CASE STUDIES OF SMEs ON THE NATURE AND LEVEL OF SKILLS REQUIRED IN THE DIGITAL ECONOMY

INFORMATION AND COMMUNICATIONS TECHNOLOGY COUNCIL

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For

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EXECUTIVE SUMMARY

In an increasingly competitive race for talent, innovative enterprises around the world are recognizing the value of a digitally skilled workforce to successfully transform, grow and enhance business operations. In Canada, one of the many employer groups increasingly seeking digitally-trained talent are small and medium-sized enterprises (SMEs) operating in the manufacturing sector. Their wide representation and significant contributions to the overall Canadian economy creates the imperative that these businesses have ample access to the kinds of talent that push technological advancement and drive successful innovation. Moreover, given the rapidly-advancing changes to the sector, understanding both current and future talent needs is increasingly essential to ensure continued growth, and sustainable job creation. With support from Innovation, Science & Economic Development Canada, ICTC has led a comprehensive case study, providing an in-depth understanding of the different skills required to effectively utilize digital technologies in Canada’s quickly-evolving manufacturing sector.

The case studies in this report were conducted for the purpose of accurately assessing the nature and level of digital skills required to make full use of the digital technologies employed by Canadian SMEs in the manufacturing sector. Our case studies include primary data gathered from seven SMEs operating in the sector, with the overall objective being to answer the following questions:

1. What types of digital skills are required to effectively leverage relevant digital technologies in the workplace?
2. What is the degree of importance of each skill category?
3. How are these skills being adopted by employees in the workplace?
4. What is being done to ensure these skills are updated or maintained over time?
5. What are the challenges encountered by employers in upskilling/integrating these skills into the workplace?
6. What has the resulting impact been on a firm’s competitive position, on productivity, and on return on investment (ROI) for employees acquiring these skills?

Throughout the course of our research, we have identified some broad trends including the nature of skill requirements, their main use and projected future needs. Primarily, foundational skills – including basic skills like literacy and numeracy – were found to be critical for all roles as they are the ‘base’ on which all other skills are built. On a deeper level, further results indicated that the type of digital skills required by manufacturing companies is largely technical skills, including the use of office productivity software, the use of sector specific software and computer/ICT literacy. In terms of the degree of importance attributed to these skills, results showed that greater emphasis is placed on highly technical/digital skills, followed by business and interpersonal skills. Largely speaking, entrepreneurial skills were found to be of lesser importance, with the exception of their application for managerial/leadership positions. Informational skills also tended to score lower than others, with many companies indicating that they were outsourced when found to be lacking in-house.

1 Foundational skills refer to basic literacy and numeracy while business and interpersonal skills encompass communication, social, creativity, sales, management and continual learning skills. Digital and technical skills consist of computer/ICT literacy, use of social media, automated technologies, and sector-specific software. Informational skills consist of cybersecurity or information processing skills. Entrepreneurial skills consist of investing skills, leadership and digital entrepreneurship.
Throughout the course of our interviews, our SMEs suggested that they invest heavily in training to make up for skills shortages or gaps. However, it is important to note that SMEs tend to face greater challenges than larger companies in accounting for changing skill needs at an accelerated pace. Such challenges include the lack of financial access to capital, as well as concerns surrounding the potential for employee turnover prior to company’s ability to recoup the cost of the investment. Other major challenges identified included time constraints and the remote location of some SMEs, resulting in an inadequate stream of talent.

In order to make significant headway and effectively overcome these challenges, SMEs in the Canadian manufacturing sector will need to focus on making fundamental revisions to their operational policies and strategies going forward. From the greater utilization of strategically-vetted and forward-looking practices including programs aimed at upskilling the existing workforce, strategic hiring of recent graduates, or government-backed financial incentives for SME digital revitalization, Canada’s manufacturing sector will be tasked with implementing large-scale changes today in order to remain competitive in the global economy.
SECTION I: INTRODUCTION, LITERATURE REVIEW AND METHODOLOGY

INTRODUCTION

Manufacturing has and continues to play a vital role in Canada’s economy, accounting for approximately 14% of GDP and employing nearly 1.69 million Canadians. Over the years, the manufacturing industry has recorded high levels of GDP contributions, imports, exports and other investments in research and development (R&D). These kinds of investments have led to the existence of 50,902 manufacturing businesses in Canada by 2015, 50,610 of which were small and medium-sized enterprises (SMEs). It is no surprise that SMEs act as the main driving force of Canada’s economy, and as a result, their success is vital to Canada’s continued economic development. Moreover, SMEs are recognized as important economic drivers globally, providing significant economic and employment opportunities to the global workforce. While the saturation of SMEs is by no means unique to Canada, the success of Canadian SMEs will be increasingly dependent on their ability to adapt to changes, stay abreast with emerging needs, and as a result, grow, evolve and remain competitive in the marketplace. According to a Conference Board of Canada report, “Canada’s future economic success may depend in large part on the ability of small, innovative companies to take advantage of global opportunities” and invest in advancing technological adoption among their workforce.

An intrinsic element underscoring Canada’s vision for a competitive digital economy is for all Canadian businesses and organizations – particularly SMEs – to constantly innovate and increase revenues from domestic and international markets. In order to achieve this, Canadian industries will need to undergo some significant changes. A 2015 Conference Board of Canada report described Canada’s economy as below-average in its capacity to innovate, ranking 9th out of 16 peer countries, and well behind other leading jurisdictions including the Netherlands, Switzerland, the US, and Sweden, among others. While the ability to innovate is comprised of several complimentary factors, a company’s capacity for R&D spending is inherently tied to accelerated product development and commercial output. Here, Canada, a country largely dominated by SMEs, faces a challenge. Since SMEs typically possess thinner cash flow than large companies, these financial restrictions impact their ability to fund innovative activity on their own, or consistently. Research indicates that, from 2011 to 2013, large businesses accounted for over 50% of all R&D spending, whereas SMEs were responsible for approximately 45%. By comparison, during this same period, 97.9% of all employer businesses in Canada were considered small to medium, with only the remaining 2.1% considered large.

However, despite the overall low levels of SME R&D spending, survey data from Statistics Canada showcases that over 41.7% of small businesses and 58.3% of medium sized businesses in Canada

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implemented at least one type of innovation in 2014 (i.e. process innovation, product innovation, organizational innovation and market innovation)\(^9\) with SMEs in the manufacturing industry recording the highest levels of innovation at 61.5\%.\(^{10}\)

**Figure 1 – Introduction of innovation between 2012 and 2014 by NAICS and Enterprise size.**

Businesses are increasingly relying on technologies to offer new products and services, and to increase their scope and scale of operations. Digital adoption can create efficiencies and improve the speed and quality of business operations. In turn, this can help to generate additional jobs in ICT and non-ICT roles alike, via added cost savings and increased revenues. ICTC has documented this “multiplier effect” to show that digital adoption and job growth extends far beyond ICT occupations. Through this effect, we estimate that a 1% increase in labour productivity generated by the adoption in technology can yield an additional $8 billion revenue to Canada’s economy.\(^{11}\)

SMEs adopt digital innovation through a variety of methods, including: using advanced technologies like additive manufacturing for producing parts; using the Internet for online banking; ordering supplies and paying taxes online; using equipment and material resource planners; utilizing e-commerce channels that allow customers to order goods and services and pay directly; and using customer relationship management systems. Furthermore, innovation helps businesses by increasing their productivity and revenue, increasing internal efficiencies, reducing costs, and encouraging better collaboration and improved product and service offerings.\(^{12}\) For SMEs in the manufacturing sector specifically, adopting digital technologies can accelerate

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\(^11\) ICTC, Digital Talent-Road to 2020 and beyond (2016).

\(^12\) European Commission, Digital Skills for SMEs (2015)
e-commerce opportunities, improve inventory control and enhance supply chain management practices, among other things.

Despite the compelling argument for greater technology adoption, Canadian enterprises and especially SMEs, will need to accelerate their ability to embrace, adopt and utilize emerging technologies in their day-to-day business operations. Education about technology's benefits, resources to train workers including managers and executives, and capital to purchase the necessary equipment and services are often lacking in SMEs, ultimately acting as barriers to business development. At the employer level, challenges mitigating digital adoption typically include too many software updates, technology becoming obsolete, lack of technical knowledge and cost of maintenance, with one of the top obstacles to digital adoption being the shortage of skills needed to succeed in the digital economy. With digital technologies possessing far reaching effects on productivity and employment, increasingly, professionals will need to be comfortable with utilizing them their daily operations. Executive leaders in innovative enterprises agree that having a strong workforce with the right combination of skills is one of the greatest drivers of robust organizational performance. As new technologies emerge, workers employed in various sectors, including the manufacturing sector, will require digital skills to perform complex and advanced tasks using innovative technologies such as manufacturing execution system (MES) and digital plasma sputtering (the process of ejecting particles from solid target materials). The extant studies conducted by different organizations into digital skills have found that there is a need for both formal educational qualifications, as well as shorter, tailored and affordable training with flexible schedules for SMEs to continuously innovate.

