five years, NGen plans to invest $6 million of Supercluster funding from its operating budget in its on-line data services and collaboration events. This investment is expected to generate at least another $6 million in matching industry contributions through partnerships with and sponsorships from industry and other supporting organizations.

The aim of these initiatives is to raise awareness about advanced manufacturing assets and capabilities resident across Canada in order to promote greater collaboration and develop new innovation and commercial partnerships involving Canadian industry. They are also intended to help smaller companies improve their understanding of and ability to manage the deployment of advanced technologies and manufacturing capabilities, take advantage of potential partnership opportunities in Supercluster projects, identify other opportunities for technology and manufacturing partnerships and business collaboration, and access more readily the expertise, services, funding, tools and testbeds available to them across Canada's advanced manufacturing ecosystem.

With respect to online services, NGen will use the data it gathers from Supercluster member registrations to develop a searchable capabilities database that will help users identify possible partnership opportunities. The database will be supplemented by publicly available information providing greater depth of detail about the technology, manufacturing, business capabilities and expertise of Supercluster members

The database will in turn provide the basis for an interactive online collaboration platform, permitting Supercluster members to request assistance with respect to innovation challenges, respond to requests posted by others, and identify potential partners and opportunities for engagement in collaborative innovation projects. The database will be particularly useful for SMEs looking to expand their partnership networks.

NGen will also host online tools on its member portal – diagnostics, training programs, business services, data pools, a Registry of IP arising from Supercluster projects and other innovation activities related to

advanced manufacturing across Canada, and other technology platforms – that will provide companies, and SMEs in particular, access to capabilities they would not otherwise be able to obtain in an easy or cost-effective way.

The Supercluster's online connectivity and collaborative innovation tools will be supplemented by collaboration opportunities built into the roundtables, workshops, technology demonstration visits, and other events that NGen will organize and support. These events are aimed at raising awareness about industry problems and possible technology solutions, sharing best practice, and identifying opportunities for collaboration. They events will be designed to bring manufacturers and technology providers together to discuss industry needs, possible solutions, and opportunities for partnership. Where possible, they will showcase technologies at work to demonstrate applications and focus discussions on practical steps to be taken or avoided in successful innovation management.

NGen will also work with ecosystem partners to facilitate access to services that can assist SME manufacturers and technology companies de-risk technology adoption and scale-up. This will help companies acquire objective advice about what improvements they could make by implementing advanced technologies, what optimal technology solutions they should consider, what are the business requirements for successful deployment, and where they could go to find the integrated solutions, funding, and other support services that would help them adopt or scale up technologies.

Industry-Led Projects

NGen will invest $192 million of Supercluster funding and is aiming to leverage at least another $358 million of industry investments in collaborative industry-led projects before the end of March 2023. (NGen will invest an additional $12 million from its Capacity Building Fund, and is aiming to leverage a further $12 million in industry contributions, in support of smaller-scale collaborative initiatives led by SMEs.)

With respect to larger Supercluster projects, eligible expenses that are incurred by industry partners will be reimbursed by NGen at a maximum rate of 44.4% (providing a maximum match of 80 cents on every dollar invested by industry). Project partners will also be encouraged to raise additional co-investment from industry amounting to at least 50% of Supercluster funding throughout the life of their project, including the commercialization of project results.

All Supercluster members will be eligible to propose and apply to participate as partners in NGen-funded projects. NGen will run both open and targeted calls for project proposals. The former process is intended to allow for innovative collaborative initiatives to develop across technologies and manufacturing sectors. The latter will permit NGen to balance its project portfolio or invest in initiatives that address specific strategic opportunities or gaps in the ecosystem. Partnerships will be facilitated by NGen's online capabilities database and collaboration platform, as well as by the organization of collaboration events in partnership with other organizations.

Supercluster-funded projects will be undertaken by consortia, each consisting of at least three private-sector recipients, including at least one SME. Partnerships with a larger number of companies and SMEs, universities, colleges, and research centres will be encouraged. Each consortium must involve partners that bring manufacturing and technology capabilities to the project.

All Supercluster-funded projects must be incremental in that they are new projects, or that Supercluster funding will be used to expand the scope or scale of the project or materially improve the project's ability to advance the Supercluster's objectives. Each of the project applicants will be required to certify that the project is not currently approved or in progress at their organizations, confirm that financial commitments are distinct from investments that would otherwise have incurred, and show why their project would not take place in the same form and with as many partners without Supercluster funding.

Each project must also demonstrate a significant commitment to sharing intellectual property arising in the project among consortium partners as well as with other Supercluster members. Project applicants will be expected to describe the foreground intellectual property likely to arise in their project and the means by which it would be protected, agree on the ownership and licensing terms that would apply within their project consortium, and identify Supercluster members that might have an interest in foreground intellectual property and to whom they would be prepared to negotiate access.

