An Assessment of the Changing Skill Needs of the Canadian Manufacturing Workforce

MARCH 2024

Future Ready

About Future Ready

The Future Ready program is a $19 million program funded in part by Employment and Social Development Canada's Sectoral Workforce Solutions Program to support companies in onboarding new and diverse workers to Canadian manufacturing. The initiative will also aid Canadian manufacturers in identifying their critical skills gaps to support the future profitability and growth of their organization through NGen's highly regarded Transformation Leadership Program. Through these approaches, the program aims to provide demand-driven solutions for the manufacturing sector, one of the sectors hardest hit by the pandemic, and a key to the recovery of the Canadian economy.

This project is funded in part by the Government of Canada's Sectoral Workforce Solutions Program

Canada

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Executive Overview

Next Generation Manufacturing Canada (NGen) is the industry-led, not-for-profit organization leading Canada's Global Innovation Supercluster for Advanced Manufacturing. NGen creates new opportunities by enhancing and leveraging the capabilities of Canada's manufacturers, engineering and technology companies, business services, researchers, academic institutions, innovation centres, business networks, and workforce. By facilitating collaboration, NGen aims to improve Canada's industrial innovation performance, connect and strengthen our advanced manufacturing ecosystem, and increase the competitiveness and growth potential of Canada's advanced manufacturing companies.

Project Context

In late 2023/early 2024, Next Generation Manufacturing contracted six industry associations to engage their members in this workforce research to help generate a snapshot of the current state of the Canadian Manufacturing workforce, and its projected future. These associations represent approximately two-thirds of the manufacturing sector identified through the North American Industry Classification System (NAICS):

- Automotive Parts Manufacturers Association (APMA)
- BioTalent Canada
- Canadian Marine Industries and Shipbuilding Association (CMISA)
- Downsview Aerospace Innovation and Research (DAIR)
- Food Processing Skills Canada (FPSC)
- Saskatchewan Industrial and Mining Suppliers Association (SIMSA)

The objective of this research was to gain an understanding of how competencies in the broader manufacturing sector are projected to change on a go-forward basis. This would allow employers to use the data to understand the upskilling and recruitment needs related to maintaining a competitive workforce.

This Report

This report documents the findings and recommendations from the manufacturing sector research focused on answering the following questions:

- To what extent can the OaSIS database support the future needs of the manufacturing sector?
- To what extent are manufacturing sub-sectors aligned on key skills and competencies?
- Where might the workforce come from with the required skill levels?
- What national support is required, if any, to help ensure the manufacturing sector can thrive with Industry 4.0?

Research Approach

The focus of this work was on the skills and competencies of the workforce. Non-specific knowledge competencies which included cognitive skills, soft skills, abilities, and work skills were studied. A mobile survey tool was developed based on the Canadian Occupation and Skills Information System (OaSIS), which offers a standardized approach to characterizing the competencies and skills required for 900 occupations. The tool used OaSIS proficiency and importance levels as a baseline to describe occupation competencies and level of proficiency.

Survey participants were able to adjust (up or down) proficiency levels to describe the current proficiency level, as well as to enter projected proficiency levels for 2030 and 2040.

What was Learned?

An analysis of the survey data shows that survey participants perceive the current skills of the workforce are greater than those depicted within the OaSIS system. Ratings of current skill levels produced rankings of competencies, by occupation type, which were common across multiple manufacturing sub-sectors, indicating that cross-sector mobility of workers is possible if knowledge specific training is provided.

Projected skill levels indicate an emerging emphasis on **digital literacy**, **cognitive skills**, and **soft skills**. The results paint a picture of a digitally literate workforce that will require cognitive and soft skill enhancement to effectively deal with the implementation of new opportunities that arise as a consequence of digital adoption.

Commonality was also observed in projected skill rankings for occupation types across multiple sectors.

Identified projected skill set combinations are not yet available over the entire Canadian workforce suggesting that firms will need to increase investment in upskilling. Owing to the commonality of the skills gaps that come from these projections, there is an opportunity for firms to reduce upskilling costs by sharing upskilling training and education programs. There is also an opportunity for educational institutions to participate in meeting the goals of the future workforce by integrating appropriate training into their programs.

How the Results Might be Used

The competitiveness of the future Canadian manufacturing workforce is dependent on the adoption of digital technologies and the skills of employees to successfully work with these technologies. Manufacturing firms can use these results to help identify where they might focus their upskilling investment.

Adoption of these technologies impacts productivity and therefore impacts the country’s overall standard of living. Since upskilling of workers is a necessary condition to achieve this outcome, policy makers should consider a national effort to ensure that the Canadian workforce has the skills needed to effectively compete.

The Approach to the Research

The OaSIS Database

Canada's Occupational and Skills Information System (OaSIS) contains data on the skills, abilities, personal attributes, knowledge and interests required to work in 900 different occupations. These occupations include ratings for over 240 competencies or descriptors, under the categories:

- Skills
- Abilities
- Personal Attributes
- Knowledge
- Interests
- Work Activities
- Work context.

Standardized measuring scales, adopted for the components of each of these competencies, are specific to each category.

The OaSIS system provides users with a standardized way to understand how the competencies vary by relevance, importance, and level of proficiency, over all the occupations in the system. For example, one can search for occupations in several sectors of the economy that might have the same core group of competencies. This standardization identifies capabilities that cannot be accessed with the traditional 'job description' approach to defining an occupation. It also allows users to assess how different occupations might have similar competencies, and understand how the competencies they have developed, or want to develop, may be useful over several sectors of the economy.

Competencies associated with an occupation can change quickly as a result of a variety of factors such as technological change, changes in social context, changes in the market, and more. Trends such as these may have impacts that are disproportionate on various sectors of the economy. The goal of Employment and Social Development Canada (ESDC) is to update the data in the OaSIS system every five years. This means that at any time the data related to a particular occupation might be five years old. Changes to the competencies needed to perform in an occupation can vary significantly in five years.

Research Objective

The objective of this research was to gain an understanding of how competencies in the broader manufacturing sector are projected to change on a go-forward basis. This would allow employers to use the data to understand the upskilling and recruitment needs related to maintaining a competitive workforce.

Research Approach

A survey methodology was applied that asked members of sub-sectors of the manufacturing sector to rate the expected changes in competencies associated with various occupations from 2024 to 2040. Specifically, participants were asked:

- how they currently perceive occupation-associated competencies compared to the description in today's OaSIS database;
- how they believe these competencies might change by 2030, and
- how the competencies might change by 2040.

The onerous job of ranking occupations on 240+ competencies was alleviated by developing 41 competencies that are composites[1] of, or match directly to, the competencies in the OaSIS database. A Knowledge, Skills, Abilities, and Other (KSAO) Framework (Table 1) guided the development of these 41 competencies (herein referred to as the NGEN41).

TABLE 1: NGEN41 COMPETENCIES WITH THE KSAO FRAMEWORK

NGEN41 in KSAO Framework				
Knowledge	**Cognitive Skills**	**Abilities**	**Soft Skills**	**Work Skills**
Knowledge of Emerging Trends and Technologies	Reading Skill	Cognitive Abilities	Team Building Skills	Skill to Use the Tools Necessary for the Job
New Relevant Knowledge	Writing Skill	Sensory Abilities	Entrepeneurial Skill	Skill Needed to Support Supplier Development
	Communication Skill	Physical Abilities	Interpersonal Skills	Skill Needed to Understand Business Principles
	Digital Literacy	Psychomotor Abilities	Leadership Skills	Skill Needed to Judge Quality
	Numeracy		Professional Composure	Skill to Conduct Work Design
	Problem Solving		Teamwork and Collaboration	Skill to Fomulate Alternative Solutions
	Creativity and Innovation		Initiative	Skill Needed to Evaluate Alternatives
	Technical Skill		Attention to Detail	Skill to Identify, Formulate, and Solve Problems
	Critical Thinking Skills		Commitment to Lifelong Learning	Project Management Skill
	Skill to Design Experiments		Social Responsibility	Skill to Design a System
	Skill to Identify Problems		Independence	Skill to Plan a Program
	Decision Making Skill		Adaptability	

[1] Source: RAD SCIENCE SOLUTIONS

The OaSIS database was used to compute proficiency ratings for all of the NGEN41 competencies for 115 manufacturing sector National Occupation Codes (NOC). This data was compiled into a database and used to set up a survey tool[2]. Participants used the survey tool to provide proficiency levels that reflected the current requirements, and the levels projected for 2030 and 2040. The level of proficiency was rated using a five-point scale (zero being not relevant and 5 being Expert level), regardless of whether or not a five-point scale was used in the OaSIS database.

Details of the development of the NGEN41 and the survey tool are included in Appendix 7 - Developing the NGEN41 and Survey Description.

Research Participants

Sub-sector-focused industry associations were competitively contracted to engage members of their sub-sector in the completion of the survey.

The associations participating in this work are detailed in Table 2: Manufacturing Sub-Sector Coverage by Industry Association, along with an estimate of the portion of the manufacturing workforce that they represent.

Table 2: Manufacturing Sub-sector Coverage by Industry Association

Manufacturing Sub-Sector	Automotive Parts Manufacturers Association (APMA),	BiTalent Canada	Canadian Marine Industriesand Shipbuilding Association (CMISA)	Downsview Aerospace Innovation and Research (DAIR)	Food Processing Skills Canada (FPSC)	Saskatchewan Industrial and Mining Suppliers Association (SIMSA)	NAICS Code Percent of Total Manufacturing Sector Employment
Food manufacturing [311]							16.1%
Chemical manufacturing [325]							5.9%
Non-metallic mineral product manufacturing [327]							3.2%
Primary metal manufacturing [331]							3.6%
Fabricated metal product manufacturing [332]							10.3%
Machinery manufacturing [333]							9.0%
Electrical equipment, appliance and component manufacturing [335]							2.5%
Transportation equipment manufacturing [336]							12.6%
Miscellaneous manufacturing [339]							3.7%
Total							66.8%

[2] Source: VAMETRIC INC.

The six industry associations represent coverage of approximately two-thirds of the manufacturing sector North American Industry Classification System (NAICS) codes.

Each industry association had ongoing access to the data that it generated, including reports that allowed tracking of participants with respect to the state of completion of the survey.

Surveys were completed from December 2023 to the end of February 2024.

PARTICIPANT SUMMARIES

Each sector represented by the contributing associations:

- Is a strong contributor to Canada's GDP.
- Forms part of the backbone of Canada's manufacturing sector.
- Represents Canada on the global stage.

Automotive Parts Manufacturers' Association (APMA)

- Canada's national association representing Original Equipment Manufacturer (OEM) producers of parts, equipment, tools, supplies, advanced technology and services for the worldwide automotive industry.
- Members account for 90% of independent parts production in Canada.
- *Fundamental objective:* Promote the original equipment automotive supply manufacturing industry both domestically and internationally.
- Provides important industry representation to both federal and provincial governments, supports regional government initiatives, and creates and executes global marketing initiatives to develop trade and business opportunities for members.
- Plays a central role in fostering collaboration and forward-thinking environment for sharing industry insights, and formulating strategies to address emerging trends and issues to help ensure the sector remains resilient, competitive, and adaptable to the dynamic demands of the automotive landscape.
- Provides members with business development solutions and opportunities as well as guidance and assistance on modernizing their operations to suit the needs of Industry 4.0.

BioTalent Canada

- Supports the people behind life-changing science.
- Guides bio-economy stakeholders with evidence-based data and industry-driven standards.
- The go-to source for labour market intelligence,
- Focused on igniting the industry's brainpower, bridging the gap between job-ready talent and employers, and ensuring the long-term agility, resiliency, and sustainability of one of Canada's most vital sectors.

- ***Vision**:* The Canadian bioeconomy is people focused, a career of choice and a key driver of the Canadian economy.
- ***Mission**:* We strengthen Canada's bioeconomy by providing valuable, evidence-based labour market information and the best job-ready human resources available.
- ***Values**:* Acting in partnership we harness our candour, enthusiasm and sincerity to demonstrate leadership, credibility, integrity and diversity.

Canadian Marine Industries and Shipbuilding Association (CMISA)

- Represents over 120 member organizations who encompass the breadth of the commercial ecosystem of Canada's marine and shipbuilding industries.
- Supports Canadian marine companies to become successful and to help market, build and promote ships and marine products across Canada and around the globe.
- ***Goal**:* Focus on industry titans, while also supporting the next generation of innovators; to drive and promote innovation, strategic partnerships, advocacy and champion the advancement of the Canadian marine and shipbuilding industry.
- Steering the course for marine industry leaders to leverage their innovation, creativity and strategic capabilities to have a greater impact for them and for our economy as a whole.

Downsview Aerospace Innovation & Research Association (DAIR)

- Not-for-profit consortium that brings together academics, companies, research organizations, and government stakeholders around a shared goal – to advance Canada's global aerospace industry leadership.
- ***Purpose**:* Facilitate innovative collaboration between industry and academia to strengthen Ontario's aerospace ecosystem to the benefit of the Canadian sector.
- Immediate goals: Foster strong R&D partnerships and create transformational solutions that can significantly boost competitiveness.
- First envisioned in 2012 by Centennial College, the University of Toronto and Bombardier, DAIR began as a working group seeking to strengthen Canadian aerospace R&D and education; Incorporated in 2018.
- Partnered with InnovaIT Professional Services (focus on strategic opportunity analysis for recruitment, training and program development in the aviation and aerospace sector) in execution of this project.

Food Processing Skills Canada (FPSC)

- Food and beverage manufacturing industry's workforce development organization.
- A non-profit organization with representatives across Canada, which supports food and beverage manufacturing businesses from coast to

coast in developing skilled and professional employees and workplace environments.

- Their work directly, and positively, impacts industry talent attraction, workforce retention and employment culture.
- Care about assisting the industry with funding, training, and retaining the very best people for the job.

Partnerships with industry, associations, educators, and all levels of governments in Canada, has supported the development of exceptional resources for the sector including the Food Skills Library, Canadian Food Processors Institute, FoodCert, The Learning and Recognition Framework, and Labour Market Information Reports.

Saskatchewan Industrial and Mining Suppliers Association (SIMSA)

- Non-profit organization representing more than 340 Saskatchewan-based supplier- members who provide goods and services to the industrial, mining, and energy sectors.
- Currently the only organization that represents suppliers that have a physical presence in Saskatchewan, with most also having their global headquarters in the province.
- Supports, promotes, and represents the interests of Saskatchewan-based suppliers who serve large-scale industrial, mining, and energy businesses both in and out of province.
- Actively markets members to procurement professionals through in-person events and via the Saskatchewan. Supplier Database, working to increase sales, educate stakeholders, and advocate for the members and industries we serve.
- Strives to engage members, their customers, government agencies, and other stakeholders to build sustainable, productive, and transparent relationships.
- Specialists can be found providing goods and services for the potash, oil, gas, uranium, nuclear, coal, gold, agriculture, base metals, steel production and other industries.

A Current Picture of the Manufacturing Sector

The Labour Market Research by Next Generation Manufacturing Canada (NGen) into the Core Competencies of the Canadian Manufacturing Workforce was intended to solicit input about the conditions facing Canadian manufacturing firms to help determine if current skills and competency levels are appropriate to meet workforce needs today and into the future, as well as how occupational skill requirements are expected to evolve over the next decade and a half.

The Relationship Between Skills and Competencies

The Indeed.com Career Guide speaks specifically about skills and competencies.

Employees need both skills and competencies to succeed in the workplace. The pathway to development for competencies is typically more intensive and takes longer than the pathway for skill development. That is because competencies involve a set of behaviours, abilities and proficiencies.

Before addressing the skills and competencies required to support the future, we need to understand the environment in which they will be used by asking questions such as,

- What does the manufacturing environment look like across sectors?
- What challenges are impacting each sector's ability to thrive now and in the future?
- What trends are driving the impacts to workforce capability?
- What is impacting recruitment and training?

Our focus is the Canadian labour market.

Skill	Competency
The ability, to use one's knowledge effectively and readily in execution or performance	Possession of sufficient knowledge or skill - combine skills, knowledge and abilities
Strength that individuals gain through training and experience	Demonstrable sets of proficiency and abilities used to achieve a goal or complete a task
Two categories: ▪ SoF (non-technical) skills: No industry-specific ▪ Hard (technical) skills: Industry-specific	Three categories: ▪ Behavioural or life skill: Manage daily and personal needs ▪ Functional or technical: Succeed in their roles ▪ Professional: Help succeed within an organization

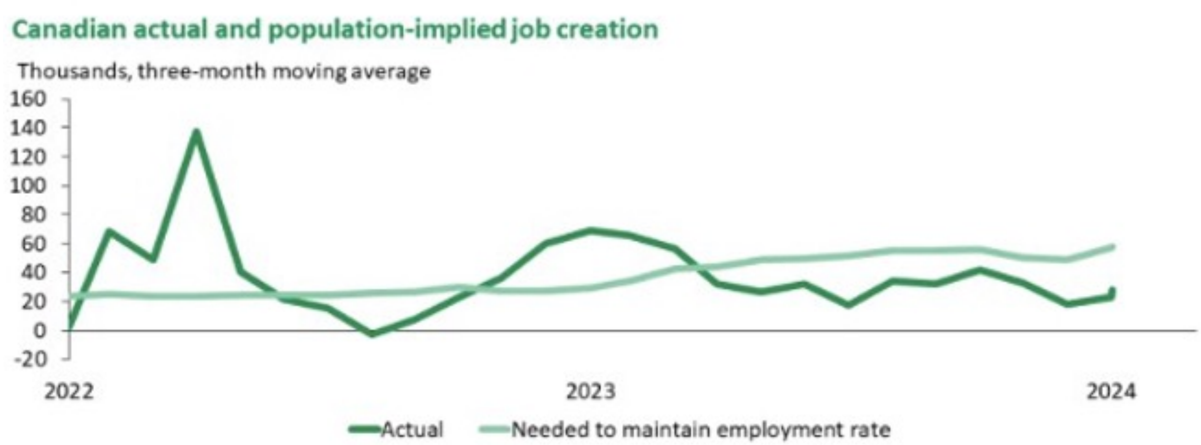
Canadian Labour Market

Manufacturing is one of four industrial categories defined by the Government of Canada, the others being Consumer Products, Service Industries and Technologies. Each of these industries is looking for success in a weakening labour market. (Mark Desormeaux, 2024)

In Desjardins Economic News (March 8, 2024), Mark Desormeaux, Principal Economist at Desjardins, highlights 4 key messages impacting the Canadian Labour Market (Mark Desormeaux, 2024):

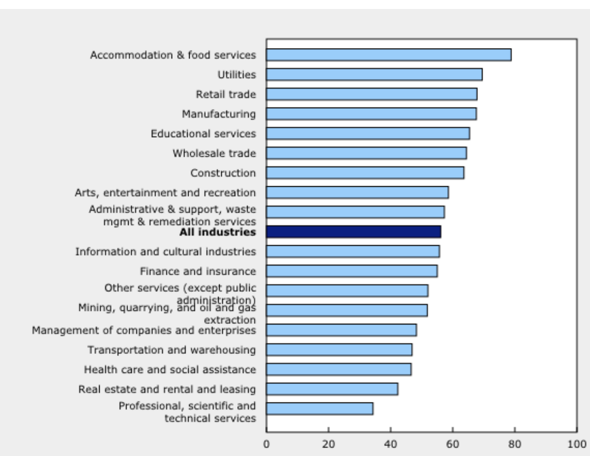
- Gains in hiring were concentrated in full-time work and private sector hiring continues to lag advances in the public sector.
- Most job gains came from self-employment, which sends mixed messages about the health of the labour market.
- Population gains continue to outstrip net job creation Figure 1: Employment Skill Not Keeping Up with Population Growth.
- The labour market is still softening despite a solid pick-up in hiring.

Figure 1: Employment Skill Not Keeping Up with Population Growth



Statistics Canada and Desjardins Economic Studies

- In a 2021 Survey of Employers on Workers' Skills, Statistics Canada reported that:The majority (56.1%) of Canadian employers reported their overall workforce was not fully proficient to perform their job at the required level, mainly driven by businesses with 20 to over 100 employees in their workforce.
- Technical, practical or job-specific skills showed the highest gap, followed by problem-solving skills. Reading comprehension and basic math and calculating skills were reported the least.
- Information and communications technology was the top factor that affected the skill requirements of employees as reported by 2/3rds of businesses, and working tools like machinery, robotics and equipment was indicated by 55.5% of businesses.
- More than 2/5ths of businesses experience difficulties recruiting employees, mainly due to a lack of interest in the sector.



Source(s): Survey of Employers on Workers' Skills, 2022 (5317).

The manufacturing sector was represented in the 17,880 Canadian establishments that contributed to these results and 67.3% of their respondents reported the lack of proficiency in their workforce.

A November 2023, Internships News blog from Inspiring Interns (Kirsten Barnes, 2023) in the UK consolidated research from a number of organizations focused on new hire expectations:

- Bright Network (Kirsten Barnes, 2023) identified:
  - a growing concern from new graduates regarding the cost-of-living crisis; they are pursuing higher salaries and enhanced job security.
  - new graduates are seeking flexibility that aligns with their personal commitment so they can achieve a work-life balance.
- Milkround (Milkround, 2024) research suggests that 31% of Gen Z graduates are eager to enhance their skills as part of their career advancement; they are looking for professional development opportunities to enhance skills.
- The Prospects Sustainability Survey (Prospects Press Office, 2022) identified that 91% of 1000 graduates expressed a strong desire to find a role where they could contribute to making a difference.

When we look at the comments made from the NGen research participants, these expectations also align to the Canadian market recruitment experiences. (Marketing Team, 2023) (Kirsten Barnes, 2023) (Milkround, 2024)

Canadian Manufacturing Sector

Manufacturing is a cornerstone of our economy accounting for approximately $174 billion (10%) of Canada's GDP and more than $354 billion (68%) of Canadian exports[3]. The 1.7 million full-time, well-paying jobs across the country rely on a highly skilled workforce that includes designers, researchers, programmers, engineers, technicians, and tradespeople.

New technologies are opening new markets for Canadian manufacturers and changing how goods are being produced. These technologies are impacting the skill and competency requirements for manufacturing roles.

Long-term success for the manufacturing sector will require collaboration between business and governments. The outcome of the research for this report identifies key focus areas for this work and (Bedard-Maltais)the ultimate ongoing success across identified manufacturing sub-sectors.

In a BDC blog, Pierre-Olivier Bédard-Maltais (Bedard-Maltais) identified the dominant trends that will shape the Canadian business environment for the next decade. He specifically identified the following for the Manufacturing sector:

- The accelerating pace of technological innovation under Industry 4.0.
  - Greater use of robotics, the Internet of things (IoT), data analytics and artificial intelligence to improve productivity, customer service and innovation. Canadian manufacturers are falling behind competitors in other countries that are embracing these advanced manufacturing technologies. Industry 5.0—is already on the horizon; it involves bringing humans back into the production process by having them work alongside advanced robotics in smart co-working environments.
- Growing customer demand for product customization and other services.
  - Customers increasingly want manufacturers to deliver customized, on-demand products. Customization starts with having the right tools to make tailored products in short lead times. Among the new tools are virtual and augmented reality devices, which can be used to co-create products with customers. Customization can also be achieved at a larger scale by using data analytics and AI to identify patterns in customer choices and preferences.
- Offer products as a service:
  - For example, a maker of heavy equipment could contract the use of its equipment on a per-hour-of-use basis rather than sell it in a one-time transaction. In this way, the manufacturer creates an ongoing relationship with the customer, providing continuous cash flow and opportunities to add more business.

[3] Source: 2ISED-ISDE Canada, 2021

- Lack of resources is a chief obstacle to adopting Industry 4.0 successfully.
  - Advanced manufacturing requires a shift in technical skills and management practices to unlock its benefits and a factory's workforce will have to include data analysts, programmers and robotics technicians. This means companies will have to widen their recruitment efforts to find these workers and support workers to adapt to new routines and technologies.
- The aging of the population and Canada's increasing dependence on immigration for population growth and to fill roles.
- Mounting sustainability challenges in a time of climate change
- Shifting market dynamics ranging from slowing economic growth to intensifying foreign competition to a transition to a services economy

This picture sets the stage for the assessment of the changing skills needs of the Canadian Manufacturing Workforce research.

SUB-SECTOR INSIGHTS AND ISSUES

The overall objective of this exercise was to develop a cross-sector pan-Canadian database of the skills and competencies of the current manufacturing workforce and to identify the critical new skills and competencies that will be required in five and ten years to support industry success.

The pace of business continues to accelerate. The context and influences that form the setting for this research must be considered when evaluating the skills and competencies of existing and future manufacturing workforces. This exploration serves to provide reinforcement that a cross-sector pan-Canadian database of the skills and competencies of the current manufacturing workforce is possible, useful and viable.

What does the manufacturing environment look like across sectors?

Each association provided context to set the stage for the skills and competency discussion and the following tables highlight the influencers that provide context to the manufacturing workforce requirements:

- Perspective
- Trends and Considerations
- Recruitment
- Challenges
- Technology
- Training at a high level

Not surprisingly, **differences** are found in the products being produced in each sector, the natural resources used in their manufacturing process, and the distribution of locations across the country.

- More importantly, **similarities** are found in the complexity and size of businesses supporting direct production, suppliers and distribution of products.
- Their impact on domestic and international markets.
- Their reliance on many different roles with varying levels of skill and education.

The following pages provide each association's insights into the manufacturing sector:

PERSPECTIVE

Associations

APMA	BioTalent Canada	CMISA	DAIR	FPSC	SIMSA
Employs over 100,000.	Bioeconomy employs nearly 200,000 with 73,940 in bio-manufacturing	Employs approximately 30,000 (Government of Canada; 2020 Annual Report)	Contributes over 212,000 jobs	Employs approximately 300,000 workers in 2022	Employs over 34,000
Supplies components to both domestic and international vehicle manufacturers especially U.S. and Mexico.	Fours sub-sectors: agri-bio (21%), bio-industrial (20%), bioenergy (5%); bio-health (54%)	Build, maintain, and retrofit large-scale commercial, research, and naval vessels, lakers, tugboats, search and rescue vessels, offshore drilling or energy platforms, ferries, fishing vessels, offshore supply vessels	Two segments – Aerospace (Engineering and Manufacturing-related occupations) and Aviation (Maintenance, pilot and crew training)	There are 13,150 food and beverage processing establishments in Canada, with the majority of establishments concentrated in Ontario, Quebec or British Columbia	Significant pillar of Saskatchewan's GDP and labor market, bolstering worldwide agricultural and energy frameworks - home of 23 of 31 critical minerals identified by Federal Government
Diverse range of companies - Tier 1, 2 and 3 but especially small and medium-sized businesses.	Each sector requires bio-manufacturing efforts to support their innovation.	Hundreds of small, mid-sized, large technology-driven businesses	Most revenue base and employment (>65%) from direct manufacturing and supply chain activities	Includes Food Manufacturing, Beverage Manufacturing and Cannabis Product Manufacturing	Symbiotic relationship between the mining industry and the local economy, fostering growth and development
Supply internal combustion and electric vehicles by producing engine parts, chassis systems, electrical systems, interior and exterior trim and advanced materials.	Since COVID, bioeconomy has increased in importance as an economic driver and population preparedness	Canada is currently making industry-launching investment in this sector through the development and acquisition of over 40 large ships for the Navy and Coast Guard	Small number of dominant OEM firms and Tier 1 supply chain firms (Ont. and Que.) alongside a much larger number of smaller OEMs, suppliers, engineering design, and support manufacturing and maintenance	Transformation of agricultural products into food or beverages, or of one form of food or beverage into other forms for consumption by humans or animals	Transition towards a decarbonized energy grid signals a transformative period, demanding adaptability and skill development within the workforce.
Invests heavily in R&D; partners with post-secondary institutions, to develop products, improve processes, efficiency and performance.	Only 30% of companies have a dedicated HR department	Supported by post-secondary institutions, provincial training authorities and agencies for advanced skill development	Large companies represent only 5-10% of the industry's number of firms, but close to 80% of total employment	Supports 11 sub-sectors and has more than 14,000 establishments; incredibly diverse in terms of employment options	Premier producer of potash globally; 2nd largest producer of uranium internationally; pivotal role in nuclear energy sector
Adapts and thrives thereby positions Canada as a leading player globally and is closely integrated into the global supply chain.	Better support for health and well-being of Canadians in the event of future health emergencies	Potential for excellent careers and significant intellectual property	Ranked #1 in R&D among all Canadian manufacturing industries – but $ is declining	Unique: More labour intensive than other forms of manufacturing	One of Canada's largest mining provinces by mineral sales – supply chain dominated by high mix, low volume work
Ontario is centre of automotive manufacturing in Canada; Quebec is next.		Rely on highly skilled workforce	Revenues for civil aircraft production dropped by nearly 34%; Canada, still faring better than the global market – expect 2019 levels by 2024	Relative inability to pass on costs to other parts of the supply chain or end consumers.	Mining sector benefits the manufacturing industry, particularly those involved in contract fabrication and manufacturing work

TRENDS

Associations

APMA	BioTalent Canada	CMISA	DAIR	FPSC	SIMSA
Growing high demand for specialized skills, especially expertise in electric and hybrid technologies, battery systems software integration and data analytics	Advancements in bio-manufacturing processes	Industry-launching investment new ships	Conservative estimates of employment growth; number of jobs dramatically decreasing 2019 and 2021; Reticent to lay off employees and in many cases are finding it less painful to keep employees on at financial loss than to try to recover a lost workforce	Legalization of edibles and infused beverages – cannabis product manufacturers had significant requirement for labour to meet product demands - wanted to hire people with experience in manufacturing food and beverage products; significant disruption in other sectors	Bracing for the impact of significant capital projects and the evolving demands of a greener economy, necessitating a strategic approach to workforce management and development.
Growing emphasis on people and soft skills that focus on human interaction	Regulations requiring greater emphasis on technology, business acumen and technical expertise	Adapting shipbuilding from bespoke construction to manufacturing processes	Scope of projects have some guarantee stable revenues and employment over long periods to OEMs and supply chain that supports them.	Consumer preferences have an enormous impact on the sector, especially when there is a wholesale shift in the types of products desired	Moving towards more complex welding tasks likely due to introduction of new materials and technologies in welding field
Persistent labor shortage and the evolving dynamics of manufacturing processes, coupled with the transition towards zero-emission vehicles (ZEVs)	Increased automation and digitalization	Retrofitting vessels	“Gig economy” allowing some workers to build flexibility in their hours and presence or to create a “hired gun” approach allowing skilled gig workers to be more mobile	Skill level for Production roles continued to grow for 2030 and 2040; non-industry observer might expect to be decrease by technology rather than work with it	Predominance for high-mix/low-volume work, contrasting significantly with industries that produce high volumes of identical products, e.g. the automotive industry.
Growing automation of assembly processes and the digitization of interfaces for tasks such as production, metrology, and quality control are increasingly noticeable on the factory assembly line	AI is revolutionizing bio- manufacturing in Canada by driving innovation, improving productivity, and advancing the development of life-saving therapies.		Modern factory is increasingly evolving to an environment in which unskilled positions are diminishing in number and their value to production while growing the market for digitally literate skills	Regulations around packaging and labelling	Anticipation that underground and mining conditions will become more intricate and challenging
Technological advancements reshaping automotive sector landscape	Efforts to foster innovation and competitiveness		Hosting a relatively young workforce; have neither had much turnover in recent years nor expect to have in the near term	Way that productivity is calculated does not look favourably on labour intensive sectors, as it is calculated on a per worker basis	Manufacturing specifications grow more stringent and products more complex; Materials used in manufacturing diversifying
Significant chip shortage, disrupting production lines and impacting vehicle availability across the globe			Manufacturing is sensitive to major socioeconomic events and conditions – leading to uncertainty	Challenges (and some opportunities) presented by climate change	Escalating complexity of engineering projects
			Federal Aerospace Review, Vision 2025 – 2019 reports, Minister for Innovation, Science and Industry – suggest national strategy		Work environment evolving to be more collaborative and versatile

WORKFORCE CHALLENGES

Associations

APMA	BioTalent Canada	CMISA	DAIR	FPSC	SIMSA
Attracting individuals to manufacturing jobs is a challenge at all levels of employment	Gap in bringing in the people with the skills to use the facilities	Retrofit jobs require large amounts of time, labour and capital	Distribution of overall employment levels in aerospace is highly focused in Central Canada	Age demographic worrying; expected to be 67,000 current workers retiring from the sector by 2030	Economic Fluctuations: Cyclical nature of mining, affects job stability and workforce planning.
Widespread retirement of experienced workers leading to substantial labour shortage and loss of valuable institutional knowledge	Lack of qualified candidates with required specialized skill sets or experience, practical and non-academic skills	Limits on availability of skilled tradespeople – force unwanted trade-offs	Aging workforce – average age of aerospace work is 54; expect large number to exit in next few years before younger workers settle in career	Demand for new labour is accelerated as the sector is predicted to continue growing – new people 50% of today's workforce	Aging workforce with sizable portion due to retire by 2030
Misconception about nature of manufacturing work and facilities	Loss of candidates and employees to large, well- known organizations	Under strain responding to significant production demands	Labour shortages: Young not coming into manufacturing industry; not attractive	Lack of interest in working in these sectors; more skilled than it is recognized to be	Labour shortfall for skilled workers
Traditional domain for unskilled workers gradually less attainable for individuals lacking fundamental skills	Insufficient capital or resources to pay competitive wages to attract and retain candidates	Location of work – smaller yards are remote; largest yards are urban	Jobs not re-bounding to 2019 levels until 2028; Concern about the ability of the industry to meet staffing levels	Climate change has outsized impact on food and beverage manufacturing due to their reliance on agricultural inputs	Lack of younger individuals entering
Challenges in maintaining competitiveness if the workforce is not adequately prepared for the technological demands of ZEV production	Lack of applicants	Competing for talent in engineering and design, skilled trades, advanced manufacturing, project management, information technology	Mandatory certification and apprenticeship challenges due to long "seat-time-based" requirements for qualification, failure to recognize cross- occupational competencies, and limitations in recognizing competencies in shorter, skill-focused learning achievement	Lack of coordination in the regulatory environment - regulatory changes that are brought from one area of government that conflict with existing regulations from another area of government	Attracting Talent: Offering competitive wages, benefits, and conditions to attract and retain skilled workers in a challenging industry, which do not want to live in smaller, sometimes remote places.
	Lack of skilled talent to grow the industry will put Canada in a position reliance on others	Attracting and retaining strong workforce	Controlled Goods Program (CGP) and International Traffic in Arms Regulations (ITAR) can restrict or delay the hiring of competent employees from foreign countries, or recent skilled immigrants to Canada.	Hiring for the current roles and skill levels is a consistent challenge and as the skill level increases for all roles into the future the challenge for employers within the sector will be greater	Shifting workforce demand: next generation values different things than predecessors – i.e. desire for deep meaning in their work and focus on lifestyle and family needs.
	>16,000 additional workers required by 2029 to sustain sector - expect only 25% to be filled	No dedicated post-secondary infrastructure	Some do not have the population base to support hiring needs; hard luring young people to small towns	Limited ability to compete with other sectors directly in wages; vulnerable to staff recruited away	
			High levels of competition and mobility of the skills within the overall industry	Hiring challenges are not felt equally across the various sub-sectors	
			Regulations confound mobility and skills development agility		

TECHNOLOGY INFLUENCES

Associations

APMA	BioTalent Canada	CMISA	DAIR	FPSC	SIMSA
Advanced machinery integral to the production of electric vehicles	Artificial Intelligence (AI), emerging technologies in all aspects of manufacturing process	Integrating new technologies in advanced manufacturing processes, systems	Automation, robotics, advanced technologies, connected networks	Co-working with robots	Adopting autonomous machines and processes
	Growing reliance on digital platforms, data analytics and automation technologies in bio-manufacturing facilities	Digital design and work packs	Artificial Intelligence (AI)	Industry 4.0 - e-commerce, technological innovation, and the rise of "smart manufacturing"	Machine learning
		New manufacturing techniques and technologies	Non-destructive testing techniques, augmented and virtual reality wearables	Availability of technology has impacts that are felt unequally across the sub-sectors and regions	Artificial Intelligence (AI)
		Advanced Robotics, Immersive Technologies, Environmental Technologies, AI, Advanced Materials (carbon composites, aluminum, polymers	Industry 4.0 has substantial impact on manufacturing	Rural employers still dealing with a lack of infrastructure, such as reliable high-speed internet, which may impact their ability to implement available technology and compete on equal footing	Broader industry trends towards complex, technology
				Lack of technology and the ability to create or invest in the creation of that technology limits those sub-sector's ability to expand to meet demand in the same way as the sub-sectors that do have access to technology	Embracing complex, technology-driven environments, particularly noticeable in fields like welding and heavy-duty mechanics
				Without access to reliable high-speed internet, it will be a challenge for some employers to integrate available technology into their operations.	Industry continues to digitize;
					Expansion and decarbonization of local electrical grid

What Does the Current Workforce Look Like?

DATA DESCRIPTION

There were 113 manufacturing organizations participating in the survey. Competency proficiency ratings were collected for 112 occupations with a total of 502 instances. The top occupations in terms of number of survey instances, along with the number of instances, is captured in Table 3: Occupations by NOC Code with Top Survey Instances.

As can be deduced from this table, most of the data is widely dispersed over the multiple occupation codes, making analysis for any one occupation code somewhat suspect.

It was decided that meaningful results might be obtained by grouping the National Occupation Codes (NOC) into 'Types' of occupation. The types used were based on the role someone might play in the manufacturing organization, as well as the occupation description for each NOC code. For example, occupations containing the words 'manager' or 'supervisor' are grouped into the occupation type 'Manager'. Occupations containing the word 'engineer' are grouped into the occupation type 'Engineer'. Occupations that make up the trades, were grouped into the occupation type 'Trades' and occupations that are clearly hands on in the production process were grouped into the occupation type 'Production'. A full listing of Occupation Types and the encompassing NOC Codes and Descriptions can be found in Appendix 8: Table of National Occupation Codes in the Survey Data and the Corresponding Occupation Types.

This grouping of the data resulted in the identification of analyzable groups of data by sub- sector that is depicted in Table 4: NAICS Groupings for Analysis. The solid light green boxes in the table represent Occupation Types containing enough data for meaningful analysis. The columns outlined in green represent Occupation Types that can be

Table 3: Occupations by NOC code with Top Survey Instances

Occupation Description	NOC Code	Number
Manufacturing managers	90010	**30**
Welders	72106.01	**25**
Engineering managers	20010	**21**
Chemical engineers	21320	**20**
Machinists	72100.01	**20**
Biomedical engineers	21399.02	**19**
Biological technologists	22110.01	**19**
Industrial and manufacturing engineers	21321	**18**
Biological technicians	22110.02	**15**
Mechanical engineers	21301	**14**
Supervisors, food and beverage processing	92012	**13**
Supervisors, other products manufacturing and assembly	92024	**13**
Construction millwrights and industrial mechanics	72400	**11**
Labourers in metal fabrication	95101	**11**
Labourers in food and beverage processing	**95106**	**10**

analyzed across sub- sectors, while the rows outlined in red represent Occupation Types that can be analyzed with a sub-sector.

In addition, data was also analyzed (number of responses permitting) according to occupation type for each industry association contracted in the survey. The rationale being that the data collected by each association is more broadly representative of the sector that the association represents.

For example, the automotive sector is broadly defined in North American Industry Classification System (NAICS) coding as 3361-Motor Vehicle Manufacturing, 3362-Motor Vehicle Body and Trailer Manufacturing, etc. However, many of the participants in the supply chain of this industry do not identify themselves by these NAICS codes, preferring instead to use codes associated with 331-Primary Metal Manufacturing or 332-Fabricated Metal Manufacturing, for example.