With support from the Digital Policy and Innovation Branch of the Department of Innovation, Science, and Economic Development Canada (ISED), ICTC has undertaken a study aimed at helping to improve the understanding of the nature and degree of digital skills required by innovative SMEs in the Canadian manufacturing sector. This report will provide evidence-based knowledge, best practices, and ways forward for the successful digitization of one of Canada's most important sectors. Thoroughly examining the nature and varying importance of the skills required in the digital economy, this report can act as a foundational grounding for future government and/or industry-led programs and policies facilitating the adoption and effective use of digital technologies.

The case studies presented in this report have been analysed based on the ICTC definition of digital skills and the digital skills framework presented in Figure 2 of this report. Further, this report is divided into four main sections, all tackling key areas related to digital adoption among Canadian SMEs. Section one provides an overview of SME digital adoption in the Canadian manufacturing sector, alongside a robust literature review on current research in this field. This section will also define the characteristics of the methodology and analytical framework used to generate the report conclusions. Section two focuses on the results of the case studies and highlights important factors including: the digital skill needs of SMEs, the degree of importance of each skill category based on the ICTC’s digital skills framework, upskilling challenges, and

http://digital.dk/SiteCollectionDocuments/Publikationer/DigitalskillsforSMEs.pdf
13 Digital Adoption: Advancing Canada’s Place in a Digital Economy
14 The Canadian Chamber of Commerce 2017. Canadian Business Speaks Up: An Analysis of the Adoption of Internet-based Technology
15 Interview with Richard Game (Evans Consoles)
16 European Commission: Digital Skills for SMEs, supra at 7.
strategies adopted to overcome skill challenges and the resulting impact on the company’s ROI. Section three of the report provides an analysis of the results and trends identified from the case studies, while section four concludes the report with a call to action for policy makers and industry, for the purpose of supporting the move towards increased digital adoption among Canadian manufacturing SMEs.

LITERATURE REVIEW

Definition of Digital Skills

The term “digital skills” is multidimensional, encompassing a wide range of activities. Moreover, the broad understanding of the importance of digital skills has begun to gain ground in recent years, in part arising from the projected digital skills gap in Canada and globally. However, the lack of consensus on the definition of digital skills has led to various broad definitions of the term. The Canadian study “Defining Essential Digital Skills in the Canadian Workplace” defines digital skills as a multifaceted concept, which encapsulates four primary skill clusters: (1) Digital Technical Skills (computer and software usage, and technically operating in a digital environment); (2) Digital Information Processing Skills (information processing, synthetizing data, ensuring cybersecurity, and creating digital information); (3) Foundational Skills (basic literacy, writing, document use and numeracy) and (4) Transversal Skills (transferable and soft skills such as teamwork, continuous learning, problem solving and relationship development). By contrast, the United Kingdom (UK) Digital Skills Workforce describes digital skills “as the skills needed to interact with digital technologies” and the European Parliament adopted the term “digital competence” as “the confident and critical use of information society technology for work, leisure, learning and communication”. Under the EU definition, digital skills are underpinned by basic skills in ICT, i.e. the use of computers to retrieve, access, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet. ICTC has defined digital skills as the wide range of high level professional capabilities that includes broader organizational competencies such as foundational, occupational, business and interpersonal, ICT and technical, informational and entrepreneurial skills. This definition is further outlined in Figure 2 of the report and throughout the case studies.

Figure 2 – ICTC Digital Skills Framework

While a universally-accepted definition of digital skills may remain elusive for now, it is increasingly clear that investment in such skills and training opportunities is necessary to generate accelerated innovation and improved market competition.\textsuperscript{21} The level of investment required by SMEs to train and upskill their workforce with digital skills is significant in terms of cost, content, time and scheduling\textsuperscript{22}, while conversely, talent shortages of this nature in SMEs are more likely to resort to production stoppages, than in larger businesses.\textsuperscript{23} Comparatively, upskilling employees in large corporations is less challenging as they tend to possess a higher capacity to source talent and build human resources practices that provide continuous skill developments.\textsuperscript{24}

Nevertheless, while easier for large companies vs. SMEs, studies indicate that Canadian SMEs can act as significant beneficiaries of these investments, generating increased returns by training and upgrading employees’ skills to a globally-accepted standard.\textsuperscript{25} This is something that will be necessary to propel the Canadian SME market forward and remain globally competitive.

Categories of Digital Skills

The recent 2017 Federal Budget set a strong foundation for addressing digital skills and labour shortages among Canadian businesses. A key pillar of the 2017 Budget, is the government’s Innovation and Skills Plan centered on increasing investment in innovation in six key areas including, advanced manufacturing, and providing more access to training for Canadians. In the same vein, in 2013 the E-leadership initiative was launched in Europe to build digital skills among business leaders, to promote e-leadership and to encourage digital entrepreneurship. The objective was founded on equipping small business owners with the right skills – foundational, business, interpersonal, digital/technical, informational, and entrepreneurial skills – that would help them lead multidisciplinary teams, develop new business models and take advantage of new business...

\textsuperscript{21} OECD, Key Issues for Digital Transformation in the G20 (2017)  
\textsuperscript{22} Ibid
\textsuperscript{23} A Workforce Strategy for Alberta’s Manufacturing Industry (2007)  
\textsuperscript{24} OECD, Key Issues for Digital Transformation in the G20 (2017)
opportunities through digital technologies. Although these kinds of skills have been identified as required for future success across industries, limited research currently exists that focuses on digital skills for the manufacturing sector.

Digital skills range from those that enable basic social interaction (communication skills, literacy, smartphone usage), to skills that enable interaction with systems and services (for example e-commerce and e-government services), and to skills that match the needs of employers and maximise employability. In January 2016, the UK Department for Business Innovation and Skills released a report titled *Digital Skills for the UK Economy*. With key insights from industry leaders around the UK, the report provided an up to date glimpse into the nature of digital skills required for the digital economy.26 The report identified three categories of digital skills required across various industries in the UK. The first category included basic digital literacy skills needed to communicate and carry out basic Internet searches. Cyber security skills are also included in this category. The second category of skills are those needed in the workplace and for working with software applications, and finally, the third category of skills are those needed specifically for ICT professions. This last category includes all the skills in categories 1 and 2 and is linked to the development of new technologies, products, and services. Further accentuating the wide-range of the digital skill trifecta, research also identified five different skill sets that will be required by future employees. These skill sets are security skills (reflecting employer concerns around data security); core business skills (in order to balance technical skills with wider business objective so that professionals can manage product development lifecycles); technology specific skills (high level technical knowledge for example in networks and devices that support voice, video, and data communications); interpersonal skills (reflecting that digital applications have become more embedded in everyday life and professionals need to understand customer relations); and analytical and research skills (in order to interpret operational data).

**Labour and Skills Requirements for the Manufacturing Sector**

While data on digital skills for the manufacturing sector is limited, some baseline research was conducted in 2015 by the Canadian Manufacturers and Exporters Association. In this study, labour and skill requirements of the Canadian manufacturing sector were identified over the next five years.27 The report identified an important demographic trend in the sector, wherein the current high-demand skilled trades and technical occupations within the sector are mostly occupied by baby boomers, set to retire over the next ten years. The industry is therefore set to face shortages in the near future, with a significant portion of the working population exiting the workforce. Despite this, finding employees with the right set of skills to replace these retiring workers is an ongoing challenge within the industry. Other key themes found in the report include the outsourcing of skills such as human resources, ICT and engineering and an acutely felt dearth of talent in certain remote geographic areas, such as Windsor and Sudbury.

**Digital Adoption, Training and Upskilling among SMEs**

Despite being profitable in the long-term, for small business owners, the ROI on digital adoption is not always immediately obvious. For small companies, time, financial and talent resources are scarce commodities. As


a result, this presents shorter-term, day-to-day challenges. A recent report by Startup Canada underlined the impact that capital challenges had on SMEs, where 43% of SMEs identified costs related to training and updating digital technologies as a barrier to digital adoption. While in some cases, SMEs may be early adopters of technology, the report also found that they are often struggling to keep up with the rate of change and employee turnover. The report also identified top digital adoption trends among SMEs in Canada, including the understanding that sales and marketing technologies are the top technologies acquired by small businesses. 74% of respondents stated that they used digital technologies to make sales and convert customers. Another 67% of respondents also reported that they use digital technologies to manage the internal operations of their company, including aspects of human resources and financial management.

Another key insight the report identified centered on the difference between early and late stage SMEs. Here, research suggested that early stage companies are three times more likely than established companies to integrate digital adoption into their supply chains, with a greater likelihood of their employees feeling confident using new technologies. On a gender comparison, the report also found that women are 20% less likely to leverage digital technologies when operating their businesses, as compared to men. Furthermore, in comparison to Canadian born business owners, digital adoption rates are two times higher amongst immigrant business owners in Canada, with immigrant businesses owners more likely to invest in digitally upskilling their workers and leveraging digital technologies than natural born-Canadians.