Projects must also meet the strategic criteria defined by NGen's Board of Directors. They must not only benefit project participants but have a positive impact in terms of Canada's advanced manufacturing ecosystem as a whole.

To that end, Supercluster projects are expected to be:

- **Transformative** – Involving the development of technological capabilities with the potential to confer a significant global competitive advantage on Canadian industry;
- **Applied** – Supporting later stage technology and manufacturing readiness with potential to generate significant long-term commercial and economic benefits;
- **Collaborative** – Attracting the participation of industry partners, especially SMEs, co-investors, as well as academic and research institutions; and,
- **Enduring** – Leaving a legacy in skills development, tools, testbeds, intellectual property, and business knowledge for Canada's advanced manufacturing ecosystem.

Projects will also be expected to include a training component and encourage the participation of women and other under-represented groups in Canada's manufacturing and technology workforce.

All project applications will be subject to an independent evaluation and approval process involving both Canadian and international industry experts.

NGen will support four types of industry-led projects:

- **High Potential Technology Development Projects:** Developing and scaling new technologies with significant commercial potential that will give Canadian manufacturers a significant competitive edge in global markets. These projects will deploy Canada's innovation strengths in engineering, robotics, artificial intelligence and advanced computing, materials, vision systems, lasers, and machining to develop new and innovative manufacturing processes and products that will enhance productivity and provide unique competitive benefits to participating firms. The integrated solutions and foreground IP arising from these projects will provide additional commercial benefits to project partners as well as to other Supercluster members, including SMEs. Based on initial expressions of interest from industry, examples of technology development projects may include applications of specialized sensors and microelectronics in products and manufacturing processes; deployment of artificial intelligence and advanced vision systems in new robotics and machine learning applications for high-speed quality control, flexible materials handling and production systems; solutions for predictive maintenance; and development of an accelerated materials characterization and testing platform for metal additive manufacturing.

- **Ground-Breaking Process Transformation Projects:** Adopting digital technologies to transform existing manufacturing processes in critical sectors of Canadian manufacturing. These projects will enable important segments of Canadian industry to leapfrog the competition and gain global competitive advantages through the application of game-changing technologies, and in so doing strengthen Canada's advanced manufacturing ecosystem. They will likewise provide extended commercial benefits through the application and subsequent licensing of foreground IP, subject to competitive considerations. These projects will enable SMEs to gain access to transformative digitization techniques as they scale-up, opening up new commercialization avenues. NGen has received initial applications for projects involving the digitization of processes related to hot ladle steel production, auto parts manufacturing, equipment assembly, food processing, and wood product manufacturing.

- **Technology Diffusion Projects:** Expanding the applications and user base in Canada for new technologies developed in Canada. These projects will entail technology demonstrations, pilots, and training programs in order to encourage new applications of technology. They will also help increase customer demand for new technologies developed in Canada by de-risking their adoption and the scale-up of manufacturing processes, leading to the creation of new products, new business opportunities, and potentially new industries. Commercial opportunities will be generated from the development of new applications of foreground IP arising from these projects, particularly for SMEs as they trial new technologies and processes generated by this IP. Initial applications suggest projects related to the development of new manufacturing capabilities involving flexible electronics and smart materials, robotics, IOT and medical devices, and new battery and alternative energy technologies.

- **Ecosystem Development Projects:** Augmenting and filling in gaps in Canada's advanced manufacturing ecosystem by developing a more integrated and collaborative network of organizations, support services, skills development programs, tools, and testbeds that will provide companies, small, medium, and large, better access to the resources and expertise they need to adopt and scale up technologies in manufacturing. Initial project applications indicate interest in supporting the development of local advanced manufacturing clusters, shop-floor digital training programs for manufacturing trades and technicians, and new advanced manufacturing technology application centres.

In addition to the transformative and commercial benefits that projects are expected to confer on consortia partners, Supercluster projects will play a key role in helping smaller companies scale-up and grow. Project funding will provide a financial incentive for larger companies to procure technologies from smaller firms and offer direct support for smaller companies partnering in project consortia.

Projects will play a second important role in enabling scale-up through the integration of solutions involving a variety of project partners. Smaller companies may have unique technology or manufacturing capabilities, but often do not have all the capabilities required in a solution that customers are seeking. Supercluster projects will combine companies with advanced technology and manufacturing capabilities in, for instance, virtual engineering, artificial intelligence, robotics and automation, computing, advanced materials, additive processes, cybersecurity, sensors, connectivity, advanced machining and automation systems in the development of new integrated solutions for Canadian industry.