Table 4: NAICS Groupings for Analysis

Description	NAICS (3)	NAICS (4)	# Occu-pations	ADMIN	ENGINEER	MANAGER	PRODUCTION	TECH-NICIAN	TECHNOLO-GIST	TRADES
Food manufacturing	311		62	8	4	23	48	4	1	**7**
Chemical manufacturing	325		130	0	36	44	9	17	23	**0**
Metal Products, Machinery, Equipment, and Component Mfg.	332; 335; 333		65	0	5	4	18	2	2	**37**
Ship and boat building		3366	34	0	3	2	12	1	0	**16**
Aerospace product and parts manufacturing		3364	61	0	10	2	17	4	0	**21**
Medical equipment and supplies manufacturing		3391	49	0	27	6	3	8	4	**0**
Total			**401**	**8**	**85**	**81**	**107**	**36**	**30**	**81**

CURRENT PROFICIENCIES

Data analysis for individual sectors were completed by the industry associations and can be found in the reports in Appendices 1 to 6.

This overall report contains analysis of the whole data set and focuses particularly on the exploration of trends across multiple sectors. For each sub-sector the data was grouped by occupation type. Statistics were generated for each competency (average and standard deviation). The input data contained survey results for the calculated OaSIS Base proficiencies, and for the current level of proficiency as perceived by participants.

The standard deviation is a measure of the dispersion of the data and is a measure of agreement between survey participants. For a sufficient number of data points, standard deviations of the proficiency dispersion that are 1 or less are considered to be reasonable and a standard deviation of 0.5 or less are considered exceptional. Recalling that a five-point scale has been used here to represent a level of proficiency, a standard deviation of 1 indicates that the majority of participants are agreeing that the change in proficiency for a given competency is within one level of expertise (each integer from zero to five represents an ascending level of expertise from not important to expert).

Figure 2: Aerospace - Production Occupation Type is a Pareto chart, for the Production occupation type in the Aerospace manufacturing sector, sorted according to average OaSIS Base Competency Proficiency. Also plotted are the averages for current proficiencies, as indicated by survey participants. The error bars in this plot equal +/- one standard deviation. In general, a trend of increasing proficiency can be observed from the base to the current levels. This indicates that survey participants believe that the current proficiency levels are higher than the computed OaSIS base levels for most of the NGEN41 competencies. This is a trend that is observed across multiple occupation types across multiple sectors.

For each occupation type analysis, the competencies were organized into rank ordered lists according to the level of proficiency (see Table 5 for the Production lists). These lists can then be used to compare how the importance of competencies have changed compared to the average of the values computed from the OaSIS database.

A comparison of where the skills are vs where people think they are

It can be seen that, although there are some differences in the top ten competencies between sectors, there is mostly agreement between the types of competencies that constitute the top ten list for a particular occupation type (in this case production).

Changes to the OaSIS base top ten ranking are also captured in the following Table 6: Competency list changes by sector for the Production occupational type for clarity.

Changes in proficiency ratings were also calculated by subtracting the averages of the surveyed proficiency levels.

These changes in proficiency were calculated for the change from the OaSIS base to the currently perceived level of competency. A few competencies disappear from the top ten list, while others are added. The competency reading skill is added across three sub- sectors, while other additions are specific to one sector.

Also captured in Table 6 are ranked order lists of changes to competency proficiency ratings that are considered to be significant.

Figure 2: Aerospace - Production Occupation Type

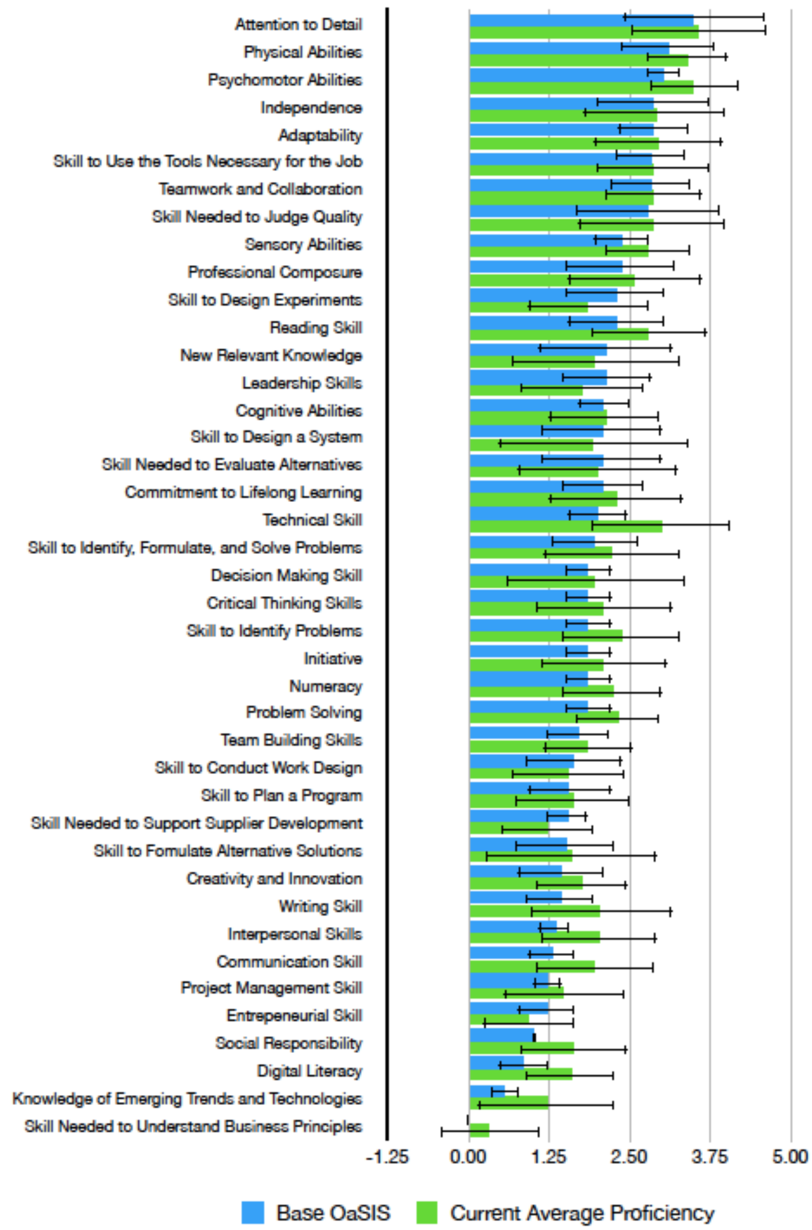


Table 5: Colour Map of Production Competency Rank Order Across Industry Association Sectors, Base to Current-1

<table>
<tr><th>Rank</th><th>Food</th><th>Mining</th><th>Pharma 3254</th><th>Aerospace</th><th>Shipbuilding</th><th>Automotive</th></tr>
<tr><th></th><th>OaSIS Base</th><th>OaSIS Base</th><th>OaSIS Base</th><th>OaSIS Base</th><th>OaSIS Base</th><th>OaSIS Base</th></tr>
<tr><td>1</td><td>Adaptability</td><td>Physical Abilities</td><td colspan="4">Attention to Detail</td></tr>
<tr><td>2</td><td colspan="3">Psychomotor Abilities</td><td colspan="2">Physical Abilities</td><td>Independence</td></tr>
<tr><td>3</td><td>Physical Abilities</td><td colspan="2">Teamwork and Collaboration</td><td colspan="2">Psychomotor Abilities</td><td>Professional Composure</td></tr>
<tr><td>4</td><td>Attention to Detail</td><td>Adaptability</td><td>Physical Abilities</td><td>Adaptability</td><td>Teamwork and Collaboration</td><td>Psychomotor Abilities</td></tr>
<tr><td>5</td><td>Teamwork and Collaboration</td><td>Attention to Detail</td><td colspan="2">Independence</td><td>Adaptability</td><td>Teamwork and Collaboration</td></tr>
<tr><td>6</td><td>Skill Needed to Judge Quality</td><td>Professional Composure</td><td>Adaptability</td><td>Skill to Use the Tools Necessary for the Job</td><td>Independence</td><td>Skill to Use the Tools Necessary for the Job</td></tr>
<tr><td>7</td><td colspan="2">Independence</td><td>Skill to Use the Tools Necessary for the Job</td><td>Teamwork and Collaboration</td><td>Professional Composure</td><td>Adaptability</td></tr>
<tr><td>8</td><td colspan="2">Skill to Use the Tools Necessary for the Job</td><td>Professional Composure</td><td>Skill Needed to Judge Quality</td><td>Skill to Use the Tools Necessary for the Job</td><td>Physical Abilities</td></tr>
<tr><td>9</td><td colspan="2">Sensory Abilities</td><td>Leadership Skills</td><td>Sensory Abilities</td><td>Skill Needed to Judge Quality</td><td>Sensory Abilities</td></tr>
<tr><td>10</td><td colspan="2">Commitment to Lifelong Learning</td><td>Skill Needed to Judge Quality</td><td>Professional Composure</td><td>Reading Skill</td><td>Skill Needed to Judge Quality</td></tr>
</table>

<table>
<tr><th>Rank</th><th>Food</th><th>Mining</th><th>Pharma 3254</th><th>Aerospace</th><th>Shipbuilding</th><th>Automotive</th></tr>
<tr><th></th><th>Current</th><th>Current</th><th>Current</th><th>Current</th><th>Current</th><th>Current</th></tr>
<tr><td>1</td><td>Adaptability</td><td>Physical Abilities</td><td>Teamwork and Collaboration</td><td colspan="3">Attention to Detail</td></tr>
<tr><td>2</td><td>Psychomotor Abilities</td><td colspan="2">Physical Abilities</td><td>Psychomotor Abilities</td><td>Physical Abilities</td><td>Independence</td></tr>
<tr><td>3</td><td>Attention to Detail</td><td>Teamwork and Collaboration</td><td>Psychomotor Abilities</td><td>Physical Abilities</td><td>Psychomotor Abilities</td><td>Skill to Use the Tools Necessary for the Job</td></tr>
<tr><td>4</td><td colspan="2">Adaptability</td><td>Skill to Use the Tools Necessary for the Job</td><td>Technical Skill</td><td>Teamwork and Collaboration</td><td>Professional Composure</td></tr>
<tr><td>5</td><td>Independence</td><td>Attention to Detail</td><td>Sensory Abilities</td><td colspan="2">Adaptability</td><td>Psychomotor Abilities</td></tr>
<tr><td>6</td><td>Teamwork and Collaboration</td><td>Professional Composure</td><td>Reading Skill</td><td colspan="2">Independence</td><td>Teamwork and Collaboration</td></tr>
<tr><td>7</td><td>Skill Needed to Judge Quality</td><td>Independence</td><td>Attention to Detail</td><td>Teamwork and Collaboration</td><td>Professional Composure</td><td>Adaptability</td></tr>
<tr><td>8</td><td>Sensory Abilities</td><td>Skill to Use the Tools Necessary for the Job</td><td>Adaptability</td><td colspan="2">Skill to Use the Tools Necessary for the Job</td><td>Physical Abilities</td></tr>
<tr><td>9</td><td>Skill to Use the Tools Necessary for the Job</td><td>Reading Skill</td><td colspan="4">Skill Needed to Judge Quality</td></tr>
<tr><td>10</td><td>Communication Skill</td><td>Sensory Abilities</td><td>Problem Solving</td><td colspan="2">Reading Skill</td><td>Critical Thinking Skills</td></tr>
</table>

The sub-sectors with the greatest number of significant changes are the Food Processing and the Pharma sub-sectors. Many of the competencies with the most significant changes do not show up in the top ten rank ordered lists of competencies. For example, although respondents thought that proficiencies in digital literacy were much higher than the OaSIS base (these were generally a whole proficiency point or more above the base), this change in proficiency was not enough to push the competency into the top ten ranking.

The top ten ranking is an arbitrary selection of competencies, chosen here for convenience and ease of understanding. It does not mean that competencies with a lower proficiency rating are not important to be able to do the job. When trying to recruit for the job, it would be expected that those that fill the most demanding competencies would be hired ahead of those that do not. That said, the person filling a particular position would ideally be proficient at the level indicated for all of the identified competencies relevant to the occupation.

In view of the commonality observed in the top ten lists and the commonality observed for the largest changes in proficiency, it would seem that a great deal of cross-sector mobility should be possible within these manufacturing sub-sectors. In general, this is the case, although consideration needs to be given to specific knowledge requirements which were not part of the survey. It could be expected that the knowledge requirements in the Pharma sub-sector might be quite different to the Aerospace sub-sector, for instance.

Similar patterns are observed for the Trades occupation, and for occupation types across the NAICS Code sub-sectors, summarized in Appendix 9: Proficiency Data.

Table 6: Summary of Most Significant Future Competency Changes from Current Levels

Differences	Food Processing	Mining	Pharma	Aerospace	Shipbuilding	Automotive
What disappears in the top ten competencies	Commitment to Lifelong Learning	Commitment to Lifelong Learning	Independence Professional composure Leadership Skills	Sensory Abilities, Professional composure		Sensory Abilities
What appears in the top ten competencies	Communication Skills	Reading Skill	Sensory Abilities Reading Skill Problem Solving	Technical Skill Reading Skill		Critical Thinking Skills
Most significant changes (Δ ≥ 0.5)	**Communication Skill** **Digital Literacy** **Reading Skill** **Writing Skill** Skill to Identify Problems Problem Solving Sensory Abilities Creativity and Innovation Interpersonal Skills New Relevant Knowledge Team Building Skills Technical Skill Skill to Plan a Program Skill Needed to Understand Business Principles Numeracy Skill to Formulate Alternative Solutions Critical Thinking Skills	**Writing Skill** **Reading Skill** **Communication Skill** **Digital Literacy** Creativity and Innovation Problem Solving Numeracy	**Digital Literacy** **Reading Skill** Creativity and Innovation **Communication Skill** Sensory Abilities Skill Needed to Understand Business Principles Skill to Use the Tools Necessary for the Job Problem Solving **Writing Skill** Skill Needed to Support Supplier Development Decision Making Skill Teamwork and Collaboration Physical Abilities Knowledge of Emerging Trends and Technologies	Technical Skill **Digital Literacy** Interpersonal Skills **Communication Skill** Knowledge of Emerging Trends and Technologies Social Responsibility **Writing Skill** **Reading Skill** Skill to Identify Problems	**Reading Skill** **Digital Literacy** Knowledge of Emerging Trends and Technologies **Writing Skill** Team Building Skills **Communication Skill**	**Communication Skill** **Writing Skill** Interpersonal Skills Skill to Identify, Formulate, and Solve Problems **Digital Literacy** Critical Thinking Skills Skill to Conduct Work Design

WHAT THE INDUSTRY SAYS

The manufacturing sector in Canada is working hard to continue to thrive, despite significant challenges. All associations highlighted the recognition of the impacts of technology, changing workforce expectations for younger hires, the need to adopt new recruitment and training strategies, the lack of 'prestige' surrounding the manufacturing roles and career opportunities and the need to review and revise existing regulatory and certification requirements because of the impact they are having on 'time to role".

What workforce challenges are impacting each sector's ability to thrive now and in the future?

- Attracting individuals to manufacturing jobs is a challenge and therefore there is a lack of applications.
- The aging workforce is due for retirement with a shrinking candidate pool.
- Rural locations are impacted more by the lack of resources than urban locations.

What trends are driving the impacts to workforce capability?

- Regulations continue to impact the ability to bring workers in quickly.
- Rapid and escalating change in manufacturing processes due to technology.
- Climate change, the 'gig' economy and external influences impact each sector differently.

What is impacting recruitment and training?

- The desire to recruit skilled immigrants and promote diversity and inclusion for growth by including underrepresented groups such as women, new Canadians and Indigenous Peoples.
- There is a requirement for a highly skilled workforce.
- The need to collaborate with post-secondary institutions, former employees, consultants, specialists, trainers and mentors.
- Revisiting training requirements and accreditation models.

The tables on the following pages provide specific details for each association.

RECRUITMENT INFLUENCES

Associations

APMA	BioTalent Canada	CMISA	DAIR	FPSC	SIMSA
More flexible approach to education requirements with emphasis on candidate's potential, problem-solving abilities, and people skills	Manufacturing and production, distribution and logistics and management, finance and administration jobs continue to be the hardest hit areas	Software engineers, software architects, systems engineers now and projected increase in demand	Demographic patterns resulting in a diminished pool of candidates and growth requirements are creating a highly competitive situation for skilled workers	Has had to direct significant resources to recruitment and retention, and these resources have had to increase to deal with increased retirements	Move from solely technical skills to more a more broadly skilled and adaptable workforce across various sectors.
Removing barriers and promoting diversity and inclusion by identifying new pools of talent that have been historically excluded	Lack of qualified candidates with practical and non-academic skills	Increased level of diversity, equity and inclusion: Focus on women, new Canadians, Indigenous Peoples	Regulations, lack of attraction to the industry, and anachronistic training and certification regimes cause delays and challenges to bridge the gap between worker demand and supply	Cannabis - almost exclusively domestic Canadians, because many immigrants were worried about the impact on their ability to visit their home country and/or send money to relatives	Aging demographic, and low unemployment rates and evolving job market demands, poses additional hurdles, particularly in attracting and retaining necessary skilled labour
Significant challenges in hiring employees, prompting a shift in traditional hiring practices	Talent needed is in short supply	Current and projected future deficits in attraction and retention of talent	Manufacturing is not seen as particularly attractive to youth in many cases	Climate change - labour impact caused by climate change and severe weather events is felt the hardest by seasonal manufacturers	Requirement to be versatile and adaptable to handle diverse array of tasks within projects
	Need to find people with the right skills and experience to support industry demand	Competition for talent	Finding skilled, experienced workers for line work, assembly, machine operations, skilled trades, and related factory-floor positions is substantial and growing challenge, but not identified as most important by all	Production (Production and Trades) and non-production roles (Manager) employers listed lack of applicants with the proper experience or proper training as among their top challenges	Mining will be short around 18% of the current direct and indirect mining workforce by 2030
	Active recruitment of new grads		Some measure of recruiting difficulty – not all identified as manufacturing jobs	Employers are struggling to find staff that already have the required skill level	Some shifts toward specialized knowledge and problem-solving abilities
	Candidates lack soft skills such as problem-solving, collaboration and the business development skills that support commercialization		High levels of competition and mobility of the skills; niche manufacturing raiding other firms and sectors	Smaller employers require staff to have a more diverse skillset as there are still all the same tasks that need to be completed to ensure products are manufactured	
			Lack of interest from young workers challenging for smaller or more remote	Location of the processing facilities – rural and semi-rural areas, limits ability to recruit	
			Lack of commitment in domestic populations – Gen Z and millennials		

TRAINING INFLUENCES

Associations

APMA	BioTalent Canada	CMISA	DAIR	FPSC	SIMSA
Shift toward hiring individuals with foundational skills and then investing in on-the-job training programs to refine the specific job skills to support retention	Skills required to meet labour demands align with other key job functions, including management, business development, and information technology.	Integrating new training models	Rapid changes in skill requirements are being seen in many occupations, suggesting that accepted levels of proficiency and the training pathways to deliver them may no longer be properly targeted and delivered	Expected increase in the skill level of the workforce for 2030 and 2040	Need for workers to keep pace with technological advancements.
Investment in employee development programs in- house and third-party to address technical and soft skill shortage	Work-integrated learning (WIL) is a catalyst for sustained growth - can serve as effective tool for skill development	Developing strategies to focus on skills gaps	Understanding of connected technologies, digital literacy, and lifelong learning are becoming a critical skill set		Importance of interpersonal skills in a technologically advancing world
Training, apprenticeships, and partnerships with post- secondary institutions to upskill existing workforce and attract new talent	Ability to adapt to new technologies, processes, and regulations	Revisit training requirements and accreditation models: Focus on outcomes and competencies specific to marine and shipbuilding	Colleges and universities are not able to graduate enough technical individuals to meet industry demand		Need for ongoing learning and adaptation
	Forward thinking approach to skill development, anticipating evolving demands	Ensure programs like welding offer access to variations for different ship-oriented materials	Related certification pathways take 2 to 4 years to complete and even then, newly graduated recruits are often estimated to be months away from full productivity with specialty equipment and proprietary systems and techniques		Shifting Skills-demand: Addressing the mismatch between industry needs and available skills through targeted training and education. In-demand skills are changing as digitization propagates through the supply chain.
	Link to Student Work Placement Program (SWPP)	Explore private / public sector partnerships for training infrastructure	Many new non-traditional skills requirements for the future		
	Hire promising candidates then provide own training to produce the exact, highly tailored skill sets for specific positions		Niche manufacturing – struggle with finding capable employees and therefore have to invest heavily in mentoring and training		

Many of these insights align with concepts presented by NGen's Chief Manufacturing Officer, Stewart Cramer in industry briefings: Future Ready: Workforce 4.0 and Transferable Skills *(©2023 Next Generation Manufacturing Canada and Shunk and Associates)*.

- For the past 7 quarters, the global manufacturing industry's main concern has been labour shortages.
- These shortages are due in large part to a lack of workers with technical skills.
- Other factors include increasing retirement rates and growing complexity in the global supply chain.
- And there is a direct link to the skills and competency research driving next steps:

52%

Of production workers want upskilling, 21% participate

65%

Of prospective employees look at upskilling opportunities when considering an employer

61%

Of employees look at upskilling when deciding to remain at their current employer

Ref. The American Upskilling Study", Gallup and Amazon assessment, 2021

Industry 4.0 is a reality, and the workforce knows it is coming.

- The workforce is being supplemented or replaced with automated tools.
- "Lack of a digital culture and training is the #1 challenge for [successful adoption of] Industry 4.0"
- Any transition to Industry 4.0 without preparing the workforce **WILL FAIL!**

People are your #1 differentiator in the global marketplace is the new normal and Canada's Labour Crunch is hindering our position:

> "Virtually everyone I spoke to during our Vision 2025 consultations agreed that Canada is in a **fierce competition for talent**. The jurisdictions that win that competition will dominate the industry,"
>
> *The Honourable Jean Charest, Chair AIAC's recent Vision 2025*

As one of the DAIR participants expressed, "...[people] are not coming fast enough, with the skills we need."

Projected Workforce Requirements

How do competency proficiencies change moving forward? In general, survey participants believed that workers will need to become increasingly proficient at most of the NGEN41 competencies over the next decade and a half.

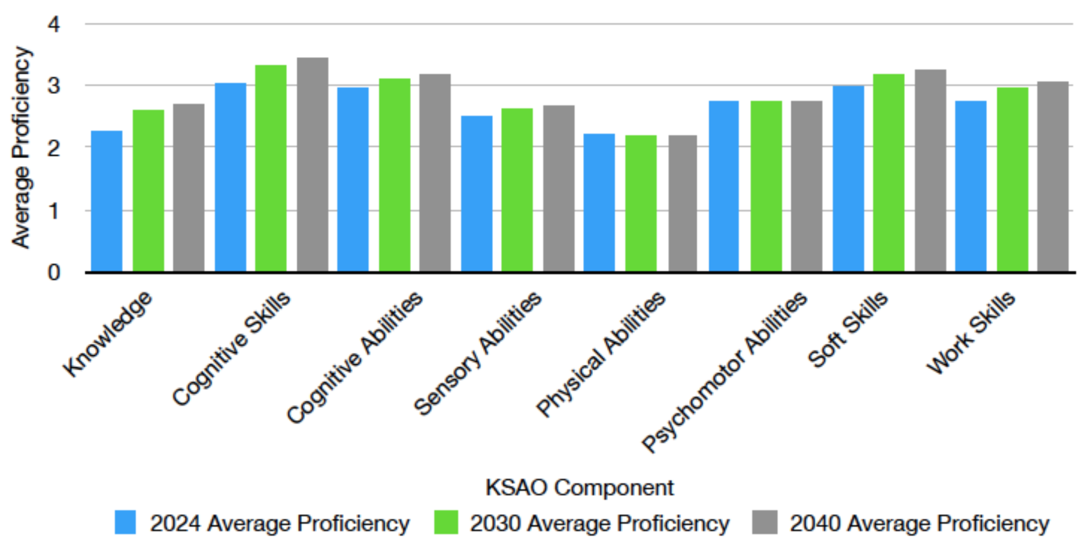
Proficiency Changes

This can be seen in Figure 3: Projected Aggregate Changes of the NGEN41 KSAO Competencies which, for all of the survey data, plots the aggregate competency proficiencies, comparing the current competency levels to those projected for 2030 and 2040. The NGEN41 competencies in this figure are aggregated according to the KSAO construct (previously defined in the Research Approach section). The abilities portion of the framework has been separated into its components since the components are independent of each other.

Average proficiencies from 2024 to 2040 increase for the Knowledge, Cognitive Skills, Soft Skills, and Work Skills constructs. Cognitive Abilities and Sensory Abilities also increase over the time frame, while Physical Abilities and Psychomotor Abilities remain flat.

The relatively flat levels for Physical Abilities and Psychomotor Abilities are consistent with the idea that there will be an increase in automation and robotics that will diminish the need for people to contribute in this way. This pattern more or less repeats itself in the occupation types in the dataset (Figure 4: NGEN41 KSAO Changes by Occupation Type).

Figure 3: Projected Aggregate Changes of the NGEN41 KSAO Competencies



The increase in the Knowledge construct is not surprising given how the rapid change in new technologies are expected to drive a rapid change in how manufacturing gets done. As Industry 4.0 and artificial intelligence technologies become more prevalent in the manufacturing environment, the knowledge to apply these technologies to become more productive and competitive will demand that everyone in the workplace contribute new knowledge to facilitate new ways of doing things.

Concomitant with the adoption of these technologies, one could expect an increase in the level of proficiency of cognitive skills and this is observed over every occupation type represented in Figure 4. This is consistent with the need to have a workforce with a higher level of education and experience to effectively implement advanced manufacturing technologies and methods.

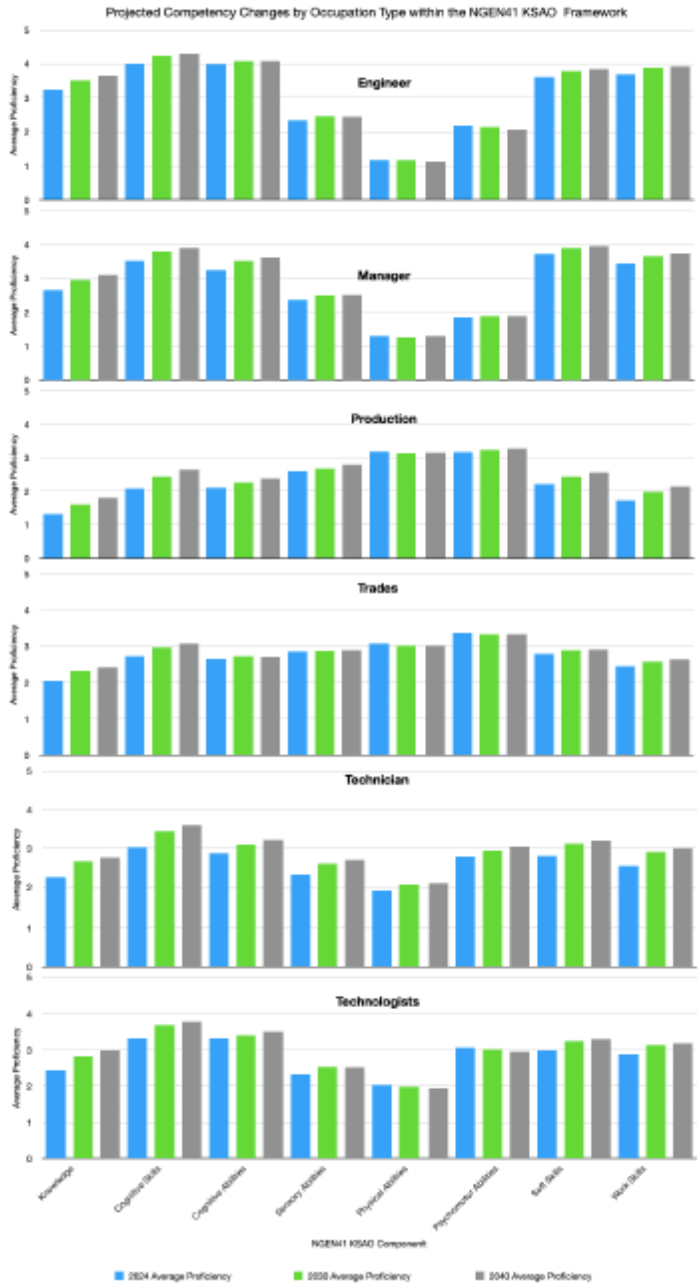
Increases in proficiency levels for soft skills and work skills are also observed over all occupation types.

The increase in work skills is consistent with a work environment that is less based on routine and more fluid in the range of possible tasks needed to advance work processes. Adoption of new manufacturing technologies does not lead to a static outcome. Rapid changes in technology and the resulting capabilities will continue to drive change on an ongoing basis.

This kind of change environment will require significant collaboration to

- recognize and solve problems,
- embrace the new technologies, and
- adopt new ways of doing things

Figure 4: NGEN41 KSAO Changes by Occupation Type



An increase in collaboration and collective effort means more interaction between people.

Productively managing these interactions requires an increase in soft skill effectiveness.

Although competencies related to physicality, (i.e. Physical Abilities and Psychomotor Abilities), are flat to slightly decreasing across most of the occupation types, the exception is with Technicians; they register an increase in physicality.

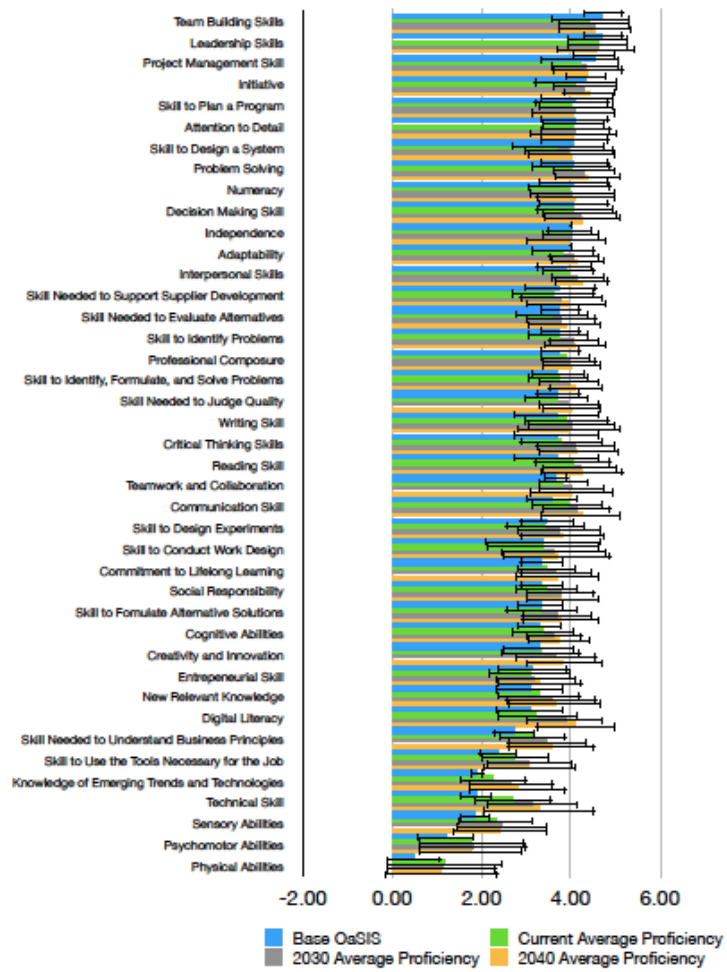
Generally, technicians are responsible for machine set ups, problem solving, calibrations, and solution implementation. These tasks all require a high degree of human interaction with the machine environment.

Individual Competency Changes

Manufacturing organizations trying to understand how the skill set of their workforce needs to change over time will want an assessment of how the individual competencies of the NGEN41 change. At this point, it is interesting to take a closer look to examine how the individual competencies of the NGEN41 change over the time frames of interest, as they relate to individual occupation types and manufacturing sub-sectors.

For each of the occupation types, for which there was sufficient data, Pareto charts were generated (Figure 5: Manager - Pharma 3254 is an example). These charts convey the ranking of competencies for the calculated OaSIS base plus the Current, 2030, 2040 inputs from survey participants.

Figure 5: Manager - Pharma 3254



A close examination of the Pareto chart reveals that the sort order of the competencies changed compared to the OaSIS base for each of the time frames in the survey. This is captured in Table 7: Colour map of Production competency rankings across sectors, 2024 - 2040 which is a colour map for the production occupation type, of the top 10 competencies and how they change over time for all sub-sectors in the survey.

Table 7: Colour map of Production competency rankings across sectors, 2024 - 2040

<table>
<tr><th>Rank</th><th>Food</th><th>Mining</th><th>Pharma 3254</th><th>Aerospace</th><th>Shipbuilding</th><th>Automotive</th></tr>
<tr><th></th><th>Current</th><th>Current</th><th>Current</th><th>Current</th><th>Current</th><th>Current</th></tr>
<tr><td>1</td><td>Physical Abilities</td><td>Psychomotor Abilities</td><td>Teamwork and Collaboration</td><td colspan="3">Attention to Detail</td></tr>
<tr><td>2</td><td>Psychomotor Abilities</td><td colspan="2">Physical Abilities</td><td>Psychomotor Abilities</td><td>Physical Abilities</td><td>Independence</td></tr>
<tr><td>3</td><td>Attention to Detail</td><td>Teamwork and Collaboration</td><td>Psychomotor Abilities</td><td>Physical Abilities</td><td>Psychomotor Abilities</td><td>Skill to Use the Tools Necessary for the Job</td></tr>
<tr><td>4</td><td colspan="2">Adaptability</td><td>Skill to Use the Tools Necessary for the Job</td><td>Technical Skill</td><td>Teamwork and Collaboration</td><td>Professional Composure</td></tr>
<tr><td>5</td><td>Independence</td><td>Attention to Detail</td><td>Sensory Abilities</td><td colspan="2">Adaptability</td><td>Psychomotor Abilities</td></tr>
<tr><td>6</td><td>Teamwork and Collaboration</td><td>Professional Composure</td><td>Reading Skill</td><td colspan="2">Independence</td><td>Teamwork and Collaboration</td></tr>
<tr><td>7</td><td>Skill Needed to Judge Quality</td><td>Independence</td><td>Attention to Detail</td><td>Teamwork and Collaboration</td><td>Professional Composure</td><td>Adaptability</td></tr>
<tr><td>8</td><td>Sensory Abilities</td><td>Skill to Use the Tools Necessary for the Job</td><td>Adaptability</td><td colspan="2">Skill to Use the Tools Necessary for the Job</td><td>Physical Abilities</td></tr>
<tr><td>9</td><td>Skill to Use the Tools Necessary for the Job</td><td>Reading Skill</td><td colspan="4">Skill Needed to Judge Quality</td></tr>
<tr><td>10</td><td>Communication Skill</td><td>Sensory Abilities</td><td>Problem Solving</td><td colspan="2">Reading Skill</td><td>Critical Thinking Skills</td></tr>
</table>

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<tr><th>Rank</th><th>Food</th><th>Mining</th><th>Pharma 3254</th><th>Aerospace</th><th>Shipbuilding</th><th>Automotive</th></tr>
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<tr><td>1</td><td>Adaptability</td><td>Psychomotor Abilities</td><td>Teamwork and Collaboration</td><td>Attention to Detail</td><td>Teamwork and Collaboration</td><td>Attention to Detail</td></tr>
<tr><td>2</td><td>Psychomotor Abilities</td><td>Teamwork and Collaboration</td><td>Skill to Use the Tools Necessary for the Job</td><td>Psychomotor Abilities</td><td>Attention to Detail</td><td>Skill to Use the Tools Necessary for the Job</td></tr>
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<tr><td>4</td><td>Physical Abilities</td><td>Adaptability</td><td>Sensory Abilities</td><td>Adaptability</td><td>Psychomotor Abilities</td><td>Teamwork and Collaboration</td></tr>
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<tr><td>9</td><td>Skill to Identify Problems</td><td>Reading Skill</td><td>Problem Solving</td><td>Skill to Use the Tools Necessary for the Job</td><td colspan="2">Skill Needed to Judge Quality</td></tr>
</table>

9	Skill to Identify Problems	Reading Skill	Problem Solving	Skill to Use the Tools Necessary for the Job	Skill Needed to Judge Quality	
10	Skill to Use the Tools Necessary for the Job	Technical Skill	Professional Composure			Critical Thinking Skills

Rank	Food	Mining	Pharma 3254	Aerospace	Shipbuilding	Automotive
	2040	2040	2040	2040	2040	2040
1	Adaptability	Teamwork and Collaboration	Skill to Use the Tools Necessary for the Job	Attention to Detail	Teamwork and Collaboration	Attention to Detail
2	Teamwork and Collaboration	Psychomotor Abilities	Adaptability	Psychomotor Abilities	Attention to Detail	Skill to Use the Tools Necessary for the Job
3	Psychomotor Abilities	Adaptability	Teamwork and Collaboration		Reading Skill	Teamwork and Collaboration
4	Skill Needed to Judge Quality	Physical Abilities		Independence	Physical Abilities	Independence
5	Attention to Detail	Skill to Use the Tools Necessary for the Job	Sensory Abilities	Physical Abilities	Adaptability	Professional Composure
6	Skill to Identify Problems	Attention to Detail	Digital Literacy	Skill Needed to Judge Quality	Psychomotor Abilities	Adaptability
7	Physical Abilities	Professional Composure	Psychomotor Abilities	Adaptability	Skill to Use the Tools Necessary for the Job	Psychomotor Abilities
8	Reading Skill	Independence	Problem Solving	Skill to Use the Tools Necessary for the Job	Independence	Technical Skill
9	Communication Skill	Reading Skill	Independence	Digital Literacy	Problem Solving	Critical Thinking Skills
10	Problem Solving	Technical Skill	Attention to Detail	Professional Composure	Skill Needed to Judge Quality	

Some shuffling of competencies is observed between time frames. Some of these changes are small (perhaps even insignificant), while some competencies disappear completely from this list of 10, and others suddenly appear (i.e. Digital Literacy in 2040).

Considering that these lists are organized by proficiency level, they can be considered a reflection of how important competencies are to be able to do the job.

Magnitude of Changes

Additionally, the magnitude of change can be computed for each of the NGEN41 competencies to see where the largest changes are in proficiency level. These indicate where the largest gaps are in workforce proficiency.

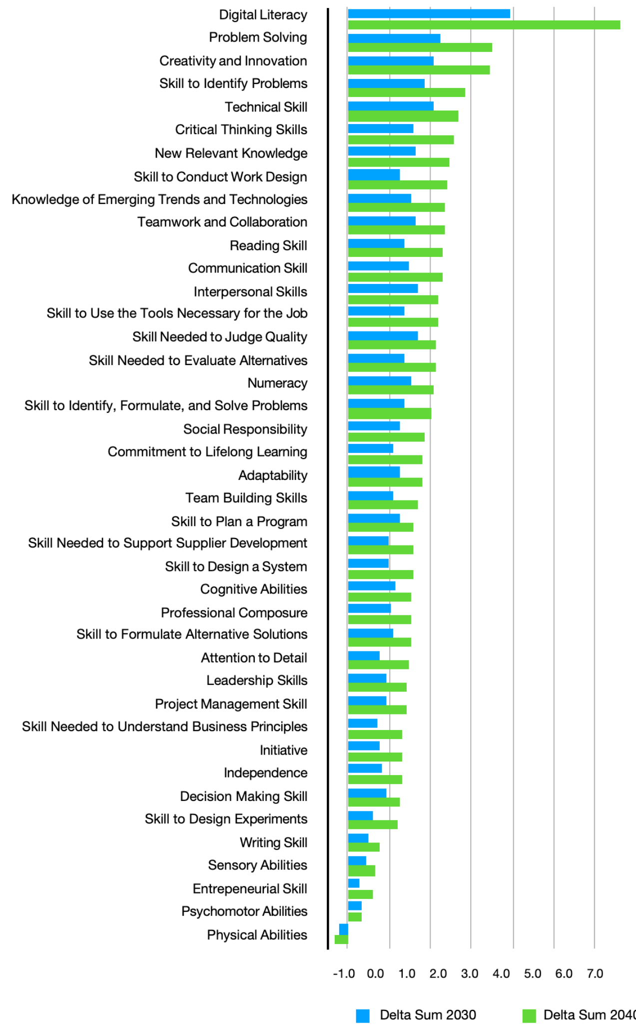
Figure 6: Proficiency Changes from Current for Production Across Six Manufacturing Sub-sectors is a Pareto chart of these changes across six sub- sectors for the Production occupation type. The chart is organized according to the sum of the changes in proficiency.

