



SMART MANUFACTURING

FOR A CONNECTED WORLD

Digital Technology Adoption: The Road to Canada's Economic Recovery

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EXECUTIVE SUMMARY

DIGITAL TECHNOLOGY ADOPTION: THE ROAD TO CANADA'S ECONOMIC RECOVERY

For decades, business leaders have recognized the need to support the adoption of digital technologies within Canadian small and medium-sized (SME) manufacturing firms. Several initiatives to achieve that objective were underway before the global pandemic forced businesses to grapple with solutions to respond to the worldwide health and economic crisis. Businesses that had already started or were well on their way toward digital transformations in their operations and manufacturing processes were better equipped and more resilient to the devastating market disruptions. However, companies lagging in the adoption of digital technologies were disadvantaged in their ability to design and develop new products.

Looking forward to an economic recovery phase, SME manufacturers will be the major driver in creating jobs, strengthening domestic supply chain networks, and creating new, high-value, export-ready products. Unlocking Canada's 50,000+ traditional SME manufacturers' full potential and capabilities will lead Canada's recovery with an accelerated and comprehensive program to support the adoption of transformational technologies.

The Smart Manufacturing for a Connected World program is designed to accelerate the adoption of digital manufacturing technologies. It has been delivered in collaboration with NRC IRAP since 2017. The program has also been delivered regionally to fill ecosystem support gaps for SMEs. It builds on investments made by various levels of government, and is designed to leverage existing programs and infrastructure to support Canadian organizations in their digital transformation. It can be utilized to create a seamless, scalable accelerated process to rapidly evolve capabilities and capacities of Canadian SME

manufacturers. Augmenting existing funding streams and leveraging the insights gained from the Digital Technology Adoption Pilot Program (DTAPP) provides the final component of a comprehensive approach to accelerating SME adoption and removing the identified barriers preventing SMEs from moving forward with their digital strategies.

As part of Canada's commitment to developing a digital strategy, this white paper has been prepared in collaboration with NRC IRAP to demonstrate how such an approach would provide an effective and impactful outcome for Canada's traditional SME manufacturers, while at the same time making maximum use of existing program investments and best practices. An accelerated approach will ensure that these companies perform a key role in Canada's health and economic recovery, thrive in a strong and resilient domestic supply chain, and build export-ready products that compete on a global stage.

Smart Manufacturing for a Connected World



REMAP regards Smart Manufacturing as the rapid transfer of science and technology into digital manufacturing, product design, optimized supply chains, new business models, globalization and speed to market.

INTRODUCTION

STATE OF DIGITAL ADOPTION OF SME MANUFACTURERS IN CANADA

Of the approximately 50,000+ SME manufacturers in Canada, less than 20% are focused on high-end, transformational manufacturing technologies. The remaining traditional SME manufacturers have the most to gain in terms of revenue and job growth by mapping their digital transformation of their products and processes. This presents a significant opportunity for these companies to leverage a proven, existing methodology that positions them as drivers of Canada's economic recovery and strengthening the Canadian manufacturing sector.

However, the challenge of adopting technologies is overwhelming for many Canadian SMEs, resulting in overall slower transformation compared to similar companies globally. Furthermore, many traditional SME manufacturers do not define themselves as advanced manufacturers, are often physically distanced from the resources based in large urban hubs, and invest less in R&D than their global counterparts. This represents significant untapped potential to support Canada's economic recovery.

Regardless of sector, the COVID-19 pandemic has accelerated the need for SMEs to harness digital technologies in order to navigate the "new normal" of how business is being conducted. In response, several key regional and provincial programs have been provided to SMEs to support them on their digital adoption journey.

However, few of these programs are focused primarily on advancing the capacity and capabilities of the SME manufacturer. The Smart Manufacturing for a Connected World program is complementary to these initiatives as they serve as supports for early-stage digitization implementation, addressing largely

the digital needs related to websites, e-commerce enablement, online marketing, and business processes for supporting remote telework.

Objective and Alignment with Government Priorities

Current programs are not specific to the SME manufacturing sector or designed to address potential product creation and new business models. The objectives of the REMAP and IRAP partnership to deliver the Smart Manufacturing for a Connected World program directly supports key government objectives as the planning for post-pandemic economic recovery begins in earnest.

Increased Resilience

Manufacturers are in the spotlight now – previous resistance to digital technologies are outweighed by a sense of urgency. Accelerating the adoption of transformative technologies enables the traditional SME manufacturer to operate remotely while implementing



It is no longer a question of if plants need to digitize, but whether it can be done in time.”

**– ManufacturingTomorrow.com,
April 2020**

agile and adaptive business models. This approach will strengthen Canada's health and economic resilience while reducing the future impacts of unforeseen and/or major market disruptions.

Job Creation

There is growing evidence that the manufacturing sector is a key contributor to job creation.

Manufacturing becoming more complex through the adoption of advanced technologies triggers a job multiplier effect. It is estimated that one high-tech manufacturing job creates 16 net new non-manufacturing jobs that support the organization.



These jobs give rise to a host of skilled para-professional and professionals in non-manufacturing jobs such as logistics and transportation, customer service, technical support, regulatory and safety specialists, distribution employees trained in use of information driven tools for receiving, storing and picking, the list goes on and on.”

Future Proofing the Canadian Manufacturing Sector

Large scale delivery of the Smart Manufacturing for a Connected World program is a good model for generating a critical mass of companies that have tightly-coupled design, products, processes, and supply chains in a way that will significantly enhance competitiveness and ensure many more SME manufacturers are in a position to leverage advanced manufacturing opportunities, funding, and partnerships.

Communities of all sizes, particularly those that are outside of large urban centres, will depend on their local SME manufacturing bases to retain and grow jobs. By engaging local municipal economic development, post-secondary supports, IRAP, and other stakeholders in the ecosystem, funding at the federal level through IRAP programming will build transformation and resilience at the community level across Canada.

Strengthening the Domestic Supply Chain

The Smart Manufacturing for a Connected World program directly supports SMEs in curating and building domestic supply chains, increasing Canadian competitiveness and decreasing dependencies on external suppliers subject to policy and trade disruptions. By engaging all stakeholders in the manufacturing ecosystem, the program creates opportunities to build local supplier networks and new innovative solutions that strengthen Canada's competitive advantage.

Reference: The Multiplier Effect: There Are More Manufacturing Related Jobs Than You Think, by Keith D. Nosbusch and John A. Bernaden of Rockwell Automation

Collaborating Within the SME Ecosystem

A key aspect of the Smart Manufacturing for a Connected World program is the strong collaboration and engagement model across diverse innovation and manufacturing ecosystems. Many organizations and agencies across Canada have come together to support SME manufacturers by leveraging diverse strengths of different organizations and aligning them to advance their digital transformation.