Outside of Canada, the OECD further highlights the importance of innovation among SMEs. In the report entitled “Leveraging Training and Skill Development in SMEs”, the OECD found that participation in systemic training is a regular activity among SMEs, and is one that is the result of the production of new goods or services, the introduction of new technologies or equipment, or the improvement of work processes and procedures. Further, with recommendations including the need for SMEs to facilitate programs to increase awareness of available training and support, as well as the encouragement of innovation as a strategy to trigger skills development, the report solidifies the notion of using group-based mechanisms to ensure continuing skills development and capacity building among all employees.

In February 2013, the Canadian Chamber of Commerce in partnership with the Employment and Social Development Canada held a skills symposium for SMEs to examine upskilling and training barriers. The symposium examined Canada’s investment in training and found that Canada’s investment had dropped significantly since prior years. Not only did Canada invest 64% of the U.S. total on training per employee, this investment had dropped by 38% since 1993. Similar to other studies, the report identified time, cost, risk of staff departure, regulatory burden, program visibility, employee attitudes and low employee skills bases as some of the major obstacles to the success of upskilling initiatives. A few notable recommendations made by the panelists included the provision of formal accreditation for trainers, easing the requirements for

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participation in government programs and the development of a sector-based design and delivery of training tools.\textsuperscript{30}

\textsuperscript{30} The Canadian Chamber of Commerce, Closing the Skills Gap: Mapping the Path for Canadian Businesses, 2013
METHODOLOGY

The methodology used to identify trends and provide results for digital skills in the Canadian manufacturing sector in this study is comprised of two key elements: a literature review and interviews with seven high-level executives representing SMEs within the manufacturing industry31. The manufacturing companies interviewed in this report are from a variety of different specialty areas, including the chemical manufacturing industry, transportation equipment manufacturing, machinery manufacturing, and computer and electronic product manufacturing. The firms selected were assessed based on two criteria: first, they had to have fewer than 500 employees; and second, they had to have completed some kind of digital adoption. Through a combination of primary data collected through the interviews and secondary data extracted from a literature review, this report can be used to inform future policies and initiatives, and to act as a benchmark for “what works” when trying to increase digital skills among SMEs.

The following firms were selected for the case studies and are presented in the next section:

1) Asco Aerospace Industries – Transportation Equipment Manufacturing
2) TE Connectivity – Computer and Electronics manufacturing
3) Norsat Canada – Computer and Electronics manufacturing
4) CCC Sulphur – Chemical manufacturing
5) Biovectra – Chemical manufacturing
6) Evans Consoles – Machinery manufacturing
7) ORD Solutions – Machinery manufacturing

31 The interview questions are referenced in appendix A of this report
SECTION II: CASE STUDIES

ASCO AEROSPACE CANADA LTD.

Company Profile: Founded in 1986, Asco is a supplier and specialist in the design and manufacture of high lift devices and complex structural components, with some of its notable activities including the manufacture of landing gear subassemblies, leading edge slat mechanisms and trailing edge flap support mechanisms. Asco displays a good example of continuous innovation and digitization of the transportation and equipment manufacturing sector in Canada. Starting its Canadian operations in 2013, Asco is currently ranked among the top 100 aerospace companies in North America.

Number of Employees in Canada: 165

Location in Canada: Delta - British Columbia,

Other Locations: Belgium (headquarters), France, USA, Germany, Brazil

Industry: Transportation Equipment Manufacturing

Digital Projects Implemented: Asco’s recent digital initiative involves the use of laser systems to create digital data to interpret results. Industrial lasers have become a tool of choice on which innovative manufacturers rely for improved performance. Asco is creating simulated manufacturing environments, enabling rapid production of materials as well as real time collaboration through unique software. The unique features of laser technologies introduce new production capabilities, provide high speed performance, decrease maintenance costs, and drastically reduce set up times and inventory costs.

Furthermore, Asco utilizes three major digital systems: Microsoft Office Suite products, Material Requirement Planner/Equipment Resource Planner (MRP/ERP) systems and Computer Aided Design (CAD) systems. The MRP system is a mechanism for planning materials required for the production process, while the ERP system integrates all the organization’s systems. Models received in Asco’s manufacturing business are 3D models, as 2D models are no longer current.

Nature and Level of Importance of Skills Required: According to Asco’s Vice President Kevin Russell, laser technology is the biggest digital system implemented over the last two years. At Asco, employees who work with this technology require, at minimum, basic digital skills such as an ability to work with and understand computer systems. This being said, as basic digital skills do not cover all of the capabilities and expertise needed to work with these technologies, additional training is usually required.

Beyond basic/foundational skills, specific skills are required to fully utilize these technologies, among which ERP/MRP experience is often essential. Although our interviewee explained that an applicant does not always need to have knowledge of the identical ERP/MRP system used by the company, as there are various models available in the market, he highlighted the importance of knowledge and expertise in working with a 3D modelling system. Once an employee has these basic skills more training will be provided to use organization specific technologies. Often, when a new technology is introduced, existing employees are upskilled via a training program on that new technology, in order to provide everyone with the basic ability to fully utilize the new system(s).
The full requirements to use Asco’s heavy machinery are very diverse. Our interviewee observed that most of the equipment used in the manufacturing plant are so specialized, that finding someone with the specific set of skill requirements can be a real challenge, potentially affecting the production cycle. Therefore, the company focuses primarily on acquiring talent with basic digital skills, and afterwards, providing specific training on the company’s different technologies. According to Asco Vice President Kevin Russel, “We don’t have to hire new people; we just train the existing employees or put them into different jobs so we don’t have a negative experience”.

At Asco, the higher the level of automation that occurs within the business, the more skill needs change, with the most critical and difficult-to-source skills often being technical and digital in nature. Due to the advent of advanced technologies and automation, employees require higher capabilities of digital skills to work with most technologies, but the importance level of these skills ultimately depends on the role. For instance, managerial roles require high levels interpersonal and soft skills as well as digital/technical skills like computer/ICT literacy, using office productivity software and enterprise-specific programs. Conversely, administrative and clerical roles require some level of basic digital skills, complemented by business and interpersonal skills, but do not require high proficiency in most digital skillsets.

“MANAGERIAL ROLES REQUIRE HIGH LEVELS OF INTERPERSONAL AND SOFT SKILLS BUT DIGITAL/TECHNICAL SKILLS LIKE COMPUTER/ICT LITERACY, USING OFFICE PRODUCTIVITY SOFTWARE AS WELL AS SECTOR OR ENTERPRISE-SPECIFIC PROGRAMS ARE ALSO CRITICAL.”

Strategies to acquire, maintain and update skills: At Asco, having a background in the company’s existing technologies is vital. This explains why current employees are upskilled whenever a new technology is introduced into the company’s manufacturing plant, as opposed to searching for new hires who have these skills.

Asco’s key human capital strategy surrounds the training, upskilling and continual development of its employees. Due to its extensive investment in innovation, the company has its own training program, with an established corporate technology group at its headquarters. The corporate technology group is responsible for incorporating new technologies, and is ultimately tasked with developing training programmes for the company. Training at Asco is usually provided on an “as needed” basis and/or when an employee is lagging in the technology adoption process. Additionally, while the training programs are developed by Asco, the company often hires the technology providers to teach and deliver the training sessions to the workers. It is, however, important to note that the company does not rely on outsourcing to cover any of its work functions. Instead, with added difficulty in finding talent with the specific skills needed, the company believes in continually developing the internal workforce and expanding their expertise to accelerate highly-specialized core skills.

Challenges: The process of upskilling employees at Asco does not appear to be a major challenge, but one area of concern is finding people with strong work ethic and developed interpersonal skills. Another area of concern for the company revolves around the cost and time of employee training and upskilling - finding the necessary time to schedule the training, and securing the required capital to host it can sometimes prove difficult. Our interviewee observed that high-level CAD skills are difficult to find, as most of the jobs done with CAD are very specific, and sourcing employees with these skills can be challenging.
RETURN ON INVESTMENT: One of the leading digital training initiatives at Asco was the transition from manual to automated equipment. To fully optimize the benefits of these machine technologies, the company had to search for internal talent with machine skills, and afterwards, encourage those employees to become more involved in computer controls. Recognizing that automation is the only way to compete in Canada, Asco’s Vice President Kevin Russel underlined that going digital was an essential move for the company. Due to the increasing complexity of the CAD system, the company would need to evolve to remain productive and competitive. To maintain their customers and margins, Asco had to adapt, innovate, and upskill their workforce. Despite cost implications for the company, this training has become particularly rewarding, as it has also improved the employee retention rate and increased their overall productivity in the long term.