The largest observed changes in projected proficiencies are occurring with Digital Literacy, Problem Solving, and Creativity and Innovation.

Notice that Attention to Detail, which is in the top ten lists in Table 7, are at the bottom of the change Pareto. Also, Digital Literacy, which has the largest proficiency change in 2030 and 2040, only shows up in the 2040 top ten lists for two of the sectors.

This example illustrates that both the change in competencies, as well as the relative importance of the competency to the occupation, need to be considered.

Figure 6: Proficiency Changes from Current for Production Across Six Manufacturing Sub-sectors



To understand the changes in competencies, the survey data was organized into lists of average proficiency by occupation type and by sector.

Where Are The Biggest Changes in Competencies Observed?

The differences between current proficiencies and projected proficiencies were collected across sub-sectors and inspected for agreement. Changes in competencies that were equal to or greater than 0.5 were considered significant. (Recall that a change of 1.0 is equal to a change in expertise level on the 5-point proficiency scale). Competencies were grouped according to the number of sectors in which the level of change was 0.5 or greater. Typically, this grouping was based on one less than the number of sectors being considered. For example, if 6 sectors were being studied together (for a particular occupation type) a competency made it onto the change list if the observed change was significant over at least 5 of the sectors.

- future cross-sector mobility, assuming that the changes have a similar relative ranking in the list of proficiencies for the occupation type in each sector (more on this later).

Here, for reasons outlined previously we start by considering the data collected from participants associated with the individual industry associations. As previously indicated, the data is sufficient for analysis for the 'Production' and 'Trades' occupation types.

The dataset for BioTalent Canada contained two large datasets for two clearly different sectors:

- the Pharma Sector 3254, and
- the Medical Equipment Sector 3391.

Accordingly, only the Pharma data was used for this analysis since the other set was not large enough to support relevant outcomes.

Table 8: Summary of Most Significant Future Competency Changes from Current Levels

Change Rank Order	Production across Industry Association Sectors		Production across NAICS Codes		Trades across Industry Association Sectors		Trades across NAICS Codes		Engineer across NAICS Codes	
	2030	2040	2030	2040	2030	2040	2030	2040	2030	2040
1	Digital Literacy	Digital Literacy	Digital Literacy	Digital Literacy	Digital Literacy	Digital Literacy	Digital Literacy	Digital Literacy		Knowledge of Emerging Trends and Technologies
2		Problem Solving			Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies		
3		Creativity and Innovation								

This approach looks for commonality across sub-sectors for a particular occupation. It is an indicator of

- how broad a particular change in competency is within the manufacturing sector, and

The largest changes across multiple sub-sectors from the participant-calibrated 'Current' proficiency level to the 2030- and 2040-time frames are captured in Table 8: Summary of Most Significant Future Competency Changes from Current Levels. Across the Production and Trades occupation types, Digital Literacy consistently ranks first with the largest changes in proficiency level. This is a reflection of several of the trends currently shaping manufacturing sector organizations. Industry 4.0 driven automation and data driven production strategies demand a higher level of digital literacy. This competency does not show up as a large gap for the Engineer occupation type, presumably because the impression is that Engineers are already sufficiently proficient with digital tools.

After digital literacy, cognitive and knowledge competencies show the largest gaps. Those with 'hands on' production responsibilities are expected to be more proficient at Problem Solving and to play a greater role in Creativity and Innovation. These findings paint a picture of a more skilled production workforce that will need problem solving skills to support an Industry 4.0 framework, but also to enhance productivity by using these problem-solving skills to find more efficient and effective ways of using enhanced production processes to support competitiveness.

Those within the Trades and Engineer occupations appear to be expected to support productivity gains using a Knowledge of Emerging Trends and Technologies. As adoption of digital automation, data intense processes, and the use of artificial intelligence broadens, emerging digital tools, better understanding of processes, and the resulting changes to processes will drive an ongoing change paradigm in which these occupations are likely to be at the fore front of implementing new approaches.

The summary of competency changes in occupation types within a sector (Table 9: Summary of Most Significant Future Competency Changes Within Sectors) shows some of the same trends, but also some sector differences. Digital literacy shows the largest competency gap in both the Aerospace 3364 and Chemical Manufacturing 325 sub-sectors. This gap is apparent for Production and Trades occupation types, but also for the Manager occupation type.

Notably, it was expressed that this is not a gap for Engineers.

It is interesting that for Engineers, in addition to the aforementioned 'Knowledge of Emerging Trends and Technologies', a mix of soft skills, cognitive skills, and work skills show up as gaps. This is particularly true of the Aerospace sub-sector where it appears that an enhanced level of responsibility to work with, or lead teams appears to be expected going forward. It also appears, that in this sector, Engineers are expected to play a bigger role in independently ensuring that problem solving is aligned with the needs of the business.

The Manager occupation type, in addition to the projected gap in Digital Literacy, also lists projected gaps in 'Technical Skill', 'Knowledge of Emerging Trends and Technologies', and 'Creativity and Innovation'. Taken together, these gaps infer increasing responsibility for Managers to understand technical details and the emerging trends and technology in order to support the efforts of other occupation types in developing and implementing creative solutions to production challenges.

Taken together, these analyses infer that all of the job functions in the organization have some competency building to do in order to effectively contribute to an environment in which change will happen more rapidly and demand everyone to take more responsibility to flexibly support the incorporation of change into the workplace.

Table 9: Summary of Most Significant Future Competency Changes Within Sectors

Change Rank Order	Chemical Manufacturing 325						Aerospace 3364					
	Manager		Engineer		Production		Engineer		Production		Trades	
	2030	2040	2030	2040	2030	2040	2030	2040	2030	2040	2030	2040
1	Digital Literacy	Digital Literacy		Knowledge of Emerging Trends and Technologies		Digital Literacy	Skill to Plan a Program	Skill to Plan a Program	Digital Literacy	Digital Literacy	Digital Literacy	Digital Literacy
2		Technical Skill		Adaptability		Indepen-dence	Teamwork and Collaboration	Knowledge of Emerging Trends and Technologies			Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies
3		Knowledge of Emerging Trends and Technologies		Technical Skill			Project Management Skill	Teamwork and Collaboration			Decision Making Skill	Decision Making Skill
4		Creativity and Innovation						Skill to Identify Problems				
5								Skill Needed to Support Supplier Development				
6								Project Management Skill				
7								Initiative				
8								Skill Needed to Understand Business Principles				

Dealing With the Gaps

There are multiple approaches that manufacturing sector organizations can use to achieve the workforce competency levels needed to effectively operate in 2040. Most organizations will need to adopt several of these approaches in order to achieve the workforce talent levels projected for 2040. We discuss some of those here in the context of the nuances that were evident from the survey data analysis.

Specific approaches to solving the skills gap problem include:

1. Upskilling
2. Recruitment within the Manufacturing Sector
3. Recruitment from other Sectors
4. Training and Education Collaborations
5. Supporting a National Strategy for Workforce Upskilling

UPSKILLING

Investing in the training needed to improve proficiency levels within an organization's existing workforce is one of several strategies to achieve the desired talent competency level by 2040. This approach requires the organization to identify competency gaps in their existing workforce and then to find and engage in the appropriate training to close the competency gap.

Which gaps should organizations target to invest in the training to close the gap? Ideally, all gaps would be identified and invested in, but this may not be feasible. There is also the dichotomy, pointed out earlier, that the most important competencies associated with the ability to perform in an occupation may not be the same competencies that are projected to have the largest performance gaps. The competencies with the largest gaps are not necessarily the competencies that are rated most important to do the job. There is a trade-off between the size of the competency gap and the relative importance of the competency to occupational performance.

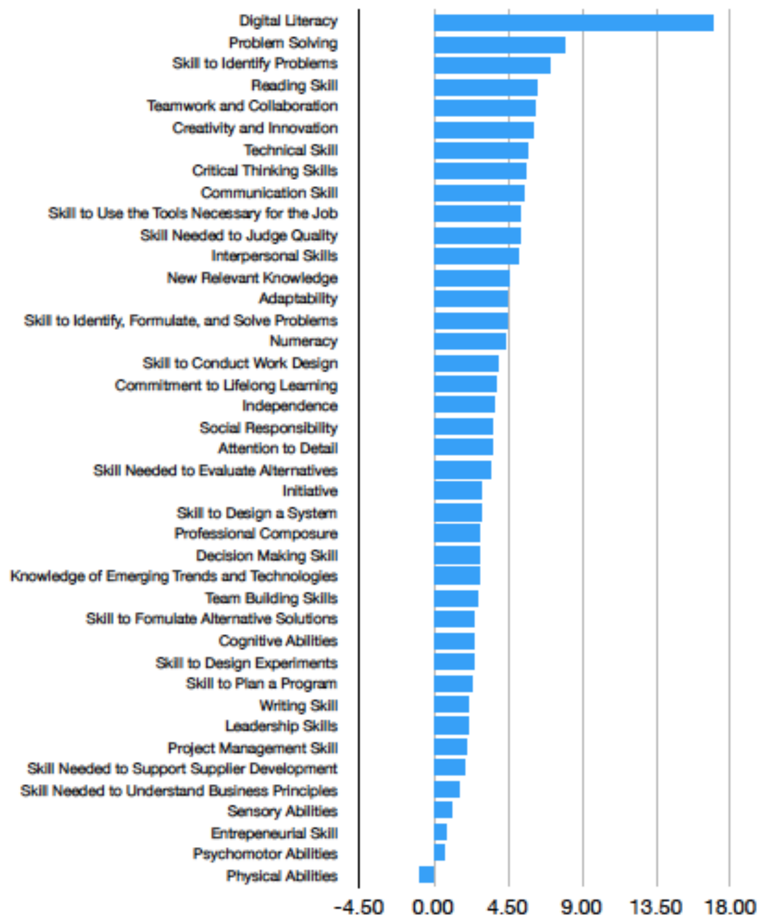
To reconcile this dichotomy, we have considered the product of these two numbers which we call the **Skill Upgrade Ratio**.

Competencies with a big gap but a lower level of relative importance will be elevated, as will competencies with a smaller gap but a larger relative importance. The third column in Table 10: Competency Rankings for 2040 - Production - Across NAICS Codes 325, 3364, 3366, 332,335,333, 311 contains a rank order list of the Skill Upgrade Ratio for the same data.

Inspection of this list reveals that the approach 'juggles' the top competencies from the Change and Proficiency rankings. It is also interesting to examine more closely the relative competencies on the Skill Upgrade Ratio list.

Figure 7: Sum of Skill Upgrade Ratio - Production - Across NAICS Codes 325, 3364, 3366, 332,335,333, 311 plots the sum of the Skill Upgrade Ratio for the Production occupation type, across all of the listed NAICS codes. It is clear from this plot that the most important competency for upskilling is **Digital Literacy**. It is also interesting though to look at what other competencies have priority. In the first 10 of these skills, a combination of cognitive skills and soft skills dominate the order of importance. This is consistent with the idea that a future workplace will require workers that are not only able to competently work with the technology and machines of automation, but will also need to have increased cognitive skills, be able to effectively work with others to solve problems, and creatively implement improvements as technology continues to evolve.

Figure 7: Sum of Skill Upgrade Ratio - Production - Across NAICS Codes 325, 3364, 3366, 332,335,333, 311



This observation extends to other occupation types as well (see Appendix 10: Skill Upgrade Ratio Plots for plots of the other occupation types).

Figure 7 (and the plots for other occupation types in the Appendices) is also relevant to those in the training and education business. Soft skills training is typically not explicitly targeted in education and training programs that are focused on delivering technical knowledge. While there are clearly some technical related skills that rank high on the Upgrade list, there is a preponderance of cognitive and soft skills that also are important. This is an opportunity for educators and trainers to provide programs focused on upgrading these particular skills.

Table 10: Competency Rankings for 2040 - Production - Across NAICS Codes 325, 3364, 3366, 332,335,333, 311

NGEN41 Ranked Change to 2040	NGEN41 Ranked Proficiency 2040	Skill Upgrade Ratio for 2040
Digital Literacy	Teamwork and Collaboration	Digital Literacy
Problem Solving	Psychomotor Abilities	Problem Solving
Communication Skill	Attention to Detail	Skill to Identify Problems
Critical Thinking Skills	Adaptability	Reading Skill
Creativity and Innovation	Physical Abilities	Teamwork and Collaboration
Interpersonal Skills	Skill to Use the Tools Necessary for the Job	Creativity and Innovation
Skill Needed to Evaluate Alternatives	Reading Skill	Technical Skill
Social Responsibility	Digital Literacy	Critical Thinking Skills
Teamwork and Collaboration	Independence	Communication Skill
Technical Skill	Skill Needed to Judge Quality	Skill to Use the Tools Necessary for the Job
Adaptability	Problem Solving	Skill Needed to Judge Quality
Decision Making Skill	Sensory Abilities	Interpersonal Skills
Skill Needed to Understand Business Principles	Technical Skill	New Relevant Knowledge
Independence	Skill to Identify Problems	Adaptability
Numeracy	Professional Composure	Skill to Identify, Formulate, and Solve Problems
Skill to Design a System	Communication Skill	Numeracy
Skill to Design Experiments	Commitment to Lifelong Learning	Skill to Conduct Work Design
Skill to Identify, Formulate, and Solve Problems	Critical Thinking Skills	Commitment to Lifelong Learning
Attention to Detail	Numeracy	Independence
Physical Abilities	Skill to Identify, Formulate, and Solve Problems	Social Responsibility
Entrepeneurial Skill	Writing Skill	Attention to Detail
Professional Composure	Cognitive Abilities	Skill Needed to Evaluate Alternatives
Knowledge of Emerging Trends and Technologies	Creativity and Innovation	Initiative
Psychomotor Abilities	Interpersonal Skills	Skill to Design a System
Reading Skill	Initiative	Professional Composure
Sensory Abilities	Decision Making Skill	Decision Making Skill
Skill Needed to Support Supplier Development	Team Building Skills	Knowledge of Emerging Trends and Technologies
Skill to Conduct Work Design	Leadership Skills	Team Building Skills
Skill to Plan a Program	Skill to Design Experiments	Skill to Formulate Alternative Solutions
New Relevant Knowledge	Skill Needed to Evaluate Alternatives	Cognitive Abilities
Cognitive Abilities	Skill to Design a System	Skill to Design Experiments
Commitment to Lifelong Learning	New Relevant Knowledge	Skill to Plan a Program
Initiative	Skill to Plan a Program	Writing Skill
Leadership Skills	Social Responsibility	Leadership Skills
Project Management Skill	Skill to Conduct Work Design	Project Management Skill
Skill Needed to Judge Quality	Skill to Formulate Alternative Solutions	Skill Needed to Support Supplier Development
Skill to Formulate Alternative Solutions	Skill Needed to Support Supplier Development	Skill Needed to Understand Business Principles
Skill to Identify Problems	Project Management Skill	Sensory Abilities
Skill to Use the Tools Necessary for the Job	Entrepeneurial Skill	Entrepeneurial Skill
Team Building Skills	Knowledge of Emerging Trends and Technologies	Psychomotor Abilities
Writing Skill	Skill Needed to Understand Business Principles	Physical Abilities

RECRUITMENT

One approach to recruitment might be to use the top ten competencies from the Upskilling ranking in Figure 7 and then search the OaSIS database for those competencies and the associated average proficiencies from the analysis.

This was attempted using the online OaSIS search tool which allows someone to build a list of competencies and associated proficiency or importance scales, and then to search the OaSIS database for occupation descriptions that are close to the list. In this case, the NGEN41 top ten were converted back to the original OaSIS descriptors and the proficiency and importance scales were set to the averages from the survey analysis for the Production occupancy type. Since OaSIS does not allow fractional proficiencies, the averages were rounded to the closest integer. The search inputs can be found in Appendix 11: OaSIS Searches for Occupations Having the Top 5 Production Upskilling Competencies.

In the case for which the NGEN41 top ten for production were searched, there were no matches. This was somewhat surprising given the 900 occupations in the database. However, in hindsight, perhaps not so surprising given that the competency combination is based on a projection of an occupation in 2040. A second search on only the top five competencies produced the same result. Further investigation generated the results in Table 11: Results of Advanced OaSIS Competency Searches.

When Teamwork and Collaboration are added to the 4 other NGEN41 competencies, the OaSIS database returns zero occupations. The projected combination of cognitive skills and soft skills is simply not currently available according to the OaSIS database.

The 48 occupations generated by the OaSIS database up to the Upskilling Rank 4 in Table 11: Results of Advanced OaSIS Competency Searches, are listed in Appendix 11. They are a mix of occupations from Business, Finance and administration, Natural and applied sciences and related occupations, Health occupations, Occupations in education, law, social, community and government services, Occupations in art, culture, recreation, and sport, Sales and service occupations, Trades, transport and equipment operators and related occupations, and finally, Occupations in manufacturing and utilities. The Training, Education, Experience, and Responsibilities (TEER) categorization of these occupations are almost all college or university degree-specified or apprenticeship training of two or more years.

Not only is the set of competencies currently unavailable in another occupation to recruit, but the list of occupations that satisfy even

Table 11: Results of Advanced OaSIS Competency Searches

Upskilling Rank	NGEN41 Competency	Oasis Competencies	# Occupations uncovered in OaSIS Advanced Search
1	Digital Literacy	Digital Literacy	188
2	Problem Solving	Problem Solving	78
3	Skill to Identify Problems	Problem Identification	55
4	Reading Skill	Reading Comprehension	48
5	Teamwork and Collaboration	Concern for Others, Collaboration	0

the first 4 top competencies require considerable education and training.

NATIONAL STRATEGY FOR THE DEVELOPMENT OF MANUFACTURING WORKERS

If upskilling is the only path to achieving a competitive manufacturing workforce in 2040, then it would be logical that the upskilling has to start now since it typically takes a number of years for educational institutions to respond to market needs. Furthermore, these institutions are unable to respond to multiple demands from multiple organizations, all of them asking for customized outcomes. How then to cost effectively engage in the upskilling work needed for the Canada's workforce to be competitive in 2040?

One approach would be to remove the burden of upskilling from individual manufacturing organizations. This is not to suggest that individual manufacturing organizations shouldn't invest in upskilling, but rather that the upskilling should be organized to provide organizations with the maximum results for their investment dollars. The development of a standard which can be widely communicated and acted upon by educational institutions and training organizations might be a solution. It would require manufacturing organizations to agree on the training standard and then to invest in putting their employees through the training. It would also require an investment in the future workforce that will gradually replace the current cadre of workers, and this same standard might be used as the driver for curriculum development with the formal educational institutions.

An individual manufacturing organization would be unable to take this on. It will require a collective effort that is representative of the whole manufacturing sector. It will also require an independent organization to organize the work needed to develop the standard, and to drive training and education market response to facilitate upskilling to the standard.

Recommendations

Each association provided insights into approaches and considerations that are required to ensure the sector is able to continue to flourish as Industry 4.0 continues to push forward. The depth and breadth of information provided by the sub-sector associations allows us to comfortably answer these questions:

To what extent can the OaSIS database support the future needs of the manufacturing sector?

The OaSIS system serves as an excellent starting point to define occupational competencies and skills. Its standardized approach to defining skills and competencies across the entire Canadian workforce provides employers with a window to cross-sector mobility and recruitment.

However, although the database is relatively new (2022), manufacturing organizations that participated in the survey consistently identify higher current levels of proficiency across most skills and competencies, than those indicated in the database. This suggests that the OaSIS system is lagging in its indication of skill levels with respect to current employee performance.

RECOMMENDATIONS

1. Economic and Social Development Canada should consider a broad-based survey of Canadian employers to ensure that skill ratings in the database reflect the current employment reality.
2. Based on the projected rate of change of skill levels with some of the competencies studied here, the system may require an update frequency that exceeds the currently anticipated rate of 20% of the system per year.

To what extent are manufacturing sub-sectors aligned on key skills and competencies?

Workforce skills and competencies were shown to be almost identical across various manufacturing sub-sectors for the skills and competencies that were included in this study. Specific knowledge competencies were not addressed here.

This suggests that recruitment across different manufacturing sectors should be possible if training is provided for sub-sector specific knowledge. This approach would need to be justified based on the cost of the training involved, compared to the difficulty of recruitment of individuals that are already fully skilled in sub-sector specific knowledge.

It is clear that the similarities between sub-sectors can enable broad-based training in the competencies that make up the NGEN41. There was also agreement on skills and competencies that are projected to be needed in the next 16 years. There is an opportunity for manufacturing organizations to reduce training costs by aggregating their training requirements on a go-forward basis. Another opportunity may be found in taking a pan-Canadian perspective on upskilling workers from one sector to another. This could be highly effective at retaining critical manufacturing talent in the event of broad shifts in sectoral employment levels.

RECOMMENDATIONS

Suggested training recommendations to support building the skills and competencies of the manufacturing sector workforce were embedded in each association's research report. A full list of these recommendations, by association, are included in *Appendix 12: Association Recommendations*.

The key messages identified across sub-sectors are summarized below:

Training
Provide training initiatives, collaborating with education partners
Provide ongoing professional development
Training programs should focus on software integration, robotics and control systems
Look beyond the classroom for learning opportunities, including work-integrated learning
Establish train-the-trainer programs in post-secondary institutions using former, retired and/or physically disabled employees, trade unions, industry experts
Revisit training requirements and accreditation models, including micro-credentials, shorter training to re-skill, up-skill and cross-skill
Create private / public sector partnerships for training infrastructure, including centralized training hubs devoted to hands-on training common to industry requirements
Provide increased support for research and innovation focused on training efficacy

Where might the workforce come from with the required skill levels?

Identifying, building and training the skills and competencies of the manufacturing workforce is critical - once you have them. Searching for future projected competencies in the OaSIS system proved fruitless inferring that firms cannot recruit their way to the future. Investment in employee upskilling is the most probable path to achieving future competitive skill levels.

We know from all of the associations that recruitment is a significant challenge. The manufacturing sector is not seen as "sexy" by young Canadians, according to one association. All agree that there are opportunities to market the sector differently in order to better entice potential younger new hires to apply for roles in the first place and excite them during the recruitment process. Recruitment marketing should include a focus on upskilling investment so young recruits will perceive the opportunity to grow favourably.

RECOMMENDATIONS

As stated earlier, recruitment across different manufacturing sectors should be possible if training is provided for sub-sector specific knowledge. In order to recruit effectively, the industry needs to be marketed more effectively. Suggestions focused on supporting marketing and recruitment were provided by every association and are also included in Appendix 12.

Here is a summary of key highlights.

Marketing
Raise awareness of careers across manufacturing and provide a better understanding of the roles in advanced manufacturing.
Raise awareness about the state-of-the-art facilities, advanced technologies, clean environments and career paths
Communicate with stakeholders and training providers to ensure skills for today and the future are being taught
Alter traditional perceptions of manufacturing sector
Promote the opportunities to engage in well-paid and stable roles
Promote and facilitate second career opportunities
Promote greater mobility
Raise awareness of careers across manufacturing and provide a better understanding of the roles in advanced manufacturing.

Recruitment
Build academic-industry collaborations so industry has ‘first shot’ at graduates and closer to training institutions
Look beyond the traditional pool of applicants to include competitors and unrelated industries, and other jurisdictions. Increase the level of diversity, equity and inclusion: Women, new Canadians, Indigenous Peoples.
Provide more incentives such as rapid advancement, job enrichment, varied work and training, more social engagement within company
Encourage slowed retirement of skilled and experienced workers
Recruit skilled immigrants
Embrace cross migration of workforces to areas with more affordable costs
Re-assess bureaucracy and regulations to enable faster availability to work
Move operations from urban core where competition is high to suburban or rural settings where they can dominate the job market

What national support is required to help ensure the manufacturing sector can thrive with Industry 4.0?

Some of the association participants specifically mentioned the need for a national strategy to support their sector. When you look at the interconnectedness of the skills, competencies and recommendations for learning, recruiting and marketing across the sector, a national strategy should be considered - one that focuses on addressing the workforce challenges experienced by the entire sector. The transferable skills embodied in the NGEN41 are well suited to a program focused on skill development that is relevant to all manufacturing sectors.

RECOMMENDATIONS

Like the other sector-wide recommendations posed by the Associations, suggestions focused on building a national strategy on recruitment, training and other challenges is included in Appendix 12: Association Recommendations.

Here is a summary of key highlights:

National Strategy
Build a coordinated national strategy for relevant post-secondary training
Create a sector-wide approach to address workforce challenges and highlight opportunities
Hold Provincial and National tables to highlight and discuss challenges and potential solutions

The Canadian manufacturing sector is recognized on the international stage. It is clear from this research that there are challenges impacting the sector today that will, if not addressed, impact on our ability to continue to compete at the levels we are at today.

The recommendations provided here are mostly tactical and have visible outcomes if they are applied successfully. It appears that all research participants are aligned on the need to move forward with actions to support minimizing these challenges in both the short and longer term.

Summary

This research has clearly identified the changing skill needs in the Canadian Manufacturing Workforce. This research provides valuable insights to support and guide the short and long- term decisions required to help ensure the manufacturing sector continues to thrive in Canada.

Opportunities can be created immediately for the existing workforce to support:

- cross-sector mobility
- the use of experienced workers at all levels and roles to support upskilling
- the identification of individual skill and competency development requirements for future success

To help ensure a relevant future workforce, employers need to:

- invest in upskilling
- expand their reach for recruitment beyond the historical pools
- work to entice a more diverse and younger workforce

Cross-sector marketing to younger generations is key and can be started almost immediately. The marketing focus should be on:

- the opportunities for long term career development
- upskillng
- the organization's ability to align individual and work-related expectations

This research extends outside the manufacturing organizations themselves. Policy makers should consider a national program focused on upskilling the entire manufacturing workforce to help ensure the capability exists to successfully participate in the sector's digital future.

Digital skills alone are not enough; the focus needs to include cognitive and soft skills.

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Appendices

Appendix 1- Automotive Parts Manufacturing Association Report

Appendix 2- Bio Talent Canada Report

Appendix 3- Canadian Marine Industries and Shipbuilding Association Report

Appendix 4- Downsview Aerospace Innovation and Research Report

Appendix 5- Food Processing Skills Canada Report

Appendix 6- Saskatchewan Industrial and Mining Suppliers Association Report

Appendix 7- Developing the NGEN41 and Survey Description

Appendix 8- Table of National Occupation Codes in the Survey and the Corresponding Occupation Types.

Appendix 9- Proficiency Data

Appendix 10- Skill Upgrade Ratio Data

Appendix 11- OaSIS Database Searches for future skills matching

Appendix 12 - Association Recommendations

Appendix 1

Automotive Parts Manufacturing Association Report

FINAL REPORT

LABOUR MARKET RESEARCH REGARDING THE COMPETENCIES OF THE CANADIAN MANUFACTURING WORKFORCE

NGen Program No. ESDC-18734392

Project Commissioned by:
Next Generation Manufacturing Canada (NGen)

Prepared by:
Automotive Parts Manufacturers' Association (APMA)

ABOUT APMA

The APMA is Canada's national association representing OEM producers of parts, equipment, tools, supplies, advanced technology and services for the worldwide automotive industry.

In 2018, automotive parts shipments were over $35 billion, and the industry employment level was over 100,000 people. The Association was founded in 1952 and its members account for 90% of independent parts production in Canada.

The APMA's fundamental objective is to promote the original equipment automotive supply manufacturing industry both domestically and internationally.

The APMA provides important industry representation to both federal and provincial governments, supports regional government initiatives, and creates and executes global marketing initiatives to develop trade and business opportunities for our membership. In addition to advocacy, the APMA also provides its members business development solutions and opportunities as well as guidance and assistance on modernizing their operations to suit the needs of Industry 4.0.

CONTENTS

SUMMARY: AUTOMOTIVE PARTS MANUFACTURING

The automotive parts manufacturing industry in Canada is a crucial component of the broader automotive sector, contributing billions in shipments and employing over 100,000. With over 100 years in Canada, the industry has proven to be innovative with high standards for quality, supplying components to both domestic and international vehicle manufacturers, especially the U.S. and Mexico.

The automotive parts manufacturing sector in Canada is made up of a diverse range of companies, including large Tier 1, 2 and 3 companies but especially small and medium- sized businesses. Despite global challenges like the pandemic, supply chain issues and labour shortages, the industry continues to be a strong contributor to the GDP, and the backbone of Ontario's manufacturing sector.

Key players include Magna, Linamar, Martinrea and ABC Technologies to name a few. They have operated in Canada for decades and supply both internal combustion and electric vehicles by producing engine parts, chassis systems, electrical systems, interior and exterior trim and advanced materials. Being members of the APMA, these companies help support research projects to provide feedback on the overall health of the sector.

Canadian automotive parts manufacturers invest heavily in research and development, often in partnership with colleges and universities, to develop cutting-edge products and to improve processes, efficiency and performance. Supply chain integration is a strength of Canadian automotive parts manufacturers because they are closely integrated into the global supply chain, supplying components to vehicle manufacturers worldwide. They collaborate with OEMs)to develop solutions and seamless integration into the vehicle assembly process. Looking within Canada specifically, Ontario remains the centre of automotive manufacturing in Canada, with a concentration of parts manufacturers in cities up and down Highway 401 like Windsor, Toronto and Kitchener-Waterloo. Quebec is next in line for a strong presence in the transportation equipment manufacturing, aerospace and critical mineral sectors.

Despite evolving market dynamics and technological disruptions, Canadian manufacturers continue to adapt and thrive, positioning the country as a leading player globally. The graph below illustrates that automotive manufacturers in Ontario stand as the largest employers in the industry. With extensive operations and workforce, they significantly contribute to the employment landscape, showcasing their pivotal role in driving the automotive sector forward.

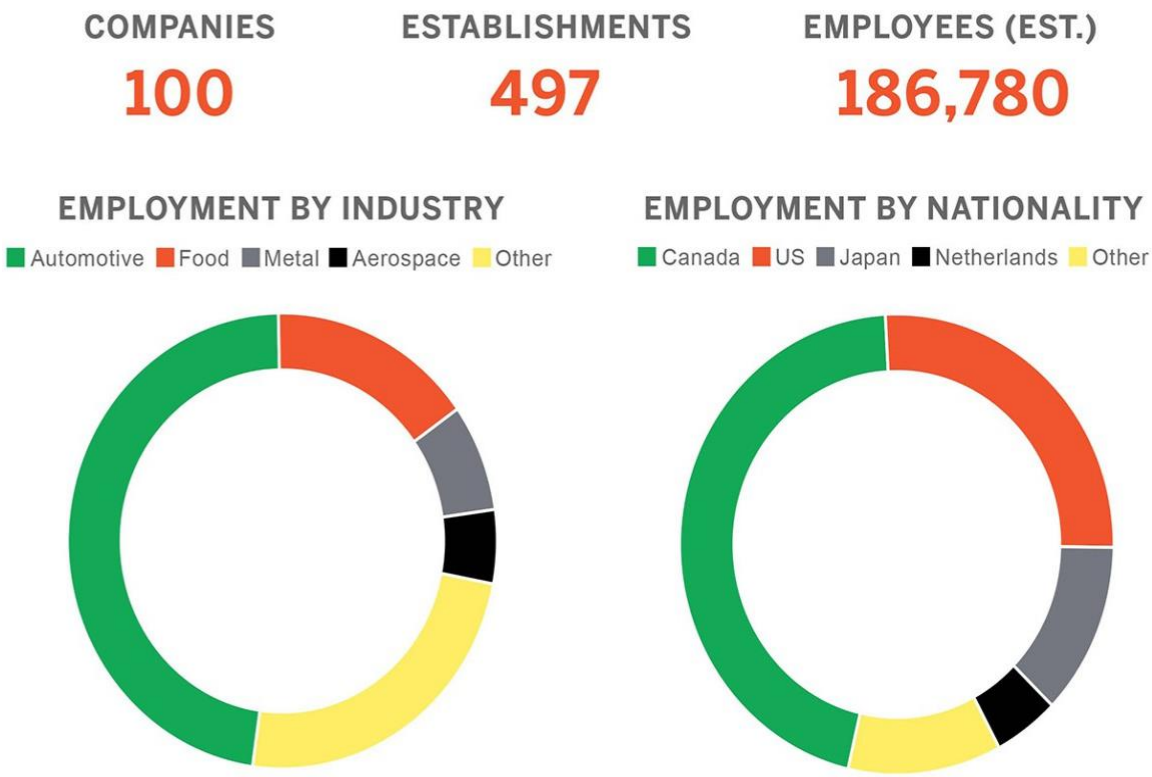


Figure 1 Automotive Industry Contribution to the Ontario Economy (February 2022), Source Trillium Network for Advanced Manufacturing

SECTOR OVERVIEW

With over 100 years in Ontario, automotive parts manufacturers have seen trends in employment demand reflect the ever-changing landscape shaped by population dynamics, economic forces and technological advancements. Below are significant key trends currently impacting the industry:

High Demand for Skilled Employees

There is consistent demand for highly skilled workers to address the existing labour shortage but this continues to take place across all major Canadian industry. In automotive, highly skilled positions require expertise in electric and hybrid technologies, battery systems, software integration and data analytics. As the industry shifts towards Zero Emission Vehicles, the need for specialized skills continues to grow.

People/Soft Skills

Beyond technical competencies, there is a growing emphasis on people/soft skills in the automotive workforce, skills that focus on human interaction. Effective communication, teamwork, leadership and conflict management are critical components of a well-rounded employee profile. The ability to collaborate and adapt is vital in manufacturing plants to create company culture and retain workers.

Attracting Talent to Manufacturing Jobs

Attracting individuals to manufacturing jobs remains a significant challenge – not just highly skilled but all levels of employment. This is partly due to misconceptions about the nature of the work and manufacturing facilities. Stronger marketing and communications to raise awareness about the state-of-the-art facilities, advanced technologies, clean environments and career paths would significantly increase talent attraction.

Investment in Employee Development

To address technical and soft skills shortages, companies are investing in employee development programs both in-house and third-party. Training initiatives, apprenticeships and partnerships with colleges and universities are used to upskill the existing workforce and attract new talent. These programs aim to ensure that employees have the skills needed for their current job and to excel in a rapidly evolving industry.

Promotion of Diversity and Inclusion

In order to attract new talent, companies are identifying new pools of talent that have been historically excluded from the sector. With diversity in hiring practices, mentorship, wraparound supports and DEI training for all staff, the effort is resulting in individuals from various backgrounds, genders and demographics entering the automotive sector in higher numbers while removing barriers to access labour.

On-the-Job Training for Higher Retention

Companies are recognizing the scarcity of candidates who have the precise skills required for the automotive industry. In response, there has been a shift toward hiring individuals with foundational skills and then investing in on-the-job training programs to refine the specific skills for the job. This strategy has yielded higher retention rates because of the effectiveness of real-world, hands-on learning experiences.

Flexibility in Education Requirements

The emphasis on traditional educational qualifications is giving way to a more flexible approach. Companies are placing greater importance on candidates' potential, problem- solving abilities and soft/people skills. This shift reflects an understanding that the ability to learn and apply new skills quickly is often more valuable than specific educational criteria.

METHODOLOGY & SAMPLING STRATEGY

As part of this research project, APMA pledged to gather survey data and statistical insights from 25 companies engaged in automotive parts manufacturing. The sample selection aimed to mirror the distribution of manufacturing companies of different scales across various Canadian jurisdictions. To ensure inclusivity, a multi-phase strategy was devised, guaranteeing that all regions had the chance to participate and were adequately informed about the research endeavor.

We invited organizations within the automotive sector to actively participate in our research initiative focused on assessing current and anticipated workforce conditions. By joining this collaborative effort, the organization would play a pivotal role in shaping the future of the automotive industry workforce.

APMA's research initiative unfolds in two primary phases, complemented by outcomes from similar programs currently underway at the APMA in the areas of workforce development. The first phase entails contextual interviews designed to extract vital RFQ- required information. This encompasses an in-depth exploration of current and anticipated employment levels, the mass retirement currently taking place and recruitment challenges – especially those looking to new pools of talent, as articulated by the participating companies in the research. In addition to the interviews, participants are engaged in an online survey, utilizing the tool provided by NGen. This survey is specifically designed to assess the current and projected skill levels essential for various key manufacturing positions within their respective facilities. Together, these comprehensive research methods aim to paint a detailed and nuanced picture of the workforce landscape in Canada’s automotive manufacturing sector.

After the synchronous discussion and introduction of the walkthrough, participants received a follow-up email containing all essential links, codes, and instructions for completing the online survey. They were strongly encouraged to promptly engage in the survey activity. APMA employs a tracking system to monitor the progress of these participants, relying on filtered data reports supplied by NGEN and utilizing smart lists within the APMA’s tracker. This strategic approach ensures efficient monitoring and facilitates a streamlined process for overseeing participant engagement and survey completion.

In strategizing participation targets, APMA committed to incorporating data from a minimum of 25 companies within Canada’s automotive manufacturing sector. Considering the substantial concentration of the sector being in Ontario, it is expected that the final sample will mirror this geographical distribution. Additionally, deliberate efforts have been made to include companies of diverse sizes across Tier 1, 2 and 3, fostering a balanced and inclusive representation within the research sample.

Phase 1: Review Member Database

Within our extensive database of parts manufacturers, APMA has pinpointed over 100 organizations deemed potential participants for the NGen research project possessing manufacturing capabilities in Canada. These entities were further categorized based on the existing relationships APMA has cultivated with them, prioritizing those with the expectation of leveraging past interactions and meaningful relationships to encourage active engagement in the current initiative. APMA reached out to more than 50 companies identified from this filtered listing, initiating contact and extending invitations.

Phase II: Outreach to Members

Upon receiving commitments for Phase I, APMA successfully scheduled initial interview appointments with the participating companies. Through the interview process APMA members displayed some hesitancy towards participating in the research, primarily due to constraints on their resources. These organizations were cautious about committing additional time and manpower to the research initiative. Concerns regarding the allocation of financial and human resources prompted initial reservations among members.

However, as the objectives and benefits of the research became clearer and as APMA provided assurances regarding support and assistance throughout the process, members gradually overcame their hesitation and became more willing to participate.

Phase III: Follow-up

Subsequent actions were taken to engage high-priority stakeholders who hold a unique or significant position within the sector and to ensure a balanced representation reflecting the industry's profile accurately.

Final Sample

The selection of the final 25 companies presents a well-rounded depiction of the Canadian automotive sector, encompassing a diverse cross-section of the industry. This compilation effectively captures operational diversity, encompassing a wide range of business sizes and activities within the automotive landscape.

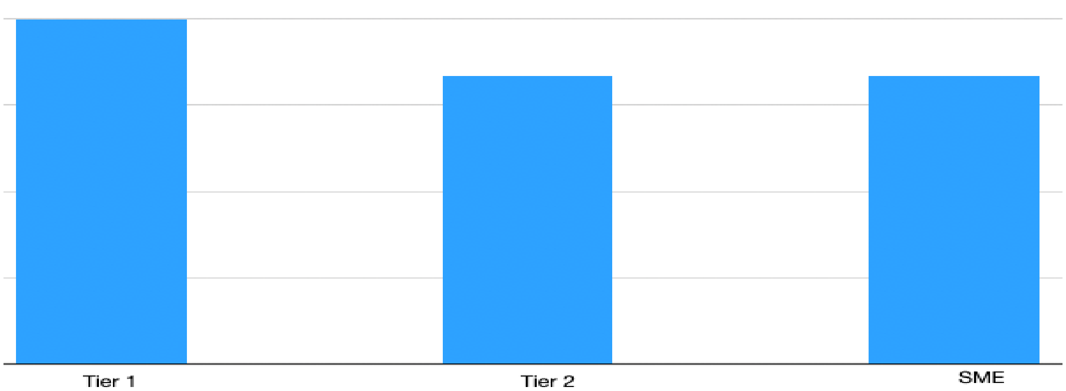


Figure 2 Final Sample, Company Size

As outlined in the sampling strategy, an intentional over-representation of large firms (over 250 million) was implemented within the sample to ensure a more accurate reflection of the overall workforce and the application of recommendations to labour market implications.