The lack of cohesive and standardized benchmarking and data sharing makes achieving this objective challenging. This is particularly the case at local levels, where the best information on the state of SME manufacturers is often only gathered via surveys which may reside in the organization's database or by pulling data from Statistics Canada repositories. In both cases, there is a lack of specificity on the capabilities and capacities of traditional SME manufacturers and there is no easy or accurate way to look at progress along different facets of digital transformation.

There is a gap in the ecosystem serving traditional SME manufacturers with programs, projects, and budgets geared to their size and scale. Large-scale government programming and project funding are oftentimes too big, and general digitization projects do not speak to the needs of the small to medium-sized manufacturer.

Academic programs provide some support but largely depend on the company proactively finding an appropriate institution and researcher, and then ensuring that budgets and timelines meet the company's requirements.

The Smart Manufacturing for a Connected World program is a comprehensive and practical approach that builds on foundational investments by the public and private sector to deliver transformational manufacturing initiatives.

Designed for the traditional Canadian SME manufacturer, the program provides an accessible readiness assessment, common vocabulary, and business planning framework that overcomes the many barriers to adoption: cost, awareness, technical knowledge, business culture barriers, and evolving new business models.

The program supports awareness, best practices, and examples from peer SME manufacturers and their digital transformation journey. The workshop provides a practical, hands-on readiness assessment of both organization's manufacturing processes and the products they build, enabling the SME manufacturer to develop tailored technology plans aligned with their business. The program is customizable, scalable, user-friendly, and directly applicable to an SME manufacturer's business and budget.

The program was a resource to assist IRAP's network of Industry Technology Advisors (ITAs) to identify companies that could be recommended for the next phase of programming with a greater emphasis on transforming the manufacturing plant itself – engaging





engaged in the next phase of the program provided by IRAP: factory tour, technical assessment, and comprehensive interactive site visit report. The results of these one-on-one consultations are preliminary but encouraging. Four of the 14 companies that underwent a 1:1 consultation have started IRAP engagements. Two of these four companies had significant contributions with large projects (automation project and process digitization). The remaining two companies had ARP type projects (feasibility study and youth employment). During this process, a new Canadian supply chain was created by linking both an Ontario and an Atlantic SME to conduct business together. Thus, mitigating a contract being awarded to an international supplier.

Going forward, it is anticipated that more of these companies will initiate new digitization projects. Some are delayed as a number of the consultations were conducted just ahead of the global pandemic.

For the next phase of the program to be delivered across Canada, REMAP has ensured a high degree of accessibility by translating the programs into both official languages and building an online portal for regional benchmarking, aggregating data, and scaling the program to reach Canada's 55,000+ SME manufacturers.

DIGITAL JOURNEY - The Road to Transformative Technologies

In 2011, as part of the federal Government's Digital Economy Strategy, the Digital Technology Adoption Pilot Program (DTAPP) was launched to promote the adoption of digital technologies by SMEs. The DTAPP program was operationalized by NRC/IRAP through the national network of the IRAP Industry Technology Advisors (ITAs), who ensured that participating companies were connected to the appropriate partners and providers. The program operated for three years and initiated 400 projects. Many of the companies

decision-makers, the leadership team, and other key stakeholders in the organization beyond the knowledge gained from the readiness assessment.

The strategic approach was to leverage the existing IRAP infrastructure with the readiness assessment developed by REMAP to empower SME manufacturers in pursuit of their digital transformation journey while still being connected to the supporting organizations of the broader innovation ecosystem.

The workshops also helped build a pipeline of project funding applications for IRAP, identifying high-potential projects for consideration. To date, REMAP has reached over 1,000 SME registrants with its Smart Manufacturing for a Connected World program.

In 2019-20, 14 SME manufacturers across Canada

used the funding for ERP and CRM projects, both of which are operations and systems-focused versus manufacturing-focused.

An evaluation of the DTAPP program conducted in 2013, identified that the engagement of IRAP ITAs was a critical element of being able to reach SMEs nationally. As the evaluation took place during the program operations, there was insufficient data to comment on the impact of technology adoption on overall productivity. The DTAPP Program was a sector-agnostic program. There were no supports specific to the manufacturing sector other than through engagement with IRAP ITAs.

A key finding of the evaluation highlighted the need to refine project selection criteria specific to the SME manufacturing sector to ensure the program resulted in the greatest impact on SMEs as possible. While the DTAPP Program was discontinued in 2014, the need to address financial support for digital adoption by SMEs remained, particularly for the manufacturing sector. Since then, there have been a number of regional initiatives that address the digitization gap, including:

The CME Digital Assessment

ACOA Digital Technology Adoption Program

Québec Audit Industrie 4.0

However, a national plan does not exist to advance the majority of SME manufacturers. Furthermore, these programs are sector-agnostic vs. specific for the SME manufacturer.

The proliferation of digital technology assessment programs demonstrates that, from an operational and infrastructure perspective, SME manufacturers have options. Missing from these programs are:

ONE

The direct connection to appropriate funding for capital investment and/or integration of technologies

TWO

A program for evaluating potential projects and prioritizing resources for new digitization initiatives

THREE

The inclusion of new product design and development, and the evolution of business models that exploit the benefit of collecting AI and big data

Just doing an assessment and engaging in limited projects will not be enough for critical mass. The DTAPP program leveraged the existing infrastructure of IRAP's ITAs and initiated a national program that was accessible to all SME manufacturers, regardless of location.

The network of ITAs were able to connect SMEs with appropriate local, provincial, and national resources and expertise. As a foundation for supporting a more comprehensive approach to accelerating digital adoption by SME manufacturers, the DTAPP program provides a very strong model.

There are key benefits to supporting a national approach similar to DTAPP through awareness, education, assessments, and project investment to build capacity:

1

Provide a consistent approach to project identification, funding, and execution across all provinces and regions

2

Aggregate, support, and track progress of SME manufacturers along their technology adoption journey, generating important insights and data that can guide the allocation of resources

These elements are crucial in times of disruption, when the country needs to mobilize the manufacturing sector to meet critical high priority needs and adapt supply chains to reflect changing market conditions.

The adoption of digital technology is an ongoing journey and emerging technologies and issues must continually be incorporated into an SME overall strategy. For example, cybersecurity and 5G connectivity are now a concern for SMEs adopting smart, connected production machinery or for the SME pursuing remote working solutions for their staff. Another example is manufacturing and AI, which are major components of the World Manufacturing Foundation Report 2020: Manufacturing in the Age of Artificial Intelligence¹. Canada is a global leader in AI, however, companies do not have enabled platforms that allow them to leapfrog into big data yet. This is where the DTAPP program could make a big difference.