“GOING DIGITAL WAS ESSENTIAL DUE TO THE INCREASING COMPLEXITY OF THE CAD SYSTEM. IT HAD A BIG IMPACT ON OUR COMPANY’S PRODUCTIVITY”
TE CONNECTIVITY

PROFILE: TE Connectivity provides engineering and development functions for its product lines sold around the world. Its innovative history includes breakthroughs in connectors, next-generation fiber, and wireless antennas that have created new standards in a wide range of industries. Showcasing its commitment to the environment, TE uses aluminum to replace weaker, heavier metals in the automotive industry, as well as Nano-carbon tubes that enable signal delivery with decreased weight. Through their Advanced Development Labs, they are continuously exploring technologies several generations out, while working to develop essential technologies for an increasingly connected world.

NUMBER OF EMPLOYEES IN CANADA: 125

LOCATION IN CANADA: Markham- Ontario,

OTHER LOCATIONS: United States (headquarters), Germany, China, and Japan

INDUSTRY: Computer and Electronics Manufacturing

DIGITAL PROJECTS IMPLEMENTED: TE uses quality digital systems to get better response times and efficiently handle customer complaints. These digital technologies enable TE to understand specific customer requests and deliver quicker responses.

TE uses the most advanced manufacturing innovations available, reducing lead time and making them more responsive. One such innovation is the TE Operating Advantage (TEOA) system for manufacturing, which allows for global breakthroughs and drives a culture of continuous improvement. TEOA is a company-wide effort designed to improve productivity, customer satisfaction, and reduce costs through standardized key performance indicators. It also includes an assessment and evaluation system, a training program grounded in a “learning by doing” approach, and a leadership and management development program.

Globally, TE Connectivity has sharpened its product mix on durable connectors and sensors. It recently shed many of its standard fiber optic connector lines to concentrate on expanded beam technology used in industrial and military/aerospace applications. Some of its more notable inventions include the development of sensor technology, the development of miniature vehicle connectors and the development of space worthy relay.

NATURE AND LEVEL OF IMPORTANCE OF SKILLS REQUIRED: At TE, every employee has a computer system, with the software on each system depending on the role of the employee. Software used by employees in non-technical roles include Microsoft Office Suite products such as T-project for project management, database management software like Excel and Word processing software. Some of the roles that require these software capabilities are customer service, sales and marketing, and warehousing staff. By contrast, for technical-based roles occupied by engineering technicians and designers, the Computer Aided Design (CAD) system is used. The CAD system makes it easier to implement designs in a shorter time.

TE employees occupying both technical and non-technical roles require computer proficiency, including basic digital literacy and numeracy (foundational skills). These skills are important in order to fully understand the needs of customers and respond to them effectively. Interpersonal skills which encompass
communication, social skills, creativity, and continuous learning are also essential to function in an innovative environment like TE.

The degree of importance for each skill depends on the type of role. For technical roles like engineering, digital and technical skills including computer/ICT literacy, working with industrial internet of things and digital communication skills are vital. Employees in these roles are expected to already be equipped with these foundational skills. For non-technical roles such as sales, customer service and administration, interpersonal and communication skills are key, as they enable staff to handle client inquiries effectively. These employees are also required to have basic computer skills, digital communication, and project collaboration skills. Entrepreneurial skills are important to an extent, but are less likely to influence hiring decisions when the other digital skills are not present. Basic ICT literacy skills are important to acquire additional technical skills because they are the foundation on which all other skills are built.

**Strategies to acquire, maintain and update skills:** One of the key strategies to upskill workers at TE is through employee training. In its training initiatives, TE undertakes different kinds of training modules for employees. Employees undergo internal as well as third party training. Internal training involves one-on-one sessions between senior employees and junior employees over a period, until a sufficient level of expertise is acquired. All employees need to have foundational skills and some basic knowledge of the software or systems, so that they can build upon their existing skills and knowledge. Third party training involves contracting the manufacturers of the software to train the employees at a scheduled time. Our interviewee explained that the company has links with external organizations such as contractors and training providers, who assist in the development and/or acquisition of very specific skills.

After the formal training has occurred, to ensure employees’ skills are maintained and updated over time, TE managers recalibrate and assess employees’ performance during annual reviews and send them for additional training when necessary. Our interviewee considered that, on average, it takes several years to train an individual on CAD, which is why the skill is best acquired at the post-secondary level. Even an employee with basic CAD skills takes, on average, a week to adapt to the specific CAD system used within the company.

**Challenges:** The major challenge for TE in delivering digital training sessions revolves around scheduling training and the associated budgetary considerations. Generally, employees can integrate and leverage the skills they have acquired into the workplace efficiently. With regards to technology adoption, TE did not experience any challenges with finding the right workers to work with the new technologies. Instead, they were able to successfully upskill their workers through rigorous training sessions, teaching them the fundamentals of how to fully utilize digital technologies. However, TE did note that highly technical occupations such as engineers are difficult to fill, often taking an average of six months to find the right fit for the position.

**Return on investment:** A major success story for TE was moving from mechanical CAD to optical rendering. Optical rendering involves generating an image from a 2D model into a 3D model by means of a computer software/program. This enabled the company to provide markedly better simulations for its customers. Moreover, upskilling employees at TE led to a significant improvement in the company's operational performance.
**NORSAT INTERNATIONAL INC.**

**COMPANY PROFILE:** Founded in 1977, Norsat International Inc. is a provider of innovative communication solutions that enables the transmission of data, audio, and video for remote applications. They provide antenna and Radio Frequency conditioning products, systems and coverage solutions for public safety, defense, and private wireless networks. Their unique technology platform allows for quick customization. Tailored to meet the needs of customers, the company’s products and other services are primarily used by telecommunications services providers, emergency services and homeland security agencies, military organizations, health care providers, news organizations and Fortune 1000 companies. Some of Norsat's products and services include customizable microwave components, portable satellite systems, maritime solutions, remote network solutions, and equipment financing.

The company is consistently ranked among the top technology companies in Canada, and is among the top 100 public companies in British Columbia. More recently, the company was named as one of the fastest growing companies in British Columbia.

**NUMBER OF EMPLOYEES IN CANADA:** 195

**LOCATION IN CANADA:** Aurora, Ontario and Richmond, British Columbia (Headquarters)

**INDUSTRY:** Computer and Electronics Manufacturing

**DIGITAL PROJECTS IMPLEMENTED:** Norsat’s most recent digital initiative was the adoption of the Enterprise Resource Planner (ERP) and Customer Relationship Management (CRM) systems to improve response times to customers. The company is currently looking at other digital initiatives including changing their ticketing service for customer support requirements. An innovative company putting the needs of their clients at the forefront, Norsat recognizes the value in upgrading their customer relationship management tool.

**NATURE AND LEVEL OF IMPORTANCE OF SKILLS REQUIRED:** Norsat employees need strong technical competencies. According to our interviewees, “[they] have a [significant] need for radio frequency (RF) engineers or technicians, but [find that] skills in that area are difficult to source.” Further commenting on the availability of skilled employees with technical backgrounds relevant to Norsat, our interviewee added that “[radio frequency programs] are not popular in school, making finding employees with the right skill set difficult”. Beyond technical skills, Norsat looks for employees who will fit in well with the organizational culture and are willing and eager to learn. Norsat identifies this “eagerness to learn” as an important skill for a prospective employee because the company tends to carry out major training sessions on a regular basis. Experiencing challenges in finding employees with the exact skill requirements at hiring, regular training is a must at Norsat. On the digital skill front, Norsat expects all employees to be able to run Microsoft Office Suite and possess basic foundational skills. They believe that, since current software available in the market have similar functionalities, most people become competent users with minimal training.

At Norsat, employees possessing a strong combination of digital and technical skills constitute a critical element to the company’s ability to successfully innovate. Our interviewees explained that many of their skills are complimentary to one another. However, where local talent is not readily available, some occupations requiring strong informational skills including data analytics and cybersecurity are outsourced. Interviewees...
also remarked that, although engineers are usually not equipped with business skills, a combination of technical and interpersonal skills are preferred in an ideal candidate.

Overall, the levels of digital skills required for technical vs. non-technical roles vary at Norsat. Employees who need higher levels of digital skills tend to be designers, developers, and technicians. Non-technical roles, including business development and sales personnel, tend to require fewer technical competencies but stronger interpersonal and entrepreneurial skills.

**Strategies to acquire, maintain and update skills:** Norsat employs different strategies to help its employees acquire the necessary digital skills to continue to succeed at the company and in the field. On a basic level, Norsat employs general training programs to help all employees work with new technologies, including office management software. For instance, when the CRM was introduced at Norsat, the sales team was also trained on how to work with the new tool – this creates an environment where all Norsat employees possess competency in the company’s main software programs. The result of this strategy was the reduced need to hire additional employees to work with the new technology. Other mechanisms to aid employees’ skill development include one-on-one mentoring and written procedures for standard equipment operation. LEAN training (a systematic method for elimination of waste using digital training) is also one of the major focuses of the company. For LEAN training, employees are sent to a month-long program that teaches them how to reduce waste via digital adoption.