Furthermore, the research participants encompass a diverse array of manufacturing activities, including Tier-1 suppliers, supply chain participants, specialized small parts producers and other supporting functions. The research also features varying levels of organizational maturity, ranging from newly established firms to more established entities. In total, interviews were conducted with 25 companies, providing profile and workforce trend data for the research. Only 16 companies accessed the online skills survey.

Throughout the process, several companies encountered difficulties in completing the survey, experiencing glitches in the program that falsely indicated they had not finished the survey. Additional follow-up with these organizations was necessary to address the issue.

Occupations Reviewed

The skills survey encompassed 32 distinct occupations, among which machinists, mechanics and assemblers emerged as the two most frequently selected for skills assessment.

- Machinists
- Tool and die makers
- Mechanical engineers
- Mechanical assemblers
- Chemical engineers
- Electrical and electronics engineers
- Metallurgical and materials engineers
- Electrical and electronics engineers (duplicate entry)
- Supervisors, electronics and electrical products manufacturing
- Metalworking machine operators
- Welding, brazing, and soldering machine operators
- Assemblers, electrical appliance, apparatus, and equipment manufacturing
- Mechanical engineering technicians
- Construction millwrights and industrial mechanics
- Industrial electricians

Figure 3: Occupations Selected by Survey Participants

FINDINGS

Workforce Trends

The prevailing trends within the automotive sector depict a dynamic landscape influenced by a range of factors. These include the persistent labor shortage and the evolving dynamics of manufacturing processes, coupled with the transition towards zero-emission vehicles (ZEVs).

As previously mentioned, participant engagement in the research was achieved through synchronous discussions aimed at gathering statistical workforce information from the human resources departments of automotive companies. During each session (or in certain instances, provided either before or after the call), participants were queried about their current and projected workforce levels, rates of retirement, and the perceived challenges in recruiting skilled workers. These interviews also elicited candid comments, offering insights into the various conditions and factors confronting these organizations, their perspectives on the underlying causes of these challenges, and the strategies they are employing to address them.

In the current landscape of the automotive sector, companies are grappling with significant challenges in hiring employees, prompting a shift in traditional hiring practices. Many organizations within our sector are experiencing difficulties in finding candidates with the exact skill sets demanded by rapidly evolving technologies and processes. As a result, a noteworthy trend has emerged where companies are increasingly opting for a strategy of hiring individuals and providing on-the-job training. This approach has demonstrated surprisingly high retention levels, surpassing initial expectations.

Recruitment and Retention Strategies

In addressing the recruitment and retention challenges within the automotive sector, APMA engaged with HR managers through outreach efforts, fostering candid discussions about the hurdles they encounter. These conversations provided valuable insights into the complexities and obstacles faced by organizations in attracting and retaining talent.

Leveraging its Diversity, Equity, and Inclusion program, APMA has extended support to these organizations, offering strategies and resources to navigate these challenges effectively. Through collaborative initiatives and tailored interventions, APMA aims to foster a more inclusive and resilient workforce within the automotive industry, ensuring its continued growth and competitiveness.

Observations

The interviews provided the opportunity to explore perspectives, experiences and solutions across the industry, no matter the company size or experience. Throughout the research process, APMA was able to deep dive into deep discussions about several planned facility developments, acquisitions and corporate expansion initiatives that were either deferred or cancelled due to the pandemic. Before and after the pandemic, the automotive industry faced significant supply chain challenges. Disruptions were widespread and seemingly endless including factory closures, travel restrictions, shortages of raw materials and shortages of microchips. These disruptions led to delays in production schedules, impacting the availability of vehicles and components globally. Most importantly, these shortages and disruptions caused rolling layoffs and temporary layoffs, impacting the long- term work of developing stronger talent pipelines.

The automotive industry has been grappling with a significant chip shortage, disrupting production lines and impacting vehicle availability across the globe. The shortage, which was only worsened by growing demand for devices during the pandemic, left automakers struggling to procure essential semiconductor components for vehicle electronic systems. This shortage led to production slowdowns, temporary plant closures, and in some cases, the prioritization of higher-margin vehicles over lower-margin. The Canadian automotive manufacturing industry continues to mitigate the impact, exploring alternative chip suppliers, adjusting production schedules and prioritizing vehicle lines. The chip shortage continues to highlight the vulnerability of global supply chains and the need for greater supply chain resilience in the future.

SKILLS ASSESSMENT

The comprehensive list of evaluated positions is detailed in Figure 3, as previously displayed. Analysis of skills and proficiencies will concentrate on the two most prevalent occupational categories highlighted in the table of top frequency values, depicted in Figure 4 below.

Occupations	NOC code	#Occupations
Metallurgical and materials engineers	21322	1
Mechanical engineers	21301	4
Electrical and electronics engineers	21310	2
Chemical engineers	21320	2
Supervisors, electronics and electrical products manufacturing	92021	2
Metalworking machine operators	94105.01	1
Mechanical assemblers	94204.01	4
Welding, brazing and soldering machine operators	72106.02	1
Assemblers, electrical appliance, apparatus and equipment manufacturing	94202.01	1
Mechanical engineering technicians	22301.02	3
Machinists	72100.01	4
Industrial instrument technicians and mechanics	22312	1
Welders	72106.01	1
Tool and die makers	72101.01	1
Industrial electricians	72201	2
Construction millwrights and industrial mechanics	72400	2

Figure 4 Occupations selection by respondents

The top two occupations were classified under trades and production, along with their respective NOC codes.

Machinists (Trades)

Machinists are instrumental in numerous manufacturing sectors, serving as vital contributors to the Canadian automotive industry. Their role involves the setup and operation of diverse machine tools for cutting and grinding various materials such as metal and plastic. They meticulously fabricate and modify parts and products, ensuring adherence to precise dimensions and tolerances.

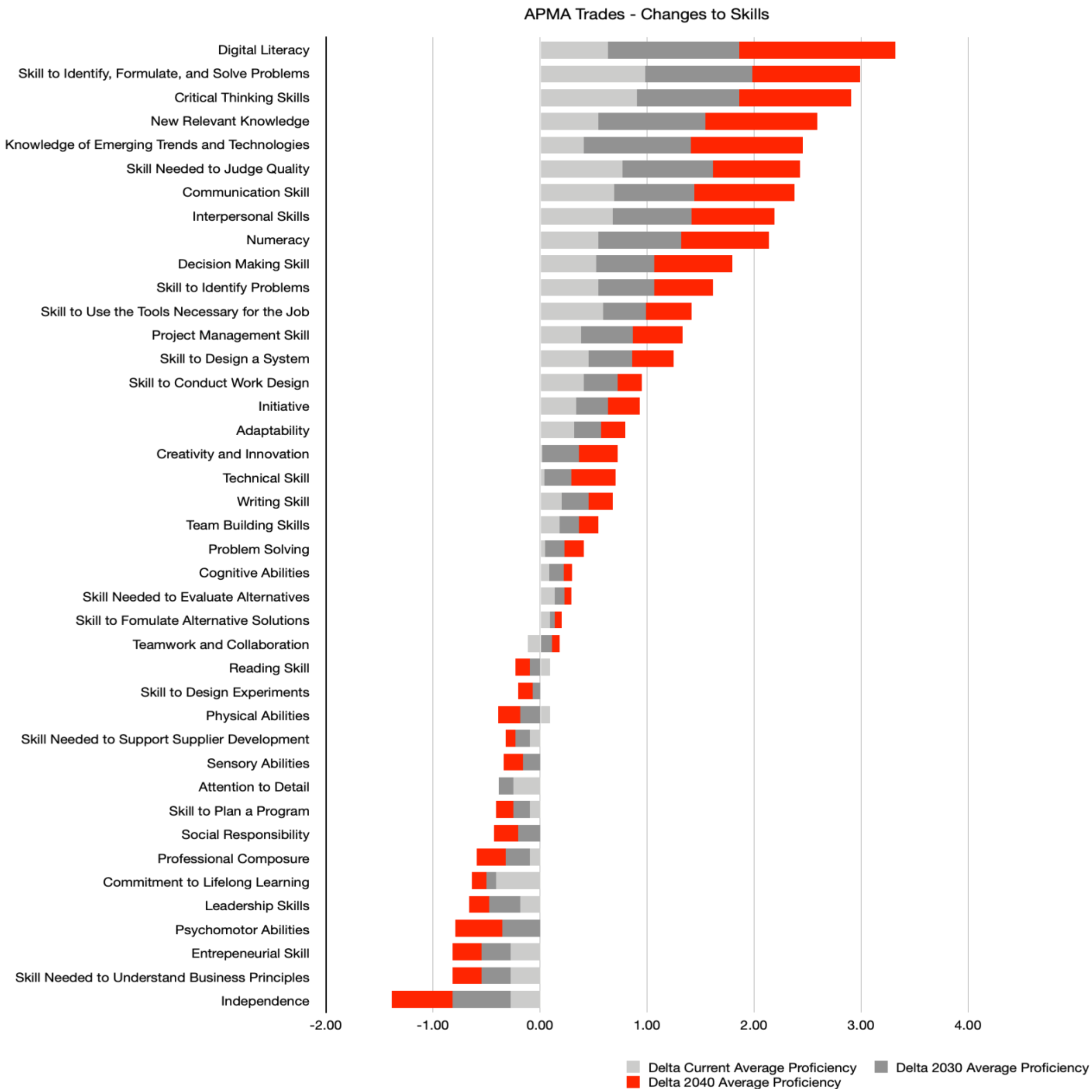


Figure 5 Change from Base Levels -Machinist

Survey respondents observed that proficiency levels for the Machinist NOC generally aligned with their experiences, although a few proficiencies exhibited significant deviations from the base rates indicated in the Base OaSIS records. Notably, digital literacy, problem- solving skills, and critical thinking skills showed notable adjustments.

Base OaSIS	Current Proficiency	Proficiency 203	Proficiency 2040	Current Proficiency Ranked OaSIS Base	Proficiency 2030 Ranked Current Proficiency	Proficiency 2040 Ranked Current Proficiency
Attention to Detail	Skill to Use the Tools Necessary for the Job	Attention to Detail	Attention to Detail	2	2	2
Independence	Adaptability	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job	2	-1	-1
Skill to Use the Tools Necessary for the Job	Attention to Detail	Numeracy	Numeracy	-2	3	3
Adaptability	Independence	Adaptability	Adaptability	-2	-2	-2
Psychomotor Abilities	Critical Thinking Skills	New Relevant Knowledge	New Relevant Knowledge	16	9	9
Professional Composure	Numeracy	Critical Thinking Skills	Critical Thinking Skills	7	-1	-1
Leadership Skills	Psychomotor Abilities	Skill to Identify, Formulate, and Solve Problems	Technical Skill	-2	1	10
Teamwork and Collaboration	Skill to Identify, Formulate, and Solve Problems	Skill Needed to Judge Quality	Skill to Identify, Formulate, and Solve Problems	23	1	0
Commitment to Lifelong Learning	Skill Needed to Judge Quality	Independence	Communication Skill	14	-5	7
Reading Skill	Skill to Conduct Work Design	Technical Skill	Skill Needed to Judge Quality	5	7	-2

Figure 6 Proficiency Rankings 2023-2040 – Machinists

The role of machinists has undergone significant evolution in recent years, with anticipated transformations in the coming decade. Moving away from predominantly manual operations, particularly in metal forming machines, modern machinists are increasingly tasked with programming manufacturing equipment using digital interfaces. In some instances, they are also expected to utilize advanced computerized tools such as Enterprise Resource Planning (ERP) systems independently to manage tasks efficiently.

Figure 6 highlights the top proficiency levels expected from 2023 to 2040 for machinists, while Figure 7 provides proficiency rankings for the same period.

2030 Proficiency STDev

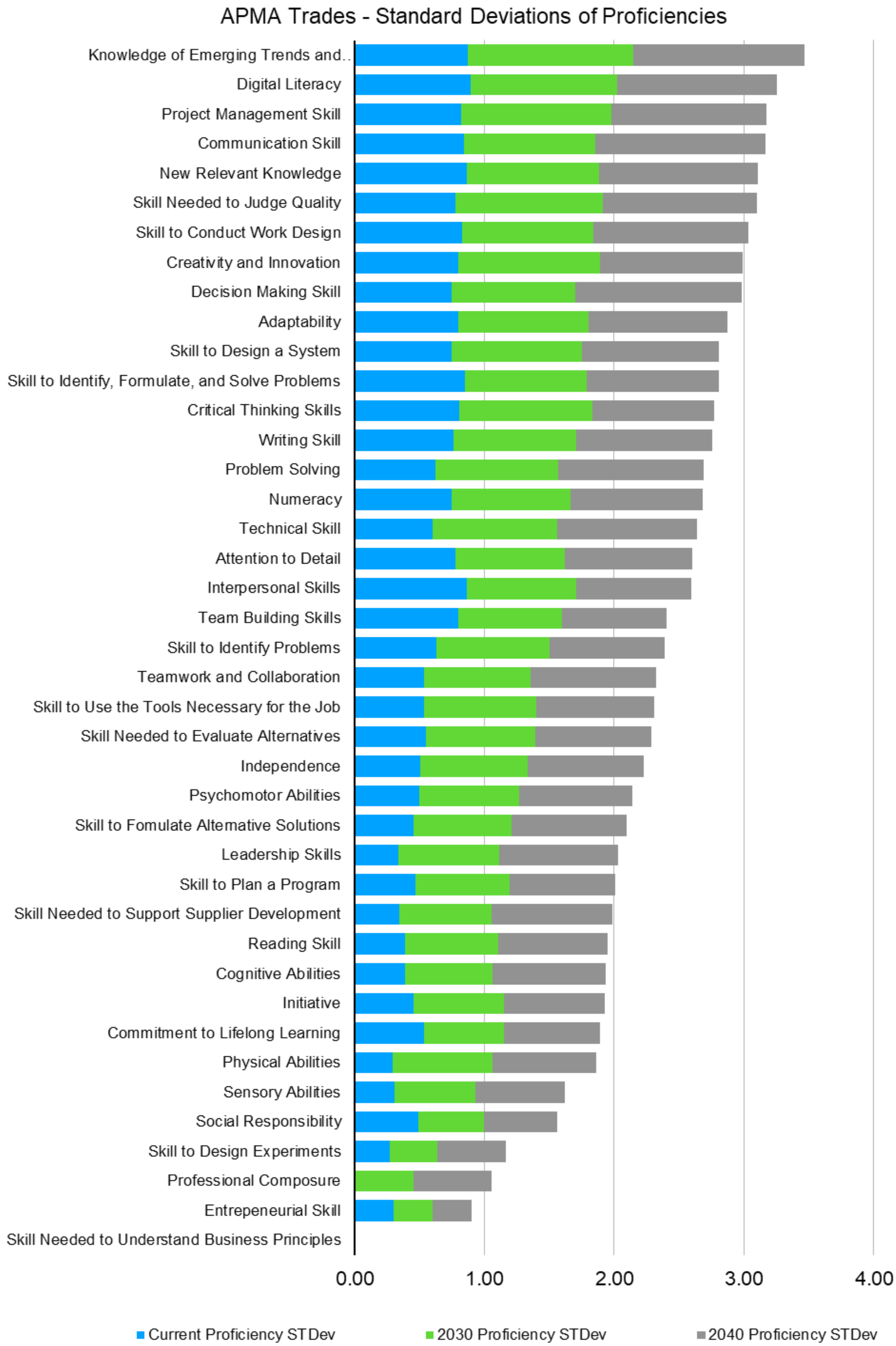


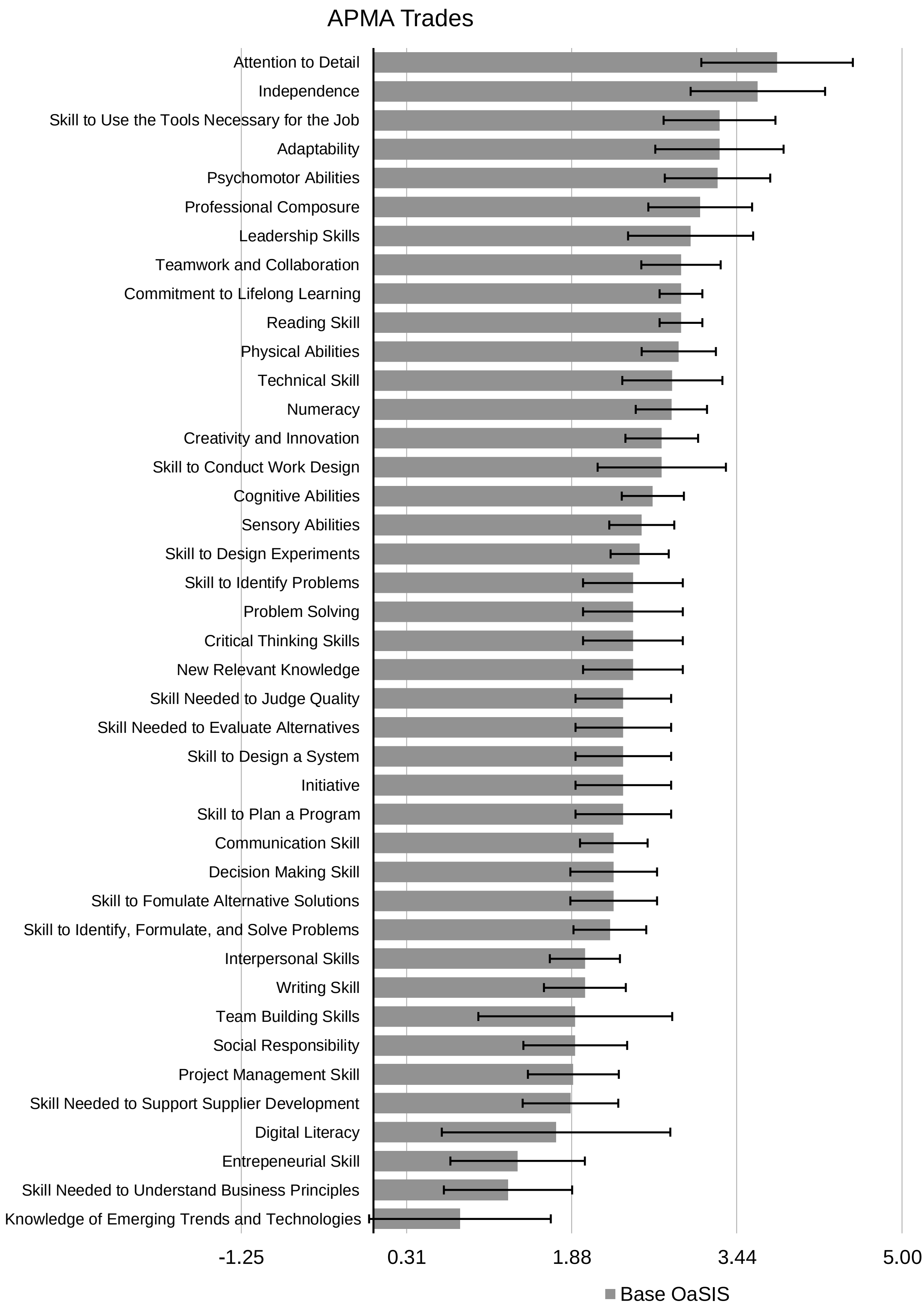
Figure 7 Top Proficiency Levels 2023-2040 -Machinist

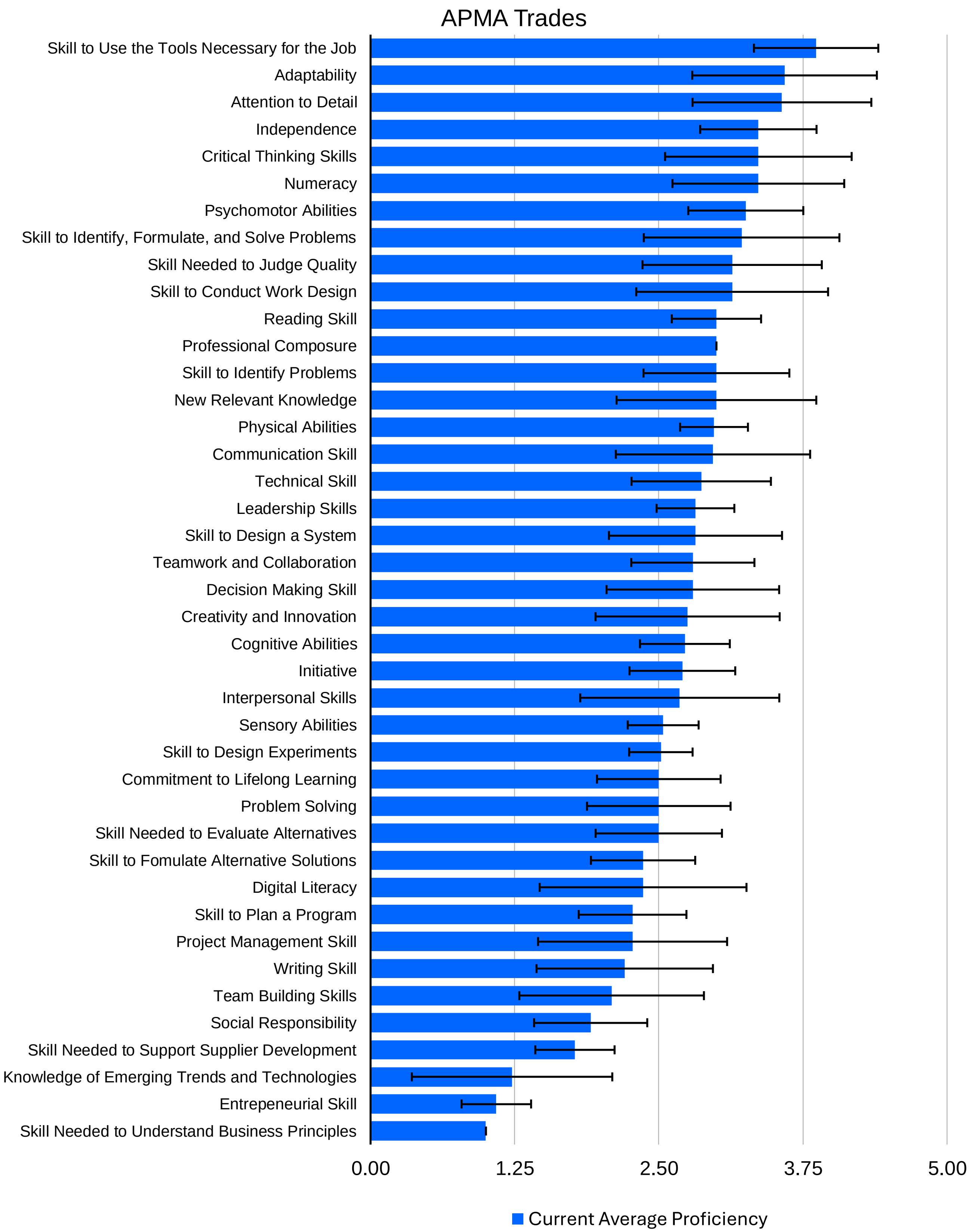
Current Average Proficiency

Within the sector, a notable trend is the widespread retirement of experienced workers, leading to a substantial labour shortage and the loss of valuable institutional knowledge. The skills depicted in this graph underscore the requirements for highly skilled employees to address this shortage. Soft skills such as communication and conflict management remain crucial priorities.

Based on projected proficiencies, the top trending skills comprise attention to detail, proficiency in utilizing job-specific tools, and critical thinking abilities. Notably, the perceptions of survey participants suggest that individuals heavily reliant on hands-on skills within the sector may witness a reduction in their roles, particularly with the industry's transition towards electrification.

The projected future skill requirements, derived from the current average proficiency displayed in the preceding slide, align closely with the expectations reflected in the perceptions of survey participants.


APMA Trades
Attention to Detail
Independence
Skill to Use the Tools Necessary for the Job
Adaptability
Psychomotor Abilities
Professional Composure
Leadership Skills
Teamwork and Collaboration
Commitment to Lifelong Learning
Reading Skill
Physical Abilities
Technical Skill
Numeracy
Creativity and Innovation
Skill to Conduct Work Design
Cognitive Abilities
Sensory Abilities
Skill to Design Experiments
Skill to Identify Problems
Problem Solving
Critical Thinking Skills
New Relevant Knowledge
Skill Needed to Judge Quality
Skill Needed to Evaluate Alternatives
Skill to Design a System
Initiative
Skill to Plan a Program
Communication Skill
Decision Making Skill
Skill to Fomulate Alternative Solutions
Skill to Identify, Formulate, and Solve Problems
Interpersonal Skills
Writing Skill
Team Building Skills
Social Responsibility
Project Management Skill
Skill Needed to Support Supplier Development
Digital Literacy
Entrepeneurial Skill
Skill Needed to Understand Business Principles
Knowledge of Emerging Trends and Technologies
-1.25
0.31
1.88
3.44
5.00
Base OaSIS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Writing Skill
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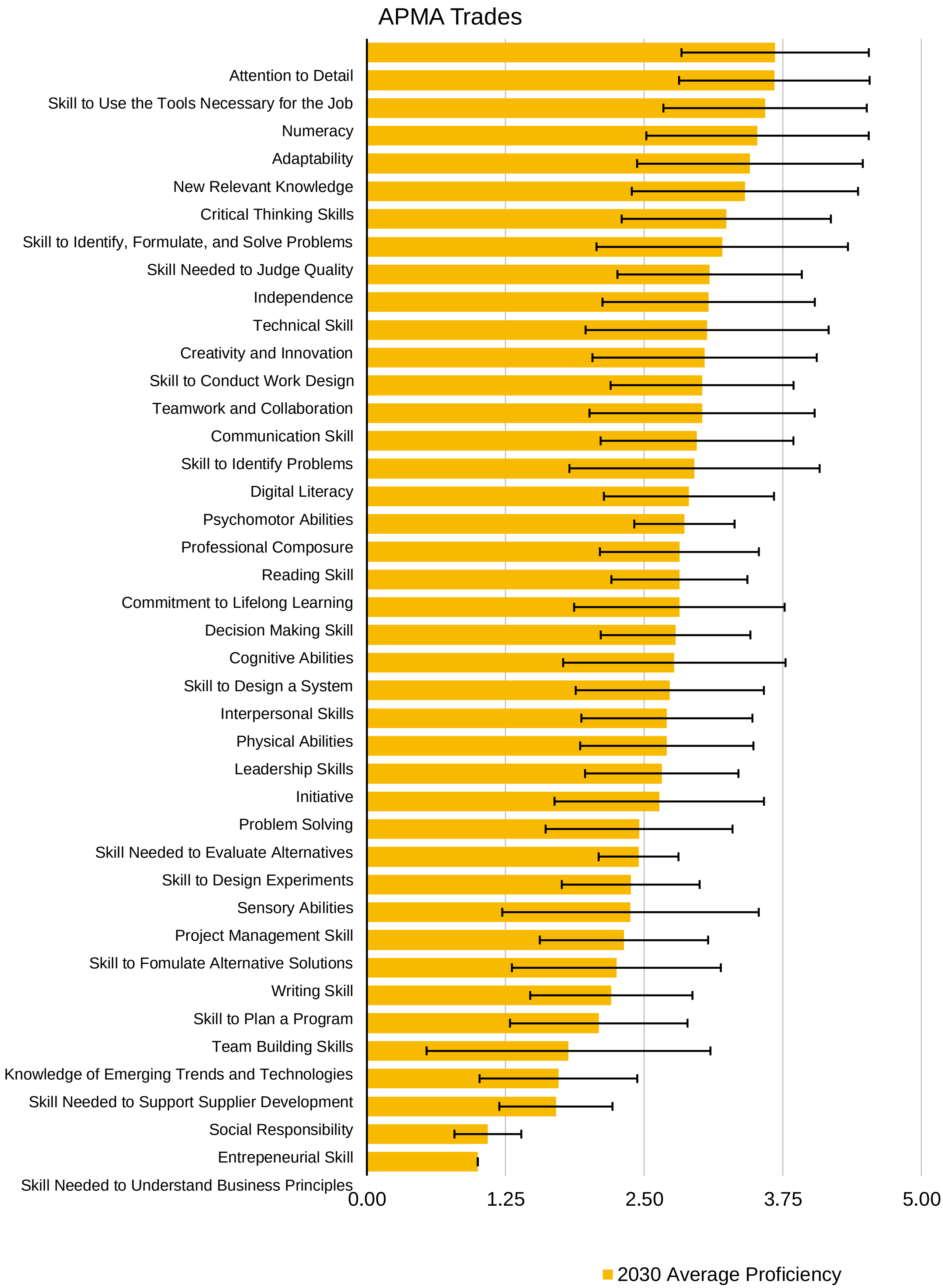
Knowledge of Emerging Trends and Technologies
Entrepeneurial Skill
Skill Needed to Understand Business Principles
0.00
1.25
2.50
3.75
5.00
Current Average Proficiency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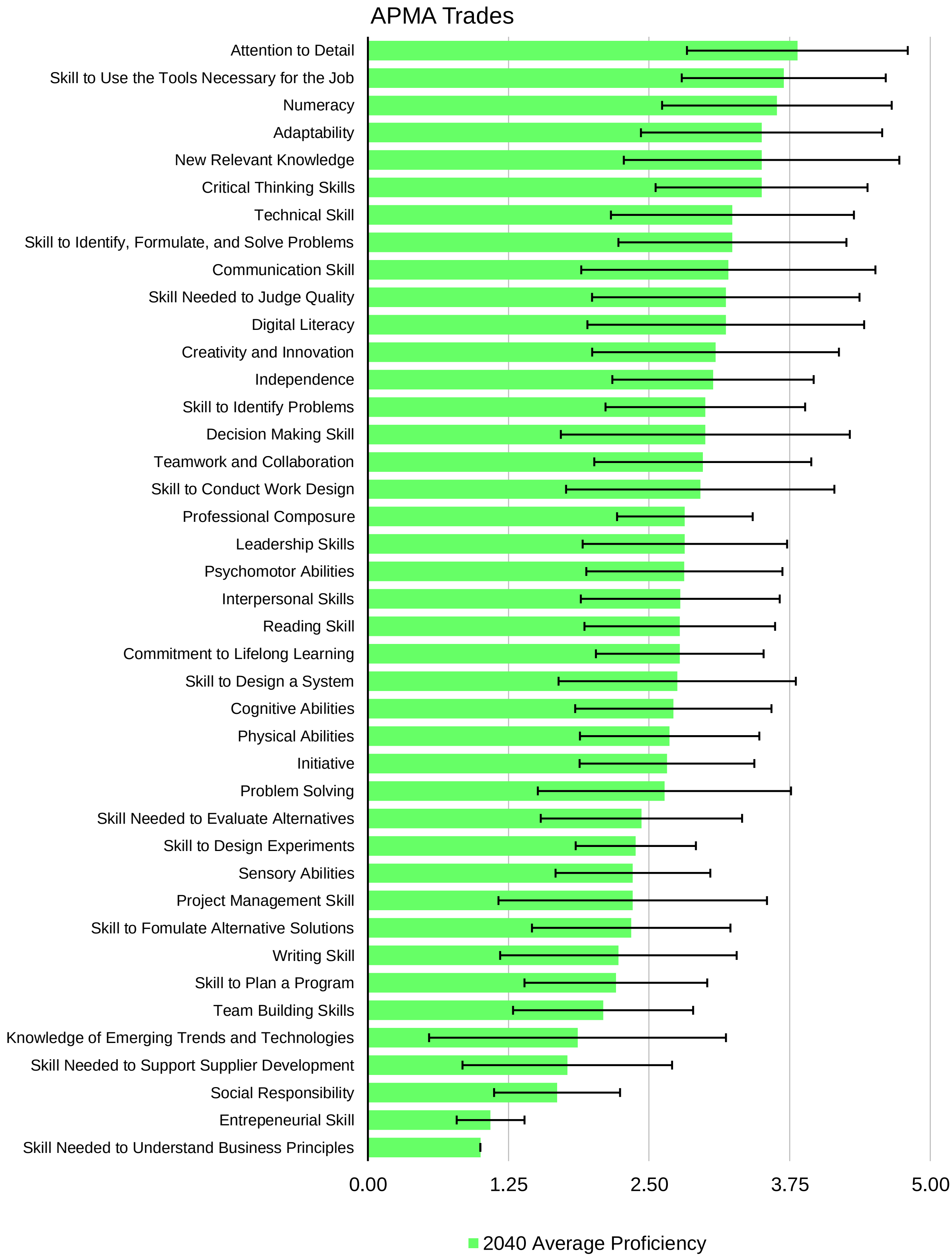
Skill Needed to Understand Business Principles
0.00
1.25
2.50
3.75
5.00
2030 Average Proficiency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Physical Abilities
Initiative
Problem Solving
Skill Needed to Evaluate Alternatives
Skill to Design Experiments
Sensory Abilities
Project Management Skill
Skill to Fomulate Alternative Solutions
Writing Skill
Skill to Plan a Program
Team Building Skills
Knowledge of Emerging Trends and Technologies
Skill Needed to Support Supplier Development
Social Responsibility
Entrepeneurial Skill
Skill Needed to Understand Business Principles
0.00
1.25
2.50
3.75
5.00
2040 Average Proficiency

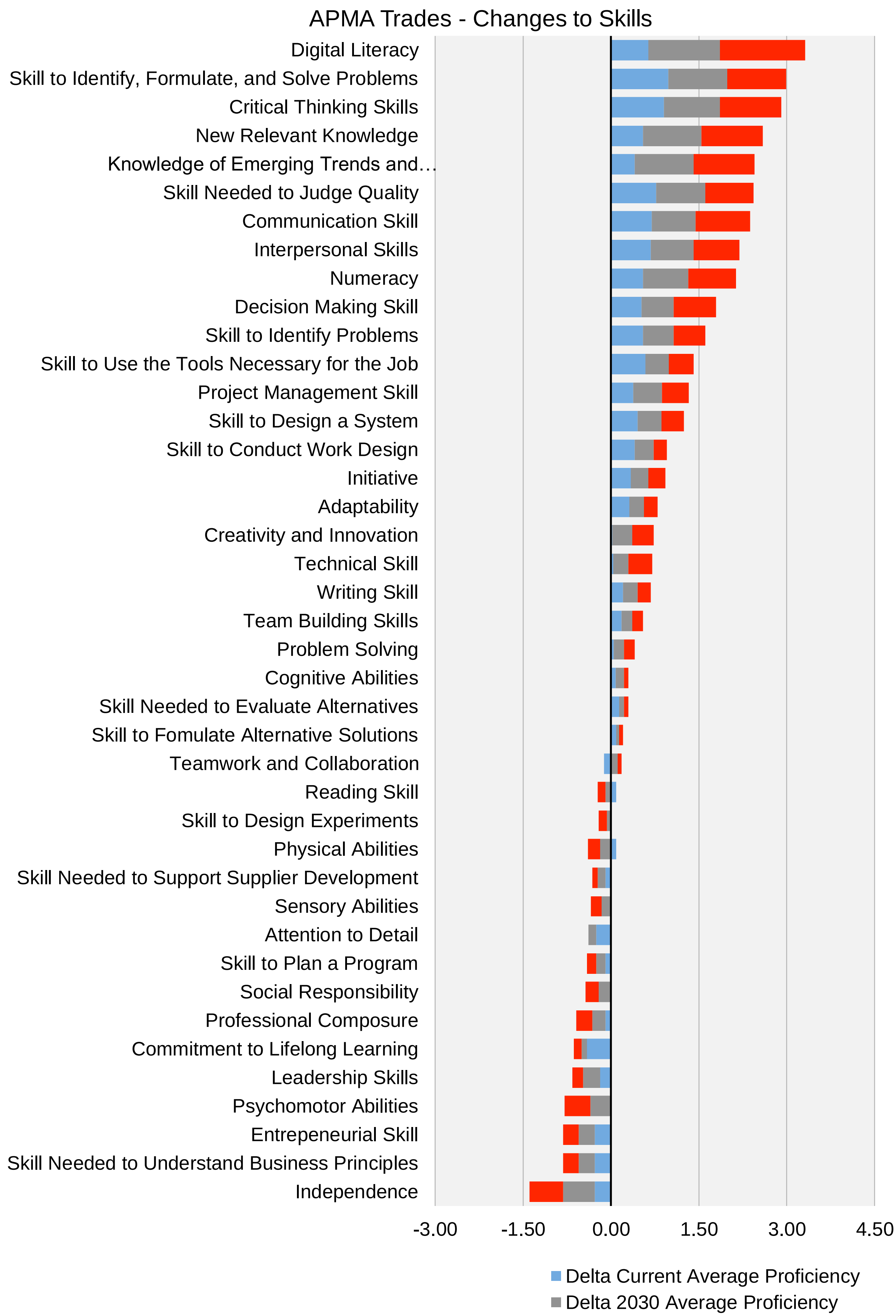
Production

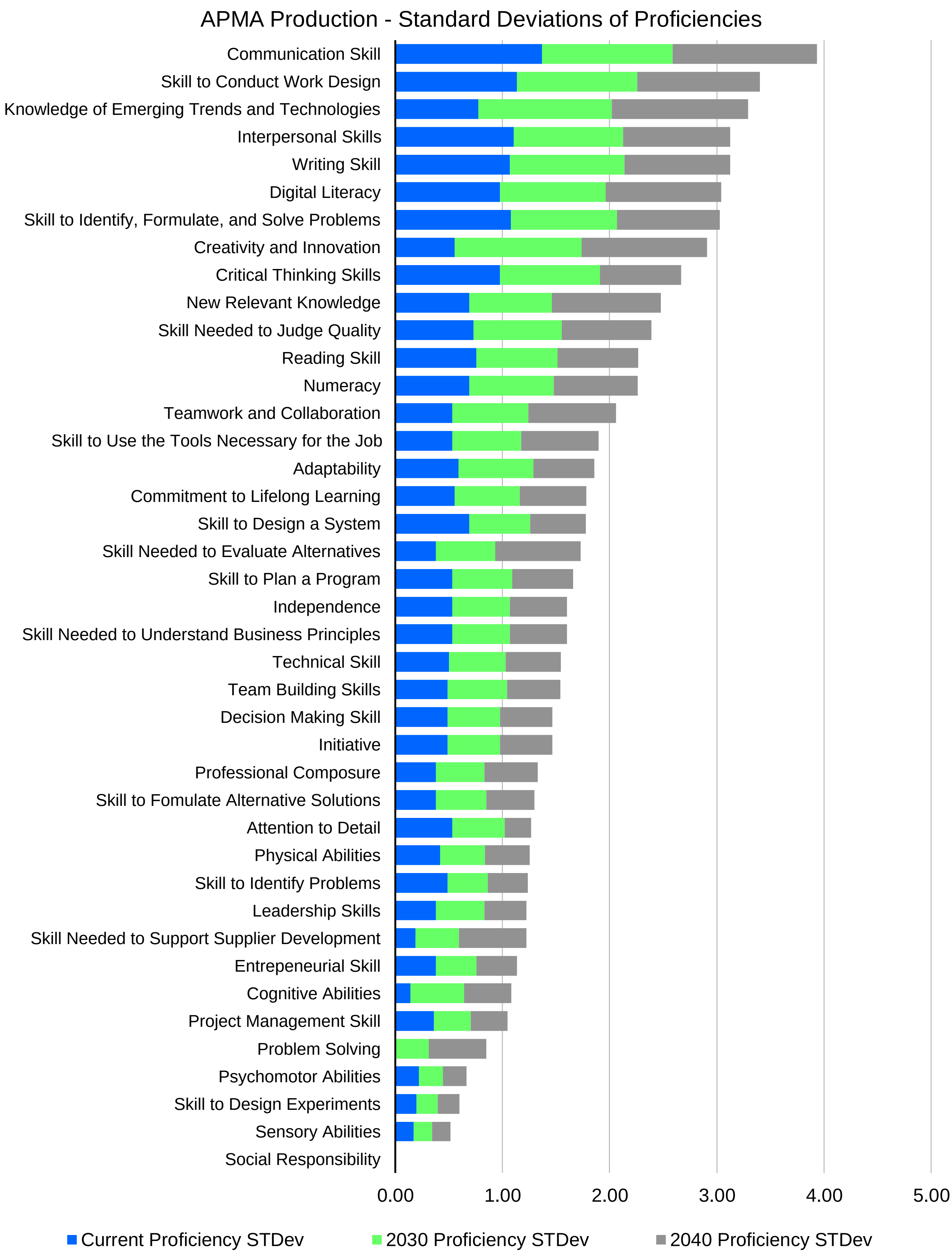
Similarly, production demonstrates a noticeable shift in the top ten or twelve skill levels. Observations of production proficiencies over time suggest a broad anticipation of elevated proficiency levels across nearly all skills in the future. This indicates a trend wherein the traditional domain for unskilled workers is gradually becoming less attainable for individuals lacking fundamental skills— proficiencies like digital literacy and communication skills emerge as exemplars of competencies that will require elevated levels in the foreseeable future.