The third way that Supercluster projects will support scale-up is through the commercialization of the intellectual property arising from the projects funded by NGen. Project partners will catalogue the foreground IP arising from projects as well as the legal measures that will be employed to protect it. Foreground IP will be shared among consortia partners. Consortia members will be expected to identify opportunities for commercializing foreground IP in applications throughout their respective enterprises or supply chains. They will also identify opportunities to share foreground IP with other Supercluster members through licensing arrangements or applications involving other customers and industry sectors. NGen will develop a Registry for IP arising from projects to facilitate its transfer to other Supercluster members subject to agreement by consortia members. NGen may also, at its discretion, support SMEs in obtaining IP protection to enable these firms to leverage commercialization opportunities.

Supercluster projects will strengthen the development of Canada's advanced manufacturing ecosystem in other ways as well. By attracting participation and co-investment from a significant number of partners, including industry, academic, and research organizations, they will help to connect and strengthen collaboration across the ecosystem. All projects will be expected to contribute to workforce development, including skills training and plans for increasing the engagement of women and under-represented groups within the advanced manufacturing workforce. They will also be required to create a legacy in the form of training capabilities, tools, testbeds, IP, industry knowledge, and new commercial and collaborative opportunities for the ecosystem, and especially for smaller firms. Projects led by larger multinational

companies will offer smaller partnering organizations opportunities to access new global supply chains and build their export capabilities. Projects led by smaller companies looking to scale-up their production capabilities will enable participating firms to meet high volume demand in international markets.

Not all project applications will be successful in obtaining Supercluster funding. However, companies will still stand to benefit from expert feedback on their applications, opportunities to raise awareness about their project interests and advanced manufacturing capabilities, the partnerships they will need to build, and the intellectual property strategies they will be required to put in place in order to submit project proposals, even though their applications may not be selected for Supercluster funding. This is especially true for SMEs who may build upon this feedback for future project applications and collaborative relationship-building.

Capacity Building Fund

In addition to larger scale collaborative technology and ecosystem development projects led by industry, NGen will allocate $12 million of the Supercluster contribution to a Capacity Building Fund that will provide financial support for small-scale collaborative innovation initiatives undertaken by SMEs. The object is to support smaller manufacturers and technology companies in managing and de-risking technology adoption and scale-up in manufacturing.

The activities this fund will support are intended to address some of the challenges that SMEs face in undertaking innovation projects. They include:

- **Pilot projects** – Development of project plans or early stage collaborative initiatives involving SMEs;
- **Feasibility studies** – Assessments of the technology, manufacturing, and commercial readiness of new technology applications for manufacturing;
- **Capability audits** – Independent audits of advanced manufacturing capabilities leading to implementation plans for improvement;
- **New cluster development** – Support for the formation of new advanced manufacturing clusters; and,
- **Access to infrastructure** – Support for the development of a project involving access to technology testing/demonstration centres.

NGen's Capacity Building Fund will help SMEs develop technology adoption and scale-up project plans for implementation, ready technologies for deployment in production, and de-risk technology adoption and scale-up projects by facilitating access to expertise, training, tools, and testbeds that are available in the ecosystem. NGen is looking to generate $12 million in additional investment from SMEs and other partners from its capacity-building funding.

As with projects, eligibility criteria for SME funding will be posted on NGen's member portal. Applications will also be made through that portal. They will be assessed and selected for funding by independent panels of industry experts.

Investment in Advanced Manufacturing Supercluster Projects and Programs

Total investment in Supercluster projects and programs is projected at $574 million over the five years of the Advanced Manufacturing Supercluster Program. NGen will target investments in each of its project and capacity-building program streams as follows.

Projected Investment in Advanced Manufacturing Supercluster Projects and Programs ($millions)		
Program Stream	**2018-23 Total**	**%**
Technology Development Projects	146.2	25%
Technology Adoption Projects	175.4	30%
Technology Diffusion Projects	146.2	25%
Ecosystem Development Projects	81.8	15%
Capacity Building Fund	24.0	5%
Total Project and Program Investment	**573.5**	**100%**

Total Investment in Ecosystem Development

NGen's Supercluster initiatives will all contribute to building Canada's advanced manufacturing ecosystem. Activities that raise awareness about the assets and resources available to companies, build connections, strengthen collaboration, and support cluster development are fundamental to achieving the Supercluster's objectives. Technology development, adoption, and diffusion projects will leave a legacy for the ecosystem including investments in training, workforce development, and technology demonstrations as well as opportunities to share intellectual property, technical expertise, and industry knowledge. These investments will ramp up over the course of the projects, and progressively enhance ecosystem resources available for SMEs as they pursue scale-up and growth. Ecosystem development projects will explicitly target industry priorities for augmenting Canada's research, training, and technology demonstration infrastructure. And, NGen's Capacity Building Fund will support smaller companies as they de-risk technology adoption and scale-up.