These general trainings are, of course, in addition to specific job-related training sessions for each role. Internal trainings are also sometimes provided, often for the purpose of awarding integration management certifications. On average, new hires with no prior radio frequency experience are trained for approximately six months before they are fully up to speed on the company’s technologies. By comparison, new hires with RF experience and training take approximately two months for the onboarding process. Overall, the company’s core belief centers on the view of training as an investment, not only in their employees, but in the overall industry itself.

The implementation of a well-functioning performance appraisal system is a cornerstone in Norsat’s efforts in developing a motivated human capital base. Depending on the type of employee, seminars are available, helping them enhance their skills. Employees are encouraged to attend these seminars, and if there is a need for additional training on basic digital skills, employees are then given the opportunity to register for specific courses at local post-secondary institutions. Through skill development grants offered by the BC government, Norsat has been able to increase the number of employees that benefit from this kind of training.

**Challenges:** Some challenges related to upskilling workers at Norsat includes the ability to ensure that employees consistently apply skills gained in training sessions to their day-to-day activities. With high competition in BC for limited provincial and national grants and funding, companies may find themselves unable to offer extensive training programs in some cases.

Sending employees to training sessions affects the company’s overall productivity and output. Due to Norsat’s location and its highly-specialized service area, it is often difficult to find the right professionals for the job. Therefore, reducing the availability of these high-impact workers creates adverse effects for the company.
With the specialized digital skills required at Norsat more frequently found in Eastern Europe and Central Asia, the company relies heavily on inter-provincial and international migration to meet its talent needs. However, completing the necessary processes to source international talent is a concern for Norsat. The processing and wait times associated with the mandatory labour market impact assessment (LMIA) place the organization in a difficult position of potentially forfeiting revenue due to extended durations in hiring qualified talent. Furthermore, since immigrants represent a large portion of employee new hires at Norsat, language is sometimes a challenge at Norsat. Resultantly, the company works with these employees and provides the necessary language and communications training when necessary.

**RETURN ON INVESTMENT:** Norsat's innovative strategies have resulted in substantial company growth, with over 30 of the company's 195 employees hired in the last three years. Measuring specific ROI in training is often difficult in early stages, as the returns of the investment may not be immediately tangible. However, it is expected that current training programs will eventually provide a positive benefit to employees and yield a higher productivity for the company. Employees have successfully adopted these skills through training, and it has helped them become more creative and innovative. This, in turn, has helped to improve the overall efficiency of the company. For instance, jobs which at one point took 50 minutes to complete, can now be done in ten minutes. By investing in training, Norsat has successfully created employees that feel valued, are efficient and as a result, remain loyal to the company.
CCC SULPHUR PRODUCTS

COMPANY PROFILE: CCC Sulphur is a full-service manufacturer of commodity and specialty products, servicing businesses in the following sectors: industrial and solvent, fine chemicals, coatings and polymer additives, oil and gas, soap and detergent, mining, pulp and paper, environmental and water treatment. CCC is a distributor and manufacturer of sulphuric acid, oleum and sodium bisulphate. Its manufacturing plant located in Elmira, Ontario produces approximately 70,000 metric tonnes of sulphuric acid, oleum, and sodium bisulphate annually. CCC has been in the business of providing intelligent chemical supply chain solutions to the Canadian market since 1965. Among other factors, the company’s growth over the past decade can be attributed to a combination of smart e-commerce solutions, and skilled employees that reflect their dedication and commitment to innovation.

NUMBER OF EMPLOYEES IN CANADA: 20

LOCATION IN CANADA: Elmira - Ontario, Toronto – Ontario (Headquarters)

INDUSTRY: Chemical manufacturing

DIGITAL PROJECTS IMPLEMENTED: The most recent digital implementation at CCC is the adoption of the Plantscape system. The Plantscape system works by taking all operating variables and bringing them to one central database for control and adjustment, which is needed for the successful function of the company’s valves. The Plantscape system integrates the control functions from continuous, batch, sequential, and discrete control processes into one affordable, scalable open system. This system combines Supervisory Control and Data Acquisition (SCADA), safety system, building, security and access control, and advanced applications.

NATURE AND LEVEL OF IMPORTANCE OF SKILLS REQUIRED: All employees at CCC require technical skills to function effectively. However, the levels of technical skills needed vary depending on the role. Some of the top skills needed are: 1) data analytical skills, 2) problem solving skills, 3) general analytical skills, 4) ability to read tables and graphs and 5) ability to work with variables to adjust necessary systems. Employees at CCC who require this combination of skills most frequently are Third-Class Stationary Engineers (engineers responsible for safe operation and maintenance of equipment) and Industrial Millwrights (defined as a person who installs, troubleshoots, maintains, and repairs industrial mechanical machinery and equipment). However, our interviewee noted that these roles also tend to be the most difficult to fill, resultant of their remote location.

"SOME OF THE SKILLS NEEDED ARE: 1) DATA ANALYTICAL SKILLS, 2) PROBLEM SOLVING SKILLS, 3) ANALYTICAL SKILLS, 4) ABILITY TO READ TABLES AND GRAPHS AND 5) ABILITY TO WORK WITH VARIABLES TO ADJUST NECESSARY SYSTEMS"

Engineers at CCC require a broad spectrum of skills to function efficiently in the work environment. When asked to comment on the degree of importance for technical roles, digital/technical skills such as the use of sector or enterprise specific programs, digital communication and working with the industrial internet of things (IIoT), were reported to be highly important. This was followed by business and interpersonal skills; however, our interviewees stipulated that business skills for technical roles were more just a “nice to have”, and are only considered complementary to digital/technical skills. Entrepreneurial skills were also less likely
to influence hiring decisions for a technical role, while, similar to most cases, foundational skills are important because they are the basis on which all other skills are built. For non-technical roles, business and interpersonal skills were found to be paramount, as these employees tend to deal with the public more frequently. All employees at CCC were found to need to some degree of ICT literacy, namely that they should be able to effectively use office productivity software to complete their day to day activities.

**Strategies to acquire, maintain and update skills:** Training forms a significant part of the skill maintenance culture at CCC. Having employees with a stationary engineering background and foundational skills help to make any additional training more easily integrated into the workplace. Through periodic training, CCC is able to upskill its employees to the current technologies, thereby functioning to reduce the challenge of finding new hires. Training is provided on an employee-to-employee basis, through third party training programs, and via internal corporate training sessions. On average, CCC estimates that it takes approximately nine months to one year for a Third-Class Stationary Engineer to fully complete the necessary skill requirements and obtain certification.

Further, our interviewees reported that due to the small size of the business, many employees carry on a variety of functions. For example, there are designated individuals whose major responsibilities also include providing training to employees. This acts as a cost-saving measure by negating the need for a holistic training-specific department. CCC also runs a job task observation program which involves observing the employees over a given period, in order to decide if and under which skill sets they need additional training. This program involves selecting all critical tasks that a given employee regularly performs and reviewing them according to those skills on an annual basis. This kind of check-in ensures that employees are consistently vetted and are able to maintain the skill needs of their roles.

**Challenges:** No major challenges were encountered when upskilling workers at CCC. However, our key informant remarked that, as with many small companies, time and budgeting considerations are always a constraint. When asked about any anticipated skills gaps specifically among the baby boomer workforce as technology progressed, our interviewees were confident that skill gaps among these workers would not be significant, as younger employees/new entrants with better adaptability around digital skills can transfer this knowledge to older workers. Rather, the more significant concern at CCC regarding the aging workforce revolves around the labour shortage that will be created as retiring workers exit the workforce in the coming years. CCC further remarked that although they are aware of the available skills development programs, they do not use any, primarily due to the length of the process and challenges with applying for these programs.

**Return on investment:** The greatest success for CCC is the company's ability to hire employees with basic skills and to train them on a continual basis, until they are fully equipped with the digital/technical skills needed to successfully operate in the workplace. For CCC, although there was no available quantitative data at the time of the interviews, our interviewee asserted that CCC's ROI in regards to improving employees' skills has been consistent.
BIOVECTRA INC.

**Company Profile:** Leveraging over 45 years of experience, BioVectra Inc. is a growing Canadian biopharmaceutical company focused on the manufacturing and product development of active pharmaceutical ingredients, pharmaceutical intermediates, and specialized bioreagents. BioVectra currently holds eight Drug Master File filings, and is an active supplier to most of the major pharmaceutical, biotechnology, and diagnostic companies in North America and Europe. From commercial fermentation of bacteria to complex multi-step chemistries, BioVectra has developed niche capabilities tailored to handle its clients' unique needs.