In production roles, the growing automation of assembly processes and the digitization of interfaces for tasks such as production, metrology, and quality control are increasingly noticeable on the factory assembly line. Notably, responses regarding production proficiencies exhibited higher standard deviations across various skill sets compared to engineering or trades. Throughout the process, it was observed that many companies rely on on-the-job training to bring new hires to a basic level of proficiency in these roles.

Consequently, the observed disparity may indicate an expectation of ongoing recruitment and workplace development efforts for relatively untrained employees in certain companies and circumstances.

The graph below illustrates the evolution of proficiencies in relation to production.


APMA Trades - Changes to Skills
Digital Literacy
Skill to Identify, Formulate, and Solve Problems
Critical Thinking Skills
New Relevant Knowledge
Knowledge of Emerging Trends and…
Skill Needed to Judge Quality
Communication Skill
Interpersonal Skills
Numeracy
Decision Making Skill
Skill to Identify Problems
Skill to Use the Tools Necessary for the Job
Project Management Skill
Skill to Design a System
Skill to Conduct Work Design
Initiative
Adaptability
Creativity and Innovation
Technical Skill
Writing Skill
Team Building Skills
Problem Solving
Cognitive Abilities
Skill Needed to Evaluate Alternatives
Skill to Fomulate Alternative Solutions
Teamwork and Collaboration
Reading Skill
Skill to Design Experiments
Physical Abilities
Skill Needed to Support Supplier Development
Sensory Abilities
Attention to Detail
Skill to Plan a Program
Social Responsibility
Professional Composure
Commitment to Lifelong Learning
Leadership Skills
Psychomotor Abilities
Entrepeneurial Skill
Skill Needed to Understand Business Principles
Independence
-3.00
-1.50
0.00
1.50
3.00
4.50
Delta Current Average Proficiency
Delta 2030 Average Proficiency


APMA Production - Standard Deviations of Proficiencies
Communication Skill
Skill to Conduct Work Design
Knowledge of Emerging Trends and Technologies
Interpersonal Skills
Writing Skill
Digital Literacy
Skill to Identify, Formulate, and Solve Problems
Creativity and Innovation
Critical Thinking Skills
New Relevant Knowledge
Skill Needed to Judge Quality
Reading Skill
Numeracy
Teamwork and Collaboration
Skill to Use the Tools Necessary for the Job
Adaptability
Commitment to Lifelong Learning
Skill to Design a System
Skill Needed to Evaluate Alternatives
Skill to Plan a Program
Independence
Skill Needed to Understand Business Principles
Technical Skill
Team Building Skills
Decision Making Skill
Initiative
Professional Composure
Skill to Fomulate Alternative Solutions
Attention to Detail
Physical Abilities
Skill to Identify Problems
Leadership Skills
Skill Needed to Support Supplier Development
Entrepeneurial Skill
Cognitive Abilities
Project Management Skill
Problem Solving
Psychomotor Abilities
Skill to Design Experiments
Sensory Abilities
Social Responsibility
0.00
1.00
2.00
3.00
4.00
5.00
Current Proficiency STDev
2030 Proficiency STDev
2040 Proficiency STDev

Base OaSIS	Current Proficiency	Proficiency 203	Proficiency 2040	Current Proficiency Ranked OaSIS Base	Proficiency 2030 Ranked Current Proficiency	Proficiency 2040 Ranked Current Proficiency
Attention to Detail	Attention to Detail	Attention to Detail	Attention to Detail	0	0	0
Independence	Independence	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job	0	1	1
Professional Composure	Skill to Use the Tools Necessary for the Job	Independence	Teamwork and Collaboration	3	-1	4
Psychomotor Abilities	Professional Composure	Teamwork and Collaboration	Independence	-1	3	-2
Teamwork and Collaboration	Psychomotor Abilities	Professional Composure	Professional Composure	-1	-1	-2
Skill to Use the Tools Necessary for the Job	Adaptability	Adaptability	Adaptability	1	0	0
Adaptability	Teamwork and Collaboration	Psychomotor Abilities	Psychomotor Abilities	-2	-2	-2
Physical Abilities	Physical Abilities	Technical Skill	Technical Skill	0	6	6
Sensory Abilities	Critical Thinking Skills	Skill Needed to Judge Quality	Critical Thinking Skills	8	1	0
Leadership Skills	Skill Needed to Judge Quality	Critical Thinking Skills	Skill Needed to Judge Quality	2	-1	0

For production, the top ten proficiency rankings from the current year to 2040 underscore a notable transformation, placing a heightened emphasis on communication skills, creativity, innovation, and problem-solving abilities. This shift reflects the evolving needs of industries and workplaces, where effective communication and the capacity to generate innovative solutions are increasingly valued. As technological advancements continue to reshape the landscape of the automotive sector, individuals with strong interpersonal skills and a knack for problem-solving are poised to thrive in the ever-changing professional environment.

DISCUSSION AND RECOMMENDATIONS

This research underscores a significant shift within the automotive sector, particularly with the industry's transition towards ZEVs. An evident trend identified in the findings is that future skills required for employees in this evolving landscape will necessitate additional training, particularly in the realm of technological proficiency for operating advanced machinery.

The shift towards ZEVs is synonymous with an increased reliance on cutting-edge technologies within the automotive sector. Future employees will need to adapt to and operate advanced machinery integral to the production of electric vehicles, emphasizing the need for enhanced technological training. Training programs focusing on software integration, robotics, and control systems will be essential to ensure that employees can effectively navigate and optimize these advanced technologies.

The research also indicates that the evolving nature of the automotive sector demands a workforce capable of continuous adaptation to technological evolution. Ongoing training programs and upskilling initiatives will be crucial to keep the workforce abreast of the latest advancements in ZEV technology and associated manufacturing processes.

While the ZEV shift presents opportunities for innovation, organizations may face challenges in maintaining competitiveness if the workforce is not adequately prepared for the technological demands of ZEV production. Companies that invest in robust training programs will be better positioned to attract skilled talent and enhance their competitiveness within the rapidly evolving automotive landscape.

Another challenge highlighted in the research is related to potential talent shortages, especially in recruiting individuals with the requisite technological expertise. As ZEV- related jobs become available, organizations may encounter difficulties in finding qualified candidates, emphasizing the importance of strategic recruitment efforts and collaboration with educational institutions.

The skills gap identified in the research poses a challenge for organizations aiming to stay at the forefront of ZEV manufacturing. Industry associations and companies need to proactively address this gap by investing in tailored training initiatives, collaborating with educational partners, and promoting ongoing professional development.

In conclusion, the research underscores the imperative for the automotive sector to invest in technological training to meet the evolving demands of ZEV production.
While challenges exist in terms of talent shortages and workforce readiness, strategic planning and targeted training efforts will position organizations to thrive in the era of electric vehicles and maintain competitiveness within the industry.

APMA's Role

At the APMA, our role is pivotal in reflecting the collective interests and concerns of the automotive industry. We serve as a unifying force, bringing together diverse stakeholders within the sector to address common challenges and advocate for shared objectives. The APMA plays a crucial role in fostering collaboration, sharing industry insights, and formulating strategies to address emerging trends and issues. The data we have gathered highlights specific skills within the automotive sector that are trending below the expectations set by industry benchmarks, such as the OaSIS compiled proficiencies.

Recognizing the importance of a skilled and adaptable workforce in maintaining the sector's competitiveness, the APMA believes in the necessity of a sector-wide approach to address these challenges effectively.

Our role as an industry association involves:

Advocacy and Representation

Representing the collective voice of the automotive industry, the APMA engages with policymakers, regulatory bodies, and other stakeholders to advocate for policies that support the sector's growth and address skill-related challenges.

Information Sharing and Collaboration

Facilitating an environment for information sharing, collaboration, and networking among industry players. This ensures that insights and best practices are exchanged, fostering a collective understanding of the evolving landscape.

Strategic Planning and Guidance

Providing strategic guidance to industry members based on research findings and emerging trends. The APMA plays a crucial role in shaping the direction of the sector, identifying areas for improvement, and fostering innovation.

Workforce Development Initiatives

Developing and supporting initiatives that contribute to the ongoing training and development of the automotive workforce. This includes advocating for educational programs, apprenticeships, and partnerships with institutions to address skill gaps and align the workforce with industry needs.

Collaboration with Educational Institutions

Forging partnerships with educational institutions to ensure that curricula align with industry requirements. The APMA actively collaborates with colleges, universities, and technical schools to bridge the gap between academic training and industry needs.

Addressing Skill Gaps

Recognizing the skill gaps identified in the data, the APMA takes a proactive approach in addressing these challenges. This may involve developing targeted training programs, supporting research initiatives,and engaging with members to identify specific areas of concern.

By advocating for a sector-wide approach, the APMA aims to leverage the collective strength of the automotive industry to tackle challenges associated with skills trends effectively. The association plays a central role in fostering a collaborative and forward- thinking environment that ensures the sector remains resilient, competitive, and adaptable to the dynamic demands of the automotive

landscape.

REFERENCES

The following are websites from organizations and associations that reflect the automotive sector and relevance to the research topic, and which have been reviewed for additional qualitative data supporting the findings of this research.

1. Trillium Network for Advanced Manufacturing: https://trilliummfg.ca/

2. Automotive News Canada: https://canada.autonews.com/

3. Electric Autonomy: https://electricautonomy.ca/

4. Driving Prosperity: The Future of Ontario's Automotive Sector: https://www.ontario.ca/page/driving-prosperity-future-ontarios-automotivesector

5. Canada's Electric Vehicle Availability Standard https://www.canada.ca/en/environment-climatechange/news/2023/12/canadas- electric-vehicle-availability-standardregulated-targets-for-zero-emission- vehicles.html

Next generation of bio-manufacturers

Defining their skills and competencies

BioTalent Canada

BioTalent Canada
Igniting the bio-economy's brainpower

Table of contents

BioTalent Canada

BioTalent Canada supports the people behind life-changing science. Trusted as the go-to source for labour market intelligence, BioTalent Canada guides bio-economy stakeholders with evidence-based data and industry-driven standards. BioTalent Canada is focused on igniting the industry's brainpower, bridging the gap between job-ready talent and employers, and ensuring the long-term agility, resiliency, and sustainability of one of Canada's most vital sectors.

Recently named a Great Place to Work® and Best Workplaces in Healthcare for 2023, by Great Place to Work Canada®, as well as being listed as a Best Workplace by HRD Canada for 2023 and a 5-Star Diversity, Equity and Inclusion Employer by Canadian HR Reporter, BioTalent Canada practices the same industry standards it recommends to stakeholders. These varied distinctions were awarded to BioTalent Canada following a thorough and independent analysis of the organization.

For more information visit biotalent.ca.

1 Background and Introduction

Thanks in large part to the recent pandemic, The Canadian bio-economy, and bio-manufacturing industry in particular, has increased in importance as both an economic driver and a means to ensure the population is better prepared and more resilient in the face of future pandemics.

But, while the sector has seen a boost in funding to build the infrastructure needed for domestic production of vaccines, personal protective equipment (PPE), and other life-changing innovations, there remains a significant gap in the bringing in the people with the skills required to work in these new facilities.

Of the nearly 200,000 people employed in Canada's bio-economy, 73,940 work within bio-manufacturing.

According to BioTalent Canada's comprehensive 2021 labour market study, an estimated 16,140 additional bio-manufacturing workers will be required by 2029 to sustain the sector – with 5,160 in bio-health manufacturing alone. But the talent needed is in short supply.

As outlined in Table 1, using a three-tiered scale to show the severity of the hiring challenges, manufacturing and production jobs continue to be the hardest hit areas for the bio-economy's labour market. And as this report will show, the skills required to meet these labour demands align with other key job functions, including management, business development, and information technology.

TABLE 1: National Bio-economy Labour Market Ratings Outlook by Job Function

Level 1	Level 2	Level 3
Labour supply is **greater than 75%** of labour demand. **Low to moderate** labour shortages are expected.	Labour supply is **between 25% and 75%** of labour demand. **Moderate to serious** labour shortages are expected.	Labour supply is **less than 25%** of labour demand. **Serious to severe** labour shortages are expected.

Job function	2021	2022	2023	2024	2025	2026	2027	2028	2029
Manufacturing and production	3	3	3	3	3	3	3	3	3
Distribution and logistics	3	3	3	3	3	3	3	3	3
Management, finance and administration	2	3	3	3	2	3	3	3	3
Quality control and assurance	1	2	3	2	2	2	3	3	3
Marketing, business development and sales	2	2	2	2	2	2	2	2	2
Legal and regulatory affairs	2	2	2	2	1	2	2	2	2
Research and development	1	2	2	2	1	2	2	2	2
Information technology	1	2	2	2	1	2	2	2	2
Other	1	2	2	2	2	2	2	2	2
Overall	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**

Source: BioTalent Canada Modeling and Projections (2020)

With only 30% of Canadian bio-economy companies having a dedicated human resource department or function, the challenges of recruiting, onboarding, and retaining skilled individuals is compounded. BioTalent Canada's research shows that the top five obstacles to company development are:

40%	**36%**	**30%**	**16%**	**13%**
Lack of qualified candidates with required specialized skill sets or experience	Insufficient capital or resources to pay competitive wages to attract and retain qualified candidates	Lack of qualified candidates with practical/non-academic skills	Loss of candidates and employees to large, well-known organizations	Lack of applicants

Without addressing these issues, the future success of the sector is grim. Productivity within the sector will stagnate, limiting Canada's ability to be seen as a global leader in health and bioscience innovations. A lack of skilled talent to grow the industry will put Canada in a position of reliance on others to navigate future pandemics as was the case in 2020.

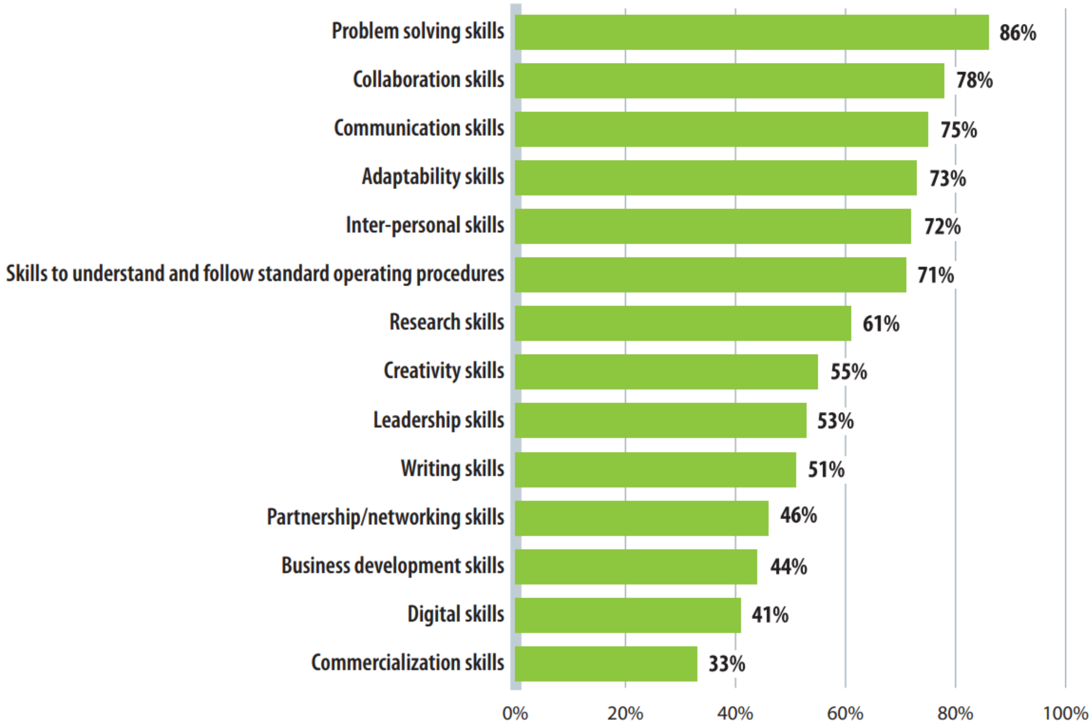
Filling the talent gap will require not only the recruitment of people interested in working in this critical sector but also finding people with the right skills and experience to support industry demands.

Working in partnership with Next Generation Canada, BioTalent Canada surveyed manufacturing stakeholders within the health and biosciences sector, asking them to respond to 41 questions rating the skills they felt were needed for a specific role in 2023, 2030, and 2040. The North American Industry Classification System (NAICS) and National Occupational Standards (NOCS) codes were used to identify specific roles and skills.

Industry support for this research was well-received with a total of 49 survey participants rating a total 173 roles. Respondents held positions as Manufacturing Managers, Biomedical Engineers, Quality Engineers, Directors of Manufacturing Operations, Process Engineers, Project Managers, CEOs, as well as other managerial, technical, and operational roles.

The data shared within this report supports results from BioTalent Canada's 2021 LMI study in terms of what skills employers rate as important to them in new hires (Figure 1) highlighting an increased desire for employees to possess not just technical skills to perform their jobs, but also soft skills like problem solving, collaboration, communication, and adaptability.

FIGURE 1: Skills Rated Very Important by Employers



Source: BioTalent Canada Survey of Employers (2020)

The findings of this report also align with BioTalent Canada's recent report, *Biosciences Booster* on the success of the [Student Work Placement Program (SWPP)](https://) which outlined the benefits of work-integrated learning (WIL) as a catalyst for the bio-economy's sustained growth. This suggests that WIL can serve as an effective tool for Canadian bio-manufacturers in developing the skills in their employees that will be required today, in 2030, 2040, and beyond.

The report also suggests an awareness by industry professionals of the increased importance technological skills and digital adoption will play for the industry's future success.

The study only scratches the surface of what skills will be required for bio-manufacturing. To gain a better perspective of the industry's talent needs, more research with a larger sample size will be necessary. A more comprehensive study would allow for a deeper understanding of the skills and competencies that will shape the future of the sector. This includes further investigation into transformative technologies like artificial intelligence (AI).

2 Definitions

The following terms formed the foundation of the study and have been used throughout the report. Definitions have been provided to help understand the research within the report.

OaSIS Database: The Occupational and Skills Information System (OaSIS) provides a comprehensive framework of the skills, abilities, personal attributes, knowledge, and interests that are usually required to work in over 900 different Canadian occupations. It also provides context for the work environment in which these occupations are performed.

Skill Base Level (OaSIS): The benchmark of skill and competency levels is a reference that is taken from the OaSIS database. This scale is between 0 and 5 and denotes what the skill level is for the occupation, with 0 being none or minimal skill and 5 being mastery. In this report, it is in reference to 2023. **This term is used interchangeably with average of base or base for simplicity**.

Variation: Represents the difference or change in skill levels between the survey responses for the years 2023, 2030 and 2040, compared to the benchmark level set in 2023 from the OaSIS database. It shows the extent to which the skill level has shifted or changed over time in relation to the initial skill base level relative to the OaSIS database.

NAICS: An acronym for the North American Industry Classification System. NAICS is a standardized system used to classify businesses and industries in North America. It helps organize and categorize different types of businesses based on their economic activities, making it easier to analyze and compare information across various sectors.

NOC: An acronym for the National Occupational Classification. NOC is a system used to organize and categorize different jobs or occupations in Canada. It helps in classifying and grouping various professions based on their main duties and responsibilities, making it easier to understand and compare different types of work.

3 A Sampling of Current and Future Skill Demand for Bio-manufacturing Roles

3.1 Who was surveyed using the Ngen Survey Tool and how

A total of 49 participants completed the survey, rating a total of 173 roles. The two largest North American Industry Classification System (NAICS) represented were Pharmaceutical and medicine manufacturing (NAICS 32541) and Medical equipment and supplies manufacturing (NAICS 33911). This aligns with the findings of BioTalent Canada's 2021 Labour Market Study which identified both manufacturing industries within the top five employers comprising a 25% share of total bio-economy employment[1].

[1] "Close-up on the bio-economy – National Report", BioTalent Canada, https://www.biotalent.ca/wp-content/uploads/BioTalent-Canada-LMI-National-Report-13OCT2021-1.pdf

Eighty-three percent of survey participant organizations fell under the bio-economy's bio-health sub-sector. It is understandable that most respondents were from bio-health, given that the sub-sector makes up more than half (54%) of all bio-economy companies[2].

Canada's bio-economy is made up of fours sub-sectors: agri-bio (21%), bio-industrial (20%), bio-energy (5%)[3]. Each sector requires bio-manufacturing efforts to support their innovation. Expanding this study in the future would allow for a more comprehensive review of the skills employers deem necessary for the industry's sustained growth.

North American Industry Classification (NAIC)

Employers in the Pharmaceutical and medicine manufacturing (NAICS 32541) area were the focus of this survey.

National Occupational Classification (NOC) codes

The National Occupational Classification (NOC) codes identified in the survey data capture key occupations within bio-manufacturing, such as Manufacturing Managers (NOC: 90010), Biomedical Engineers (NOC: 21399.02), and Biological Technologists (NOC: 22110.01). These occupations are critical for overseeing manufacturing processes, designing, and developing biotechnological products, and conducting laboratory-based research, respectively. Other NOC codes represented in this survey data are for specialized roles specific to bio-manufacturing, such as Industrial and Manufacturing Engineers (NOC: 21321), Chemical Engineers (NOC: 21320), and Biological Technicians (NOC: 22110.02). These roles contribute to various aspects of bio-manufacturing, including process optimization, quality control, and technical support.

The top five occupations represented in this survey are within Pharmaceutical and medicine manufacturing (NAICS 32541) and are:

- Manufacturing managers (90010)
- Biomedical engineers (21399.02)
- Biological technologists (22110.01)
- Engineering managers (20010)
- Chemical engineers (21320)

By focusing on occupations closely aligned with bio-manufacturing, the survey captures insights relevant to this specialized sector, including trends in technology adoption, skills requirements, and workforce development. This comprehensive approach enables us to gain a deeper understanding of the challenges and opportunities shaping the future of bio-manufacturing in Canada and inform strategic decision-making within the industry.

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[2] Ibid., pg. 8.

[3] Ibid, pg. 8

3.2 Average Skill Level Requirements and Variation from Base for All Roles in 2023, 2030 and 2040

Analyzing all the roles listed in Table 34 (see appendix) simultaneously (Table 2) allowed BioTalent Canada to conduct a comprehensive analysis of the current bio-manufacturing workforce's skills and competencies, while also identifying the critical new skills and competencies that will be required in the industry over the next five and ten years. This can help benchmark the efforts of BioTalent Canada to develop the products and services to lead employers through strategic planning, talent development, and future-proofing strategies within the bio-manufacturing sector.

TABLE 2: Average Skill Level Requirements and Variations from Base for All Roles in 2023, 2030 and 2040

Skill (n): 49 responses	Skill Level Base OaSIS 2023	Skill Level 2023 (Variation from OaSIS 2023)	Skill Level 2030 (Variation from OaSIS 2023)	Skill Level 2040 (Variation from OaSIS 2023)
Attention to Detail	4.34	4.09 (-0.26)	4.24 (-0.11)	4.26 (-0.08)
Numeracy	3.98	3.74 (-0.24)	3.92 (-0.06)	4.01 (+0.02)
Skill Needed to Evaluate Alternatives	3.92	3.62 (-0.30)	3.76 (-0.16)	3.84 (-0.08)
Skill to Design a System	3.89	3.57 (-0.32)	3.79 (-0.11)	3.83 (-0.06)
Problem Solving	3.89	3.72 (-0.17)	4.11 (+0.22)	4.23 (+0.34)
Adaptability	3.88	3.65 (-0.23)	3.97 (+0.08)	4.10 (+0.21)
Decision Making	3.88	3.73 (-0.15)	3.93 (+0.05)	3.98 (+0.10)
Reading	3.86	3.97 (+0.12)	4.17 (+0.31)	4.26 (+0.40)
Skill to Identify Problems	3.80	3.68 (-0.12)	3.94 (+0.14)	4.01 (+0.21)
Critical Thinking	3.74	3.62 (-0.12)	3.94 (+0.21)	4.08 (+0.34)
Independence	3.70	3.65 (-0.05)	3.75 (+0.05)	3.74 (+0.04)
Leadership	3.69	3.51 (-0.17)	3.62 (-0.06)	3.70 (+0.02)
Skill to Conduct Work Design	3.67	3.24 (-0.42)	3.48 (-0.19)	3.58 (-0.08)
Skill to Design Experiments	3.62	3.43 (-0.19)	3.71 (+0.08)	3.76 (+0.14)
Initiative	3.59	3.46 (-0.14)	3.70 (+0.11)	3.79 (+0.20)
Skill to Formulate Alternative Solutions	3.54	3.38 (-0.16)	3.69 (+0.14)	3.76 (+0.21)
Skill to Identify, Formulate, and Solve Problems	3.53	3.48 (-0.05)	3.70 (+0.17)	3.78 (+0.25)
New Relevant Knowledge	3.52	3.51 (-0.01)	3.76 (+0.24)	3.82 (+0.30)
Professional Composure	3.52	3.51 (-0.01)	3.64 (+0.12)	3.71 (+0.20)
Team Building Skills	3.50	3.56 (+0.06)	3.74 (+0.24)	3.79 (+0.30)
Communication	3.48	3.65 (+0.17)	4.01 (+0.53)	4.16 (+0.68)
Cognitive Abilities	3.47	3.51 (+0.04)	3.71 (+0.23)	3.78 (+0.31)
Commitment to Lifelong Learning	3.47	3.50 (+0.03)	3.75 (+0.28)	3.79 (+0.32)
Writing	3.45	3.69 (+0.24)	3.88 (+0.43)	3.92 (+0.47)
Creativity and Innovation	3.44	3.26 (-0.19)	3.61 (+0.17)	3.77 (+0.32)
Skill to Plan a Program	3.43	3.40 (-0.03)	3.63 (+0.20)	3.62 (+0.20)
Project Management	3.38	3.25 (-0.14)	3.43 (+0.05)	3.52 (+0.14)
Skill Needed to Judge Quality	3.34	3.39 (+0.05)	3.70 (+0.36)	3.72 (+0.38)
Skill Needed to Support Supplier Development	3.28	3.21 (-0.07)	3.43 (+0.15)	3.57 (+0.29)

Skill (n): 49 responses	Skill Level Base OaSIS 2023	Skill Level 2023 (Variation from OaSIS 2023)	Skill Level 2030 (Variation from OaSIS 2023)	Skill Level 2040 (Variation from OaSIS 2023)
Digital Literacy	3.22	3.34 (+0.12)	3.90 (+0.69)	4.15 (+0.94)
Interpersonal Skills	3.14	3.27 (+0.13)	3.51 (+0.37)	3.57 (+0.43)
Skill to Use the Tools Necessary for the Job	3.12	3.27 (+0.15)	3.57 (+0.44)	3.56 (+0.44)
Teamwork and Collaboration	3.11	3.56 (+0.45)	3.76 (+0.65)	3.84 (+0.73)
Technical Skill	2.80	3.18 (+0.38)	3.59 (+0.79)	3.72 (+0.92)
Entrepreneurial Skill	2.75	2.72 (-0.02)	2.87 (+0.12)	2.93 (+0.19)
Social Responsibility	2.72	2.80 (+0.07)	3.11 (+0.39)	3.21 (+0.49)
Sensory Abilities	1.90	2.36 (+0.46)	2.54 (+0.65)	2.49 (+0.59)
Psychomotor Abilities	1.76	2.42 (+0.66)	2.43 (+0.67)	2.34 (+0.58)
Skill Needed to Understand Business Principles	1.55	2.22 (+0.67)	2.57 (+1.02)	2.67 (+1.12)
Knowledge of Emerging Trends and Technologies	1.35	2.07 (+0.71)	2.51 (+1.15)	2.76 (+1.41)
Physical Abilities	0.84	1.54 (+0.70)	1.54 (+0.70)	1.49 (+0.66)

TABLE 3: Top Five Skills with Variations for All Roles in 2023, 2030 and 2040

Comparing the skill levels in the OaSIS database with the participants' responses shown in Table 2, the top five skills that showed the greatest differences between the database and the skill levels of 2023, 2030 and 2040 are:

	2023	2030	2040
1	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies
2	Physical Abilities	Skill Needed to Understand Business Principles	Skill Needed to Understand Business Principles
3	Skill Needed to Understand Business Principles	Technical Skill	Digital Literacy
4	Psychomotor Abilities	Digital Literacy	Technical Skill
5	Sensory Abilities	Physical Abilities	Teamwork and Collaboration

This suggests survey participants perceive certain skills to be significantly more important than OaSIS-compiled proficiencies. Interestingly, participants' perceptions on the importance of emerging technologies, business principles and digital literacy – specifically in future skills trends suggest that companies acknowledge the significant role new technologies like (Artificial Intelligence) AI will have on their operations.

The data also indicates potential gaps in knowledge sharing between industry professionals and standardized databases, creating discrepancies in what skills are valued within the industry and by how much. However, this could also reflect emerging trends in the sector, aligning with advancements in bio-manufacturing processes and regulations which require greater emphasis on technology, business acumen, and technical expertise.

More research, with a larger sample size, would be required to gain better insights into the skills required to work in Canada's bio-manufacturing sector – including more responses from the other sub-sectors within the bio-economy.

TABLE 4: Comparison of Top-rated Skills in all Roles between OaSIS and 2023

When comparing the average of base from OaSIS for all the roles and sub-sectors that participants selected in the survey, the top-rated skills.

	OaSIS	2023
1	Attention to Detail	Attention to Detail
2	Numeracy	Reading
3	Skill Needed to Evaluate Alternatives	Numeracy
4	Skill to Design a System	Decision Making
5	Problem Solving	Problem Solving
6	Decision Making	Writing
7	Adaptability	Skill to Identify Problems
8	Reading	Communication
9	Skill to Identify Problems	Adaptability
10	Critical Thinking	Independence

Top-rated Skills Overlap in All Roles in OaSIS and 2023

There is a significant overlap in the OaSIS Database and participant selections for the top-rated skills, notably for attention to detail, numeracy, decision-making, problem solving, reading, and skill to identify problems. These skills would be expected in the bio-economy and particularly in bio-health, where most of the responses came from.

Attention to detail ensures accuracy and precision in handling sensitive biological materials, data analysis, and adherence to protocols which are critical for maintaining the integrity of research and production processes. **Numeracy skills** are essential for interpreting complex data sets, performing calculations for dosage formulations, and analyzing experimental results accurately.

Decision making and **problem solving** are essential for navigating complex challenges inherent in bio-manufacturing and bio-health. Professionals must make informed decisions regarding experimental design, resource allocation, and risk management to optimize outcomes and address unforeseen issues effectively.

The **ability to read, decode and synthesize information** is indispensable for staying updated on the latest research findings, regulations, and technological advancements in bio-health. It enables professionals to assimilate new information, critically evaluate scientific literature, and apply relevant knowledge to their work.

The **skill to identify problems** is essential for recognizing anomalies, deviations from expected outcomes, and potential risks in bio-health processes. This skill empowers professionals to troubleshoot issues, implement corrective measures, and ensure the quality and safety of bio-manufactured products and healthcare interventions.

Top-rated Skills Difference of all Roles between OaSIS and 2023

The skills that differ between the two lists of top-rated skills are **writing**, **communication** and **independence**, where participants perceived these as more important than OaSIS. This variance could be due to the specific emphasis or requirements within the bio-health sector. Writing Skill might be more valued for documentation and regulatory compliance in bio-manufacturing, while communication is necessary for effective collaboration and conveying complex scientific information. Independence might be highly regarded for roles requiring autonomy and self-directed work, which are common in bio-health research and development.

TABLE 5: Top rated skills comparison of all Roles OaSIS, 2030 and 2040

Comparing OaSIS skills with 2030 and 2040 shows near alignment in the skills required for the decades ahead.

	OaSIS	2030	2040
1	Attention to Detail	Attention to Detail	Attention to Detail
2	Numeracy	Reading	Reading
3	Skill Needed to Evaluate Alternatives	Problem Solving	Problem Solving
4	Skill to Design a System	Communication	Digital Literacy
5	Problem Solving	Skill to Identify Problems	Adaptability
6	Decision Making	Adaptability	Communication
7	Adaptability	Decision Making	Critical Thinking
8	Reading	Critical Thinking	Skill to Identify Problems
9	Skill to Identify Problems	Numeracy	Numeracy
10	Critical Thinking	Digital Literacy	Decision Making

When comparing the top-rated skills selected by the OaSIS Database and survey respondents for 2030 and 2040, many of the same skills exist (while ranked slightly different in importance), suggesting the value placed by employers on these abilities being essential for new hires.

However, there are some discrepancies. For instance, the OaSIS database emphasizes **skill needed to evaluate alternatives** and **skill to design a system**, which are not explicitly highlighted in the participant-selected skills for 2030 and 2040. This variance could stem from differing perspectives on their importance – with participants potentially prioritizing skills that are more directly applicable to their roles or industry context, whereas the OaSIS database might emphasize broader foundational skills necessary across various sectors.

When reviewing the top-rated skills for 2030 and 2040, exclusively, there’s a notable difference in the inclusion of **digital literacy** in the top-rated skills for 2040, indicating a growing emphasis on technological proficiency in the future. This addition reflects the anticipated evolution of the bio-economy towards more digitized processes and technologies, aligning with broader industry trends toward increased automation and digitalization.

The shift in skill importance from participant responses and the top-rated skills signal a significant perception regarding the emergence of AI, which is profoundly affecting the Canadian bio-manufacturing industry and is expected to continue impacting the industry as time progresses.

AI technologies are streamlining various aspects of bio-manufacturing processes, from drug discovery to production optimization. In drug discovery, AI-driven algorithms analyze vast datasets to identify potential drug candidates more efficiently, accelerating the development timeline. Additionally, AI-powered predictive modeling enhances process control and quality assurance in bio-manufacturing facilities, leading to improved product quality and reduced production costs. Moreover, AI-enabled robotics and automation enhance operational efficiency by automating repetitive tasks and reducing the risk of errors. Overall, AI is revolutionizing bio-manufacturing in Canada by driving innovation, improving productivity and advancing the development of life-saving therapies.

3.3 Skill Level Requirements and Variation from Base by Function in 2023, 2030 and 2040

The tables in this section categorize skills by function.

3.3.1 Engineer Skill Requirements

Engineers encompass biomedical engineers, chemical engineers, computer and telecommunications hardware engineers, engineering physicists and scientists, industrial and manufacturing engineers, and mechanical engineers. Materials scientists and industrial designers are included due to similarities in occupation and education.

TABLE 6: All Engineers skills requirements 2023, 2030 and 2040

Skill (n): 37 responses	Skill Level Base – OaSIS 2023	Skill Level* 2023 (Variation from OaSIS 2023)	Skill Level* 2030 (Variation from OaSIS 2023)	Skill Level* 2040 (Variation from OaSIS 2023)
Attention to Detail	5	4.53 (-0.47)	4.72 (-0.28)	4.78 (-0.22)
Decision Making	4.91	4.31 (-0.60)	4.51 (-0.40)	4.55 (-0.36)
Reading	4.91	4.45 (-0.46)	4.55 (-0.36)	4.58 (-0.33)
Problem Solving	4.88	4.33 (-0.55)	4.58 (-0.30)	4.61 (-0.27)
Skill Needed to Evaluate Alternatives	4.88	4.32 (-0.56)	4.43 (-0.45)	4.46 (-0.42)
Skill to Design a System	4.88	4.33 (-0.55)	4.55 (-0.33)	4.51 (-0.37)
Skill to Conduct Work Design	4.82	4.00 (-0.82)	4.09 (-0.73)	4.16 (-0.66)
Critical Thinking	4.67	4.20 (-0.47)	4.49 (-0.18)	4.55 (-0.12)
Skill to Formulate Alternative Solutions	4.66	4.27 (-0.39)	4.52 (-0.13)	4.57 (-0.09)
Numeracy	4.64	4.13 (-0.51)	4.33 (-0.31)	4.42 (-0.22)
Skill to Identify Problems	4.54	4.16 (-0.38)	4.28 (-0.25)	4.37 (-0.16)

Skill (n): 37 responses	Skill Level Base – OaSIS 2023	Skill Level* 2023 (Variation from OaSIS 2023)	Skill Level* 2030 (Variation from OaSIS 2023)	Skill Level* 2040 (Variation from OaSIS 2023)
Skill to Design Experiments	4.40	4.04 (-0.37)	4.26 (-0.15)	4.24 (-0.16)
Digital Literacy	4.33	4.02 (-0.31)	4.42 (+0.09)	4.51 (+0.18)
New Relevant Knowledge	4.33	4.22 (-0.11)	4.40 (+0.07)	4.45 (+0.12)
Creativity and Innovation	4.28	3.79 (-0.49)	4.09 (-0.19)	4.27 (-0.01)
Communication	4.19	4.04 (-0.16)	4.42 (+0.22)	4.55 (+0.36)
Skill to Identify, Formulate, and Solve Problems	4.16	3.96 (-0.21)	4.10 (-0.06)	4.15 (-0.01)
Initiative	4.15	3.80 (-0.35)	4.03 (-0.12)	4.07 (-0.07)
Cognitive Abilities	4.15	4.16 (+0.02)	4.27 (+0.12)	4.28 (+0.13)
Independence	4.10	4.16 (+0.06)	4.15 (+0.04)	4.12 (+0.01)
Writing	4.03	4.10 (+0.07)	4.22 (+0.19)	4.21 (+0.18)
Adaptability	4	3.81 (-0.19)	4.21 (+0.21)	4.31 (+0.31)
Skill Needed to Support Supplier Development	4	3.59 (-0.41)	3.90 (-0.10)	4.01 (+0.01)
Professional Composure	3.94	3.79 (-0.15)	3.87 (-0.07)	3.93 (-0.01)
Skill Needed to Judge Quality	3.94	3.90 (-0.04)	4.07 (+0.13)	4.10 (+0.16)
Team Building Skills	3.93	3.88 (-0.05)	3.87 (-0.06)	3.99 (+0.06)
Leadership	3.91	3.71 (-0.21)	3.84 (-0.07)	3.96 (+0.04)
Technical Skill	3.87	3.78 (-0.09)	4.08 (+0.21)	4.12 (+0.25)
Commitment to Lifelong Learning	3.87	4.00 (+0.13)	4.22 (+0.36)	4.24 (+0.37)
Project Management	3.83	3.55 (-0.28)	3.76 (-0.07)	3.88 (+0.04)
Skill to Plan a Program	3.78	3.63 (-0.15)	3.87 (+0.09)	3.85 (+0.07)
Skill to Use the Tools Necessary for the Job	3.69	3.68 (-0.01)	3.85 (+0.16)	3.81 (+0.12)
Interpersonal Skills	3.36	3.45 (+0.10)	3.58 (+0.22)	3.58 (+0.22)
Entrepreneurial Skill	3.21	3.13 (-0.07)	3.30 (+0.09)	3.34 (+0.13)
Social Responsibility	2.97	2.83 (-0.14)	3.07 (+0.10)	3.25 (+0.28)
Teamwork and Collaboration	2.88	3.56 (+0.68)	3.76 (+0.88)	3.82 (+0.94)
Skill Needed to Understand Business Principles	1.91	2.59 (+0.68)	2.84 (+0.93)	2.91 (+1.00)
Sensory Abilities	1.89	2.32 (+0.43)	2.43 (+0.54)	2.34 (+0.45)
Knowledge of Emerging Trends and Technologies	1.72	2.58 (+0.86)	2.98 (+1.25)	3.28 (+1.55)

Skill (n): 37 responses	Skill Level Base – OaSIS 2023	Skill Level* 2023 (Variation from OaSIS 2023)	Skill Level* 2030 (Variation from OaSIS 2023)	Skill Level* 2040 (Variation from OaSIS 2023)
Psychomotor Abilities	1.40	2.32 (+0.92)	2.27 (+0.87)	2.06 (+0.66)
Physical Abilities	0.37	1.09 (+0.72)	1.09 (+0.72)	1.03 (+0.66)

TABLE 7: Top Five Skills with Variations for Engineer Skills in 2023, 2030 and 2040

The top five rated skill levels in the OaSIS database when compared with those of respondents showed the greatest differences between the OaSIS and the current skill levels of 2023, 2030 and 2040 were:

	2023	2030	2040
1	Psychomotor Abilities	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies
2	Knowledge of Emerging Trends and Technologies	Skill Needed to Understand Business Principles	Skill Needed to Understand Business Principles
3	Physical Abilities	Teamwork and Collaboration	Teamwork and Collaboration
4	Skill Needed to Understand Business Principles	Psychomotor Abilities	Psychomotor Abilities
5	Teamwork and Collaboration	Physical Abilities	Physical Abilities

TABLE 8: Comparison of Top Ten Engineer Skills between OaSIS and 2023

Comparing the top ten rated skills determined by the OaSIS Database against survey participants' top ten rated skills for 2023 reveals a change in rankings but consistency in overall skills.