NGen will aim to generate approximately $180 million in investments in Canada's advanced manufacturing ecosystem between 2018-19 and 2022-23, leveraging contributions from the Supercluster fund as well as from industry and other supporting organizations. This amounts to 28% of total eligible Supercluster costs.

Ecosystem investments will increase in proportion to total Supercluster funding over that period of time, using the following funding streams:

- Investments in connectivity and collaboration (projected at $12 million);
- NGen's Capacity Building Fund (projected at $24 million);
- Ecosystem Development Projects (projected at $82 million); and,
- NGen will target an increase in ecosystem investments as part of its technology-related projects from 4% of total eligible project expenditures in 2019-20 to 15% in 2022-23.

Project Investments in Canada's Advanced Manufacturing Ecosystem	
Year	Share of Technology Projects devoted to Ecosystem Investments
2019	4%
2020	7%
2021	12%
2022	15%

NGen's objective is to increase total investment in Canada's advanced manufacturing ecosystem from 13% of total eligible expenses in 2018-19 to 37% of total expenses in 2022-23.

Success Factors

Some important preconditions must be met in order for NGen to meet its strategic and operating objectives:

- *A Focus on True North* – The Supercluster must distinguish itself through the value it creates for its members.
- *Regional Focus/National Scope/International Perspective* – The Supercluster will focus on leveraging the benefits of regional clusters, strengthening connections and collaboration across Canada with an eye to requirements for global competitiveness and growth.
- *Leverage Supercluster Advantages* – Solutions based on strengthening collaboration, building partnerships across technology and industry sectors, and facilitating access to ecosystem assets and resources.
- *Intelligence* – Ability to create and deliver value from information and knowledge about technology partnership and funding opportunities, technology trends, management practices, and ecosystem assets and resources.
- *Stakeholder Support* – Goodwill and active support from the public, government, industry, ecosystem partners.
- *Trust* – Objective processes governing conflicts of interest and project and program selection and support.
- *Integrity* – Systems that ensure good governance, compliance, transparency, privacy, and commercial confidentiality.

- *People* – Knowledgeable and skilled employees empowered with responsibilities and the data, knowledge, and capabilities to make good decisions.
- *Lean Enterprise* – Processes that deliver value, deployed on time, within budget, and within the scope of our strategic objectives.
- *Continuous Improvement* – Quantitatively based processes that improve performance, increase value, and reduce non-essential activity.
- *Technology/IT Infrastructure* – Appropriate, manageable, and secure tools that enable effective and efficient communication, collection, and analysis of data.
- *A Business Model for Growth* – Capitalizing on entrepreneurial opportunities for long-term financial sustainability.

Intellectual Property Strategy

NGen Canada's Intellectual Property (IP) strategy is a critical tool for achieving its objectives and maximizing the full potential of the Advanced Manufacturing Supercluster for NGen members and for Canada as a whole.

NGen will maintain clear, transparent, and predictable IP ownership policies and licensing structures for Foreground IP arising from Supercluster-funded projects, including processes for NGen members to request and negotiate licenses to use such arising IP.

Foreground IP arising out of NGen projects will be shared among participating members of project consortia and, wherever feasible, with other members of NGen Canada. Balancing this availability will be a mechanism to enable companies to recoup their investment, through licensing/sharing agreements or user fees to be paid by members who wish to access newly developed technology. Both of these considerations will be important criteria in evaluating and selecting projects for Supercluster funding.

Title to any IP arising from Supercluster funded projects will be determined by a collaboration agreement among consortium partners undertaking the project. Each collaboration agreement will include:

- Assurance of adherence to commitments set out in NGen's IP Strategy;
- A right for each participant in a project to access on fair, reasonable, and non-discriminatory terms and subject to relevant competitive issues all Foreground IP arising from the project, at least for research and development purposes; and,
- A commitment from each project participant to enter into negotiations regarding access to Foreground IP arising from the project with other members of NGen Canada subject to any limitations placed on such access.

NGen will develop a member-accessible registry of Foreground IP arising from Supercluster projects. It will develop a dispute resolution mechanism to address and resolve any disputes arising with respect to

the ownership of or access to such Foreground IP. NGen will also employ an IP manager whose responsibility it will be to:

- Assist in maximizing the benefits of Foreground IP likely to arise in Supercluster funded projects;
- Help small and medium-sized companies participating in Supercluster projects access independent expertise and advice related to strategic IP management, generation and retention; and,
- Design and deliver programming to enhance the capacity of SME members leverage IP in a fashion that enhances their capacity and enables them to compete on the global stage.