Many organizations across Canada provide self-assessments. While these tools may meet some of the needs for SMEs, they are usually the “one and done” type that do not provide a national, provincial or regional outlook. The ability to see aggregate and/or consistent data across the board is an essential element for planning, program investment, economic development, and supporting research and innovation for colleges and universities to develop the next generation of learners in the manufacturing industry. The ability to see Canada’s capacity and growth would significantly benefit all organizations supporting the digital adoption mandate.

Barriers to Adoption

A modernized DTAPP program would bridge the gap for the implementation of digital technologies from a cost perspective - even covering partial costs. The 2018 Canadian Manufacturers & Exporters (CME) Management Issues Survey², distributed to 320 manufacturers across Canada, cited several obstacles that prevent manufacturers from investing in advanced technologies. The common barriers fell into three categories:

1 HIGH PURCHASE COST AND INVESTMENT RISK

42% cited high costs/uncertain ROI;
34% cited rising costs of doing few funds left for new investments

2 LACK OF INFORMATION & TESTING OPPORTUNITIES

34% cited no immediate need;
32% were unclear how new technologies fit into existing systems

3 LABOUR AND SKILLS SHORTAGE

25% cited lack of necessary skilled workers

¹ <https://worldmanufacturing.org/report/report-2020/>

² https://cme-mec.ca/wp-content/uploads/2020/12/CME-MEC_MIS-Survey-Report-2020.pdf

The 2021 Advanced Manufacturing Outlook Report³, cited similar findings from 151 respondents from across Canada. The one interesting metric is that cost concerns were lower, but the lack of support concerns were expressed twice. Of note, is the lack of financing and support and the lack of support or services from the government. This highlights the need to resurrect a modernized DTAPP program.

1 HIGH PURCHASE COST AND INVESTMENT RISK

25% cited lack of financing and support
 23% cited too costly
 21% cited investment not necessary for continuous operations
 19% cited uncertainty, risk and disruption
 17% cited lack of support or services from government

2 LACK OF INFORMATION & TESTING OPPORTUNITIES

38% cited difficulties integrating advanced technologies in existing systems
 23% cited lack of adequate information about advanced technologies
 23% were not sure where to start
 19% were not convinced of the economic benefit
 14% were concerned about cyber security threats
 14% cited weak customer demand

3 LABOUR AND SKILLS SHORTAGE

28% cited lack of skills to support investment



[On Industry 4.0 adoption] People have to be ready and they have to be educated, look for the cost benefit and then move forward.” - Steve Loftus

Reference: 2021 Advanced Manufacturing Outlook Report, Industry 4.0 is here, are Canadian manufacturers ready?

TECHNOLOGY PRIORITIES OUTLOOK	2020	1 Year	3 Years	5 Years
Robotics, Automation	49%	24%	20%	7%
Data Computing	46%	33%	11%	8%
Cloud	42%	26%	16%	3%
IIoT	41%	22%	15%	9%
Advanced Analytics	41%	18%	20%	9%
3D Printing, Additive	38%	14%	17%	11%
Digital Transformation	38%	22%	12%	6%
Artificial Intelligence	34%	13%	13%	14%
Virtual Reality	28%	8%	8%	12%

Reference: 2021 Advanced Manufacturing Outlook Report (n183)

³ <https://www.canadianmanufacturing.com/features/advanced-manufacturing-outlook-report-now-available/>

Beyond Business Operations

There is wide and ever-growing range of technologies that can strengthen and improve Canadian SME competitiveness well beyond business operation systems:

- Infrastructure elements such as connectivity on the factory floor
- Data exchanges between machines
- The use of collaborative robots to process enhancements with automation Intelligent production systems
- The incorporation of sensors and devices into products
- Incorporation of artificial intelligence Deep machine learning systems Data analytics programs
- The data itself as new product lines for revenue generation

These digital technologies continue to rapidly evolve. There are significant opportunities that are enabled through digitization, but these have not been realized at scale by traditional Canadian SME manufacturers.

The adoption of transformative technologies is led by large, well-capitalized manufacturers with more than 500 employees, which accounts for only approximately 0.6% of Canada's manufacturers. Our future competitiveness is dependent on supporting the rapid adoption of Industry 4.0 by traditional Canadian SME manufacturers.

The most recent Statistics Canada survey of Business and Innovation Strategy was conducted in 2017. It found that of the approximately 50,000+ SME manufacturers in Canada, 50.2% of small companies, and 60.3% of medium-sized companies are using some form of digital technologies, whereas only 15.5% of SMEs have adopted AI, integrated IoT/sensors, blockchain, and nano technologies. These are critical, transformative technologies essential to ensuring an agile and competitive manufacturing sector. The traditional SME manufacturers have the most to gain in terms of revenue and job growth by mapping the digital transformation of their products and processes.

Digital technologies can be a game changer for the manufacturing sector. However, the adoption of Industry 4.0 in Canada is low compared to the rest of the world. Digitization can be overwhelming for SMEs, as it requires great effort to overcome barriers to entry. Some of the more significant challenges include understanding the benefits for the average factory, calculating ROI, scaling complex, capital-intensive manufacturing processes, and retooling the workforce.

A comprehensive and holistic approach to upskill, reskill and advance digital transformation would:

- Educate through both awareness and education, at multiple management levels within the organization
- Provide a framework to assist an SME in assessing their current state
- Provide relatable case studies and mentors for guidance
- Identify achievable and affordable guidance for process improvements, automation, product design and development
- Connect the organization to relevant programs and funding resources
- Provide financial incentives and supports to reduce implementation cost
- Support companies as they adapt their business models increase resilience and competitiveness both domestically and globally

TRANSFORMATIVE TECHNOLOGIES

Artificial Intelligence (AI)
Augmented Reality (AR)
Blockchain
Collaborative Robotics
Integrated IoT/Sensors
Machine 2 Machine
Nanotechnology

INTRODUCING SMART MANUFACTURING FOR A CONNECTED WORLD

IRAP/REMAP COLLABORATION

The Smart Manufacturing for a Connected World program was developed to foster a strong, resilient base of SMEs that leverage the power of digital transformation not only to enhance their processes, but also to create new high value products. The program was launched in 2017, specifically to address identified barriers in the adoption of digital technologies by SME manufacturers.

The multi-faceted program combines awareness, education, readiness assessments, the strategic direction to map the current state of the company's processes and products, tailored one-on-one mentoring, and support for evolving business models.

The first component of the engagement is the Smart Manufacturing for a Connected World workshop providing resources and knowledge of industry trends and transformative technologies but with tangible and affordable examples. This enables peer learning from SME manufacturers and early adopters in the region sharing success stories and best practices.

Workshops were organized in collaboration with local economic development, IRAP ITAs, post-secondary institutions, and local industry associations that have established relationships with the local manufacturers and could provide immediate, tangible and independent resources for SMEs.