	OaSIS	2023
1	Attention to Detail	Attention to Detail
2	Decision Making	Reading
3	Reading	Skill to Design a System
4	Problem Solving	Problem Solving
5	Skill Needed to Evaluate Alternatives	Skill Needed to Evaluate Alternatives
6	Skill to Design a System	Decision Making
7	Skill to Conduct Work Design	Skill to Formulate Alternative Solutions
8	Critical Thinking	New Relevant Knowledge
9	Skill to Formulate Alternative Solutions	Critical Thinking
10	Numeracy	Skill to Identify Problems

The consistency in top-rated skills between the OaSIS and participant ratings suggests a strong agreement regarding the importance of the skills within the engineering field, highlighting their significance in the profession. With engineering considered a top field of study by employers (53% recruit workers with engineering qualifications[4]), understanding what specific skills employer seek within the field can help better align academic studies with industry expectations.

[4] Ibid., pg. 37.

TABLE 9: Comparison of Top Ten Engineer Skills between OaSIS, 2030 and 2040

Comparing the top-rated skills from OaSIS to 2030 and 2040 reveals consistency in several skills. This reflects evergreen qualities needed in the workforce and suggests a consistent demand for fundamental competencies across the years.

	OaSIS	2030	2040
1	Attention to Detail	Attention to Detail	Attention to Detail
2	Decision Making	Problem Solving	Problem Solving
3	Reading	Reading	Reading
4	Problem Solving	Skill to Formulate Alternative Solutions	Skill to Formulate Alternative Solutions
5	Skill Needed to Evaluate Alternatives	Skill to Design a System	Digital Literacy
6	Skill to Design a System	Critical Thinking	Critical Thinking
7	Skill to Conduct Work Design	Decision Making	Decision Making
8	Critical Thinking	Digital Literacy	Skill to Design a System
9	Skill to Formulate Alternative Solutions	New Relevant Knowledge	Communication
10	Numeracy	Skill Needed to Evaluate Alternatives	New Relevant Knowledge

There were also variations in the rankings and additions of certain skills in 2030 and 2040 compared to OaSIS. For example, **communication** appears in the top ten skills for 2040 but not in OaSIS or 2030. The emergence of communications as a skill in 2040 indicates a shifting emphasis towards interpersonal and collaborative abilities, likely influenced by evolving workplace dynamics and technological advancements. This aligns with BioTalent Canada's LMI study where 75% of employers deemed the skill as very important[5].

The top ten skills for 2030 and 2040 show a high degree of similarity. Both years feature nearly identical lists of skills, with only slight variations in their rankings. The consistent presence of skills such as **attention to detail**, **problem solving**, **reading**, **skill to formulate alternative solutions**, **decision making**, **critical thinking**, **digital literacy** and **skill needed to evaluate alternatives** suggests a stable that over the two periods, essential skill requirements remain a priority for employers. With 30% of bio-economy employers currently reporting a lack of qualified candidates with practical/non-academic skills as a challenge to their recruitment efforts[6], identifying ways to enhance training in these skills will be crucial for the sector to address the impending talent shortage and find a path towards sustained growth.

[5] Ibid., pg. 41.
[6] Ibid., pg. 34.

3.3.2 Manager Skill Requirements

Managers include engineering managers and manufacturing managers.

TABLE 10: All Managers skills requirements in 2023, 2030 and 2040

Skill (n): 28 responses	Skill Level Base – OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Leadership	5	4.86 (-0.14)	4.85 (-0.15)	4.83 (-0.17)
Team Building Skills	5	4.73 (-0.27)	4.83 (-0.17)	4.88 (-0.12)
Project Management	4.79	4.46 (-0.32)	4.61 (-0.17)	4.64 (-0.15)
Skill to Plan a Program	4.54	4.27 (-0.26)	4.34 (-0.20)	4.34 (-0.20)
Attention to Detail	4.46	4.32 (-0.15)	4.34 (-0.12)	4.34 (-0.12)
Decision Making	4.46	4.37 (-0.10)	4.46 (+0.00)	4.56 (+0.10)
Initiative	4.46	4.35 (-0.12)	4.49 (+0.02)	4.56 (+0.10)
Numeracy	4.46	4.23 (-0.24)	4.32 (-0.15)	4.34 (-0.12)
Problem Solving	4.46	4.30 (-0.16)	4.54 (+0.07)	4.61 (+0.15)
Skill to Design a System	4.46	4.08 (-0.38)	4.20 (-0.27)	4.29 (-0.17)
Skill Needed to Support Supplier Development	4.23	3.97 (-0.26)	4.13 (-0.10)	4.30 (+0.07)
Interpersonal Skills	4.17	4.18 (+0.01)	4.37 (+0.20)	4.44 (+0.27)
Skill to Identify, Formulate, and Solve Problems	4.05	3.95 (-0.10)	4.13 (+0.07)	4.30 (+0.24)
Adaptability	4	3.83 (-0.17)	4.05 (+0.05)	4.22 (+0.22)
Independence	4	4.04 (+0.04)	4.10 (+0.10)	3.98 (-0.02)
Professional Composure	4	4.07 (+0.07)	4.12 (+0.12)	4.17 (+0.17)
Skill Needed to Evaluate Alternatives	4	3.87 (-0.13)	3.95 (-0.05)	4.12 (+0.12)
Skill Needed to Judge Quality	4	3.81 (-0.19)	4.10 (+0.10)	4.15 (+0.15)
Skill to Identify Problems	4	3.88 (-0.12)	4.17 (+0.17)	4.22 (+0.22)
Critical Thinking Skills	3.93	4.01 (+0.09)	4.39 (+0.46)	4.44 (+0.51)
Reading Skill	3.93	4.24 (+0.32)	4.46 (+0.54)	4.54 (+0.61)
Skill to Conduct Work Design	3.93	3.79 (-0.13)	4.00 (+0.07)	4.12 (+0.20)
Writing Skill	3.93	4.09 (+0.16)	4.27 (+0.34)	4.32 (+0.39)
Skill to Design Experiments	3.85	3.69 (-0.15)	3.97 (+0.12)	4.07 (+0.22)
Communication Skill	3.79	4.09 (+0.30)	4.40 (+0.61)	4.45 (+0.66)
Creativity and Innovation	3.73	3.55 (-0.18)	3.90 (+0.17)	4.02 (+0.29)
Teamwork and Collaboration	3.73	3.88 (+0.15)	4.02 (+0.29)	4.12 (+0.39)

Skill (n): 28 responses	Skill Level Base – OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Entrepreneurial Skill	3.54	3.42 (-0.12)	3.56 (+0.02)	3.71 (+0.17)
Cognitive Abilities	3.50	3.54 (+0.04)	3.82 (+0.32)	3.91 (+0.41)
Commitment to Lifelong Learning	3.46	3.65 (+0.19)	3.90 (+0.44)	3.95 (+0.49)
Digital Literacy	3.46	3.52 (+0.05)	4.07 (+0.61)	4.24 (+0.78)
New Relevant Knowledge	3.46	3.65 (+0.19)	3.88 (+0.41)	3.93 (+0.46)
Skill to Formulate Alternative Solutions	3.46	3.56 (+0.10)	3.85 (+0.39)	4.02 (+0.56)
Social Responsibility	3.46	3.62 (+0.15)	4.02 (+0.56)	4.07 (+0.61)
Skill Needed to Understand Business Principles	3	3.41 (+0.41)	3.73 (+0.73)	3.80 (+0.80)
Skill to Use the Tools Necessary for the Job	2.31	2.64 (+0.33)	2.99 (+0.68)	3.02 (+0.71)
Technical Skill	1.92	2.64 (+0.71)	3.12 (+1.20)	3.24 (+1.32)
Knowledge of Emerging Trends and Technologies	1.87	2.31 (+0.45)	2.77 (+0.90)	2.91 (+1.05)
Sensory Abilities	1.73	2.17 (+0.44)	2.41 (+0.68)	2.34 (+0.61)
Psychomotor Abilities	0.94	1.52 (+0.58)	1.67 (+0.73)	1.64 (+0.71)
Physical Abilities	0.13	0.79 (+0.65)	0.79 (+0.66)	0.77 (+0.63)

TABLE 11: Top Five Manager Skills with Variations Between OaSIS, 2023, 2030 and 2040

When comparing the skill levels in the OaSIS database with the participants' responses for the function of managers, shown in the above table, the top 5 skills that showed the greatest differences between the OaSIS and the skill levels for 2023, 2030 and 2040 were:

	2023	2030	2040
1	Technical Skill	Technical Skill	Technical Skill
2	Physical Abilities	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies
3	Psychomotor Abilities	Skills Needed to Understand Business Principles	Skill Needed to Understand Business Principles
4	Knowledge of Emerging Trends and Technologies	Skill to Use the Tools Necessary for the Job	Digital Literacy
5	Sensory Abilities	Psychomotor Abilities	Skill to Use the Tools Necessary for the Job

TABLE 12: Comparison of Top Ten Manager Skills Between OaSIS and 2023

Comparing the top ten rated skills determined by the OaSIS Database against survey participants' top ten rated skills for 2023 reveals a minor change in ranking for a few skills but shows overall agreement in what skills are seen as important.

	OaSIS	2023
1	Leadership Skills	Leadership Skills
2	Team Building Skills	Team Building Skills
3	Project Management	Project Management
4	Skill to Plan a Program	Decision Making
5	Attention to Detail	Initiative
6	Decision Making Skill	Attention to Detail
7	Initiative	Problem Solving
8	Numeracy	Skill to Plan a Program
9	Problem Solving	Reading
10	Skill to Design a System	Numeracy

The top ten skills for managers in bio-manufacturing, as rated by both participants and the OaSIS database, exhibit a considerable degree of consistency, with skills like **leadership**, **team building**, **project management**, **decision-making**, **initiative**, **attention to detail**, **problem solving**, **skills to plan a program** and **numeracy** appearing in both lists.

These skills are crucial for effective management roles in any industry, including bio-manufacturing. The alignment between participant perceptions and overall sector trends is evident in the emphasis placed on these foundational managerial skills. It's worth noting that slight variations in ranking between the participant ratings and the OaSIS database could stem from nuanced perceptions or experiences within the bio-manufacturing sector. Overall, the consensus on these core managerial competencies reflects a shared understanding of the skills needed to drive success in managerial roles within bio-manufacturing.

TABLE 13: Comparison of Top Ten Manager Skills between OaSIS, 2030 and 2040

When comparing the OaSIS database to the projected proficiencies for 2030 and 2040, several top trending skills emerge consistently across all three sets, with a few new skills identified for 2030 and 2040.

	OaSIS	2030	2040
1	Leadership Skills	Leadership Skills	Team Building Skills
2	Team Building Skills	Team Building Skills	Leadership Skills
3	Project Management	Project Management	Project Management
4	Skill to Plan a Program	Problem Solving	Problem Solving
5	Attention to Detail	Initiative	Initiative
6	Decision Making Skill	Decision Making	Decision Making
7	Initiative	Reading	Reading
8	Numeracy	Critical Thinking	Interpersonal Skills
9	Problem Solving	Interpersonal Skills	Critical Thinking
10	Skill to Design a System	Attention to Detail	Numeracy

Similarities in top ten skills are expected as managerial roles often require strong **leadership**, **decision making** and **problem solving** abilities. Additionally, the emphasis on **interpersonal skills** reflects the importance of effective communication and collaboration in managerial positions.

Numeracy appears to regain prominence in 2040, suggesting a potential shift towards data-driven decision-making within managerial roles. Overall, the perception of survey participants seems to align well with the ongoing emphasis on **leadership**, **teamwork** and strategic thinking within the managerial landscape of the bio-manufacturing sector.

3.3.3 Supervisor Skill Requirements

Supervisors include those in other products manufacturing and assembly, plastic and rubber products manufacturing, and supply chain coordination roles.

TABLE 14: All Supervisors skills requirements in 2023, 2030 and 2040

Skill (n): 13 responses	Skill Level Base - OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Adaptability	4	3.82 (-0.18)	4.00 (+0.00)	3.93 (-0.07)
Independence	4	3.73 (-0.27)	3.64 (-0.36)	3.64 (-0.36)
Initiative	4	3.43 (-0.57)	3.71 (-0.29)	4.00 (+0.00)
Leadership	4	3.89 (-0.11)	4.00 (+0.00)	3.93 (-0.07)
Team Building Skills	4	3.57 (-0.43)	3.79 (-0.21)	3.57 (-0.43)
Project Management	3.81	3.45 (-0.36)	3.46 (-0.36)	3.46 (-0.36)
Teamwork and Collaboration	3.5	3.77 (+0.27)	3.86 (+0.36)	3.93 (+0.43)
Attention to Detail	3.14	3.43 (+0.29)	3.57 (+0.43)	3.36 (+0.21)
Problem Solving	3.07	3.36 (+0.29)	3.64 (+0.57)	3.93 (+0.86)
Professional Composure	3.07	3.39 (+0.32)	3.43 (+0.36)	3.50 (+0.43)
Skill Needed to Evaluate Alternatives	3.07	2.77 (-0.30)	3.07 (+0.00)	3.00 (-0.07)
Skill to Design a System	3.07	2.73 (-0.34)	3.07 (+0.00)	3.29 (+0.21)
Skill to Identify Problems	3.07	3.32 (+0.25)	3.79 (+0.71)	3.86 (+0.79)
Interpersonal Skills	3.04	3.39 (+0.35)	3.61 (+0.57)	3.61 (+0.57)
Commitment to Lifelong Learning	3	2.95 (-0.05)	3.00 (+0.00)	3.07 (+0.07)
Communication	3	3.52 (+0.52)	3.71 (+0.71)	4.07 (+1.07)
Critical Thinking	3	3.21 (+0.21)	3.43 (+0.43)	3.43 (+0.43)
Decision Making	3	3.34 (+0.34)	3.43 (+0.43)	3.43 (+0.43)
Numeracy	3	3.25 (+0.25)	3.21 (+0.21)	3.43 (+0.43)
Reading	3	3.57 (+0.57)	3.71 (+0.71)	3.86 (+0.86)

Skill (n): 13 responses	Skill Level Base - OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Skill to Plan a Program	3	3.41 (+0.41)	3.50 (+0.50)	3.29 (+0.29)
Social Responsibility	3	3.07 (+0.07)	3.14 (+0.14)	3.14 (+0.14)
Writing	3	3.43 (+0.43)	3.43 (+0.43)	3.36 (+0.36)
Skill Needed to Judge Quality	2.93	3.34 (+0.41)	3.43 (+0.50)	3.57 (+0.64)
Skill to Formulate Alternative Solutions	2.93	2.73 (-0.20)	3.14 (+0.21)	3.21 (+0.29)
Skill to Identify, Formulate, and Solve Problems	2.81	3.17 (+0.35)	3.53 (+0.71)	3.67 (+0.86)
Cognitive Abilities	2.79	2.94 (+0.15)	3.22 (+0.43)	3.29 (+0.50)
Skill to Design Experiments	2.51	2.68 (+0.16)	2.94 (+0.43)	3.01 (+0.50)
Skill to Use the Tools Necessary for the Job	2.50	3.07 (+0.57)	3.29 (+0.79)	3.15 (+0.64)
Skill Needed to Support Supplier Development	2.5	2.63 (+0.13)	2.57 (+0.07)	2.71 (+0.21)
Sensory Abilities	2.29	2.78 (+0.50)	2.79 (+0.50)	2.72 (+0.43)
Digital Literacy	2.07	2.61 (+0.54)	3.50 (+1.43)	4.00 (+1.93)
Entrepreneurial Skill	2.07	2.20 (+0.13)	2.14 (+0.07)	2.21 (+0.14)
New Relevant Knowledge	2.07	2.36 (+0.29)	2.64 (+0.57)	2.86 (+0.79)
Creativity and Innovation	2.04	2.73 (+0.70)	3.18 (+1.14)	3.39 (+1.36)
Knowledge of Emerging Trends and Technologies	2.02	2.25 (+0.23)	2.45 (+0.43)	2.59 (+0.57)
Skill Needed to Understand Business Principles	2	2.48 (+0.48)	2.71 (+0.71)	2.93 (+0.93)
Psychomotor Abilities	1.94	2.49 (+0.55)	2.36 (+0.43)	2.29 (+0.36)
Skill to Conduct Work Design	1.86	2.23 (+0.38)	2.71 (+0.86)	2.86 (+1.00)
Technical Skill	1.84	2.99 (+1.15)	3.19 (+1.36)	3.41 (+1.57)
Physical Abilities	1.46	2.24 (+0.79)	1.96 (+0.50)	1.96 (+0.50)

TABLE 15: Comparison of Top Five Supervisor Skills between OaSIS, 2023, 2030 and 2040

When comparing the skill levels in the OaSIS database with the participants' responses the top five skills that showed the greatest differences between the OaSIS and the current skill levels for 2023, 2030 and 2040 were:

	2023	2030	2040
1	Technical Skill	Digital Literacy	Digital Literacy
2	Physical Abilities	Technical Skill	Technical Skill
3	Creativity and Innovation	Creativity and Innovation	Creativity and Innovation
4	Reading	Skill to Conduct Work Design	Skill Needed to Understand Business Principles
5	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job	Communication

TABLE 16: Comparison of Top Ten Supervisor Skills between OaSIS and 2023

Comparing the top ten rated skills determined by the OaSIS Database against survey participants' top ten rated skills for 2023 shows a slight difference in certain skills and ranking.

According to the OaSIS database, adaptability, independence, initiative, leadership skills, and team building skills all had the same rating. Additionally, problem solving, professional composure, the ability to evaluate alternatives, the skill to design a system and the ability to identify problems all share the same rating. To simplify the table, we have listed the top ten skills as they appear in Table 14.

For the 2023 participant rankings, initiative, writing, and attention to detail all held the same value.

	OaSIS	2023
1	Adaptability	Leadership
2	Independence	Adaptability
3	Initiative	Teamwork and Collaboration
4	Leadership	Independence
5	Team Building Skills	Team Building Skills
6	Project Management	Reading
7	Teamwork and Collaboration	Communication
8	Attention to Detail	Project Management
9	Problem Solving	Initiative
10	Professional Composure	Writing

The top skills identified by participants for supervisors in 2023 largely align with those in the OaSIS database, emphasizing **leadership**, **team building**, **adaptability**, **teamwork**, **independence**, **initiative** and **project management**. However, participants placed slightly less emphasis on attention to detail, **skill needed to evaluate alternatives**, and **skill to design a system**, instead prioritizing **reading**, **communication** and **writing** skills. Overall, while there are some differences, the core competencies remain consistent between participant perceptions and the OaSIS database for supervisor roles in 2023.

TABLE 17: Comparison of Top Ten Supervisor Skills Between OaSIS, 2030 and 2040

Similar differences were noted when comparing the top ten ranked skills for 2030 and 2040 against the OaSIS Database's top ten skills.

	OaSIS	2030	2040
1	Adaptability	Adaptability	Initiative
2	Independence	Teamwork and Collaboration	Digital Literacy
3	Initiative	Leadership	Adaptability
4	Leadership	Skill to Identify Problems	Problem Solving
5	Team Building Skills	Team Building Skills	Communication
6	Project Management	Communication	Leadership
7	Teamwork and Collaboration	Reading	Skill to Identify Problems
8	Attention to Detail	Initiative	Teamwork and Collaboration
9	Problem Solving	Problem Solving	Skill to Identify, Formulate, and Solve Problems
10	Professional Composure	Independence	Reading

The trends in skills required for supervisors reflects the evolving demands of the Canadian bio-manufacturing industry. **Adaptability**, **teamwork and collaboration** and **leadership** will remain key skills for the role well into the future. This aligns with the dynamic nature of bio-manufacturing, where the ability to adapt to new technologies, processes, and regulations is paramount. Additionally, the emphasis on **teamwork and collaboration** underscores the interdisciplinary nature of bio-manufacturing, where diverse teams must work together cohesively to achieve common goals.

A notable trend observed in recent years, particularly in 2040, is the increasing importance of **initiative** and **digital literacy**. This suggests a shift towards a more proactive approach and integrating digital technologies into bio-manufacturing processes. As the industry adopts advanced digital tools and automation, supervisors will be expected to not only possess the adaptive and digital skills to drive innovation and optimize operations, but they will also need to maintain strong leadership and interpersonal skills. Furthermore, **digital literacy** has emerged as a critical skill, reflecting the growing reliance on digital platforms, data analytics and automation technologies in bio-manufacturing facilities.

3.3.4 Technician Skill Requirements

Technicians encompass biological, chemical, dietary, electrical and electronics engineering technicians, industrial engineering and manufacturing technicians, mechanical engineering technicians, and prosthetic and orthotic technicians.

TABLE 18: All Technicians skills requirements in 2023, 2030 and 2040

Skill (n): 19 responses	Skill Level Base - OaSIS 2023	Skill Level* 2023 (Variation from OaSIS 2023)	Skill Level* 2030 (Variation from OaSIS 2023)	Skill Level* 2040 (Variation from OaSIS 2023)
Attention to Detail	4.13	3.78 (-0.34)	4.08 (-0.04)	4.17 (+0.04)
Adaptability	3.92	3.56 (-0.35)	3.79 (-0.13)	4.04 (+0.13)
Reading	3.5	3.49 (-0.01)	3.88 (+0.38)	4.00 (+0.50)

Skill (n): 19 responses	Skill Level Base - OaSIS 2023	Skill Level* 2023 (Variation from OaSIS 2023)	Skill Level* 2030 (Variation from OaSIS 2023)	Skill Level* 2040 (Variation from OaSIS 2023)
Skill to Use the Tools Necessary for the Job	3.35	3.24 (-0.11)	3.76 (+0.42)	3.89 (+0.54)
Numeracy	3.25	3.23 (-0.02)	3.58 (+0.33)	3.75 (+0.50)
Skill to Conduct Work Design	3.17	2.60 (-0.56)	2.92 (-0.25)	3.08 (-0.08)
Professional Composure	3.08	3.03 (-0.05)	3.38 (+0.29)	3.46 (+0.38)
Skill to Design Experiments	3.08	2.81 (-0.27)	3.38 (+0.29)	3.50 (+0.42)
Commitment to Lifelong Learning	3	2.74 (-0.26)	3.08 (+0.08)	3.21 (+0.21)
Communication	3	3.14 (+0.14)	3.58 (+0.58)	3.83 (+0.83)
Independence	3	2.90 (-0.10)	3.25 (+0.25)	3.25 (+0.25)
New Relevant Knowledge	3	3.00 (+0.00)	3.33 (+0.33)	3.33 (+0.33)
Problem Solving	3	2.90 (-0.10)	3.58 (+0.58)	3.75 (+0.75)
Critical Thinking	2.96	2.85 (-0.10)	3.21 (+0.25)	3.54 (+0.58)
Skill to Design a System	2.96	2.78 (-0.18)	2.92 (-0.04)	3.00 (+0.04)
Skill to Formulate Alternative Solutions	2.96	2.78 (-0.18)	3.13 (+0.17)	3.13 (+0.17)
Skill to Identify Problems	2.96	2.95 (-0.01)	3.50 (+0.54)	3.67 (+0.71)
Teamwork and Collaboration	2.96	3.40 (+0.44)	3.83 (+0.88)	3.92 (+0.96)
Decision Making	2.92	2.88 (-0.04)	3.29 (+0.38)	3.42 (+0.50)
Skill Needed to Evaluate Alternatives	2.92	2.85 (-0.06)	3.25 (+0.33)	3.38 (+0.46)
Writing	2.92	3.17 (+0.25)	3.58 (+0.67)	3.79 (+0.88)
Cognitive Abilities	2.89	2.91 (+0.02)	3.14 (+0.25)	3.35 (+0.46)
Skill to Identify, Formulate, and Solve Problems	2.72	2.69 (-0.03)	2.97 (+0.25)	3.01 (+0.29)
Creativity and Innovation	2.65	2.49 (-0.16)	2.94 (+0.29)	3.06 (+0.42)
Psychomotor Abilities	2.57	2.94 (+0.37)	3.03 (+0.46)	3.15 (+0.58)
Technical	2.53	3.14 (+0.61)	3.86 (+1.33)	4.07 (+1.54)
Skill to Plan a Program	2.33	2.40 (+0.06)	2.96 (+0.63)	2.96 (+0.63)
Leadership	2.25	2.15 (-0.10)	2.38 (+0.13)	2.63 (+0.38)
Interpersonal Skills	2.19	2.40 (+0.20)	2.90 (+0.71)	3.15 (+0.96)
Initiative	2.17	2.47 (+0.30)	2.83 (+0.67)	3.00 (+0.83)
Social Responsibility	2.17	2.33 (+0.17)	2.79 (+0.63)	2.88 (+0.71)
Team Building Skills	2.17	2.39 (+0.22)	2.92 (+0.75)	2.96 (+0.79)

Skill (n): 19 responses	Skill Level Base - OaSIS 2023	Skill Level* 2023 (Variation from OaSIS 2023)	Skill Level* 2030 (Variation from OaSIS 2023)	Skill Level* 2040 (Variation from OaSIS 2023)
Skill Needed to Support Supplier Development	2.15	2.40 (+0.25)	2.65 (+0.50)	2.85 (+0.71)
Entrepreneurial Skill	2	1.83 (-0.17)	2.04 (+0.04)	2.13 (+0.13)
Digital Literacy	1.96	2.40 (+0.44)	3.17 (+1.21)	3.58 (+1.63)
Skill Needed to Judge Quality	1.92	2.29 (+0.38)	3.13 (+1.21)	3.17 (+1.25)
Sensory Abilities	1.85	2.27 (+0.42)	2.51 (+0.67)	2.60 (+0.75)
Project Management Skill	1.83	1.93 (+0.10)	2.24 (+0.42)	2.28 (+0.46)
Physical Abilities	1.39	2.01 (+0.62)	2.09 (+0.71)	2.14 (+0.75)
Knowledge of Emerging Trends and Technologies	0.59	1.40 (+0.80)	2.09 (+1.50)	2.34 (+1.75)
Skill Needed to Understand Business Principles	0.33	0.86 (+0.53)	1.54 (+1.21)	1.71 (+1.38)

TABLE 19: Comparison of Top Five Technician Skills Between OaSIS, 2023, 2030 and 2040

When comparing the skill levels in the OaSIS database with the participants' responses for the function of technicians, shown in the above table, the top five skills that showed the greatest differences between the OaSIS and the current skill levels for 2023, 2030 and 2040 were:

	2023	2030	2040
1	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies
2	Physical Abilities	Digital Literacy	Digital Literacy
3	Technical Skill	Technical Skill	Technical Skill
4	Skill Needed to Understand Business Principles	Skill Needed to Understand Business Principles	Skill Needed to Understand Business Principles
5	Teamwork and Collaboration	Skill Needed to Judge Quality	Skill Needed to Judge Quality

TABLE 20: Comparison of Top Ten Technician Skills between OaSIS and 2023

Comparing the top ten rated skills determined by the OaSIS Database against survey participants' top ten rated skills for 2023 near alignment with the rankings of skills required.

According to the OaSIS database, commitment to lifelong learning, communication skill, independence, new relevant knowledge, and problem solving all had a value of 3. To simplify the table, we have listed the top ten skills as they appear in Table 18.

	OaSIS	2023
1	Attention to Detail	Attention to Detail
2	Adaptability	Adaptability

	OaSIS	2023
3	Reading	Reading
4	Skill to Use the Tools Necessary for the Job	Teamwork and Collaboration
5	Numeracy	Skills to Use the Tools Necessary for the Job
6	Skill to Conduct Work Design	Numeracy
7	Professional Composure	Writing
8	Skill to Design Experiments	Technical Skill
9	Commitment to Lifelong Learning	Communication
10	Communication Skill	Professional Composure

In comparing the two sets of skills for technicians in bio-manufacturing, there is a high level of agreement between the skills rated by participants in 2023 and the skills averaged from the OaSIS database. Both groups rated **attention to detail**, **adaptability**, and **reading** as the top three skills, indicating alignment in their perceptions of key competencies. The only difference between the top five rankings was a minor shift in perceived importance of **skill to use the tools necessary for the job** and **numeracy**, which flipped position for the participant rankings.

There were slight differences, such as respondents' ranking **teamwork and collaboration** and **writing** in the top ten for 2023, which are not as prominent in the OaSIS database.

TABLE 21: Comparison of Top Ten Technician Skills Between OaSIS, 2030 and 2040

Trends in skills required begin to emerge when comparing the OaSIS Database with participant rankings for 2030 and 2040.

	OaSIS	2030	2040
1	Attention to Detail	Attention to Detail	Attention to Detail
2	Adaptability	Reading	Adaptability
3	Reading	Skill to Use the Tools Necessary for the Job	Technical Skill
4	Skill to Use the Tools Necessary for the Job	Adaptability	Reading
5	Numeracy	Technical Skill	Skill to Use the Tools Necessary for the Job
6	Skill to Conduct Work Design	Teamwork and Collaboration	Communication
7	Professional Composure	Communication	Teamwork and Collaboration
8	Skill to Design Experiments	Problem Solving	Writing
9	Commitment to Lifelong Learning	Numeracy	Problem Solving
10	Communication Skill	Skill to Identify Problems	Numeracy

The trends for skills among technicians in bio-manufacturing emphasize the value to employers of core competencies like **attention to detail**, **adaptability**, **technical skills** and **problem solving** across both 2030 and 2040 projections. This underscores the importance of precision, flexibility, and technical proficiency within the sector. Additionally, the prominence of **communication,** and **teamwork and collaboration** skills reflects the increasing interconnectedness of roles and the emphasis on cross-functional cooperation in bio-manufacturing settings. The inclusion of **reading** skills and **numeracy** underscores the significance of fundamental literacy and numeracy competencies in interpreting technical documentation and executing tasks accurately.

3.3.5 Technologist Skill Requirements

Technologists consist of chemical, industrial engineering, and manufacturing technologists, along with mechanical engineering technologists.

TABLE 22: All Technologists Skills Requirements in 2023, 2030 and 2040

Skill (n): 23 responses	Skill Level Base - OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Attention to Detail	4.04	3.89 (-0.14)	4.11 (+0.07)	4.11 (+0.07)
Adaptability	4	3.42 (-0.58)	3.79 (-0.21)	3.89 (-0.11)
Numeracy	4	3.60 (-0.40)	3.86 (-0.14)	3.86 (-0.14)
Skill Needed to Evaluate Alternatives	4	3.57 (-0.43)	3.61 (-0.39)	3.64 (-0.36)
Commitment to Lifelong Learning	3.89	3.55 (-0.34)	3.82 (-0.07)	3.79 (-0.11)
New Relevant Knowledge	3.89	3.52 (-0.38)	3.82 (-0.07)	3.93 (+0.04)
Skill to Identify Problems	3.89	3.75 (-0.14)	3.96 (+0.07)	3.93 (+0.04)
Skill to Use the Tools Necessary for the Job	3.57	3.57 (+0.00)	3.93 (+0.36)	3.89 (+0.32)
Creativity and Innovation	3.46	3.04 (-0.43)	3.54 (+0.07)	3.64 (+0.18)
Cognitive Abilities	3.46	3.31 (-0.15)	3.42 (-0.04)	3.49 (+0.04)
Skill to Design Experiments	3.30	3.07 (-0.23)	3.41 (+0.11)	3.48 (+0.18)
Independence	3.25	3.09 (-0.16)	3.25 (+0.00)	3.32 (+0.07)
Critical Thinking	3.21	3.17 (-0.04)	3.64 (+0.43)	3.79 (+0.57)
Skill to Identify, Formulate, and Solve Problems	3.21	3.22 (+0.01)	3.49 (+0.29)	3.56 (+0.36)
Skill to Conduct Work Design	3.11	2.58 (-0.53)	2.93 (-0.18)	2.89 (-0.21)
Skill to Design a System	3.11	2.90 (-0.21)	3.21 (+0.11)	3.21 (+0.11)
Leadership	3.07	2.79 (-0.29)	2.89 (-0.18)	2.86 (-0.21)
Professional Composure	3.04	2.98 (-0.05)	3.21 (+0.18)	3.29 (+0.25)
Skill to Formulate Alternative Solutions	3.04	2.75 (-0.29)	3.11 (+0.07)	3.07 (+0.04)
Communication	3	3.23 (+0.23)	3.68 (+0.68)	3.82 (+0.82)
Decision Making	3	3.04 (+0.04)	3.32 (+0.32)	3.25 (+0.25)
Digital Literacy	3	3.14 (+0.14)	3.86 (+0.86)	4.18 (+1.18)

Skill (n): 23 responses	Skill Level Base - OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Initiative	3	2.88 (-0.13)	3.29 (+0.29)	3.36 (+0.36)
Problem Solving	3	3.00 (+0.00)	3.68 (+0.68)	3.93 (+0.93)
Reading	3	3.63 (+0.63)	4.00 (+1.00)	4.11 (+1.11)
Skill Needed to Judge Quality	3	2.95 (-0.05)	3.32 (+0.32)	3.29 (+0.29)
Skill to Plan a Program	3	3.02 (+0.02)	3.36 (+0.36)	3.36 (+0.36)
Writing	3	3.41 (+0.41)	3.71 (+0.71)	3.71 (+0.71)
Teamwork and Collaboration	2.93	3.29 (+0.36)	3.54 (+0.61)	3.68 (+0.75)
Technical Skill	2.83	3.19 (+0.36)	3.68 (+0.86)	3.90 (+1.07)
Interpersonal Skills	2.82	2.79 (-0.03)	3.18 (+0.36)	3.11 (+0.29)
Psychomotor Abilities	2.61	3.19 (+0.58)	3.15 (+0.54)	3.04 (+0.43)
Project Management	2.46	2.56 (+0.10)	2.75 (+0.29)	2.96 (+0.50)
Skill Needed to Support Supplier Development	2.45	2.58 (+0.13)	2.80 (+0.36)	2.91 (+0.46)
Team Building Skills	2.11	2.66 (+0.55)	3.11 (+1.00)	3.14 (+1.04)
Entrepreneurial Skill	2.07	2.17 (+0.10)	2.36 (+0.29)	2.32 (+0.25)
Social Responsibility	2.04	2.13 (+0.10)	2.54 (+0.50)	2.57 (+0.54)
Sensory Abilities	1.98	2.35 (+0.37)	2.59 (+0.61)	2.59 (+0.61)
Physical Abilities	1.39	2.20 (+0.81)	2.21 (+0.82)	2.03 (+0.64)
Knowledge of Emerging Trends and Technologies	0.46	1.28 (+0.81)	1.86 (+1.39)	2.21 (+1.75)
Skill Needed to Understand Business Principles	0.11	1.17 (+1.06)	1.71 (+1.61)	1.89 (+1.79)

TABLE 23: Comparison of Top Five Technologist Skills Between OaSIS, 2023, 2030 and 2040

When comparing the skill levels in the OaSIS database with the participants' responses for the function of technologists, shown in the above table, the top 5 skills that showed the greatest differences between the OaSIS and the current skill levels for 2023, 2030 and 2040 were:

	2023	2030	2040
1	Skill Needed to Understand Business Principles	Skill Needed to Understand Business Principles	Skill Needed to Understand Business Principles
2	Physical Abilities	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies
3	Knowledge of Emerging Trends and Technologies	Team Building Skills	Digital Literacy
4	Reading	Reading	Technical Skill
5	Psychomotor Abilities	Technical Skill	Reading

TABLE 24: Comparison of Top Ten Technologist Skills Between OaSIS and 2023

Comparing the top ten rated skills determined by the OaSIS database against survey participants' top ten rated skills for 2023 reveals a slight shift in what skills are deemed important.

According to the OaSIS database, creativity, innovation, and cognitive abilities all had the same rating. To simplify the table, we have listed the top ten skills as they appear in Table 22.

	OaSIS	2023
1	Attention to Detail	Attention to Detail
2	Adaptability	Skill to Identify Problems
3	Numeracy	Reading
4	Skill Needed to Evaluate Alternatives	Numeracy
5	Commitment to Lifelong Learning	Skill to Use the Tools Necessary for the Job
6	New Relevant Knowledge	Skill Needed to Evaluate Alternatives
7	Skill to Identify Problems	Commitment to Lifelong Learning
8	Skill to Use the Tools Necessary for the Job	New Relevant Knowledge
9	Creativity and Innovation	Adaptability
10	Cognitive Abilities	Writing

TABLE 25: Comparison of Top Ten Technologist Skills between OaSIS, 2030 and 2040

Upon reviewing the participant adjusted data for technologists in 2023, both sources emphasize attention to detail, numeracy, skills to identify problems, skills to use the tools necessary for the job, and skills needed to evaluate alternatives. However, the participants placed a higher emphasis on reading and writing skills, while the OaSIS database highlighted creativity and innovation and cognitive abilities.

A comparison of 2030, and 2040 skills shows alignment for the top-ranked skills, with slight differences in their variations.

	OaSIS	2030	2040
1	Attention to Detail	Attention to Detail	Attention to Detail
2	Adaptability	Skill to Identify Problems	Digital Literacy
3	Numeracy	Reading	Reading
4	Skill Needed to Evaluate Alternatives	Skill to Use the Tools Necessary for the Job	Skill to Identify Problems
5	Commitment to Lifelong Learning	Digital Literacy	Adaptability
6	New Relevant Knowledge	Numeracy	Technical Skill
7	Skill to Identify Problems	Commitment to Lifelong Learning	Numeracy
8	Skill to Use the Tools Necessary for the Job	New Relevant Knowledge	Problem Solving
9	Creativity and Innovation	Adaptability	New Relevant Knowledge
10	Cognitive Abilities	Technical Skill	Skill to Use the Tools Necessary for the Job

The skill requirements for technologists in the bio-manufacturing sector in Canada is consistent across the years 2030 and 2040. **Attention to detail**, **adaptability**, **digital literacy** and **problem solving** skills emerge as critical proficiencies required for technologists. These trends underscore the importance of precision, flexibility and technological proficiency within the evolving landscape of bio-manufacturing.

As the sector continues to advance, technologists will need to possess strong analytical skills, a capacity for learning new technologies, and the ability to adapt to changing industry demands. This aligns with Canada's efforts to foster innovation and competitiveness within its bio-manufacturing sector by ensuring that technologists are equipped with the necessary skills to drive growth and development in this critical industry.

3.4 Skill Level Requirements and Variation from Base by National Occupation Code (NOC) in 2023, 2030 and 2040

Manufacturing managers and biomedical engineers were the two roles with the greatest number of survey responses. Both roles play vital roles in the Canadian bioeconomy landscape.

Biomedical engineers contribute to the design, development and maintenance of medical equipment and technologies essential for healthcare, pharmaceuticals, and biotechnology. They are involved in creating innovative solutions to medical challenges, improving patient care and advancing medical research.

Manufacturing managers are responsible for overseeing the production processes within the bio-economy sector. They ensure efficient operations, quality control, and regulatory compliance in the manufacturing of medical devices, pharmaceuticals, and other bio-based products. Manufacturing managers play a fundamental role in optimizing production processes, reducing costs and meeting industry standards to deliver high-quality products to the market.

Both the biomedical engineer and manufacturing manager roles were included in BioTalent Canada's National Occupational Standards (NOS) due to their significance within bio-manufacturing.