**Number of employees in Canada:** 290

**Location in Canada:** Charlottetown, Prince Edward Island (Headquarters) and Nova Scotia

**Industry:** Chemical manufacturing

**Digital Projects Implemented:** With rapid developments in biotechnology, innovation is inherently tied to the pharmaceutical industry. This requires having the foresight to anticipate future client needs, and the willingness to invest in new technologies. BioVectra has worked closely with its customers, building capacity, and growing expertise to meet industry needs. The company uses a wide range of digital software and technology solutions such as the Enterprise/Material Resource Planner (ERP/MRP) and the Computer Aided Design systems in its day-to-day activities. However, with pressure from domestic and international markets, BioVectra is constantly upgrading its process-specific automation in its laboratories, helping them more efficiently manage their systems and analyze data. In the production and warehouse, BioVectra staff currently use barcode management technologies for tracking inventory materials and are constantly exploring ways to further automate the area.

Over the years, BioVectra has developed proprietary technologies for PEGylation as an effective mechanism for drug delivery. BioVectra has remained conscious of its product quality and has continuously ensured the quality of its lab information management and systems is up to internationally-accepted standards. Moreover, the company ensures that state of the art systems are utilized in the production plants and laboratories, while also completing regular reviews of employees, to confirm that they are efficiently trained in the company's information management systems.

**Nature and Level of Importance of Skills Required:** As part of its strategic objectives, BioVectra requires employees to showcase a commitment to continuous learning, entrepreneurial thinking, and basic IT skills. Employees are also required to achieve core soft skills like decision making, problem solving, and analytical thinking in all roles.

BioVectra's approach to innovation and growth is directly tied to having employees with the right skill sets. A heightened emphasis is placed on technical and digital skills such as computer and ICT literacy, for all employees. For non-technical roles, namely in sales and marketing, employees are required to have the right mix of business and interpersonal skills, allowing them to effectively engage with customers. Top skills required for non-technical roles include interpersonal skills, competency with office productivity software, as well as social media and marketing knowledge. Our interviewees noted that foundational skills are assumed to be possessed by every employee, given the fact that the average educational level for employees in the organization is a postsecondary degree. Employees in technical roles are required to possess digital, technical, as well as business and entrepreneurial skills, namely at the managerial level. While some
informational roles including data analytics and cybersecurity are outsourced, all employees are further trained on digital and technical skills when necessary in order to ensure high rates of productivity.

“At BioVectra, significant emphasis is placed on technical and digital skills such as computer and ICT literacy. The ability to use sector or enterprise specific software for technical roles is also important”

Strategies to acquire, maintain and update skills: When rolling out a new software, BioVectra offers training related to the implementation and use of the software, firstly to employees who will be working directly with it. Training strategies used at BioVectra are numerous, and include one-on-one sessions, third party training, mentorship and knowledge transfer programs.

The focus on skills development has always been an integral part of the BioVectra’s philosophy. Having benefitted from several government skills development programs from the province of Prince Edward Island, the company makes use of this investment via the continuous upskilling its workers. The company is also currently exploring ways of cross-training employees, allowing them to function in several roles and effectively handle different processes.

Challenges: Overall, the company experiences very minimal challenges in upskilling its workers. Generally, BioVectra’s employees are receptive to training, and have proven to be efficient in handling new processes after undergoing training. Although cost is not a significant issue for BioVectra in comparison to smaller companies, scheduling challenges do exist. Another key area of concern is efficiently sourcing talent for business development, managerial or executive roles. As a recent example, the company had been seeking to source a Director of drug development for over 12 months before finding a suitable candidate.

Return on Investment: BioVectra offers different training modules to its employees and the overall results have been positive, creating improved operational efficiency. BioVectra has forged strong partnerships with local colleges and the universities who design and customize programmes to fit their unique needs and benefit from a high retention rate, characteristic of Atlantic Canada. Overall, while no specific quantitative data on ROI was provided, our interviewees reported that the return on investment for them takes the form of increased employee efficiency, high retention rates and increased productivity.
EVANS CONSOLES

COMPANY PROFILE: Evans Consoles provides highly customized, modular console workstation solutions for mission critical control centres in industries such as air traffic control, power generation, emergency response, telecommunications, and transportation. Founded in 1980, Evans Consoles is an innovation leader that has successfully developed and applied technologies linking scientific research to commercialization, jobs, and economic growth.

NUMBER OF EMPLOYEES IN CANADA: 350

LOCATION IN CANADA: Calgary –Alberta (Headquarters)

OTHER LOCATIONS: USA, India, Netherlands, UAE, China

INDUSTRY: Machinery Manufacturing

DIGITAL PROJECTS IMPLEMENTED: Through NRC-IRAP funding, Evans Consoles has received support and advisory services since 2010, primarily centered on seven major projects, helping the company further improve its productivity and remain competitive. The funding has also assisted the company in recruiting technical graduates, the extent of which has grown the company's product development team to over 50 employees, the largest in the industry. Evans Consoles received up to $193,878 for two projects under the NRC's Digital Technology Adoption Pilot Program (DTAPP). Under this program, companies were meant to utilize digital technologies to increase productivity and efficiency, to reduce the company's overall operational costs and ultimately, to help them become more digitally skilled and competitive in today's marketplace. The first project involved training employees in the transition to newer 3D manufacturing and engineering technologies, while the second project focused on improving their Enterprise Resource Planning systems for the purpose of achieving a higher level of accuracy, efficiency and useful communications between the engineering and manufacturing groups.

NATURE AND LEVEL OF IMPORTANCE OF SKILLS REQUIRED: Evans Consoles employees require a variety of skills and use different types of technologies and software depending on their roles. Specifically, engineers must possess extensive design skills, and the company primarily seeks to hire engineers with 3D design backgrounds. For marketing roles, the company hires individuals with a good understanding of digital animation, but they must also possess characteristics of flexibility and adaptability. Where animation-skilled marketing staff was not available, marketing employees had to acquire technical animation skills through training. Overall, all employees had to learn the basics of manipulating the company's 3D platform.

Currently, on a broad spectrum, Evans Consoles primarily uses engineering software and modelling software in technical roles. Rendering software is also utilized for digital marketing, public relations, and design. Marketing employees use rendering technology in combination with animation and virtual reality tools to create advertisements and other media related to the company’s public presence. Assisting employees in the sales department, the company developed a sales automation tool (an automation quote program that allows you to mail the control room), effectively reducing processing times.

With most roles requiring an basic knowledge of engineering principles, Evans Consoles places emphasis on technical skills such as using sector or enterprise specific programs, digital communication, product
collaboration, data analytics and cloud computing. While valuable across roles, strong interpersonal skills and cultural fit are crucial for roles that require interaction with clients and/or members of the public. Similarly, entrepreneurial skills were perceived as more valuable for non-technical roles, in comparison to purely technical roles.

**Strategies to acquire, maintain and update skills:** Evans Consoles’ hiring strategy includes specifically hiring applicants with the necessary basic skills required to effectively function, and then complementing these skills with additional online training. Employees’ performance on technical aspects of the job is monitored through regular evaluations and, when necessary, additional training modules are offered.

While the company transitioned from 2D to 3D engineering platforms, some workers experienced challenges in adapting to the new technology at the accelerated rate required to maintain operations. As such, additional training was provided to aid the employees in the transition. However, some turnover was experienced as a result of the significant operational changes. On the whole, Evans Consoles found that younger employees and new graduates were better able to adapt to the transition than older workers. New roles were also created due to this transition of work.

**Challenges:** Overall, Evans Consoles was able to successfully manage the outcomes of their training program and effectively integrate new skills requirements into the workplace. The key challenge for the firm was not so much the digital transition itself, but rather competition for funding to help scale up, as well as talent competition with the oil industry, due to overlapping skill requirements between the two sectors. Another challenge was in the ability of employees to successfully acquire the new skills after the transition. Ultimately, those who could not adapt were let go.

**Return on Investment:** SNAP, a sales automation application designed by the Evans Consoles has recorded substantial successes for the company with a record high of 400% in profit margins. Through automation of its manufacturing, design and rendering systems as well as its transition from 2D to 3D engineering platforms, the company grew from 20 million in sales to 80 million in sales in one year. Despite not increasing the size of their manufacturing plant, the company produced four times more and increased its staff by 75%.

With automation permeating the manufacturing sector, Evans Consoles has successfully implemented a company-wide transition to a greater reliance on digital services, something that has drastically improved output and worker efficiency. Key examples of this include: Evans’ Oculus system that can perform virtual walk-throughs, and the transition from 2D to 3D systems. However, with advancements and technological developments, a certain degree of worker transition is to be expected. At Evans Consoles, CMC programmers were no longer required on the floor, due to the transition from models to 3D rendering. Additionally, transitioning to 3D platforms allowed the company to be more creative and focus greater efforts on innovation and smart product development.