By including the hands-on component of the workshop, participants not only receive new knowledge, but also a structured and tailored readiness assessment that

identifies potential project direction. Several companies incorporated the readiness assessment program into their overall business planning, new products, and processes and updated it regularly to track progress.

Unique to the Smart Manufacturing for a Connected World model, is the provision of both the manufacturing process and product development. The tool provides a common vocabulary to engage the executive team and other stakeholders in the organization. The company can leverage the readiness assessment to prioritize and tackle next steps from the customized digital roadmap created in the workshop.

A comprehensive approach, coupled with an ongoing monitoring program linked to business planning, is a unique offering that can form a critical foundation to both support and accelerate an SME's digital transformation journey on a continual basis. In the future, a digital readiness assessment, will be available as an interactive online portal that will make it easier for SMEs to use, update, and benchmark their progress.

Other provincial and national digitization support programs provide a one-time snapshot of operational processes with a primary focus on productivity improvements. This leaves product digitization out and delivers only a portion of the benefit of digital technology adoption, specifically, in the creation of new products, business development and revenue streams that leverage services created by the resulting data.

The IRAP – REMAP collaboration provides the framework for both a shift in company culture and the foundation for addressing product development opportunities. The direct link to IRAP provides the SMEs with streamlined access to enabling funding from various sources to advance those initiatives. The partnership offered a broader reach to SMEs across Canada with practical tools, complemented by project funding from IRAP, making for a highly effective means of increasing overall R&D investment by SMEs.

The ability to holistically measure and plan a company's adoption of technologies for product and process help to reduce the risk and uncertainty that is a typical barrier for SME manufacturers. The process identifies opportunities for the creation of new high value-added products that combine hardware, software, and data, creating more globally competitive companies.

Leveraging this methodology and scaling it digitally to reach more of the 55,000+ of traditional SME manufacturers has the power to unleash the significant potential within these companies to develop new products, create new employment, increase investment, and strengthen both the communities in which they operate and the manufacturing sector overall.

The Engagement Model

The Smart Manufacturing for a Connected World program enables companies to advance from assessment to customized strategy to action in a condensed time as part of a comprehensive program in a one-stop shop format.



The first engagement at the community level brings all stakeholders together and educates them on the importance of digital manufacturing, product design, and digital transformation. Engaging the community is essential to ensure direct connections between the SME and the funding sources (including local college resources) best suited to the objectives of the company. The workshop is now digitized and the education is being delivered virtually.



A second stage of engagement provides an on-site evaluation at their manufacturing plant, which allows for more in-depth assessment of the potential applications and priorities for digital adoption and transformation. In the wake of the global pandemic, virtual site tours were conducted to ensure health and safety protocols. A detailed summary report, along with the ongoing updated readiness assessment, provided valuable business planning tools for the SMEs, charting prioritized areas for investment in process and product development.

An updated assessment tool has expanded to incorporate emerging areas of interest for SME manufacturers, such as cybersecurity, data governance, and business model directions.



The third engagement in the process is a critical component for delivering successful results overall – a direct connection to project-based funding. Participation in the workshop from funding agencies (municipal economic development and local post-secondary institutions) promotes a streamlined approach to advancing SMEs in new initiatives identified in the readiness assessment completed in the workshop.

Community Engagement

The Smart Manufacturing for a Connected World program provides an accessible, hands-on approach to digital planning and leverages peer learning while influencing and inspiring technology adoption. The program is customizable, scalable, user-friendly, and directly applicable to an SME's business and budgets.

This program is applicable to any market segment from high-tech automated products to handmade artisan items and services. This approach also applies to manufacturing environments with fully-connected digital processes to standalone manually-operated tools. The products assessed range from drinking straws, treated lumber designers, and kitchen cabinets, which were low on the digital adoption scale, to Light Detection and Ranging (LiDAR) sensors for automotive, power electronics for fuel-efficient furnaces, and ruggedized sensors for concrete curing, which are high on the digital adoption scale.

Communities Served (2017-2020)

Surrey, BC
Mission, BC
North Vancouver, BC
Saskatoon, SK

Brampton, ON
Thornhill, ON
Barrie, ON
Scarborough, ON
Windsor, ON

Lower Sackville, NS
Halifax NS
Moncton, NB
Charlottetown, PEI

Sectors Served (2017-2020)

311 - Food Manufacturing
315 - Clothing Manufacturing
321 - Wood Product Manufacturing
322 - Paper Manufacturing
323 - Printing and Related Support Activities
325 - Chemical Manufacturing
326 - Plastics and Rubber Products
manufacturing

3261 - Plastic Product Manufacturing
332 - Fabricated Metal Product Manufacturing
333 - Machinery Manufacturing
339 - Miscellaneous Manufacturing
3391 - Medical Equipment and Supplies
manufacturing



Smart Manufacturing for a Connected World: No SME Left Behind from Digital Transformation, was featured in the 2019 World Manufacturing Report: Skills for the Future of Manufacturing⁴. Each submission was reviewed by the World Manufacturing Editorial Board, and selected based on community impact, ingenuity, and knowledge contribution to global manufacturing. The Smart Manufacturing for a Connected World feature was one of ten winners showcased from the open call for Skills Initiatives papers. “It is important to showcase and highlight practical, real-world examples of those who are making great strides in the area of manufacturing.” **-The World Manufacturing Forum**

⁴ <https://worldmanufacturing.org/wp-content/uploads/WorldManufacturingFoundation2019-Report.pdf>

SMART MANUFACTURING FOR A CONNECT WORLD SUCCESS STORY

One SME participant in the Smart Manufacturing for a Connected World workshop from Barrie, Ontario, identified a key project opportunity and secured funding to digitize their product. The company doubled its revenue with a new product line and business model. The company successfully leveraged all supports available during the workshop by collaborating with the IRAP ITA, local colleges and regional funding agencies.