NGen's IP Strategy aims to help Supercluster members, and particularly its smaller members, enhance their ability to exploit the commercial value of their IP, or IP licensed by them. It will promote and support the improvement of IP management techniques, strategic commercialization of IP to enhance manufacturing value creation, and IP sharing to allow project partners and other Supercluster members realize collaborative business opportunities. Collaboration with other project participants will also assist smaller companies protect and defend IP arising in projects. The overall objective of the strategy is to enable Canadian manufacturers and technology companies – small and medium-sized firms in particular – to compete globally and create value for Canadians by leveraging IP applications in Canadian manufacturing leading to the development of new commercial opportunities in global markets.

Data Strategy

Data are critical resources driving advanced manufacturing in the 21_{st} century. Every product, process, and interaction today can create data. It is the ability to collect, communicate, and analyze that data, and transform data into new solutions – and new sources of business revenue, that enables game changing improvements in productivity, process efficiency, and customer value for manufacturing companies and across value chains. It is what drives innovation. Ultimately it is what defines the potential for manufacturers to differentiate themselves from their competitors, build partnerships for scale, and grow.

The innovation and economic benefits that will flow from Canada's Advanced Manufacturing Supercluster will depend on the collection, management, and use of data by NGen to generate value for Supercluster members and ensure the efficient and compliant administration of its operations and activities.

NGen will collect data from:

- The registration of NGen members in its capabilities database;
- The details provided in applications for Supercluster funding;

- The development and maintenance of data-based platforms arising from Supercluster projects and other collaborative innovation initiatives, including data from surveys, benchmarking tools, and shared data pools;
- The funding agreements, investment commitments, flow of funds, and financial reporting requirements related to Supercluster, industry, and other investments in NGen projects, programs, and operating expenses; and,
- Guidance received from NGen's Board of Directors, advisory committees, project selection panels, and members engaged in projects and programs.
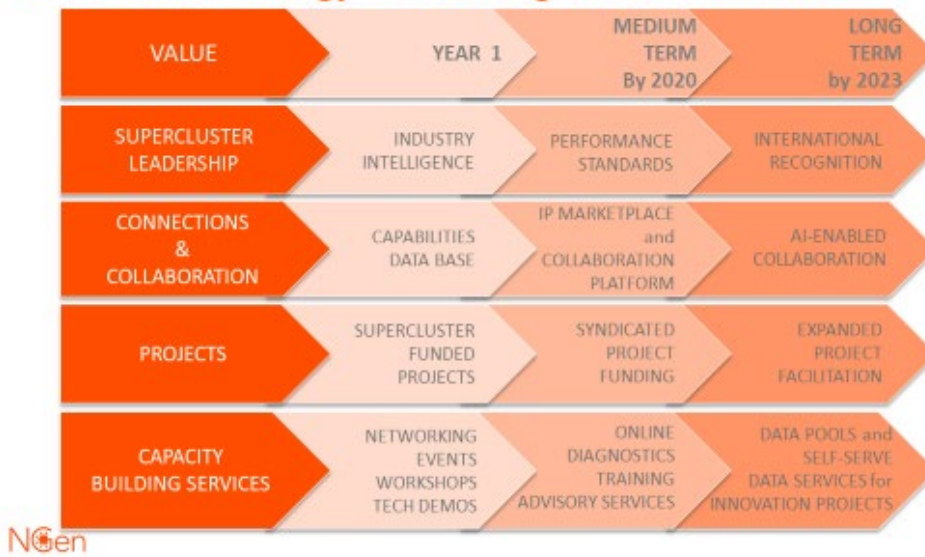
The data that NGen acquires and manages will not only be used for its own administrative, reporting, compliance, and performance improvement requirements. Data will also be used to create value for the members of the Supercluster. To that end, within limitations of privacy protection and commercial confidentiality, NGen will share raw data that it collects with its clients and encourage data sharing among Supercluster members. NGen will focus on maximizing the value of the data it manages through analytics and intelligence in the form of insights, curated connections, collaboration platforms, and reports to inform and support business and policy decision-making. NGen will also host data pools that support innovation and competitiveness improvements on the part of Supercluster members.

The long-term sustainability of NGen as a business will depend on its ability to monetize the value it is able to provide Supercluster members from the data it collects, manages, and uses. NGen will continually analyze the data it houses internally as well as data available from external sources – from Supercluster members as well as from other clients and public sources – to improve performance and develop new value-adding services and revenue streams.

NGen will use data to create value for Supercluster members within each of its domains of business activity. NGen will:

1. Exercise Supercluster leadership by sharing knowledge based on industry trends, practice, and experience, generating customized analysis to inform business and policy decisions, and setting standards for industry performance;
2. Enhance connections and collaboration by identifying and sharing information with respect to capabilities and partnership opportunities across Canada's advanced manufacturing ecosystem;
3. Support innovation projects by collecting and sharing information required for its project application, design, evaluation, approval, contracting, monitoring, and reporting process, subject to relevant confidentiality issues; and,
4. Build capacity by enabling access to software tools, services, and business intelligence, as well as to data pools and data sharing protocols that will provide the scale required for companies to benefit from digital technologies.