Both roles are seen as essential for bio-manufacturing, and the frequency of their selection by survey respondents underscores that importance.

3.4.1 Manufacturing Managers

Nineteen participants from organizations in Pharmaceutical and Medicine Manufacturing (NAIC 32541), Medical Equipment and Supplies Manufacturing (NAIC 33911), Other Chemical Product Manufacturing (32599), and Sugar and Confectionery Product Manufacturing (31134) selected the manufacturing manager occupation as one of the key roles to assess in our survey.

TABLE 26: **Manufacturing Managers (90010) Skills Requirements in 2023, 2030 and 2040**

Skill (n): 19 responses	Skill Level Base OaSIS 2023	Skill Level 2023 Variation from OaSIS 2023	Skill Level 2030 Variation from OaSIS 2023	Skill Level 2040 Variation from OaSIS 2023
Leadership	5	4.78 (-0.22)	4.73 (-0.27)	4.68 (-0.32)
Skill to Plan a Program	5	4.45 (-0.55)	4.59 (-0.41)	4.55 (-0.45)
Team Building Skills	5	4.66 (-0.34)	4.77 (-0.23)	4.86 (-0.14)
Project Management	4.6	4.34 (-0.26)	4.42 (-0.18)	4.33 (-0.27)
Skill to Identify, Formulate, and Solve Problems	4.1	3.95 (-0.15)	4.15 (+0.05)	4.42 (+0.32)
Adaptability	4	3.83 (-0.17)	4.09 (+0.09)	4.18 (+0.18)
Attention to Detail	4	3.98 (-0.02)	4.05 (+0.05)	4.05 (+0.05)
Decision Making	4	3.91 (-0.09)	4.05 (+0.05)	4.18 (+0.18)
Entrepreneurial Skill	4	3.65 (-0.35)	3.77 (-0.23)	3.86 (-0.14)
Independence	4	3.98 (-0.02)	4.05 (+0.05)	3.91 (-0.09)
Initiative	4	3.89 (-0.11)	4.09 (+0.09)	4.18 (+0.18)
Numeracy	4	3.97 (-0.03)	4.14 (+0.14)	4.14 (+0.14)
Problem Solving	4	3.93 (-0.07)	4.23 (+0.23)	4.36 (+0.36)
Professional Composure	4	4.07 (+0.07)	4.18 (+0.18)	4.23 (+0.23)
Skill Needed to Evaluate Alternatives	4	3.78 (-0.22)	3.95 (-0.05)	4.18 (+0.18)
Skill Needed to Judge Quality	4	3.72 (-0.28)	4.09 (+0.09)	4.14 (+0.14)
Skill Needed to Support Supplier Development	4	3.82 (-0.18)	4.00 (+0.00)	4.14 (+0.14)
Skill to Design a System	4	3.78 (-0.22)	3.91 (-0.09)	4.14 (+0.14)
Skill to Identify Problems	4	3.77 (-0.23)	4.18 (+0.18)	4.27 (+0.27)
Interpersonal Skills	3.8	3.87 (+0.07)	4.16 (+0.36)	4.30 (+0.50)
Skill to Design Experiments	3.8	3.53 (-0.27)	3.80 (+0.00)	3.89 (+0.09)
Creativity and Innovation	3.5	3.36 (-0.14)	3.82 (+0.32)	3.82 (+0.32)
Teamwork and Collaboration	3.5	3.72 (+0.22)	3.95 (+0.45)	4.14 (+0.64)
Communication	3.33	3.89 (+0.56)	4.24 (+0.91)	4.28 (+0.95)
Cognitive Abilities	3.11	3.23 (+0.12)	3.61 (+0.50)	3.70 (+0.59)
Commitment to Lifelong Learning	3	3.25 (+0.25)	3.64 (+0.64)	3.68 (+0.68)
Critical Thinking	3	3.34 (+0.34)	3.91 (+0.91)	4.00 (+1.00)
Digital Literacy	3	3.13 (+0.13)	3.95 (+0.95)	4.36 (+1.36)
New Relevant Knowledge	3	3.20 (+0.20)	3.59 (+0.59)	3.68 (+0.68)
Reading	3	3.82 (+0.82)	4.14 (+1.14)	4.23 (+1.23)
Skill Needed to Understand Business Principles	3	3.39 (+0.39)	3.77 (+0.77)	3.86 (+0.86)
Skill to Conduct Work Design	3	3.18 (+0.18)	3.55 (+0.55)	3.77 (+0.77)
Skill to Formulate Alternative Solutions	3	3.14 (+0.14)	3.55 (+0.55)	3.82 (+0.82)
Social Responsibility	3	3.28 (+0.28)	3.91 (+0.91)	4.00 (+1.00)
Writing	3	3.56 (+0.56)	3.82 (+0.82)	3.86 (+0.86)

Skill (n): 19 responses	Skill Level Base OaSIS 2023	Skill Level 2023 Variation from OaSIS 2023	Skill Level 2030 Variation from OaSIS 2023	Skill Level 2040 Variation from OaSIS 2023
Skill to Use the Tools Necessary for the Job	2	2.52 (+0.52)	3.05 (+1.05)	3.05 (+1.05)
Sensory Abilities	1.92	2.47 (+0.55)	2.74 (+0.82)	2.65 (+0.73)
Knowledge of Emerging Trends and Technologies	1.75	2.18 (+0.43)	2.61 (+0.86)	2.84 (+1.09)
Technical Skill	1.6	2.59 (+0.99)	3.01 (+1.41)	3.10 (+1.50)
Psychomotor Abilities	1.4	1.96 (+0.56)	2.08 (+0.68)	1.99 (+0.59)
Physical Abilities	0.25	1.19 (+0.94)	1.20 (+0.95)	1.16 (+0.91)

TABLE 27: Comparison of Top Five Manufacturing Managers Skills Between OaSIS, 2023, 2030 and 2040

When comparing the skill levels in the OaSIS database with the participants' responses for the role of manufacturing managers, shown in the above table, the top 5 skills that showed the greatest differences between the OaSIS and the skill levels over time, listed in descending order, are:

	2023	2030	2040
1	Technical Skill	Technical Skill	Technical Skill
2	Physical Abilities	Reading	Digital Literacy
3	Reading	Skill to Use the Tools Necessary for the Job	Knowledge of Emerging Trends and Technologies
4	Psychomotor Abilities	Digital Literacy	Reading
5	Writing	Physical Abilities	Skill to Use the Tools Necessary for the Job

Comparing 2023, 2030 and 2040 to OaSIS indicates an anticipated shift in required skill levels by the decade's end for Manufacturing Managers. **Technical skills**, **reading** and **physical abilities** will retain significance, with increased emphasis on **digital literacy**, **knowledge of emerging trends and technologies**, and proficiency in using job-specific tools. This trend aligns with the projected data for 2040, where these skills are expected to further increase in importance.

TABLE 28: Comparison of Top Ten Manufacturing Managers Skills Between OaSIS and 2023

According to the OaSIS database, leadership, skill to plan a program and team building all had the same rating. Additionally, 14 skills, including adaptability, all had a rating of 4 in the OaSIS database. To simplify the table, the top ten skills are listed as they appear in Table 26.

	OaSIS	2023
1	Leadership Skills	Leadership Skills
2	Skill to Plan a Program	Team Building Skills
3	Team Building Skills	Skill to Plan a Program
4	Project Management	Project Management

	OaSIS	2023
5	Skill to Identify, Formulate, and Solve Problems	Professional Composure
6	Adaptability	Independence
7	Attention to Detail	Attention to Detail
8	Decision Making Skill	Numeracy
9	Entrepreneurial Skill	Skill to Identify, Formulate, and Solve Problems
10	Independence	Problem Solving

These perceptions of OaSIS and participant's responses for 2023 align with each other to a large extent. **Leadership**, **team building**, **project management** and **problem solving** skills are commonly expected and valued in managerial roles, especially in manufacturing where coordination and efficiency are paramount. The emphasis on planning and program management also reflects the need for strategic thinking and execution in the manufacturing domain.

Respondents indicated greater value for skills such as **independence**, **attention to detail** and **numeracy** for manufacturing roles in 2023. These skills appeared in the top ten, differing from the skillset outlined by OaSIS. This suggests that participants placed particular importance on autonomy, precision and numerical competence in managerial roles, perhaps indicating specific challenges or expectations within the bio-economy.

TABLE 29: Comparison of Top Ten Manufacturing Managers Skills Between OaSIS, 2030 and 2040

The top ten rated skills for 2030 and 2040 showed considerable alignment:

	OaSIS	2030	2040
1	Leadership Skills	Leadership Skills	Team Building Skills
2	Skill to Plan a Program	Team Building Skills	Leadership Skills
3	Team Building Skills	Skill to Plan a Program	Skill to Plan a Program
4	Project Management	Project Management	Project Management
5	Skill to Identify, Formulate, and Solve Problems	Problem Solving	Skill to Identify, Formulate, and Solve Problems
6	Adaptability	Professional Composure	Problem Solving
7	Attention to Detail	Interpersonal Skills	Interpersonal Skills
8	Decision Making Skill	Skill to Identify Problems	Skill to Identify Problems
9	Entrepreneurial Skill	Initiative	Digital Literacy
10	Independence	Skill to Identify, Formulate, and Solve Problems	Professional Composure

The participant's selection for both 2030 and 2040 reflects a consistent emphasis on **leadership**, **teamwork**, **project management** and **problem solving** abilities. These skills are foundational for effective management and collaboration within bio-manufacturing.

The inclusion of skills like **professional composure**, **interpersonal skills** and **initiative** suggests an awareness of the importance of personal qualities and proactive behavior in managerial roles. These skills indicate a recognition of the need for resilience, effective communication and self-motivation in navigating the challenges of the bio-economy.

The addition of **digital literacy** in the 2040 list reflects the evolving technological landscape and the increasing importance of digital tools and platforms in modern workplaces. This adaptation to technological advancements aligns with broader trends in industry digitization and automation.

Overall, the participant's selections for both 2030 and 2040 demonstrate a forward-thinking approach to skill development, anticipating the evolving demands of the bio-economy. By prioritizing key competencies such as **leadership**, **teamwork**, **adaptability** and **digital literacy**, participants are preparing themselves for success in an increasingly dynamic and competitive industry landscape.

3.4.2 Biomedical Engineers

Eighteen participants from organizations in Pharmaceutical and Medicine Manufacturing (NAIC 32541), Medical Equipment and Supplies Manufacturing (NAIC 33911), and Printing and related support activities (32311) selected the biomedical engineer occupation as one of the key roles to assess in our survey.

TABLE 30: Biomedical Engineers (21399.02) Skills Requirements in 2023, 2030 and 2040

Skill (n): 18 responses	Skill Level Base – OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Attention to Detail	5	4.54 (-0.46)	4.78 (-0.22)	4.83 (-0.17)
Critical Thinking	5	4.07 (-0.93)	4.67 (-0.33)	4.78 (-0.22)
Decision Making	5	4.35 (-0.65)	4.67 (-0.33)	4.67 (-0.33)
Digital Literacy	5	4.06 (-0.94)	4.50 (-0.50)	4.56 (-0.44)
New Relevant Knowledge	5	4.33 (-0.67)	4.67 (-0.33)	4.78 (-0.22)
Problem Solving	5	3.94 (-1.06)	4.56 (-0.44)	4.50 (-0.50)
Reading	5	4.28 (-0.72)	4.61 (-0.39)	4.67 (-0.33)
Skill Needed to Evaluate Alternatives	5	4.25 (-0.75)	4.39 (-0.61)	4.44 (-0.56)
Skill to Conduct Work Design	5	3.81 (-1.19)	4.00 (-1.00)	4.06 (-0.94)
Skill to Design a System	5	4.25 (-0.75)	4.67 (-0.33)	4.61 (-0.39)
Skill to Formulate Alternative Solutions	5	4.04 (-0.96)	4.67 (-0.33)	4.67 (-0.33)
Skill to Identify Problems	5	4.28 (-0.72)	4.44 (-0.56)	4.61 (-0.39)
Skill to Design Experiments	4.9	4.21 (-0.69)	4.57 (-0.33)	4.51 (-0.39)
Skill to Identify, Formulate, and Solve Problems	4.6	3.88 (-0.72)	4.10 (-0.50)	4.27 (-0.33)

Skill (n): 18 responses	Skill Level Base – OaSIS 2023	Skill Level* 2023(Variation from OaSIS 2023)	Skill Level* 2030(Variation from OaSIS 2023)	Skill Level* 2040(Variation from OaSIS 2023)
Creativity and Innovation	4.5	3.64 (-0.86)	4.17 (-0.33)	4.39 (-0.11)
Skill Needed to Support Supplier Development	4.5	3.49 (-1.01)	4.17 (-0.33)	4.17 (-0.33)
Communication	4.33	3.71 (-0.62)	4.55 (+0.22)	4.77 (+0.44)
Cognitive Abilities	4.26	4.22 (-0.05)	4.32 (+0.06)	4.32 (+0.06)
Technical Skill	4.1	3.63 (-0.47)	4.16 (+0.06)	4.21 (+0.11)
Adaptability	4	3.50 (-0.50)	4.28 (+0.28)	4.50 (+0.50)
Commitment to Lifelong Learning	4	4.01 (+0.01)	4.33 (+0.33)	4.22 (+0.22)
Independence	4	4.17 (+0.17)	4.22 (+0.22)	4.17 (+0.17)
Initiative	4	3.79 (-0.21)	4.06 (+0.06)	4.06 (+0.06)
Leadership	4	3.67 (-0.33)	3.83 (-0.17)	3.83 (-0.17)
Numeracy	4	3.71 (-0.29)	4.11 (+0.11)	4.17 (+0.17)
Professional Composure	4	3.69 (-0.31)	3.89 (-0.11)	3.83 (-0.17)
Skill Needed to Judge Quality	4	3.83 (-0.17)	4.11 (+0.11)	4.06 (+0.06)
Skill to Plan a Program	4	3.57 (-0.43)	4.11 (+0.11)	4.22 (+0.22)
Skill to Use the Tools Necessary for the Job	4	3.46 (-0.54)	3.83 (-0.17)	3.78 (-0.22)
Team Building Skills	4	3.93 (-0.07)	4.00 (+0.00)	4.00 (+0.00)
Writing	4	4.01 (+0.01)	4.33 (+0.33)	4.28 (+0.28)
Project Management Skill	3.8	3.37 (-0.43)	3.69 (-0.11)	3.86 (+0.06)
Interpersonal Skills	3.4	3.42 (+0.02)	3.68 (+0.28)	3.51 (+0.11)
Entrepreneurial Skill	3	2.90 (-0.10)	3.22 (+0.22)	3.17 (+0.17)
Social Responsibility	3	2.85 (-0.15)	3.17 (+0.17)	3.33 (+0.33)
Teamwork and Collaboration	3	3.65 (+0.65)	4.11 (+1.11)	4.17 (+1.17)
Skill Needed to Understand Business Principles	2	2.57 (+0.57)	3.06 (+1.06)	3.17 (+1.17)
Sensory Abilities	1.67	1.85 (+0.18)	2.06 (+0.39)	1.95 (+0.28)
Knowledge of Emerging Trends and Technologies	1.5	2.46 (+0.96)	2.94 (+1.44)	3.50 (+2.00)
Psychomotor Abilities	1.4	2.36 (+0.96)	2.62 (+1.22)	2.40 (+1.00)
Physical Abilities	0.38	1.27 (+0.89)	1.32 (+0.94)	1.16 (+0.78)

TABLE 31: Comparison of Top Five Biomedical Engineer Skills Between OaSIS, 2023, 2030 and 2040

When comparing the skill levels in the OaSIS database with the participants' responses for the role of biomedical engineers, the top five skills that showed the greatest differences between the OaSIS and participant selection, were:

	2023	2030	2040
1	Psychomotor Abilities	Knowledge of Emerging Trends and Technologies	Knowledge of Emerging Trends and Technologies
2	Knowledge of Emerging Trends and Technologies	Teamwork and Collaboration	Teamwork and Collaboration
3	Physical Abilities	Skill Needed to Understand Business Principles	Skill Needed to Understand Business Principles
4	Teamwork and Collaboration	Psychomotor Abilities	Psychomotor Abilities
5	Skill Needed to Understand Business Principles	Physical Abilities	Physical Abilities

These results suggest several implications for biomedical engineering in Canada within the bio-manufacturing sector.

Firstly, the discrepancies between participant perceptions and the OaSIS database underscore potential areas of prominence or specialization within the field. For instance, the recurrent emphasis on skills like **psychomotor abilities,** and **knowledge of emerging trends and technologies** reflect the dynamic nature of biomedical engineering, where hands-on proficiency and staying on top of cutting-edge advancements are key aspects of the role.

Additionally, the focus on **teamwork and collaboration** signals the importance of interdisciplinary collaboration and effective communication within biomanufacturing settings, where complex projects often require cross-functional teams.

Moreover, the perceived significance of skills like **physical abilities** and **understanding business principles** suggests a multifaceted role for biomedical engineers, encompassing both technical expertise and business acumen, which aligns with the diverse challenges and opportunities present in the current bio-manufacturing landscape.

Overall, these results highlight the nuanced skill requirements and evolving demands within biomedical engineering in Canada's bio-manufacturing sector, emphasizing the need for tailored training and professional development initiatives to ensure workforce readiness and innovation in this dynamic field.

TABLE 32: Comparison of Top Ten Biomedical Engineer Skills Between OaSIS and 2023

Several similarities were noted in the top ten ranked skills when comparing the average of base for all the role of biomedical engineer with participant rankings for 2023 with slight variations on their perceived importance.

According to the OaSIS database, new relevant knowledge, problem solving, reading, skill needed to evaluate alternatives, skill to conduct work design, skill to design a system, skill to formulate alternative solutions, and skill to identify problems all have a value of 5. To simplify the table, the top ten skills are listed as they appear in Table 30.

	OaSIS	2023
1	Attention to Detail	Attention to Detail
2	Critical Thinking	Decision Making
3	Decision Making	New Relevant Knowledge
4	Digital Literacy	Reading
5	New Relevant Knowledge	Skill to Identify Problems
6	Problem Solving	Skill Needed to Evaluate Alternatives
7	Reading	Skill to Design a System
8	Skill Needed to Evaluate Alternatives	Cognitive Abilities
9	Skill to Conduct Work Design	Skill to Design Experiments
10	Skill to Design a System	Independence

When comparing the OaSIS and 2023 skills required for biomedical engineers in Canadian bio-manufacturing there is alignment with expectations, as they emphasize **critical thinking**, **problem solving** and **technical skills** crucial for the field. However, the prominence of **cognitive abilities** and **independence** may be somewhat surprising but could reflect the evolving nature of the profession.

TABLE 33: Comparison of Top Ten Biomedical Engineer Skills Between OaSIS, 2030 and 2040

Likewise, a comparison of 2030 and 2040 rankings for skills required showed consistency with the top ranked skills.

	OaSIS	2030	2040
1	Attention to Detail	Attention to Detail	Attention to Detail
2	Critical Thinking	Skill to Formulate Alternative Solutions	Critical Thinking
3	Decision Making	New Relevant Knowledge	New Relevant Knowledge
4	Digital Literacy	Critical Thinking	Skill to Formulate Alternative Solutions
5	New Relevant Knowledge	Decision Making	Reading
6	Problem Solving	Skill to Design a System	Decision Making
7	Reading	Reading	Digital Literacy
8	Skill Needed to Evaluate Alternatives	Skill to Design Experiments	Skill to Identify Problems
9	Skill to Conduct Work Design	Problem Solving	Communication
10	Skill to Design a System	Digital Literacy	Skill to Design a System

Looking ahead to future skills levels in 2030 and 2040, the top trending skills include **critical thinking**, **digital literacy**, **skill to formulate alternative solutions** and **communication**, among others. These perceptions are also in line with expectations, as they anticipate the increasing importance of technology, communication and adaptability as bio-manufacturing in Canada evolves.

Overall, the survey participants' perceptions align well with sector trends, emphasizing the need for a balance between technical expertise and soft skills to meet the demands of the industry's future.

4 Discussion and Summary

The pandemic has put Canada's bio-economy, specifically bio-manufacturing, into focus as a critical sector not as a driver of innovation and economic growth, but more importantly to better support the health and well-being of Canadians in the event of future health emergencies.

Investments to grow the industry have been made over the last few years to increase the domestic capacity to develop and manufacture vaccines, and personal protective equipment (PPE), but without the talent to work in the facilities, these investments will fall short.

According to BioTalent Canada's research, nearly 200,000 people currently employed in the bio-economy, with 73,940 work within bio-manufacturing; and an estimated 16,140 additional bio-manufacturing workers will be required by 2029 to sustain the sector – with 5,160 in bio-health manufacturing alone. With only 25% of those positions predicted to be filled during this time period there will be a significant talent shortage.

This significant labour shortage projected in bio-manufacturing exacerbate challenges related to current and future skill levels, potentially hindering the for the bio-economy's ability to meet growing demands and innovate effectively.

While some shortages may be mitigated by more active recruitment of new graduates in relevant fields, additional strategies will be required, such as recruiting skilled immigrants and looking beyond traditional pools. Raising awareness of bio-manufacturing careers within the bio-economy, among these groups and promoting greater mobility could enable more graduates to find work more closely related to their studies while mitigating some of the anticipated labour shortages.

In some cases, it will be necessary to hire promising candidates with most of the qualifications they need and provide their own training to produce the exact, highly tailored skill sets for specific positions. Many employers also report that candidates lack soft skills such as problem-solving, collaboration and the business development skills that support commercialization.

The data collected in this survey illustrates this, with several important skills being ranked higher than the OaSIS database at the present time and in the years to come, notably knowledge of emerging trends and technologies, digital literacy and skills needed to understand business principles.

People looking to enter the sector will need to look beyond the classroom to develop the skills employers seek when recruiting.

Work-integrated learning (WIL) programs like BioTalent Canada's Student Work Placement Program (SWPP) are an essential piece to solving the talent gap. The program helps students gain the top-ranked soft skills that survey respondents indicated as a requirement to the roles reviewed while also offering employers a unique opportunity to learn new insights and industry trends from prospective new hires.

While insightful, the data discussed in this report only reflects a small sample-size of Bio-manufactruing in Canada. A more comprehensive study is required to understand the full scope of the key skills required to support the sustained growth of bio-manufacturing activities within Canada's bio-economy.

5 Gathering the Data

The survey used for this study was provided by Next Generation Canada and was shared with BioTalent Canada's stakeholders between December 2023 to the end January 2024.

Considered one of the most robust in the sector, BioTalent Canada's network consists of health and biosciences companies, academic and research institutions, government agencies, industry associations, training providers, non-profits, and service providers. BioTalent Canada works closely with this network to address workforce needs, facilitate training, and support industry growth. Through surveys, focus groups and insights, these stakeholders contributed to participant recruitment for our survey.

BioTalent Canada gathered the data for this report through:

- **Targeted outreach:** Focused on established bio-manufacturing firms with commercial products and revenue streams, excluding startups, ensured relevance and reliability of data.
- **Engagement and support:** One-on-one assistance and guidance provided to participants to ensure a smooth survey process and high completion rates.

6 Acknowledgements

BioTalent Canada would like to thank the partners, wage subsidy employers, and project supports that took the time to complete the survey for this report. Your continued support in the research conducted by BioTalent Canada has been integral in the development of the products and services that shape the future success of the Canadian health and biosciences sector.

7 Partners

Platinum
Innovative Medicines Canada

Gold
Applied Pharmaceutical Innovation
Bioscience Association Manitoba
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Immigrant Employment Council of BC (IEC-BC)
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Sanofi
Xenon Pharmaceuticals Inc
Zymeworks Inc.

Academic
Carleton University
Loyalist College
Queen’s University
Red River College
University of Guelph
Western University

Would being part of a national bio-economy network of employers be an advantage for you?
Email Soufiane at info@biotalent.ca to find out more.

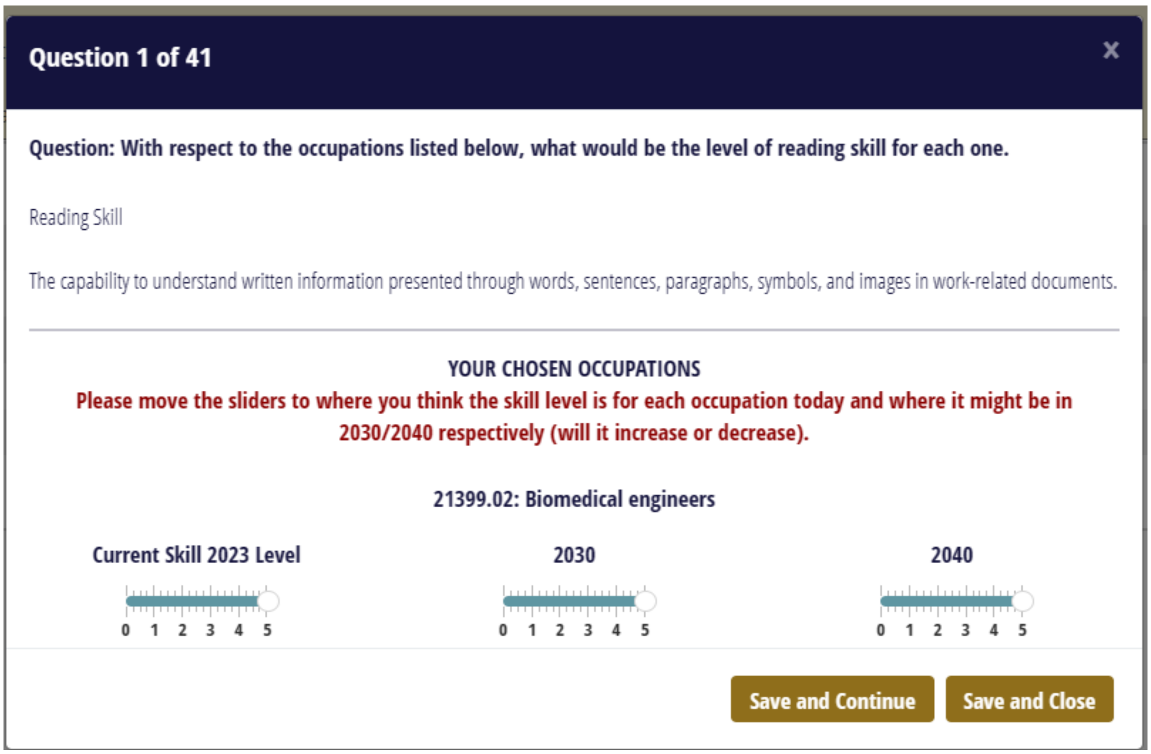
8 Appendix

8.1 Data Interpretation

Survey participants responded to 41 questions using a sliding scale of 0 to 5 to rate skills, with 0 indicating minimal or no use in the selected role and 5 denoting mastery. Ratings were provided for 2023, 2030 and 2040. Participants worked with skill levels from the OaSIS database, adjusting them as needed for their specific role and year. Unmodified responses indicated agreement with the presented skill level from the OaSIS database.

FIGURE 2: Sample Survey Question

A sample survey question is as follows:



When reviewing the tables within the report, consider the following. "Table 2: Average Skill Level Requirements and Variations from Base for All Roles in 2023, 2030 and 2040" has been used as an example:

Skill (n): 49 responses	Skill Level Base OaSIS 2023	Skill Level 2023 (Variation from OaSIS 2023)	Skill Level 2030 (Variation from OaSIS 2023)	Skill Level 2040 (Variation from OaSIS 2023)
Attention to Detail	4.34	4.09 (-0.26)	4.24 (-0.11)	4.26 (-0.08)
Numeracy	3.98	3.74 (-0.24)	3.92 (-0.06)	4.01 (+0.02)
Skill Needed to Evaluate Alternatives	3.92	3.62 (-0.30)	3.76 (-0.16)	3.84 (-0.08)

Skill: The skills participants responded to. Included in this column is the number of respondents.

Skill Level Base – OaSIS 2023: Indicates the skill level extracted from the OaSIS database for 2023, serving as the baseline for measuring changes.

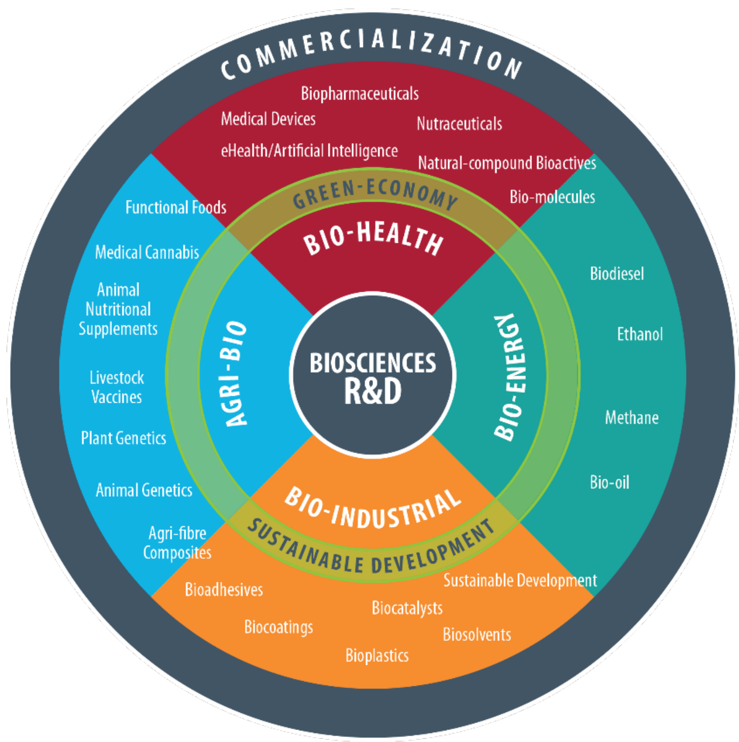
Skill Level 2023 (Variation from OaSIS 2023): Displays the average skill level participants selected on a 0-5 scale, with the variation in brackets compared to the base level.

Skill Level 2030 (Variation from OaSIS 2023): Displays the average skill level participants selected on a 0-5 scale, with the variation in brackets compared to the base level.

Skill Level 2040 (Variation from OaSIS 2023): Displays the average skill level participants selected on a 0-5 scale, with the variation in brackets compared to the base level.

8.2 Distribution of responses

Canada's bio-economy is deeply rooted in research and development (R&D) and manufacturing activities, accounting for nearly half of all jobs within the sector (26% and 22%, respectively)[7]. This study focused solely on bio-manufacturers, an area that has seen increased growth in Canada following the pandemic and is now seen as a strategic asset for Canada.



The study, as illustrated in Table 34, "Distribution of Responses," shows a disproportionate representation of bio-health manufacturers despite the presence of bio-manufacturers in the agri-bio, bio-industrial, and bio-energy sub-sectors. While bio-health constitutes 54% of the bio-economy, it accounts for 83% of manufacturers in the Next Generation survey.

As expected, the survey results align with the focus of the study, which was to identify the most prevalent manufacturing occupations in bio-manufacturing organizations. The survey primarily targeted manufacturing managers, making it unsurprising that they emerged as the most common occupation. Other frequently observed roles, including biomedical engineers, biological technologists, chemical engineers and biological technicians, are inherently associated with biosciences. These roles demand specialized knowledge and skills in biotechnology, further underscoring the relevance of these survey findings.

[7] Ibid., pg. 23.

TABLE 34: Distribution of responses

Occupation (NOC) / Industry (NAIC)	Basic chemical manufacturing (3251)	Medical equipment and supplies manufacturing (3391)	Other chemical product manufacturing (3259)	Other miscellaneous manufacturing (3399)	Pharmaceutical and medicine manufacturing (3254)	Plastic product manufacturing (3261)	Printing and related support activities (3231)	Sugar and confectionery product manufacturing (3113)	Total
Manufacturing managers (90010)		2	1		15			1	**19**
Biomedical engineers (21399)		7			10		1		**18**
Biological technologists (22110)		3		1	12				**16**
Engineering managers (20010)		3		1	10	1	1		**16**
Chemical engineers (21320)		3		1	10				**14**
Industrial and manufacturing engineers (21321)		6		1	7				**14**
Biological technicians (22110)	1	3		1	7				**12**
Supervisors, other products manufacturing and assembly (92024)		1	1		8		1		**11**
Mechanical engineers (21301)		5			1		1		**7**
Chemical technologists (22100)			1		5				**6**
Chemical technicians (22100)					3				**3**
Agricultural and bio-resource engineers (21399)	1							1	**2**
Assemblers, electrical appliance, apparatus, and equipment manufacturing (94202)		1			1				**2**
Computer and telecommunications hardware engineers (21311)		1					1		**2**
Electrical and electronics engineers (21310)		2							**2**
Industrial designers (22211)		2							**2**
Industrial engineering and manufacturing technicians (22302)		1			1				**2**
Industrial engineering and manufacturing technologists (22302)					2				**2**
Materials scientists (21109)					1		1		**2**
Mechanical engineering technicians (22301)		2							**2**
Other labourers in processing, manufacturing, and utilities (95109)					2				**2**
Chemical plant machine operators (94110)					1				**1**

Occupation (NOC) / Industry (NAIC)	Basic chemical manufacturing (3251)	Medical equipment and supplies manufacturing (3391)	Other chemical product manufacturing (3259)	Other miscellaneous manufacturing (3399)	Pharmaceutical and medicine manufacturing (3254)	Plastic product manufacturing (3261)	Printing and related support activities (3231)	Sugar and confectionery product manufacturing (3113)	Total
Dietary technicians (32129)					1				1
Electrical and electronics engineering technicians (22310)		1							1
Electronics assemblers and fabricators (94201)		1							1
Engineering physicists and engineering scientists (21399)					1				1
Labourers in chemical products processing and utilities (95102)					1				1
Machine operators in electrical apparatus manufacturing (94205)					1				1
Machining and tooling inspectors (72100)		1							1
Mechanical engineering technologists (22301)		1							1
Other repairers and servicers (73209)		1							1
Other trades helpers and labourers (75119)					1				1
Product inspectors (94219)					1				1
Production logistics workers (14402)					1				1
Prosthetic and orthotic technicians (32129)		1							1
Statistical officers and related research support occupations (12113)		1							1
Supervisors, plastic and rubber products manufacturing (92013)						1			1
Supervisors, supply chain, tracking and scheduling coordination occupations (12013)					1				1
Total Respondents	1	13	1	1	28	1	2	2	49

Appendix 3

Canadian Marine Industries and Shipbuilding Association Report

HMCS Halifax

Canadian Marine Industries and Shipbuilding Association

NGEN WORKFORCE RESEARCH PROJECT REPORT

March 8, 2024

Colin Cooke
President and CEO
Canadian Marine Industries and Shipbuilding Association

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INTRODUCTION AND BACKGROUND

Our Association

The Canadian Marine Industries and Shipbuilding Association (CMISA) represents over 120 member organizations who encompass the breadth of the commercial ecosystem of Canada's marine and shipbuilding industries.

The Canadian Marine Industries and Shipbuilding Cluster

Canada is currently making an industry-launching investment in our sector through the development and acquisition of over 40 large ships for the Royal Canadian Navy (RCN) and the Canadian Coast Guard (CCG) as part of Canada's National Shipbuilding Strategy or NSS.

This offers a once-in-a-generation opportunity for one of Canada's oldest and most important industry clusters to leverage current trends and shifting demands to enhance its manufacturing and production capacity by integrating new technologies and training models. In effect, it gives a key sector of the global marketplace a critical boost as we look to the transformational global needs of the 21st century.

Although the NSS presents a foundational opportunity to enhance and grow this cluster, the opportunity is broader than current market conditions. Canada's marine cluster is comprised of hundreds of small, mid-sized, and large technology-driven businesses relying on a highly skilled workforce. The potential for increased high-quality careers as well as significant intellectual property development are both additional positive benefits supported by the NSS.

Large-scale operations include shipyards with the capacity to build, maintain, and retrofit large-scale commercial, research, and naval vessels, as well as lakers, tugboats, search and rescue vessels, offshore drilling or energy platforms, ferries, fishing vessels, and offshore supply vessels.

This level of domestic industry capacity is made possible through the support of well over a thousand small, mid-sized, and large specialized suppliers, service providers, and strategic partners located across Canada, representing a wide range of expertise throughout our marine industry and shipbuilding supply chain.

Our industry cluster is diversified in its capacity for commercial, civil, and defense requirements, in large part through technology-driven businesses of varying sizes that develop and sell commercial products in areas such as:

- Marine robotics,
- Manned and unmanned vehicles,
- Ship-borne software, sensors, electronics, navigation systems, and control systems/components,
- ship propulsion control systems, electrical power systems, and related components,
- Hull and structural components manufacturing,
- Ocean technology production for passive acoustic systems, radar, sonar, surveying, mapping, imaging, geomatics, as well as related software and components manufacturing, and the
- Manufacturing of unique parts and components for existing and new build vessels.

Our industry cluster is supported by Canada's ecosystem of 223 public universities, 213 public colleges, as well as provincial training authorities and agencies, that focus on advanced skills development.

Although we currently don't have a dedicated post-secondary infrastructure in support of our sector as in other jurisdictions like the UK and Australia, we do have all the education components and expertise to advance the sector. A collaborative strategy is needed involving education, organized labour, business, industry, and governments to close this gap and address this opportunity.

Our cluster is further supported by organized labour and its investment in the future of this important sector at the community level across Canada.

The most urgent challenge facing our industry cluster remains the attraction and retention of professionals in occupations related to engineering and design, a wide range of skilled trades, advanced manufacturing, project management, and information technology to enhance the consistency, safety, and efficiency of our manufacturing, production, and maintenance/retrofit environments.

Canada-Centric trends

Our industry cluster finds itself in a familiar position to many domestic industries in that we are competing for talent in occupations related to engineering and design, skilled trades, advanced manufacturing, project management, and information technology. All these occupations fall into the 'high demand and limited supply' category, leaving the sector with a large-scale problem to address.

Further challenging our companies is where many of them, specifically the shipyards, must be located due to the nature of their mandates. Many of the smaller yards are in relatively remote locations and the very largest ones are in major urban centers. Both scenarios result in significant issues in terms of attracting and retaining a capable workforce.

Opportunities for supporting the sector that are regularly highlighted by industry, organized labour, and education leaders include strategies to:

- Address shifting demographics/retirements by increasing the level of diversity, equity, and inclusion in employee recruitment and engagement, with a particular focus on recruiting women, new Canadians, and Indigenous Peoples;
- Improve employee recruitment and retention through workplace culture enhancements;
- Revisit training requirements and accreditation models by focusing on learning outcomes and competencies required for marine industries and shipbuilding manufacturing environments, rather than being geared towards residential, commercial, and institutional construction environments;
- Ensure that programs like welding offer sufficient access to variations for different ship-oriented materials such as working with aluminum;
- Develop a coordinated/national strategy for relevant post-secondary training and validate the potential for shared curricula through provincial and national tables;
- Explore private/public sector partnership opportunities for expanding training infrastructure;
- Promote and facilitate second career opportunities for experienced individuals within the sector;
- Proactively establish train-the-trainer programs in post-secondary institutions, tapping into the experience and knowledge of former, retired, and/or physically disabled employees with advanced related and transferable skills from colleges

and institutes, shipyards, the Canadian Forces, the CCG, the RCN, Transport Canada, trade unions;
- Address the long-term challenge of the industry's inconsistent employment levels during up and down economic cycles by working collaboratively to develop a sustainable business/industry model in Canada; and
- To seek to develop a federal support system (options include subsidies, grants, tax breaks, tax credits, etc.) to support mid-program students so that they can get on-the-job experience anywhere that is appropriate, rather than anywhere they can afford to go.

Current Challenges

A focused and measured collaboration between education, innovation leaders, organized labour, business, industry, and government is needed to fully leverage the potential of this industry cluster.

The sector is currently under the strain of responding to significant production demands through the NSS, while simultaneously addressing the ongoing and increasing demand for maintenance and retrofit projects. The limits on the availability of skilled tradespeople are forcing unwanted trade-offs. Given that our national fleets are increasingly at or near the end of their designed lifespans, the life-extension efforts are requiring requisitely large amounts of time, labour, and capital in order to be successful.