CLICK TO WATCH TESTIMONIALS



Carrie Wilkes
Vice President
CWB Tech



Mira Ray
Director, Research & Innovation
Georgian College



Stephanie Schlichter
Director, Business
Development, Invest Barrie



Patrick Lai
Co-founder, CTO
iGEN



Steve Loftus
President
Innovative Automation



Daniel Toto
General Manager
QTK Fine Cabinetry



Nicolas Bergwin
Co-founder
FIBOS



Nigel Burbidge
President
Footage Tools



A lot of companies manufacture, but they don't design their own products. We need to link manufacturing a lot closer to design

- Irene Sterian

Smart Manufacturing for a Connected World Transformational Program



Awareness, Education, Workshops

- In the discovery phase, SMEs learn more about Industry 4.0, new technologies, and the best way to transform their business using the Smart Manufacturing for a Connected World metric
- Demystifying Industry 4.0 by making it accessible, affordable, and achievable for the traditional SME manufacturer
- Sharing case studies and first-hand experiences from SMEs already on the Industry 4.0 journey
- Peer networking and mentoring is a key success factor for engaging the companies and ensuring that the content was relevant to them



Readiness Assessment – Mapping the Journey

- In the virtual workshop, SMEs build a digital roadmap by applying the readiness-assessment tool to chart a path forward in the measurement, identification, and implementation of a company-specific approach toward Smart Manufacturing
- The easily adaptable program empowers SMEs with a common language and a metric to prioritize constrained resources and funding with other stakeholders in the organization
- SMEs can monitor progress and set long-term goals to achieving digital transformation and the tool helps guide new business models, speed to market, and globalization



Factory Tour, Interactive Site Visit Report

- Phase 3: One-on-one consultation with the Smart Manufacturing Architect lead investigator
- Factory tour validates the technical level of the company for the implementation of Smart Manufacturing; analyzes the current state of technology for the manufacturing process and product design; highlights potential solutions for bridging of gaps identified in real time, and identifies next steps
- The Interactive Visit Report is a detailed account of the factory tour and highlights implementation solutions and/or savings associated with the processes to identify future IRAP projects

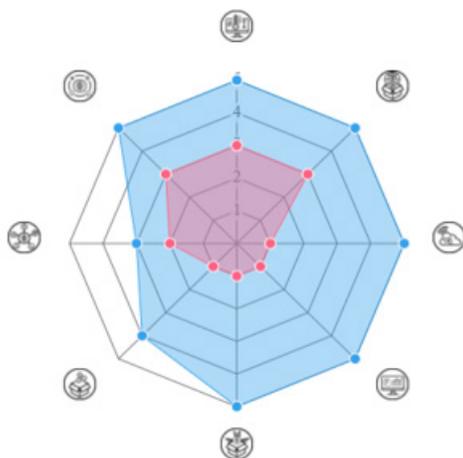


Virtual Program Delivery, Online Portal, Data Insight

- In the wake of COVID-19, the program is now being delivered virtually – the education and training are delivered via interactive webinar format
- New factory tours are executed virtually using remote-friendly tools (gimbal)
- Fully digitized readiness assessment accessible via a new portal that will enable SMEs to track and update progress
- Future plans to aggregate anonymized data at the regional, provincial, and national level – information that is not readily available to economic developers, program developers/ administrators, and post-secondary institutions seeking stronger ties with industry stakeholders

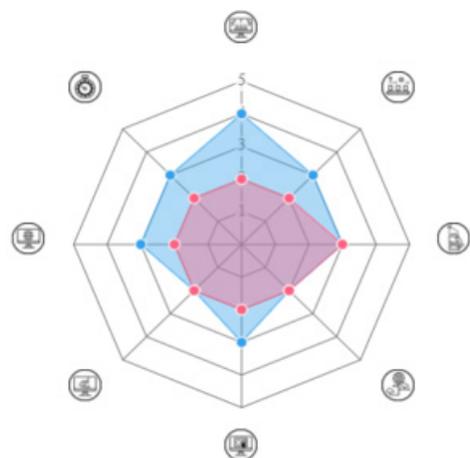
Product

The spider chart indicates the current status and desired status of the products you build.



Process

Comparison of the manufacturing processes today and in the future.



Program Benefits

The benefits of SMEs harnessing smart manufacturing methodologies are many, and primarily ensure that Canadian companies have a competitive advantage over companies that do not undertake digital transformation initiatives. By closely linking design, production, and supply chains, companies are able to:

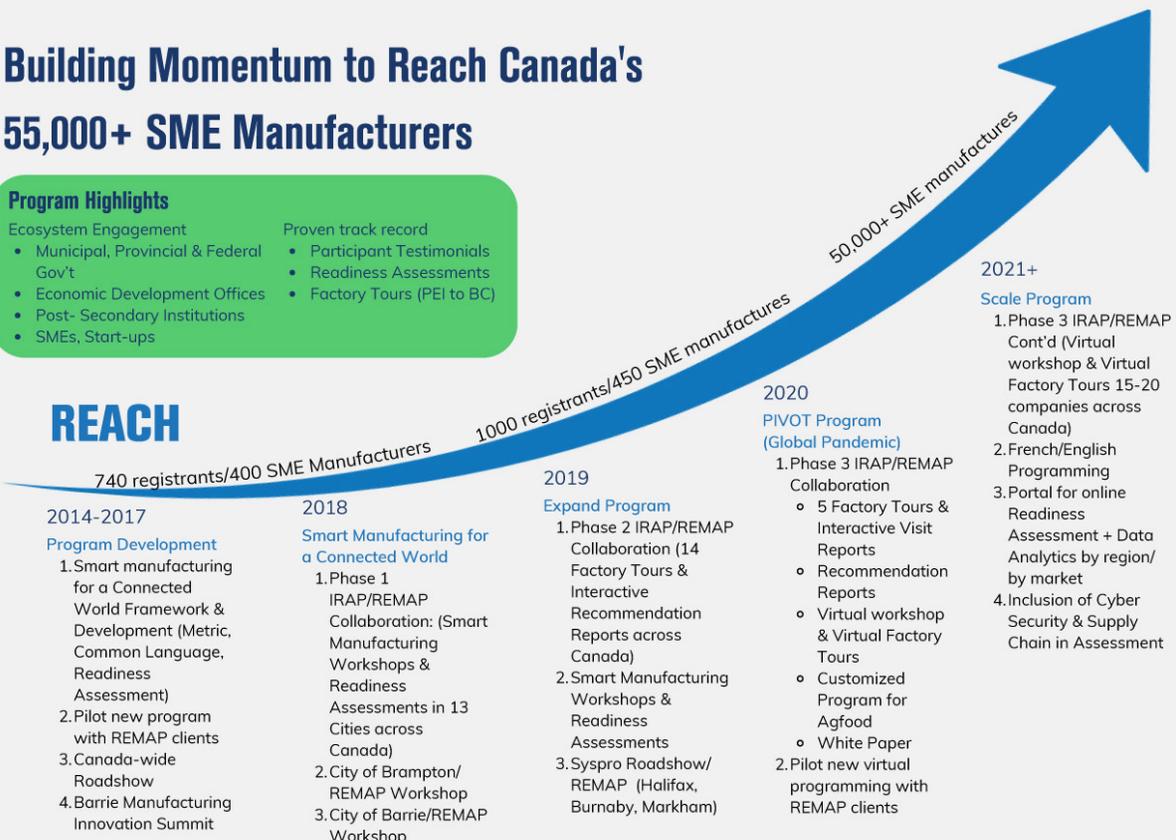
- 1 Accelerate the product development cycle, achieving in 2-3 months what previously required 2 years. There are many examples of this as many Canadian businesses successfully pivoted to design new COVID-19 relief products
- 2 Compress time to market by creating direct to customer channels, leveraging curated partnerships and re-mapping value networks to ensure reliability and resiliency of supply chains. Buying patterns, whether Business-to-Consumer or Business-to-Business, rapidly shifted to online models in response to restrictions related to controlling the spread of COVID-19
- 3 Evolve business models to incorporate digital products and data itself, creating higher value product offerings combining hardware, software and data.
- 4 Export-ready products are an outcome of tightly connecting design and production. In Canada's 2020 State of Trade Report⁵, the Minister of International Trade, Small Business & Export informs that there is no sector of the Canadian economy that is immune to global supply chain disruption. The "new normal", therefore, is creating new domestic supply chains for export-ready products.