NGen Data Strategy – Creating Value from Data

VALUE	YEAR 1	MEDIUM TERM By 2020	LONG TERM by 2023
SUPERCLUSTER LEADERSHIP	INDUSTRY INTELLIGENCE	PERFORMANCE STANDARDS	INTERNATIONAL RECOGNITION
CONNECTIONS & COLLABORATION	CAPABILITIES DATA BASE	IP MARKETPLACE and COLLABORATION PLATFORM	AI-ENABLED COLLABORATION
PROJECTS	SUPERCLUSTER FUNDED PROJECTS	SYNDICATED PROJECT FUNDING	EXPANDED PROJECT FACILITATION
CAPACITY BUILDING SERVICES	NETWORKING EVENTS WORKSHOPS TECH DEMOS	ONLINE DIAGNOSTICS TRAINING ADVISORY SERVICES	DATA POOLS and SELF-SERVE DATA SERVICES for INNOVATION PROJECTS

Initiatives within each of these business domains will develop over time as NGen moves from providing services in its initial set-up stage – direct funding of Supercluster projects, educational and networking workshops and events for small and medium sized companies, and the creation of an advanced manufacturing capabilities database to enable greater connectivity across the ecosystem – to higher value-added initiatives over the span of Supercluster funding, and beyond to sustain NGen's business over the longer term.

NGen will protect the privacy of personal information and the confidentiality of all data sources unless otherwise agreed by the provider of such data. NGen staff, its Board of Directors, and independent reviewers involved in Supercluster project selection will undertake non-disclosure agreements to ensure that confidential or commercially sensitive information is not further disclosed. Information required by Governments in order to review and audit NGen project and program activity in compliance with respective Contribution Agreements will be provided, on a confidential basis, as a requirement of the agreements that NGen will undertake with recipients of project and program funding.

NGen will make public its five-year strategic plan, annual corporate plans and reports, as well as all information required by members to propose and participate in Supercluster-funded projects and programs, including application and selection procedures and project and program eligibility requirements. NGen will also provide regular updates and data reports on its website with respect to project and program progress and Supercluster performance. General descriptions of Supercluster funded projects will be made available to the public.

While data providers must consent to the publication of any data provided to NGen, NGen retains the right to analyze, report, publicize, and commercialize any meta- and macro-level data derived therefrom, as well as any data already in the public realm.

The value of data has increased dramatically as a result of advances in computing and communications technologies. So too have cybersecurity threats. For NGen, data security is an existential issue. NGen's information management system will meet bank-level cybersecurity (256 bit encryption) standards.

Performance Measurement

The success of Canada's Advanced Manufacturing Supercluster will be measured by the outcomes it achieves. The Supercluster has ambitious targets for building collaboration and spurring economic growth over the next ten years.

Metric	Five-Year Incremental Growth Target	Ten-Year Incremental Growth Target
Value Added (GDP)	$2.5 billion	$13.5 billion
Jobs Created	2,500	13,500
Sales Revenue	$4.5 billion	$25.0 billion
Annual Growth in Labour Productivity	5%	5%
Business Investment in R&D & Technology	$465 million	$750 million
Students/Trainees	1,200	15,000
Projects/Program Initiatives	50+	50 +
Project Partners	350+	350 +
SMEs Engaged in Capacity Building Programs	500+	500 +
Supercluster Members Registered on NGen Website	2,500+	5,000 +

The Innovation Superclusters Initiative is expected to deliver outcomes in four key respects: 1) increasing competitiveness, productivity and economic growth; 2) positioning selected Canadian clusters as world-leading innovation ecosystems; 3) enhancing technological capabilities and the commercialization of new technologies; and 4) increasing collaboration between organizations across clusters and networks. Like other Superclusters, success for NGen will entail growing strong Canadian SMEs and large firms, creating value chain opportunities for Supercluster participants, and developing and commercializing new products, processes and services to solve key industrial challenges. It will also be based on NGen's ability to foster collaboration among Supercluster members and to strengthen the capacity of Canadian manufacturers and technology companies to manage technology adoption and scale-up. Short-, medium- and long-term outcomes will all be aligned to the Supercluster's strategic objectives.

NGen Objectives				
Build a shared competitive advantage that attracts world-leading research, investment and talent.	Grow the Advanced Manufacturing Supercluster into a world-leading manufacturing ecosystem.	Boost productivity, performance and competitiveness in Canadian manufacturing.	De-risk and accelerate the adoption and scale-up of advanced technologies in manufacturing.	Develop a skilled talent pool in advanced manufacturing.
Long-Term Outcomes				
New companies, products and processes are generated.	Canada's economic growth is accelerated. (Higher manufacturing GDP, increased exports).	Highly skilled workforce is expanded through increased talent development and attraction.	Competitiveness and scale of manufacturing and technology companies are increased.	Business expenditures on R&D and technology are increased.
Medium-Term Outcomes				
Cluster and network participation is expanded.	Employment growth of SMEs is increased.	Supply chain productivity is improved	Rates of technology adoption and scale-up are increased	
Short-Term Outcomes				
Private-sector investment in advanced manufacturing technology is increased.		Collaborative projects among MNEs, SMEs, academic and research institutions are increased.		