Many of our interviewees expressed a feeling that much of their current success is directly attributable to going digital. According to our interviewees, “Every company is an IT company now. If our computers go down, we would be unable to design a product or run our equipment on the floor, nothing would work”. While automation can cause disruption in traditional organizational structures, it can also create extended
opportunities resultant of cost and time savings coupled with increased productivity. Hiring 33 people in the last three months alone, Evans Consoles is currently growing at a rate of 17% each month due to digitization of the workplace.
OBJECT REPLICATION DESIGN (ORD) SOLUTIONS

COMPANY PROFILE: ORD Solutions is an innovation-driven 3D manufacturing company. Its key developments include technological advancements that continuously redefine how 3D printing is used in the additive manufacturing space. The company designs, manufactures, and sells 3D printers, accessories, and consumables to a worldwide market.

NUMBER OF EMPLOYEES: 6

LOCATION IN CANADA: Cambridge, Ontario

INDUSTRY: Machinery Manufacturing

DIGITAL PROJECTS IMPLEMENTED: ORD Solutions currently has three patent applications pending. The first application is for the development of a full colour 3D printer, which would be the first of its kind in the industry. The second patent application is for a large format vision system that would help to 3D print larger objects using a vision control robot. This vision system would allow the 3D printer to move automatically while printing large objects. The third patent application is for a new type of 3D printer that is significantly faster than the existing 3D printers available on the market today. This 3D printer that ORD would produce has a higher resolution, is full coloured and can be used for production, eventually replacing the existing 3D printing technologies.

The company uses Enterprise Resource Planner (ERP) systems to maintain inventory and keep accurate records of the parts needed for production, while also making use of office productivity software like Google apps, Microsoft publisher for advertisements, Adobe Photoshop and Illustrator, Autodesk inventor for designing the 3D printers and other hardware, Visual Studio, and SQL server for programming. The company also uses e-commerce channels for sales, fresh desk for web support, team Gantt for project management and smart drive for flowcharts.

NATURE AND LEVEL OF importance of skills required: To make use of digital technologies in the workplace, our interviewee noted that programming skills with Structured Query Language (SQL), C++, C#, 3D design and 3D printing are required to work with the digital technologies. Non-technical roles, by comparison, require basic digital knowledge including use of spreadsheets, emails, and project management software. Given the fast advances in the sector, ORD further observed that more digital skills will be required to work with 3D designs in the coming years.

When asked to comment on the level of importance of these skills, our interviewee stated that technical digital skills are the most important. The majority of employees at ORD solutions require general computing skills as well as a high level of technical expertise. Employees must also be equipped with computer programming skills and knowledge of office productivity software. Employees occupying non-technical roles, namely in finance, are required to possess basic digital skills including knowledge of accounting software to process invoices and purchase orders. Additionally, since everything the company does is cloud-based, all employees are required to have at least a basic knowledge of cloud computing. Employees occupying sales and administrative positions need to be able to use Google apps and the Google drive, while employees occupying marketing roles require some expertise in the use of social media applications and marketing platforms.
Unlike more established companies, business and interpersonal skills for technical employees at ORD solutions are extremely important. Being a small startup, ORD employees are often required to take on diverse roles that eclipse the traditional requirements of a given position. When asked to comment on the degree of importance of interpersonal and business skills, our interviewee placed these skills as immediately following digital/technical competence. Cultural fit was also found to be of importance, while informational skills were largely irrelevant in hiring decisions. According to our interviewee, “We are not big enough to have information or cybersecurity issues”, making the need to focus on these skillsets at this point, insignificant. Although entrepreneurial skills are required for management and leadership roles, standard employees at ORD solutions are not required to have these skills. However, due to the small size of the company and variety of tasks required, all employees were regarded as needing to possess superior time and process management skills.

**Strategies to acquire, maintain and update skills:** Employees working in technical positions at the company are hired with the basic technical skills required to function in the role and are further trained upon hire for additional skills which may be lacking. For instance, 3D printing is a core part of the company’s daily operations, but there are currently no courses or curriculum in post-secondary institutions that are designed to teach 3D printing. To fill this gap, the company trains its employees on these necessary skills in-house. ORD spends approximately 1% of its revenue on training each year.

To ensure the skills are being maintained and updated over time, ORD hosts weekly report sessions, conducted by the management team, in order to assess any production and skill gaps that employees may be experiencing. While regular in-house trainings are provided, employees are also encouraged to enrol in company-sponsored courses online or through colleges to continually enhance their skills.

**Challenges:** For SMEs like ORD Solutions, training employees requires significant capital and time investments. As such, when employees leave without a chance for the company to recoup a return on investment, it causes a temporary setback since resources are generally limited. On a skill-specific consideration, programming roles, business development roles and 3D design roles are often difficult for ORD to fill due to limited financial capacity to compete with industry standard wages.

**Return on Investment:** A major success story for the company involved going digital for their financial records. The company previously experienced issues with keeping accurate financial records and tracking invoices. These issues affected operations to such an extent that each time an invoice was issued, an employee was required to manually enter the information into the computer. To save time, the company began the use of software based in receipt bank technology, which automatically extracts information from the invoice and categorizes it. This accounting software functioned to save approximately 15 hours of work each week.

The return on investment for training employees at ORD solutions is significant, allowing them to work independently with minimal supervision. The varied nature of ORD’s training programs has also given employees the business knowledge they need in order to excel in their changing roles at the company.
SECTION III – ANALYSIS AND TRENDS

COMPANY PROFILES: Seven SMEs from the manufacturing sector were analysed for this research project. One is from the transportation equipment manufacturing industry, two are from the computer and electronics manufacturing equipment industry, two are from the chemical manufacturing industry and the final two are from the machinery manufacturing industry. Two firms are small, employing between 0 to 99 people while five are medium enterprises employing between 100 to 500 people. Interviews were conducted with top executives occupying senior leadership roles, such as Director of Operations/Vice President/CEO positions.

DIGITAL PROJECTS IMPLEMENTED: All firms interviewed use similar technologies, including ERP/MRP systems, Microsoft Office Suite, Customer Relationship Management Software, and Computer Aided Design. The majority of firms interviewed were in the process of innovation around their equipment and material resource planning software, whereas one firm's innovation agenda revolved around their product lines.

NATURE AND LEVEL OF IMPORTANCE OF SKILLS REQUIRED: There was minimal variability in perception among the key informants regarding the categories of skills needed, and their degrees of importance. Foundational skills, technical/digital skills and business and interpersonal skills were identified as the top skills required for the sector. All the interviewed firms possessed a high rate of experienced versus inexperienced staff, with the average education level of employees being a postsecondary degree. Generally, digital/technical skills like the use of office productivity software, enterprise specific software and computer/ICT literacy were the most important skills required for technical roles, although a combination of technical and interpersonal skills were preferred for the majority of employees. Conversely, for non-technical roles, all firms agreed that business and interpersonal skills (oral and written communication, social skills, continual learning, and creativity) combined with basic ICT literacy and use of office productivity software were critical.

Due to the nature of the manufacturing workplace and its highly technical nature, five of seven firms observed that non-technical employees in sales, administrative and marketing would require some level of ICT literacy, along with an ability to work with sector-specific software and office productivity software. This combination of technical capability was usually regarded as essential for a given employee to function effectively. With regard to entrepreneurial skills, the general consensus was that they were less relevant for junior employees, but became increasingly important for employees occupying or seeking to fill leadership and managerial positions.

Many of the small enterprises interviewed regarded informational skills to be of minimal importance, considering themselves too small to experience any significant cybersecurity threats. This is in contrast to medium enterprises, who had some level of awareness and concern over cybersecurity and data analytics. The majority of these roles, as well as other largely administrative roles including human resources, were outsourced to third party companies.

STRATEGIES TO ACQUIRE, MAINTAIN AND UPDATE SKILLS: All of the SMEs interviewed were found to offer internal training to their employees as a means of developing their skills or upskilling them. This is in line with the findings from the study conducted by the OECD and the Canadian Manufacturers and
Exporters Association which found that manufacturing companies are investing heavily in training, with over 95% of companies currently providing training to employees in technical skills.32

The most common form of training found among the SMEs is internal trainings, focusing on broad overviews of core skills. Given the often-found financial and time constraints of most SMEs, only one company interviewed was identified as having the ability to provide online training for their employees as a complimentary service to the internal and external training provided. Moreover, while the majority of companies were aware of provincial/federal skill development programs, only two out of seven noted to have taken advantage of these opportunities in the past. Non-participation in these programs was for various reasons, including the inability to meet funding requirements, the perceived bureaucratic nature of the application process, and employees’ lack of interest in upskilling programs.

Four of the seven SMEs have periodic and formal skills assessments for their employees, while two companies provided employees with avenues of returning to school to upgrade their skills. Surprisingly, only two of seven companies observed that younger employees were more adaptable to innovation, while many had voiced concerns regarding the impending talent shortage caused by retiring employees exiting the workforce.

**Challenges:** The largest barrier to training experienced by SMEs was found to be cost and scheduling. This was echoed by StartUp Canada’s report examining digital adoption opportunities and challenges among SMEs, which found that roughly 43% of SMEs experienced financial challenges when attempting to implement training programs. Other challenges experienced by the companies we interviewed were a general lack of interest in upskilling as expressed by existing employees, concerns about worker retention following training, and language barriers for companies who sourced a heavier volume of international talent.