Building Momentum to Reach Canada's 55,000+ SME Manufacturers

Program Highlights

- | | |
|---|--|
| <p>Ecosystem Engagement</p> <ul style="list-style-type: none"> • Municipal, Provincial & Federal Gov't • Economic Development Offices • Post- Secondary Institutions • SMEs, Start-ups | <p>Proven track record</p> <ul style="list-style-type: none"> • Participant Testimonials • Readiness Assessments • Factory Tours (PEI to BC) |
|---|--|

REACH



⁵ <https://www.international.gc.ca/gac-amc/publications/economist-economiste/state-of-trade-commerce-international-2020.aspx?lang=eng>

Lessons Learned

The Smart Manufacturing for a Connected World program, delivered to communities across Canada, provided opportunities to understand what program elements are necessary to help traditional SME manufacturers to successfully advance a digital transformation. These observations have formed the basis to streamline the program; accelerate opportunities for scale; and prepare traditional manufacturers as important contributors to Canada's health and economic recovery. These observations include:

Benchmarking and Data Analysis

1 The need for data sharing between stakeholder organizations between participating companies. For partners, anonymized and aggregated data will provide insight on the progress of Canadian SME manufacturers that would not otherwise be available, and can inform policy decisions and program development at all levels of government and in post-secondary institutions. For companies, the ability to benchmark themselves using different views (size, sector, geography, stage of digital adoption) is an essential input into business planning and investment strategies.

Culture and Change Management

2 Cultural and change management is a key component to success. The need for leadership buy-in is essential as risk mitigation and ROI were identified as significant barriers to the adoption of digital technologies by SME manufacturers. The approach of broad engagement in the workshop and onsite visits is critical to locking in the support from the management team to make decisions that impact all aspects of the business.

Continuous Journey and Benchmarking

3 Innovation and digital technology adoption needs to be seen as a continuous journey. One-time assessments are useful for identifying immediate projects, but long-term growth requires ongoing review and benchmarking tools that align to business priorities; overall progress and the ability to pivot quickly in the event of unforeseen and/or catastrophic disruption.

Additionally, due to the rapid evolution of technology and associated operational and governance issues, the assessment tools need to evolve as new technologies are introduced, and impacts to processes and operations are better understood (i.e. Cybersecurity for the protection of data, information, factory equipment, devices and networks from threats and attacks).

Local to National Engagement

4 To achieve national reach and to engage SME manufacturers from communities of all sizes across Canada regardless of geographical location, will require engagement from all stakeholders and partners in the ecosystem. These include municipal economic development, post-secondary institutions, and business associations already engaged with the target SME companies. These organizations can effectively mobilize and harness the existing infrastructure, resources, and staff already on the ground.

DRIVING CANADA'S ECONOMIC RECOVERY

URGENCY IN A POST-PANDEMIC RECOVERY

The impacts of the global pandemic on SMEs have been significant but uneven. While some sectors have faced more substantial impacts (hospitality and tourism), one key outcome has emerged: regardless of sector, SMEs that were already on their digital technology adoption journey were better able to adapt to the changing market conditions. SMEs that had not advanced their digital infrastructure and services were at a distinct disadvantage.

Some SMEs are experiencing increased demand but are challenged with supply chain disruptions and lack of labour. Other SMEs that leverage strategic support programs and funding mobilized by the federal government through NRC/IRAP, REMAP, Superclusters, and other funding organizations, successfully pivoted to produce COVID-19-relief products and services. In the process, they maintained or grew revenues and redeployed their resources to ensure stability of business. Others were unable to make major shifts in the face of unprecedented market conditions or because they had not advanced their digital technology adoption.

Benchmarking and Data Analysis

- 1 Strengthen Canadian high-tech manufacturing in areas aligned with capabilities
- 2 Tightly link product design and manufacturing closer together and foster the ability improve products, processes and services
- 3 Build robust and agile domestic supply chains to create resiliency, and close gaps where they exist within regions

Culture and Change Management

- 1 Healthtech: critical to recovery and resilience
- 2 Aerospace: a sector devastated by COVID-19
- 3 Automotive: a sector in transition
- 4 Supply chains: building robust domestic sources for essential products

The need for digital transformation has been apparent for more than a decade, with numerous programs and conferences promoting the concepts of Industry 4.0, Industrial Internet of Things, and the Smart Factory. However, digital transformation still remains overwhelming to many SMEs, resulting in paralysis. Most companies want to digital transformation but need a roadmap as to where to start.

In every business, around the world COVID-19 accelerated the digital transformation imperative: the need to have the ability to operate remotely, harness data to maximize efficiencies, re-shape supply chains, and accelerate the development of new products are now the primary keys to ensuring companies are able to navigate market disruption both now and in the future.