NGen will monitor outcomes specifically related to the projects and the programs that it funds in order to assess the incremental value of its activities and of the Supercluster initiative as a whole. Performance indicators will align to the strategic objectives of the Innovation Supercluster Initiative and the Advanced Manufacturing Supercluster in particular. NGen will meet the reporting requirements of the ISI program, and the operational performance expectations defined by NGen's Board of Directors, by publishing performance targets by Program Stream in the annual Corporate Plan and reporting on outcomes in the Annual Report.

Companies and partner organizations participating in Supercluster-funded projects and programs will be required to report on outcomes regularly to NGen. This will occur in the course of quarterly meetings between project consortium leaders and NGen's project management team. Overall results will be tabulated and made public by NGen in its annual corporate and other data reports. They will help to inform strategic planning by NGen's Board of Directors and any changes in the direction or administration of NGen initiatives that might be undertaken to improve performance and achieve Supercluster objectives.

Data related to project and program related outcomes will also be used to conduct comparative analyses vis-à-vis overall corporate and industry performance. This will provide a better view of the value of the Supercluster compared with general economic and industry trends.

In addition to project and programming data, NGen will track its own operational and financial performance according to Key Performance Indicators and reporting requirements established by its Board of Directors. This will allow the Board and NGen management to assess the efficiency and effectiveness of the corporation's internal processes. Management will prepare quarterly reports for internal use on:

- Legal compliance;
- Corporate risk and risk mitigation;
- Governance and operating policies;
- Employee performance;
- Financial performance;
- Financial controls and management processes;
- Supplier and partner performance; and,
- Service delivery, specifically with respect to project assessments and monitoring procedures, website and database use, and the delivery of capacity building programs.

Measuring operational performance will allow NGen to continuously work to increase customer value, improve corporate performance, and ensure robust processes are in place to manage risk, compliance requirements, and finances in a responsible way as business conditions change.

NGen's performance management systems will allow it to:

- Continuously monitor and assess the results of projects as well as the economy and efficiency of their management;
- Make informed decisions and take appropriate and timely action with respect to project and program management, corporate administration, and issues management;
- Provide effective and relevant outcomes-based reporting on programs and services; and,
- Ensure that credible and reliable performance data are being collected to effectively support evaluation.

In 2021, NGen will undertake an evaluation of its overall performance to date in order to determine the effectiveness of its programs and services, as well as address any gaps. NGen will also conduct a final evaluation of its programs and services in 2023. NGen will also work with ISED and other Superclusters to conduct a comprehensive evaluation of the ISI program.

Advanced Manufacturing Supercluster Key Performance Indicators				
Metric	Overall Supercluster Performance	Technology Development, Adoption, & Diffusion Projects	Ecosystem Development Projects	Capacity Building Fund
Leadership				
Recognition of Canada as a leader in advanced manufacturing in international business media/reports/events	√			
Number of companies scoring 80% or higher against global best practice standards (measured in terms of NGen's Next Generation Manufacturing standards).	√	√	√	√
Impact				
Manufacturing sales growth	√	√	√	√
Manufacturing Value Added (GDP) Growth	√	√	√	√
Employment Growth in manufacturing and technology companies	√	√	√	√
Sales growth for manufacturing and technology companies	√	√	√	√
Export growth for manufacturing and technology companies	√	√	√	√
Business investment in research, development, & technology	√	√	√	√
Growth in labour productivity	√	√	√	√
Number of students/trainees involved in Supercluster projects	√	√	√	

Metric	Overall Supercluster Performance	Technology Development, Adoption, & Diffusion Projects	Ecosystem Development Projects	Capacity Building Fund
Number of technology professionals engaged in Supercluster projects	√	√	√	
Number of patents created	√	√	√	√
Value of patents commercialized	√	√	√	√
New products/services created (and value)	√	√	√	√
New companies, spin-offs, joint ventures created	√	√	√	
Number of foreign companies partnering in Supercluster projects	√	√	√	
International investment attracted to Canada as a result of Supercluster activity	√	√	√	
Researchers and other highly qualified personnel attracted to Canada as a result of Supercluster activity	√	√	√	
Number of connections made between Canadian and foreign companies/clusters facilitated through Supercluster activities	√	√	√	√
Tools, testbeds created for the ecosystem	√	√	√	√
Engagement				
Total industry investment in Supercluster initiatives	√	√	√	√
Total investment by all partners in Supercluster initiatives	√	√	√	√
Total investment in ecosystem	√	√	√	√
Total number of Supercluster members registered in NGen's capabilities database	√			
Number of collaborative projects	√	√	√	
Number of Fortune 500 companies involved in collaborative projects	√	√	√	