**Return on Investment:** Five of seven firms interviewed agreed that upskilling their workforce improved productivity and efficiency, with only one firm reporting that upskilling their workforce maintained rather than improved productivity. Moreover, while the majority of firms mentioned that it was too early to assess the ROI for adopting technologies on a quantitative level, the general consensus was that implementing training programs would create positive benefits in the long term for the company. The majority of the companies cited higher employee competence and an increase in productivity for business as the major return on investment for training. These results validated the OECD’s survey results, according to which 89.9% of companies surveyed claimed higher employee competence as the return on investment for upskilling employees.

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32 Canadian Manufacturers and Exporters Association, Supra at 27
SECTION IV: POLICY RECOMMENDATIONS

VOICES FROM THE INDUSTRY

During the course of the interviews, several policy recommendations were outlined and proposed by the interviewees. The purpose of these recommendations was to act as a voice from industry to government, and provide valuable insight into what future policies and programs may prove beneficial to SMEs in the manufacturing industry. Some of the recommendations are listed below:

Funding

To assist the government in the decision to secure avenues of funding for innovation, skill development and comprehensive training programs, the following recommendations were made during the interviews:

1) Policymakers should increase opportunities for funding and grants, applicable to companies that have been recognized for innovative practices and/or successful digital adoption. Additional measures would need to be implemented allowing policymakers to properly measure innovation, including the development of an established and quantifiable innovation measure/criteria.

2) Policymakers should consider elaborating additional development programs that aim to foster innovation and growth in SMEs. Where additional programs are not feasible, knowledge of and information on current programs should be made more readily available to SMEs, and application procedures should be clear and simplified.

Education and Training

3) Policymakers should strive to improve collaboration with educational institutions in order to design programs that are better suited to meet the skill and labour needs of the manufacturing industry in the future.

4) There is a need for more specialized training, namely in niche service areas such as aerospace. Policymakers should coordinate with industry and industry associations at an accelerated rate, in order to develop a higher volume of up-to-date and relevant programs for some of Canada’s leading technical industries, including aerospace.

5) Policymakers should work with the industry to establish improved communication channels with manufacturers, allowing them to accurately evaluate current-day and future needs, while simultaneously administering more effective programs. These communication channels should be digital.

6) Policymakers and industry should collaborate on an intensive program aimed at deeply assessing current and future industry needs of the manufacturing sector. From there, policymakers could work closely with the industry in order to formulate programs that fit the unique needs of companies operating in this space. Industry members emphasised that they would like more personalised skills development services, rather than a “one size fits all” model. This tailored approach would create avenues for increased flexibility in programs created, ultimately positively impacting the adaptability and longevity of those very programs.
CONCLUSION

The importance of digital skills and training for the manufacturing workforce cannot be overemphasized. Findings from our study of seven manufacturing firms in Canada revealed that among the five categories of digital skills proposed by the ICTC digital skills framework, digital/technical skills as well as business and interpersonal skills are key categories that are and will be increasingly relevant to Canadian manufacturing SMEs. While further research is necessary to identify specific skills required for specific occupations and staff levels - including managerial and executive - our report acts as a first glimpse into the rapidly-evolving sector, and provides valuable feedback from Canadian manufacturing players.

It is no surprise that Canadian SMEs will need to continue to work on devising strategies that will enable them take advantage of the growing opportunities offered by the digital economy. Preliminary steps are currently being pursued to pave the pathway for this added value creation in the future. The upskilling of the existing workforce, strategic hiring of recent graduates with dynamic on-boarding plans, and tapping into available skilled labour channels such as Internationally Educated Professionals (IEPs) have already taken shape. With support from Canadian policymakers, industry associations and academia, digital practices can be further employed on a rolling basis, allowing the sector to remain productive and competitive in the future.

Given the significant contribution of the manufacturing sector and of SMEs in general to the Canadian economy, it is important to continue to focus on sourcing the right ingredients, identifying top skill requirements, and taking the necessary steps to coordinate and collaborate for the creation of effective training strategies. Automation is becoming a reality for many sectors of the economy, and will undoubtedly change the way we live and work as a global society. Underlining important data and analysing specific trends, this report can act as a groundwork study into the many changing aspects of the manufacturing industry in Canada and around the world. Together, we can work to advance the dialogue, to generate industry-supported programs and to continue to support the growth, the digital adoption and ultimately, the unbounded innovation potential of the Canadian manufacturing sector.
APPENDIX A

Interview Questions

BACKGROUND INFORMATION

1. What is your role within your organization?
2. How many employees work for your organization?
3. In which city is your major Canadian operation?

QUESTIONS

1. Please discuss your company’s digital projects?
2. Which digital technologies do you use in your business and which categories of employees make use of them?
3. Which digital skills are needed to effectively leverage these technologies?
4. When making general hiring decisions, which category of skills are more important to you? Please see ICTC’s digital skills framework below:

5. Did you experience any staffing impact and challenges as a result of technological advancements? (Did your businesses’ skills profile change? Specifically, what new skills did your employees have to acquire? Did you have to hire new people or retrain?)
6. What steps do you take to ensure your employees acquire these digital skills and can apply them to the relevant technologies? What were the challenges encountered?
7. What is your best success story in upskilling your workers?
8. What is the impact and ROI for upskilling or training your workers to use digital technologies? How has it impacted your workforce in terms of employee engagement, retention, and productivity?
9. If you had one suggestion or recommendation for policy makers related to digital skills and technology adoption in the manufacturing sector, what would it be?
### APPENDIX B

#### Matrix of case studies

<table>
<thead>
<tr>
<th>Name of Company</th>
<th>Nature of Skills Required</th>
<th>Most Important Category of Skills</th>
<th>Strategies to acquire/maintain/upskill</th>
<th>Challenges</th>
<th>Return on Investment</th>
</tr>
</thead>
</table>
| Asco Aerospace Inc. | ERP/MRP experience, ability to work with 3D modelling systems, computer/ICT literacy, communication skills, creativity | Technical roles: Digital/Technical skills  
Non-technical roles: Business and Interpersonal skills | • Internal training  
• Third party training | Cost, time, finding people with good work ethics and the right interpersonal skills | • Improved employee retention rate  
• Increased overall productivity |
| TE Connectivity | Basic computer literacy, CAD skills, communication, social skills, creativity and continual learning | Technical roles: Digital/Technical skills  
Non-technical: Business and interpersonal, entrepreneurial skills. | • Mentorship  
• One-on-one training  
• Third party training | • Time/scheduling  
• Finance | • Better simulation for customers  
• Improved operational performance |
| Norsat International Inc. | Good culture fit, continual learning, use of office productivity software, basic numeracy and literacy | Technical roles: Digital/Technical skills  
Non-technical: Business and interpersonal, entrepreneurial skills. | • Training  
• One-on-one mentoring  
• Written procedures  
• Coaching  
• Professional development training | • Successful integration of skills  
• Language barriers  
• Remote location | • Growth(30 new hires within the last 3 years)  
• Improved lead times  
• Increased engagement and productivity |
| CCC Sulphur Products | Data analytical skills, problem solving skills, analytical skills, ability to | Technical roles: Digital/Technical skills  
Non-Technical: | • Internal corporate training | • Time  
• Budgeting | • Maintained productivity |
<table>
<thead>
<tr>
<th>Company</th>
<th>Commitment/Training/Observation</th>
<th>Technical Roles: Digital/Technical skills, business and interpersonal skills</th>
<th>Non-technical roles: Business and Interpersonal skills, entrepreneurial thinking</th>
<th>Other Benefits</th>
</tr>
</thead>
</table>
| Biovectra Inc.          | Commitment to continual learning, entrepreneurial thinking, basic digital literacy, decision making, problem solving, analytical thinking | Technical roles: Digital/Technical skills, business and interpersonal skills Non-technical roles: business and interpersonal skills, digital/technical skills | • One-on-one training  
• Third party training  
• Mentorship | • Scheduling  
• Filling managerial and business development positions  
• Improved operational efficiency |
| Evans Consoles          | Digital marketing/animation, computer/ICT literacy, engineering design skills, flexibility, adaptability, cultural fit, customer service | Technical roles: Digital/Technical skills  
Non-technical: Business and Interpersonal skills, entrepreneurial thinking | • Hiring employees with the requisite skills  
• Online training | • Competition with other industries for available talent  
• Distorted wages by the oil sector  
• Increased sales  
• Bigger workforce  
• Increased creativity |
| ORD Solutions           | SQL, C++, C#, 3D Design, 3D Printing, Knowledge of spreadsheets, emails and project management skills | Technical roles: Digital/technical skills, business and interpersonal skills Non-technical roles: Digital skills/business and interpersonal skills | 1. Internal training  
2. Opportunity to return to school | • Time  
• Cost  
• Better lead times  
• Greater efficiency |
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