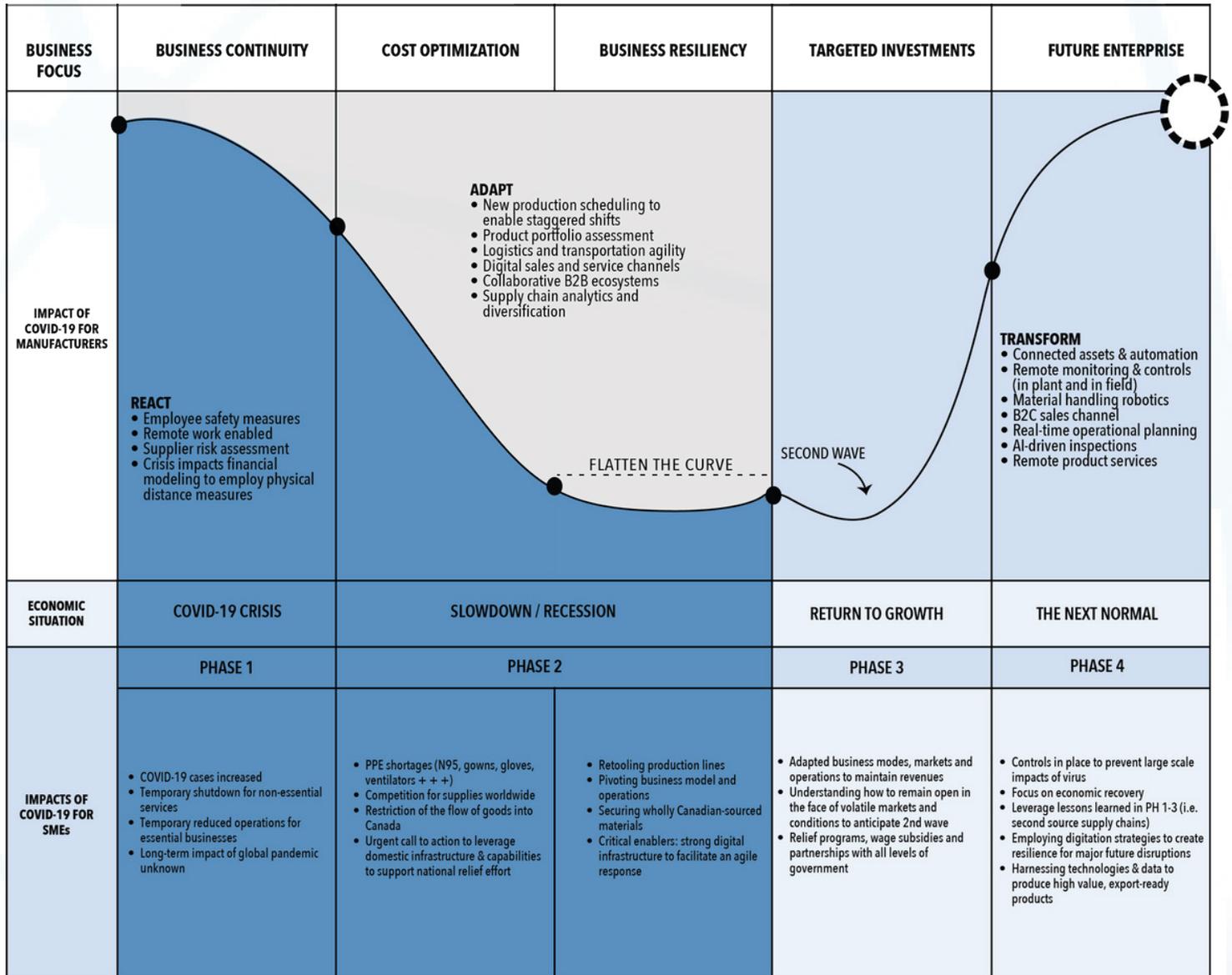


The global pandemic created a burning imperative for companies to have a robust technical infrastructure and end-to-end digital process in place as the essential elements to safeguard production.

According to the Hackett Group, 77% of companies have strengthened their commitment to digital transformation due to the COVID crisis. Those companies moving forward with predictive maintenance, smart manufacturing, robots, cybersecurity, augmented reality and virtual reality will be positioned for success. Unfortunately, those still largely manual are likely to be left in the dust.”

Reference: Select Hub Article ft LMA Consulting Group, Leveraging Technology to Maintain a Competitive Edge in 2021

HOW WILL MANUFACTURERS LEVERAGE TECH IN THE NEW NORMAL?



Reference: Adapted from – 2020 IDC The Five Stages to Enterprise Recovery - Leveraging Technology to Flatten the Curve and Emerge Digitally Fit

Recommendations

The IRAP - REMAP collaboration to deliver the Smart Manufacturing for a Connected World program is a model with great potential to scale up. The program, its workshops, and its readiness-assessment tools have been translated into a digital format and work continues to launch the full readiness-assessment portal.

The broad collaboration and manufacturing network already in place enabled continued service delivery by engaging with companies and stakeholders to gather feedback and further development of the program. As municipalities plan for the recovery post-pandemic phase, economic development officers in every community will be seeking ways to support and strengthen local businesses that provide employment and contribute to the commercial tax base in their community.

A scaled version of the Smart Manufacturing for a Connected World framework has the potential to be a structured program that can be leveraged by communities across Canada, introducing the opportunity of a shared investment model that would further increase its sustainability and reach.

Summary of Observations Regarding the Acceleration of Digital Adoption by Canadian SME Manufacturers:

1

The traditional SME manufacturing sector in Canada represents a significant potential to contribute to Canada's economic recovery post COVID-19 if the adoption of digital technologies for both process and product development can be accelerated

2

In order to achieve an accelerated rate of digital adoption by SMEs, an initiative needs to build on the existing programs and leverage best practices learned over the past decade. Essential elements of the initiative should include:



A national approach to supporting education on digital adoption for SME manufacturers, awareness, and examples of state-of-the-art adoption



Standardized readiness assessments that can be accessed on demand, maintained and updated by SMEs



Mentoring of SMEs at different stages of digital transformation



Project identification, screening and funding to execute identified projects



Access at the regional, provincial and national level to access aggregate data in real-time regarding progress (by sector, by technology, by process and product views, and business model evolution)

3

A re-envisioned and modernized DTAPP program would be an essential resource to support and mobilize digital technology adoption strategies at scale for Canada's 50,000+ SMEs and it would close a big gap in the funding landscape.

4

The DTAPP model of project-based funding to SMEs would provide a solid foundation to support the project funding required for SME manufacturers to execute the identified priorities to maintain the momentum in their digital adoption journey.

5

The addition of screening through the Smart Manufacturing for a Connected World readiness-assessment and one-on-one consultations provided by either the program or current providers will ensure the ability to track ROI of the investments and progress against larger objectives pertaining to an SME's processes, product design and development, and evolution of business models. It will also provide the SME with a digitization roadmap to discover innovation projects and opportunities to achieve their digital adoption targets.

6

The traditional SME manufacturer has typically underinvested in innovation and R&D and has been slow to adopt digital technologies due to numerous barriers. This has undermined Canada's overall global competitiveness in the manufacturing sector. The global pandemic accentuated the gap between companies who were ahead in digital technology adoption and those who were behind.

7

Economic development at a municipal level has prioritized support for the manufacturing sector in order to ensure jobs are maintained and created in their communities. The economic development officers present in the local community add a strong understanding of the specific needs of that community's SME manufacturers and can continue to provide support and connections throughout the digital adoption journey. A strong, sustainable and resilient local manufacturing base is considered essential for community prosperity.

8

Traditional SME manufacturers are located in communities large and small throughout Canada, many without direct access to innovation support programs available in large urban centres. This has made engaging them a significant challenge but REMAP has found avenues to resolve these issues. The Smart Manufacturing for a Connected World program builds on the existing offices, infrastructure, investments, and staff of federal, provincial, and municipal governments as well as academia to deliver a highly integrated approach to connecting SME manufacturers across Canada. The methodology continues to foster strong ties between NRC's IRAP program and regional economic development offices – an underutilized and largely untapped resource that can play a key role in accelerating Canada's economic recovery and building resilient communities.