Metric	Overall Supercluster Performance	Technology Development, Adoption, & Diffusion Projects	Ecosystem Development Projects	Capacity Building Fund
Number of companies with fewer than 500 employees involved in collaborative projects	√	√	√	
Number of partners/sponsors supporting Capacity Building Programs	√			√
Number of Supercluster members engaged in collaborative projects	√	√	√	
Number of members engaged in Capacity Building Programs	√			√
Activities supported by Capacity Building Programs (type, number, participation)	√			√
Companies funded through Capacity Building Programs	√			√
Value for Money				
Total amount of private and public sector investment per dollar of Supercluster funding	√	√	√	√
Industry investment per dollar of Supercluster funding	√	√	√	√
Supercluster membership retention rate	√			
Supercluster membership engagement rate (percent of members engaged in projects, programs, and activities)	√	√	√	√
Number of activities, projects, and programs delivering productivity improvements.	√	√	√	√

Five-Year Budget Estimates

Advanced Manufacturing Supercluster Funding & Expense Projections ($000s)						
	2018-19	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2018-23 Total**
Funding						
Innovation Superclusters Initiative	1,754	20,098	32,465	100,601	74,847	229,765
Contributions from Industry and Other Supporting Organizations	-	14,995	49,792	176,623	128,650	370,060
Other Sources of Funding	230	760	1,563	3,248	2,874	8,675
Total Funding	**1,984**	**35,853**	**83,820**	**280,472**	**206,371**	**608,500**
Expenses						
Project and Program Expenses	-	28,942	76,069	271,593	196,950	573,554
Operating & Administration Expenses	2,257	6,817	7,674	8,706	9,160	34,614
Amortization	7	50	75	100	100	332
Total Expenses	**2,264**	**35,809**	**83,818**	**280,399**	**206,210**	**608,500**
Net Surplus/(Deficit)	**(280)**	**44**	**2**	**73**	**161**	**-**

Note: Amounts represent the Supercluster's budget forecast and as such, are estimates only. The level of Innovation, Science and Economic Development Canada (ISED) funding by fiscal year will be determined via consultations with and approval from ISED.

Long-Term Sustainability

NGen will work to diversify sources of private and public sector funding to ensure its long-term sustainability when the Supercluster Initiative comes to an end in 2023. It will solicit funding support from public sector sources to complement Supercluster funding for industry-led projects and capacity building initiatives prior to 2023. It will position itself as a preferred vehicle for government funding of industry-led projects in advanced manufacturing after that date.

NGen will also aim to cover costs of administration and capacity building initiatives fully from private sector sources within five years. Potential sources of private sector support will come in the form of service fees or sponsorships for NGen activities.

To reach financial sustainability with minimal risk, NGen will develop a portfolio of activities and products intended to generate revenue. These will include (but are not limited to):

- Project and program participation fees for organizations wishing to participate in NGen-supported activities;
- Sponsorship fees for NGen activities like demo days, events, workshops and/or project development conferences;

- Admission fees for events intended to connect NGen members to potential customers, partners, talent or investors;
- Access fees for talent- and market-development programs for NGen members; and,
- Fee-for-service activities related to project / partnership development activities.

Conclusion

The Advanced Manufacturing Supercluster offers Canada an important strategic opportunity to build and sustain world leading capabilities in advanced manufacturing. By funding industry's innovation priorities, it will accelerate the development, adoption, and scale-up of technologies in manufacturing, creating unique competitive advantages for this highly strategic sector of the Canadian economy. By supporting collaborative innovation initiatives, it will combine strengths across technology and manufacturing sectors and help de-risk investments in innovation. By engaging SMEs, it will help them build advanced manufacturing capabilities, support the integration and scale-up of new technology solutions for manufacturing, and create new opportunities for commercializing IP. By focusing on workforce development, it will support the development of a highly skilled, inclusive workforce in manufacturing. And, by knitting together Canada's advanced manufacturing ecosystem, it will facilitate partnerships and raise awareness about the world-class assets and research, technology, and manufacturing capabilities resident across the country.

The beneficiaries of Supercluster initiatives will not only be those companies and other organizations participating in the projects and other initiatives that NGen will fund. The Supercluster will provide support to, and result in commercial and economic opportunities for, Canada's advanced manufacturing ecosystem as a whole. Ultimately, NGen aims to build a stronger advanced manufacturing sector that will benefit this and future generations of Canadians.