9

The digital transformation imperative has accelerated exponentially due to the impacts of the COVID-19 pandemic. This has been recognized by the delivery of prioritized support programs for businesses but none are specific to the traditional SME manufacturing community. With the exception of targeted programs addressing the emergency needs of health care and the production of personal protective equipment (PPE) related to the COVID-19 pandemic, none address the development of new products and revenue streams for SME manufacturers. It is critical to Canada's economic security to foster the capability of SMEs to design, develop, produce, and source new products to ensure resilience in the face of future disruptions.

10

The Smart Manufacturing for a Connected World program, including the methodology, workshops, readiness assessment, one-on-one consultation, factory tour, and interactive site visit report is an effective and high-impact program that creates long-term sustainable growth capacity for the traditional SME manufacturer through structured and prioritized digital transformation initiatives.

11

The collaborative delivery model between NRC's IRAP ITAs together with REMAP; engaging post-secondary institutions and local municipal economic development officers created a broad access to the large community of traditional SME manufacturers and funding programs scaled to the size and scope of projects undertaken by these companies. It is a made-for-Canada approach geared to the specific needs of the SME manufacturing sector that are not being met with other programs.

12

Scaling the proven Smart Manufacturing for a Connected World program through the online portal and self-service system will allow for direct delivery of services to more than 50,000+ traditional SME manufacturers while achieving maximum benefit from existing program infrastructures.

Three net new key benefits arise from the expanded Smart Manufacturing for a Connected World program delivery:

Benchmarking for individual SMEs: SME manufacturing companies will be able to evaluate themselves against similar manufacturing companies by size, sector, geography, and stage of digital adoption, giving them feedback on their competitiveness and prioritization for areas of investment.

1

Key insights for program planning will benefit organizations supporting the growth and development of the Canadian manufacturing sector. Accurate, real-time information derived from the anonymized aggregated data from the online self-assessment portal system will inform policy at federal, provincial, and local levels, while also informing post-secondary institutions about industry needs. A holistic data view of traditional SME manufacturers will now be possible, encompassing capacity, capabilities, and tracking ongoing progress of the degree of digital technology adoption, both traditional and transformative, and how it is being applied to process, product design, and development, manufacturing capabilities, new product introductions, and export markets looking at eight factors/evolution. This capability has never been available before at a Canada-wide level.

2

The necessary shift in business planning and organizational culture to support the successful integration of digital technologies is supported through a standardized, easy-to-use assessment model that is accessible to business executives as well as technology experts. By introducing a common vocabulary, SMEs are more easily able to integrate digital technologies into their overall business planning and budgeting processes, further reducing the identified barriers to adoption. The companies will have an ongoing visual assessment tool to chart, monitor, and report on their progress and accommodation for a Smart Manufacturing for a Connected World designation in the future.

3

Conclusion

Before the global pandemic, the adoption rate of digital technologies by traditional SME manufacturers in Canada was very low for a number of reasons. Funding gaps, lack of basic knowledge, and the right skills within their firms continued to be barriers. A slow rate of adoption was further compounded by the exponential growth of transformative technologies such as sensors/IoT, data analytics, and AI.

The global pandemic has significantly impacted Canada's economy and put manufacturing in the spotlight as new products and services are required to combat COVID-19. Companies lagging behind in digital operations and manufacturing processes were disadvantaged in their ability to quickly design and develop new products. It has been well documented that those businesses that had already started or were well along the way in the adoption of digital technologies were more resilient in addressing the pandemic's market impacts. The global competitive landscape that was responsive to digitally-enabled SME manufacturers before the worldwide pandemic has only intensified Canadian need to invest in adopting transformational technologies.

For Canada's economic recovery and future prosperity, a concerted effort is required to unlock our country's 50,000+ traditional SME manufacturers' potential. Prior studies have identified the barriers to adoption of digital technologies within this sector and programs over the last decade, and most recently in response to the pandemic, have established best practices for ensuring successful outcomes for SMEs that pursue digital technology strategies. The opportunity now exists to leverage the existing programs, methodologies, delivery infrastructure, and scale programming will greatly accelerate the digital imperative for the critical mass of traditional SME manufacturers.

While there are many assessment tools available for every business focus, there remains an essential need to standardize manufacturing capabilities and how data is captured. Ensuring that a seamless process exists for moving through awareness, education, readiness assessments, project identification, project funding, and tracking progress. The collaboration between IRAP and REMAP was created to deliver the Smart Manufacturing for a Connected World program across Canada. This comprehensive program is complementary to regional and provincial assessments and/or programs. However, this collaborative model has been designed specifically to transform the traditional manufacturer and has flexibility to be delivered nationally.

The inclusion of a funding framework similar to the previous DTAPP program would ensure that Canadian SME manufacturers can execute this significant initiative, one that is essential to our country's future prosperity and to ensure no SME is left behind in their digital transformation.

REFERENCES

- 1 [Smart Manufacturing for a Connected World Seminar & Workshop](#), Published by REMAP Network 2020
- 2 [2021 Advanced Manufacturing Outlook Report](#), Published by Plant Magazine
- 3 [Back to the Future: Manufacturing Beyond Covid-19, Key Findings for a Resilient Manufacturing Sector in the New Normal](#), Published by the World Manufacturing Forum
- 4 [The 2020 World Manufacturing Forum Report, Manufacturing in the Age of Artificial Intelligence](#)
- 5 [The 2019 World Manufacturing Forum Report, Skills for the Future of Manufacturing](#), see the Smart Manufacturing for a Connected World: No SME Left Behind From Digital Transformation, Page 99
- 6 [Renewing and Reimagining our Regional Economy, Report From the Manufacturing Sector Table](#), Published by the Toronto Region Board of Trade
- 7 [Evaluation of the Digital Technology Adoption Pilot Program \(DTAPP\)](#)

*Note: Some of the studies and metrics are dated pre-COVID-19, however, but contain the most recent available date referencing Canadian SME manufacturers.

About REMAP

Refined Manufacturing Acceleration Process (REMAP) is a business-led network that brings together industry leaders from across Canada in innovation incubators academia, research, and companies of all sizes to drive innovation for a global market. Working collaboratively, the network supports leading-edge research to advance new capabilities in R&D (TRL 4-8), product design and manufacturing processes that solve today's industry challenges. These capabilities are intended to accelerate the commercialization of Canadian innovation – ensuring that Canada's investment in electronics technology translates into differentiated solutions for economic growth and job creation. Sharing resources across 46 labs and factories throughout ReMAP's network helps all stakeholders in the Canadian manufacturing value chain lower cost, improve processes, and bring export-ready products to market – faster.



**A Collaborative Model For Transforming
Traditional SME Manufacturers**