Large, mid-sized, and small sector businesses are also balancing the need to remain competitive and adjust to customer demands by integrating technology into their processes. To enhance their consistency, quality, competitiveness, and dependability, they are making investments whenever possible into advanced manufacturing processes, systems, and technologies.

The sector is also concurrently developing strategies to begin addressing the previously mentioned *Canada-centric trends*, with a specific focus on skill gaps and the attraction and retention of personnel in key occupations.

Adapting to Change

In terms of current realities, the sector is also undergoing a major shift due to several trends in adapting shipbuilding from a bespoke construction industry to advanced manufacturing processes, particularly in the new-build yards.

Examples include:

- The adoption of digital design which can transfer digital data to a plate cutting line, and using robotic welders, fabricate ship floors and ceilings, as well as providing long-term digital twins for future use in maintenance, upkeep, and other refits over the lifespan of the ship.
- Implementing the use of digital work packs, as opposed to a paper-based project management system, ensuring that procedures related to drawings, instructions to employees, safety requirements, and protocols are all digitized. and the
- Testing of new manufacturing techniques and technologies, some adapted from other industries that have/or are shifting to advanced manufacturing, to enhance quality, productivity, consistency, and safety.

Present Realities and Influences

Current and future opportunities to grow this sector are significantly influenced by trends in the adoption of technology to enable vessels to better respond to commercial, defense, and environmental requirements, and for builders to enhance productivity and safety.

These include:

Advanced Robotics: Applied in response to a growing demand for building, maintaining, and repairing larger vessels and used for welding, cutting, and painting, all of which require precision and attention to detail.

Immersive Technologies: Augmented Reality (AR) and Virtual Reality (VR) – for example enabling the development of 3D models for design purposes which engineers can use to evaluate ergonomics, develop collision avoidance models, and test maintenance protocols.

Environmental Technologies: Energy efficiency enhancements through the adoption of innovations from hull designs and propeller optimization to hull coatings and the use of green-fuel propulsion systems. Environmental technologies have become a priority for our sector due to changes in environmental/emissions regulations and firm net-zero deadlines that are fast-approaching.

Artificial Intelligence: AI parameters are currently being integrated into marine product development by applying variables for fuel efficiency, climate, currants, systems maintenance, and port congestion. The simulation of construction processes and operating conditions can also make for safer work environments, more efficient manufacturing and maintenance, and a superior finished product.

Advanced Materials: Although we traditionally relate steel to shipbuilding, carbon composites and aluminum are regularly being used to reduce costs and enhance structural strength. These materials also minimize maintenance costs due to reduced corrosion, as well as reduced fuel consumption, carbon emissions, and operating costs, as a result of lower weight vessels.

All of the above trends in the adoption of technology are opportunities for Canada that require a strategy for skills development, training, and retraining if Canada's marine industries and shipbuilding cluster is to not only achieve sustainability, but competitiveness and growth in a global market.

CURRENT AND FUTURE SKILLS DEMAND IN THE SECTOR

Our members constantly deal with the daily challenge of trying to recruit and retain talent in occupations related to engineering and design, skilled trades, advanced manufacturing, project management, and information technology.

The impact of not having an adequate supply of talent can clearly be seen in delays experienced across Canada in the delivery of projects, large and small, as we enter a time of economic uncertainty. Although we welcome the NSS and the infrastructure it is helping to create for the industry's long-term sustainability, a talent strategy was not part of the initial plan and needs to be promptly developed to ensure high-quality supply of professionals in all job groups.

The strategy needs to be developed in consideration of current demands from industries outside of our sector (competition for talent), and with a longer-term vision for establishing a training infrastructure to grow this sector as an important contributor to Canada's current and future GDP.

It is also increasingly difficult for CMISA members to recruit talent with the requisite skill levels. This places another demand on employers through the need for upskilling of employees to adapt to the work environment.

Although some sector initiatives are in place to begin addressing the above issues, these initiatives are not sector-wide, nor are they accessible across Canada.

As potential areas for enhancement, we currently have opportunities to validate a number of approaches, including:

1. Reviewing the strategies used by the NSS projects in Australia and the UK to learn from their successes and failures,

2. Evaluating training and accreditation requirements for the manufacturing of ships and marine technologies, in contrast with the requirements for training journey persons for construction environments,

3. Addressing the lack of training infrastructure by validating the use of alternative facilities for on-site training which could expand the training footprint for colleges, institutes, and universities, while increasing the number of graduates. Infrastructure for validation could include Canada's largest and mid-sized shipyards, as well as facilities operated by the Canadian Forces, the CCG, the RCN, Transport Canada, and trade unions,

4. Determining the capacity of current training resources by consulting with post-secondary stakeholders. Hybrid, consortium, and collaborative approaches to achieve current and future goals could be validated,

5. Looking outside of Canada to address talent shortages, and particularly for skilled trades in markets that have considerable expertise in shipbuilding and marine industries (e.g., Ukraine). According to a 2018 study by the Canadian Apprenticeship Forum, immigrants comprised 8.7% of apprentices despite accounting for more than 20% of the population. This reality provides an opportunity for Canada to build on its framework of the Federal Skilled Trades Program, which has a goal of bringing in 3,000 skilled tradespeople annually, and

6. Assessing the viability of streamlining requirements for licensing or certification, as international trade professionals need to have their qualifications evaluated through equivalency assessment paths. In certain cases, they also require essential skills training before they can be considered for programs needed to receive their Canadian license or certification.

Emerging Skills Demand

As an industry cluster, our members face current and projected future deficits in all related occupations for engineering and design, skilled trades, advanced manufacturing, project management, and information technology.

SKILLED TRADES

We have a significant current and projected demand for: Welders, Pipefitters, Plumbers, Electricians, Structural Metal Fabricators and Ironworkers, Scaffolders and Riggers, Millwrights, Machinists, Painters (industrial and marine coatings), Quality Inspectors, Surveyors, and Carpenters.

Skills required to successfully perform in these occupations include: technical skills, numeracy, reading skills, physical abilities, communication and writing skills (technical), team work, skills to use tools, and many others.

ENGINEERING AND DESIGN

We are experiencing significant current and projected demand for Mechanical Engineers, Electrical Engineers, and Naval Architects/Designers, which are essential to the daily operation of small to large-scale businesses.

These occupations require a variety of skills, including: cognitive abilities, mathematics skills, skills to form alternative solutions, critical thinking, skills to formulate and solve problems, skills to design a system, skills needed to evaluate alternatives, communication skills, listening skills, and many others.

ADVANCED MANUFACTURING

Professionals under this banner come predominantly from engineering, information technology, and project management backgrounds and are in demand in numerous sectors, including: aerospace, automotive, oil and gas, healthcare, and life sciences.

Advanced manufacturing occupations in the shipbuilding and marine industries sector are in increasing demand to add value by enhancing processes and limiting the expense and timeframe required to build, maintain, and retrofit vessels. These occupations focus on improving production flow, integrating the use of robotics, and taking a modular approach to production.

These occupations are also sought after due to their contribution to the reliability, efficiency, dependability, and overall safety of the sector.

Skills required for these occupations include: technical skills, project management skills, critical thinking, problem solving, digital literacy, skills to evaluate alternatives, leadership skills, skills to identify problems, initiative, communication skills, skills to design experiments, skills to identify, formulate, and solve problems, interpersonal skills, and many others.

INFORMATION TECHNOLOGY

Expertise in fields such as robotics, virtual and augmented reality, artificial intelligence and machine learning (AI/ML), are all in significant demand in our sector.

Occupations such as software engineers, software architects, and systems engineers are in constant demand with a projected increase in demand due to the integration of technology in the engineering/design, building, retrofitting, and maintenance of vessels.

Skills required in these and related information technology occupations for the sector include: digital literacy, cognitive abilities, relevant knowledge, project management skills, skills to identify problems, teamwork and collaboration, attention to detail, communication skills, critical thinking skills, skills to formulate alternative solutions, and many others.

DATA REVIEW FROM NGEN41 SURVEY

The NGen41 Survey has provided valuable data on 40 skills through the measurement of the changes in average proficiency for each skill as related to three occupation types:

1. Welding,
2. Skilled Trades, and
3. Production Occupations.

Based on data provided by CMISA members, each skill was rated by NGen at its Current Average Proficiency, its 2030 Average Proficiency, and its 2040 Average Proficiency (please see Appendix A – Skilled Trades Average Proficiency Analyzer, Appendix B – Welding Average Proficiency Analyzer, and Appendix C – Production Occupations Average Proficiency Analyzer).

The following observations from the NGen data are based on a measurement using the NGen total sum of change or delta in three key rankings of data provided by this study:

1. Delta or change for Current Average Proficiency: calculated as the change between data from the Employment and Skills Development Canada (ESDC)

Occupational and Skills Information System (OaSIS) and the Current Average Proficiency,
2. Delta or change for the 2030 Average Proficiency, and
3. Delta or change for the 2040 Average Proficiency.

Top 3 Skills with Upward Changes in Average Proficiency

The following 3 skills were identified per occupation as having the highest upward change in required average proficiency to 2030/40.

Occupation	HIGHEST INCREASE IN AVERAGE PROFICIENCY TO 2030/40
Skilled Trades	Digital literacy, Knowledge of Emerging Trends and Technologies, Team Building
Welding	Digital literacy, Knowledge of Emerging Trends and Technologies, Team Building
Production	Digital Literacy, Knowledge of Emerging Trends and Technologies, Reading Skills

We can clearly see a trend towards an increased and common requirement in proficiency for Digital Literacy, as well as Knowledge of Emerging Trends and Technologies for all three occupations, and in Team Building for two out of the three occupations.

The integration of new technologies into the operation of large, mid-sized and small enterprises will require an increased proficiency of skills related to technology, and will also require new approaches to engaging, managing, and measuring teams.

Achieving increases in average proficiency for these Top 3 skills may also require the largest focus on investment for training and retraining, with a potential bigger impact on larger enterprises focused on large-scale shipbuilding projects versus maintenance, retrofit, and repair services, which are crucial to the sector, but not linked to large-scale production. This will, however, need to be validated with CMISA members of varying sizes.

Conversations between CMISA, its members, and ESDC on this very topic would be timely to define the scope of the challenge, and how it will be addressed through programming and funding.

Next 10 Skills and Correlation in High Upward Changes to Average Proficiency

When we look at the next 10 skills directly below the Top 3, we see a correlation for every occupation type with respect to 5 skills.

Once again, we measured this by using the total sum of change or delta in Current Average Proficiency, and 2030/2040 Average Proficiency:

HIGH LEVELS OF INCREASE IN AVERAGE PROFICIENCY TO 2030/40			
	Skilled Trades	Welding	Production
Communication Skills	√	√	√
Interpersonal Skills	√	√	√
Problem Solving Skills	√	√	√
Skills Needed to Judge Quality	√	√	√
Writing Skills	√	√	√

The skills in the above table are foundational skills for employees in most businesses. We can clearly see that for the marine industries and shipbuilding sector, a projected increase in proficiency for these skills is shared across all three occupation types.

Although these skills would be used in concert with changes in technology, they remain core skills required by all employers having participated in the study, and in general, across our sector.

They also represent a consistent demand on our sector to expand training and retraining, as many new employees entering our sector require upskilling.

Shared Low to Negative Changes in Average Proficiency Across all Occupations

When looking at skills with average proficiency changes measured at either below .50 or reaching a negative total sum in change leading to 2030/40, we continue to see some commonality, as well as a few surprises.

We see the following skills ranked at low change levels in average proficiency for all three occupation types:

1. Attention to Detail,
2. Cognitive Abilities,
3. Decision Making Skills,
4. Entrepreneurial Skills,
5. Independence,
6. Professional Composure, and
7. Skill Needed to Evaluate Alternatives.

These rankings come as a surprise and may merit further engagement with CMISA members to better understand the WHY behind these low to negative changes in average proficiency.

A better appreciation for the influence of technology on these occupations, and any potential correlation with their measurement for future average proficiency at low or negative levels, may be linked and would be useful to understand.

Occupation-based Low to Negative Changes

When looking at skills with average proficiency changes measured at below .50 or reaching a negative total sum in change leading to 2030/40 per occupation type, we can observe the following results:

SKILLED TRADES

Some low to negative changes in average proficiency, such as Skill Needed to Understand Business Principles, Skill to Design Experiments, and Entrepreneurial Skill did not come as a surprise for Skilled Trades.

Three rankings that did come as surprises at the lower and often negative levels were:

1. Commitment to Lifelong Learning,
2. Attention to Detail, and
3. Professional Composure.

Lifelong Learning was a surprise due to the current and future impact of technology on all areas of touch labour/skilled trades which if not directly causing an impact on an individual trade, will in most cases require an understanding of the integration of a new technology in processes being adopted in production environments (e.g. adoption of digital work packs). If a trade professional is asked to work in sequence with technology as that technology is being implemented in their work environment, that trade professional will need to understand and adapt to the use of that technology.

This will most likely have a greater impact on larger enterprises focused on large-scale production, versus mid-sized to smaller enterprises focused on repair, retrofit, and maintenance.

Attention to Detail was also a surprise, as precision and quality of work is always a measurement of skill for trade professionals.

Professional Composure was also perceived as a surprise, due to a general consensus within the sector that workplace culture enhancements could be improved to ensure a more welcoming work environment for all employees. Composure is a trait or quality that is not solely in the domain of management, and one that, if adopted broadly throughout the skilled trades, might lead to improved employee recruitment and retention initiatives.

WELDING

When considering the significant changes to this skilled trade being developed and implemented in the coming decade, some of the anticipated changes in average proficiency also came as surprises.

The adoption of digital work packs and digital design, the advent of plate cutting lines, and the eventual use of robotic welders to fabricate ship floors and ceilings, as well as providing long-term digital twins for future use in maintenance, upkeep, and other refits over the lifespan of a ship, are all changes that will impact welding as a skilled trade.

Welding trade professionals will need to significantly enhance their competencies in the adoption of new technologies, or at a minimum, better understand how these new technologies will be implemented in their work environments, as they continue to deliver repair and maintenance duties that are not addressed through new technologies.

The following low to negative rankings for average proficiency changes came as a surprise for Welding, based on the above considerations:

1. Critical Thinking,
2. Cognitive Abilities,
3. Commitment to Lifelong Learning,
4. Adaptability,

5. Skill to Formulate Alternative Solutions,
6. Professional Composure.

PRODUCTION OCCUPATIONS

Considering the current and future integration of new technologies in shipbuilding and marine industry environments, as well as general support in the sector for the adoption of enhanced workplace culture/human resources best practices to support recruitment and retention initiatives, it was a surprise to see the following ranked as requiring low or negative changes in average proficiency:

1. Critical Thinking,
2. Attention to Detail,
3. Professional Composure,
4. Project Management Skills,
5. Leadership Skills,
6. Cognitive Skills, and
7. Adaptability.

Perhaps as a next step, further discussion with CMISA members could lead to a better understanding of these projected requirements, and how the sector should adapt towards them, for enterprises of all sizes and scope.

NAICS CODES FOR THE SECTOR

A noteworthy and regularly raised concern for our sector is the lack of proper NAICS codes dedicated to the occupations directly used by shipyards and related industries.

Too frequently, our human resources teams need to 'borrow' a code from another industry to 'best fit' the job in question. This does not meet the needs of our companies and indeed possibly leads to a lack of awareness/understanding by policy-makers and education specialists, as they miss the subtlety of the requirements of the sector by assuming that they are interchangeable skill sets.

Simplistically, someone who can weld a car component might be capable of welding in a ship after retraining, but they are not the same skill sets beyond the basic principles of the trade.

CONCERNS REGARDING SURVEY METHODOLOGY

The CMISA team did find it relatively difficult to convince member companies to complete the survey.

Feedback included ‘it is by academics, for academics’ and ‘we don’t see how it addresses the issues.’ The discomfort with the process in no way suggests that they do not want their voices heard and indeed, our correspondents truly appreciated being asked their thoughts on such a fundamental issue to their businesses.

Future surveys might be structured with more input from end users up front. But ultimately, the point that many respondents kept making was for us to find solutions to get more skilled people in their doors and they will happily find the tools required to train them for the new skills needed down the road.

With regard to the data received, the quality of the signal for the competencies that we have put forward was significant. Looking at the Welders data, we see that the 2040 Average Proficiency for Digital Literacy is 2.82 with a STD Dev of 0.55 - a good signal indicating good agreement between survey participants. On the other hand, the 2040 Average Proficiency for Knowledge of Emerging Trend and Technologies is 1.79 with a STD Dev of 1.46 - not good agreement among survey participants, and therefore not a strong signal.

A final noteworthy item is that shipyards are not created equally in that the smaller yards have some significantly different challenges when compared to the large yards, especially when pay is considered. With such a small sampling, the size differences in the yards are not necessarily averaged out.

That said, there is a universal need for good workers across the job spectrum so the underlying call for help to get more capable, interested people for their teams is true for all the shipyards in Canada.

SUMMARY

The NGen41 Survey and associated data confirm the perception that small, medium, and large employers in the shipbuilding and marine industries sector in Canada need to increase recruitment, retention, and retraining related to current occupations and related skills to sustain current activities (engineering/design and skilled trades), as well as for new occupations focused on the integration of new technology and advanced manufacturing.

As identified through our review of the NGen41 Survey data, a significant investment will be required to address not only current needs to enhance average proficiency levels in a number of skills, but due to the limited pool of available talent for our sector, combined with the constant need for training and retraining, the engagement of ESDC will be required to plan, deliver, and fund these activities as a priority for the future sustainability and growth of the marine industries and shipbuilding cluster.

CMISA has proposed a number of recommendations in this report to address these challenges, and we would welcome a collaboration with NGen and ESDC to further advance their validation and potential implementation.

Respectfully submitted by,

Colin Cooke
President and CEO
Canadian Marine Industries and Shipbuilding Association

Appendix A

SKILLED TRADES AVERAGE PROFICIENCY ANALYZER

	Base OaSIS	Current Average Proficiency	Delta Current Average Proficiency	2030 Average Proficiency	Delta 2030 Average Proficiency	2040 Average Proficiency	Delta 2040 Average Proficiency	Delta Sum
Digital Literacy	0.93	1.63	0.70	2.57	1.63	3.25	2.32	4.65
Knowledge of Emerging Trends and Technologies	0.60	1.42	0.82	1.93	1.33	2.27	1.67	3.82
Team Building Skills	1.33	2.15	0.82	2.30	0.97	2.45	1.12	2.90
Problem Solving	2.20	2.73	0.53	3.22	1.02	3.37	1.17	2.72
Communication Skill	2.04	2.65	0.61	2.87	0.82	2.97	0.92	2.35
Writing Skill	1.47	2.07	0.60	2.30	0.83	2.37	0.90	2.33
Interpersonal Skills	1.77	2.12	0.35	2.63	0.85	2.76	0.99	2.19
Skill to Identify, Formulate, and Solve Problems	1.95	2.25	0.30	2.67	0.72	2.83	0.87	1.89
Reading Skill	2.73	3.02	0.28	3.43	0.70	3.62	0.88	1.87
Technical Skill	2.39	2.62	0.23	3.10	0.71	3.24	0.85	1.80
Skill Needed to Judge Quality	2.20	2.62	0.42	2.80	0.60	2.93	0.73	1.75
Skill to Conduct Work Design	1.80	2.17	0.37	2.37	0.57	2.48	0.68	1.62
Skill to Identify Problems	2.27	2.52	0.25	2.90	0.63	2.97	0.70	1.58
Teamwork and Collaboration	2.90	3.05	0.15	3.45	0.55	3.72	0.82	1.52
Physical Abilities	2.85	3.44	0.59	3.31	0.46	3.28	0.42	1.47
Psychomotor Abilities	3.01	3.43	0.42	3.50	0.49	3.57	0.55	1.46
New Relevant Knowledge	2.07	2.20	0.13	2.57	0.50	2.82	0.75	1.38
Numeracy	2.33	2.30	-0.03	2.85	0.52	3.18	0.85	1.33
Critical Thinking Skills	2.07	2.25	0.18	2.57	0.50	2.65	0.58	1.27
Creativity and Innovation	2.40	2.57	0.17	2.73	0.33	3.10	0.70	1.20
Skill to Use the Tools Necessary for the Job	2.91	3.02	0.11	3.31	0.39	3.46	0.54	1.05
Sensory Abilities	2.40	2.55	0.15	2.73	0.33	2.83	0.43	0.92
Skill to Plan a Program	2.07	2.20	0.13	2.38	0.32	2.50	0.43	0.88
Initiative	2.07	2.42	0.35	2.30	0.23	2.32	0.25	0.83
Leadership Skills	2.40	2.55	0.15	2.68	0.28	2.73	0.33	0.77
Project Management Skill	1.63	1.65	0.02	1.88	0.26	2.06	0.43	0.71
Skill to Fomulate Alternative Solutions	2.00	2.07	0.07	2.25	0.25	2.37	0.37	0.68
Adaptability	3.07	3.13	0.07	3.32	0.25	3.43	0.37	0.68
Skill Needed to Support Supplier Development	1.70	1.75	0.05	1.93	0.23	2.03	0.33	0.62
Social Responsibility	1.47	1.30	-0.17	1.75	0.28	1.77	0.30	0.42
Decision Making Skill	2.13	2.17	0.03	2.27	0.13	2.37	0.23	0.40
Commitment to Lifelong Learning	2.87	2.88	0.02	2.98	0.12	3.07	0.20	0.33
Cognitive Abilities	2.26	2.31	0.05	2.40	0.14	2.40	0.14	0.32
Skill Needed to Evaluate Alternatives	2.20	2.15	-0.05	2.30	0.10	2.42	0.22	0.27
Skill Needed to Understand Business Principles	1.00	0.98	-0.02	1.07	0.07	1.15	0.15	0.20
Skill to Design a System	2.13	2.07	-0.07	2.20	0.07	2.30	0.17	0.17
Independence	3.73	3.80	0.07	3.78	0.05	3.77	0.03	0.15
Skill to Design Experiments	2.18	2.03	-0.15	2.15	-0.03	2.27	0.09	-0.10
Attention to Detail	3.87	3.75	-0.12	3.87	0.00	3.87	0.00	-0.12
Entrepeneurial Skill	1.33	1.18	-0.15	1.28	-0.05	1.38	0.05	-0.15
Professional Composure	3.00	2.78	-0.22	2.85	-0.15	2.95	-0.05	-0.42

Source: NGen41 Survey

Appendix B

WELDING AVERAGE PROFICIENCY ANALYZER

	Base OaSIS	Current Average Proficiency	Delta Current Average Proficiency	2030 Average Proficiency	Delta 2030 Average Proficiency	2040 Average Proficiency	Delta 2040 Average Proficiency	Delta Sum
Digital Literacy	0.00	1.07	1.07	2.11	2.11	2.82	2.82	6.00
Knowledge of Emerging Trends and	0.25	1.04	0.79	1.75	1.50	2.04	1.79	4.07
Team Building Skills	1.00	1.82	0.82	2.00	1.00	2.18	1.18	3.00
Writing Skill	1.00	1.75	0.75	1.96	0.96	2.04	1.04	2.75
Skill to Conduct Work Design	1.00	1.64	0.64	1.86	0.86	1.93	0.93	2.43
Problem Solving	2.00	2.39	0.39	2.86	0.86	2.93	0.93	2.18
Skill Needed to Judge Quality	2.00	2.36	0.36	2.71	0.71	2.96	0.96	2.04
Communication Skill	2.00	2.54	0.54	2.68	0.68	2.75	0.75	1.96
Technical Skill	2.00	2.39	0.39	2.68	0.68	2.68	0.68	1.75
Interpersonal Skills	1.60	1.73	0.13	2.24	0.64	2.34	0.74	1.51
Psychomotor Abilities	2.90	3.32	0.42	3.41	0.51	3.44	0.54	1.47
Skill to Identify, Formulate, and Solve Problems	1.80	1.93	0.13	2.30	0.50	2.52	0.72	1.35
Teamwork and Collaboration	3.00	3.07	0.07	3.39	0.39	3.68	0.68	1.14
Social Responsibility	1.00	1.07	0.07	1.50	0.50	1.50	0.50	1.07
New Relevant Knowledge	2.00	2.04	0.04	2.36	0.36	2.57	0.57	0.96
Creativity and Innovation	2.00	2.21	0.21	2.29	0.29	2.46	0.46	0.96
Skill to Use the Tools Necessary for the Job	2.67	2.72	0.05	3.03	0.36	3.17	0.50	0.90
Physical Abilities	3.00	3.43	0.43	3.25	0.25	3.18	0.18	0.86
Numeracy	2.00	1.86	-0.14	2.36	0.36	2.61	0.61	0.82
Sensory Abilities	2.25	2.39	0.14	2.54	0.29	2.57	0.32	0.75
Reading Skill	3.00	3.00	0.00	3.32	0.32	3.39	0.39	0.71
Project Management Skill	1.40	1.49	0.09	1.64	0.24	1.76	0.36	0.69
Initiative	2.00	2.29	0.29	2.14	0.14	2.21	0.21	0.64
Skill to Identify Problems	2.00	2.04	0.04	2.25	0.25	2.32	0.32	0.61
Critical Thinking Skills	2.00	2.11	0.11	2.21	0.21	2.18	0.18	0.50
Leadership Skills	2.00	2.07	0.07	2.14	0.14	2.21	0.21	0.43
Cognitive Abilities	2.05	2.10	0.05	2.14	0.09	2.14	0.09	0.24
Commitment to Lifelong Learning	3.00	2.93	-0.07	2.96	-0.04	3.11	0.11	0.00
Adaptability	3.00	2.86	-0.14	3.00	0.00	3.07	0.07	-0.07
Entrepeneurial Skill	1.00	0.86	-0.14	0.93	-0.07	1.00	0.00	-0.21
Skill Needed to Understand Business Principles	1.00	0.89	-0.11	0.89	-0.11	0.89	-0.11	-0.32
Skill to Plan a Program	2.00	1.79	-0.21	1.86	-0.14	1.93	-0.07	-0.43
Decision Making Skill	2.00	1.82	-0.18	1.86	-0.14	1.89	-0.11	-0.43
Skill to Fomulate Alternative Solutions	2.00	1.79	-0.21	1.86	-0.14	1.89	-0.11	-0.46
Skill Needed to Evaluate Alternatives	2.00	1.75	-0.25	1.82	-0.18	1.89	-0.11	-0.54
Skill Needed to Support Supplier Development	1.50	1.29	-0.21	1.32	-0.18	1.32	-0.18	-0.57
Skill to Design Experiments	1.90	1.61	-0.29	1.69	-0.21	1.76	-0.14	-0.64
Attention to Detail	4.00	3.71	-0.29	3.82	-0.18	3.82	-0.18	-0.64
Independence	4.00	3.79	-0.21	3.75	-0.25	3.71	-0.29	-0.75
Skill to Design a System	2.00	1.68	-0.32	1.75	-0.25	1.79	-0.21	-0.79
Professional Composure	3.00	2.50	-0.50	2.54	-0.46	2.57	-0.43	-1.39

Source: NGen41 Survey

Appendix C

PRODUCTION OCCUPATIONS AVERAGE PROFICIENCY ANALYZER

	Base OaSIS	Current Average Proficiency	Delta Current Average Proficiency	2030 Average Proficiency	Delta 2030 Average Proficiency	2040 Average Proficiency	Delta 2040 Average Proficiency	Delta Sum
Digital Literacy	0.54	1.40	0.87	2.23	1.69	2.75	2.21	4.77
Reading Skill	1.46	2.37	0.90	2.88	1.42	3.15	1.69	4.02
Knowledge of Emerging Trends and	0.25	1.08	0.83	1.33	1.08	1.46	1.21	3.12
Interpersonal Skills	1.22	1.67	0.46	2.40	1.18	2.40	1.18	2.82
Problem Solving	1.54	1.92	0.38	2.50	0.96	2.79	1.25	2.60
Writing Skill	1.23	1.83	0.60	2.10	0.87	2.21	0.98	2.44
Creativity and Innovation	1.31	1.77	0.46	1.92	0.62	2.40	1.10	2.17
Communication Skill	1.15	1.65	0.50	1.90	0.75	2.04	0.88	2.13
Team Building Skills	1.15	1.69	0.54	1.85	0.69	1.90	0.75	1.98
Social Responsibility	1.08	1.21	0.13	1.90	0.83	1.90	0.83	1.79
Skill Needed to Judge Quality	2.15	2.38	0.23	2.71	0.56	2.75	0.60	1.38
Initiative	1.54	1.96	0.42	2.00	0.46	2.00	0.46	1.35
New Relevant Knowledge	1.23	1.50	0.27	1.69	0.46	1.79	0.56	1.29
Skill Needed to Understand Business Principles	0.08	0.44	0.37	0.48	0.40	0.52	0.44	1.21
Numeracy	1.38	1.48	0.10	1.85	0.46	1.87	0.48	1.04
Teamwork and Collaboration	2.96	2.94	-0.02	3.33	0.37	3.62	0.65	1.00
Commitment to Lifelong Learning	2.15	2.27	0.12	2.52	0.37	2.62	0.46	0.94
Skill to Plan a Program	1.15	1.40	0.25	1.46	0.31	1.52	0.37	0.92
Skill to Identify, Formulate, and Solve Problems	1.46	1.68	0.22	1.73	0.27	1.75	0.29	0.77
Skill to Fomulate Alternative Solutions	1.15	1.38	0.23	1.42	0.27	1.42	0.27	0.77
Skill to Identify Problems	1.85	1.90	0.06	2.17	0.33	2.21	0.37	0.75
Technical Skill	1.88	1.93	0.05	2.17	0.30	2.22	0.34	0.69
Decision Making Skill	1.54	1.67	0.13	1.71	0.17	1.75	0.21	0.52
Skill Needed to Evaluate Alternatives	1.62	1.77	0.15	1.79	0.17	1.81	0.19	0.52
Critical Thinking Skills	1.54	1.60	0.06	1.73	0.19	1.77	0.23	0.48
Attention to Detail	3.00	3.15	0.15	3.15	0.15	3.17	0.17	0.48
Sensory Abilities	2.24	2.35	0.11	2.39	0.15	2.45	0.21	0.47
Professional Composure	2.46	2.62	0.15	2.56	0.10	2.52	0.06	0.31
Skill to Use the Tools Necessary for the Job	2.62	2.61	-0.01	2.72	0.11	2.80	0.18	0.28
Project Management Skill	1.15	1.19	0.04	1.25	0.09	1.28	0.13	0.26
Leadership Skills	1.92	2.00	0.08	2.00	0.08	2.00	0.08	0.23
Physical Abilities	3.06	3.15	0.08	3.12	0.06	3.10	0.04	0.18
Entrepeneurial Skill	1.15	1.15	0.00	1.19	0.04	1.21	0.06	0.10
Skill to Design a System	1.62	1.56	-0.06	1.65	0.04	1.67	0.06	0.04
Skill to Design Experiments	1.76	1.73	-0.03	1.77	0.00	1.83	0.07	0.03
Cognitive Abilities	1.87	1.89	0.03	1.88	0.01	1.86	-0.01	0.03
Psychomotor Abilities	3.06	3.05	-0.01	3.05	-0.01	3.03	-0.03	-0.06
Skill to Conduct Work Design	1.54	1.46	-0.08	1.52	-0.02	1.56	0.02	-0.08
Skill Needed to Support Supplier Development	1.38	1.31	-0.08	1.35	-0.04	1.40	0.02	-0.10
Independence	2.92	2.90	-0.02	2.85	-0.08	2.79	-0.13	-0.23
Adaptability	3.08	2.90	-0.17	2.98	-0.10	3.06	-0.02	-0.29

Source: NGen41 Survey

Appendix D

METHODOLOGY

CMISA was invited by Next Generation Manufacturing Canada (NGen) which administers funding as the leader of Canada's Global Innovation Cluster for Advanced Manufacturing, to participate in a workforce survey.

NGen is taking a cross-sectoral look at skilled trades and production occupations in Canada, and CMISA was approached to ensure that Canadian shipyards, large and small, from all regions of the country, are included in this research.

CMISA reached out to its members, and based on NGen's requirements, invited at least one representative, but ideally several team members, to complete a 5-minute survey.

CMISA proposed that company representatives from the following roles be invited to complete the survey:

1. Operations,
2. Human Resources, and
3. Either a General Manager, Business Development or Project Estimator.

The purpose of the survey was to measure the changes in proficiency requirements for 40 skills between current needs, and future needs, in 2030 and 2040.

We appreciate the participation of the following CMISA member companies, and 11 representatives from these members, for their participation in the survey:

A. F. Theriault and Son Ltd.
Canadian Maritime Engineering
Chantier Naval Forillon
Point Hope Maritime
Ontario Shipyards
Titan Boats Ltd.
Victoria Shipyards

CMISA has since received and reviewed the survey results, and this report provides an overview of the data compiled and potential for future considerations.

Appendix 4

Downsview Aerospace Innovation and Research Report

Next Generation Manufacturing Canada

Labour Market Research Regarding the Competencies of the Canadian Manufacturing Workforce

NAICS Sector Code 3364:
Aerospace Product and Parts Manufacturing

Prepared by:

Downsview Aerospace Innovation & Research (DAIR)

In partnership with:

InnovaIT Professional Services

Date:

February 29, 2024

ABOUT DAIR

Downsview Aerospace Innovation & Research (DAIR) is a not-for-profit consortium that brings together academics, companies, research organizations, and government stakeholders around a shared goal – to advance Canada's global aerospace industry leadership. Located at Downsview Park in Toronto, DAIR builds on the legacy of visionaries, leaders and workers who helped make Canada a global aerospace and aviation champion.

First envisioned in 2012 by Centennial College, the University of Toronto and Bombardier, DAIR began as a working group seeking to strengthen Canadian aerospace R&D and education. In 2018, DAIR expanded its operations, staff, and physical site leading to its incorporation in 2020 and the appointment of a Board of Directors and a full-time Executive Director to direct continuing growth.

DAIR's stated purpose is to facilitate innovative collaboration between industry and academia to strengthen Ontario's aerospace ecosystem to the benefit of the Canadian sector. Its immediate goals are to foster strong R&D partnerships and create transformational solutions that can significantly boost competitiveness.

In the execution of this project for NGEN Canada, DAIR has partnered with InnovaIT Professional Services. Headquartered in Nova Scotia, InnovaIT has executed on several key projects in training research for aerospace and aviation, with DAIR and with the Canadian Council for Aviation and Aerospace.

ABOUT INNOVAIT PROFESSIONAL SERVICES

InnovaIT Professional Services (InnovaIT) is focused on meeting the needs of a diverse range of clients for professional/ technical services, strategic training development, research, and management consulting.

InnovaIT employs a proven model of collaboration and professional approaches supporting its clients to help identify and advance their strategic objectives, especially as it pertains to attracting, retaining, and developing human capital. InnovaIT has been proudly doing that for over two decades. Recent engagements include strategic opportunity analysis for training in the aviation and aerospace sector, consulting for competency-based micro-credential program development in aerospace, process improvement for a private aerospace technology trainer, online program evaluation for a large regional college, and research and analysis of certification opportunities in the non-destructive testing industry.

CONTENTS

SUMMARY: AEROSPACE PRODUCT & PARTS MANUFACTURING

"Globally, labour shortages have had a tremendous impact on manufacturing GDP and these challenges are expected to pose more problems in upcoming years. According to globalEdge, the global manufacturing shortage could exceed 8 million workers by 2030, resulting in a potential revenue loss of $607B USD. According to a report published by Canadian Manufacturers and Exporters (CME) in October 2022, this impact is already being felt in Canada where there has been a loss of $13B comprised of lost or rejected orders and postponed and cancelled projects due to labour shortages. There are several conflating factors contributing to this shortfall. The existing workforce is ageing. As an example, the average age of an aerospace worker in Canada today is 54. Approximately 30% of the Canadian manufacturing workforce will be eligible to retire by 2030. Exacerbating this, young people are not coming into manufacturing careers at an adequate rate to replace and augment this aging workforce."[1]

To protect and develop manufacturing sectors across Canada, it is essential that the Canadian manufacturing workforce be recognized as a key national asset and that a focused and sustained national strategy be implemented to develop and enhance the skills of this workforce. Furthermore, it is essential that more young Canadians enter the manufacturing workforce. A clearer and focused view of workforce conditions, challenges, and skill levels is necessary to provide recommendations in support of these vital steps. The Labour Market Research by Next Generation Manufacturing Canada (NGen) into the Core Competencies of the Canadian Manufacturing Workforce is intended to solicit input about the conditions facing Canadian manufacturing firms to help determine if current skill levels are appropriate to meet the workforce needs, as well as how occupational skill requirements are expected to evolve over the next decade and a half.

In late 2023, Downsview Aerospace Innovation & Research (DAIR) responded to a NGen RFQ and was selected to implement the research for the aerospace manufacturing sector, as part of the broader manufacturing report. DAIR subsequently partnered with InnovaIT Professional Services, a consultancy in Nova Scotia with expertise in competency modelling, corporate training, and labour market information research to help prepare a pan-Canadian sector report for NGen. DAIR and InnovaIT have worked on similar projects related to aerospace training and skills in recent years.

As part of its mandate DAIR establishes and maintains relationships with many sector and cross-sectoral organizations across the country and was able to leverage partners such as the Trillium Network for Advanced Manufacturing, Aero-Montréal, Manitoba Aerospace, Aerospace Industries Association of Canada (AIAC)-Pacific, and the Atlantic Canada Aerospace and Defence Association (ACADA) to support the outreach effort.

The primary research methodology consisted of two key activities: synchronous polling to collect key statistics and conditions relating to issues of recruitment, workforce growth forecasts and retirement; and an online survey to review and predict skill levels for key positions in aerospace manufacturing. Supplementing the primary research, recent research reports from DAIR, the AIAC, the Ontario Aerospace Council (OAC), and the Canadian Council for Aviation and Aerospace (CCAA) provided useful secondary input supporting the findings of primary research activities.

[1] From NGEN RFQ, Labour Market Research into the Core Competencies of the Canadian Manufacturing Workforce

DAIR and InnovaIT committed to reaching at least 30 Canadian aerospace firms and developed a strategy to identify and invite a suitable sample of firms representing a range of activities, company sizes, and geographic jurisdictions. Eventually, leveraging DAIR's network, they were successful in the outreach contacting over 75 firms and confirming 30 firms from coast to coast who participated in the contextual interviews. Due to technical difficulties and security limitations a handful of participants were unable to complete the survey but the remaining survey participants generated nearly 8,000 data points for research analysis on occupational skills through the survey.

The interviews also generated excellent intelligence regarding workforce recruitment and retention as well as a large body of candid commentary, descriptions of workforce development conditions, and strategies being employed to combat the growing gap in hiring requirements.

The results – both in the workforce trends interview and the online survey – were not surprising, but rather validated what the industry has been hearing from some time and supporting the hypothetic prediction by globalEdge. Demographic patterns resulting in a diminished pool of candidates and growth requirements are creating a highly competitive situation for skilled workers. Regulations, lack of attraction to the industry, and anachronistic training and certification regimes cause delays and challenges to bridge the gap between worker demand and supply. Meanwhile, rapid changes in skill requirements are being seen in many occupations, suggesting that accepted levels of proficiency and the training pathways to deliver them may no longer be properly targeted and delivered.

The survey and poll results uncovered fragility in the sector and presented industry voices calling, as they have for more than a decade, for a national strategy for aerospace similar in scope to Canada's Oceans Strategy. Recommendations at the end of this paper provide industry suggestions as to what a national strategy might encompass with regards to skills development and training.

SECTOR OVERVIEW

The aerospace sector is a significant contributor to the economy and workforce in Canada. Spanning domestic and export services and supply chains, it is a highly stratified industry characterized by a hierarchy of structures, tiers, and market segments. As a note, traditionally, aerospace tends to be associated with engineering and manufacturing-related occupations, while aviation is focused on maintenance which can include manufacturing occupations, as well as pilot and crew training. For the purposes of this report these terms are merged for simplicity and readability, unless otherwise stated.

In 2022, the industry contributed close to $27B to national gross domestic product (GDP) and over 212,000 jobs to the Canadian economy. This was an increased contribution to Canada's economy of $1.8B to GDP and 14,400 jobs between 2021 and 2022. Most of the revenue base and employment (>65%) come from direct manufacturing and supply chain activities. Indirect and related employment adds at least half again the number of jobs in the economy.

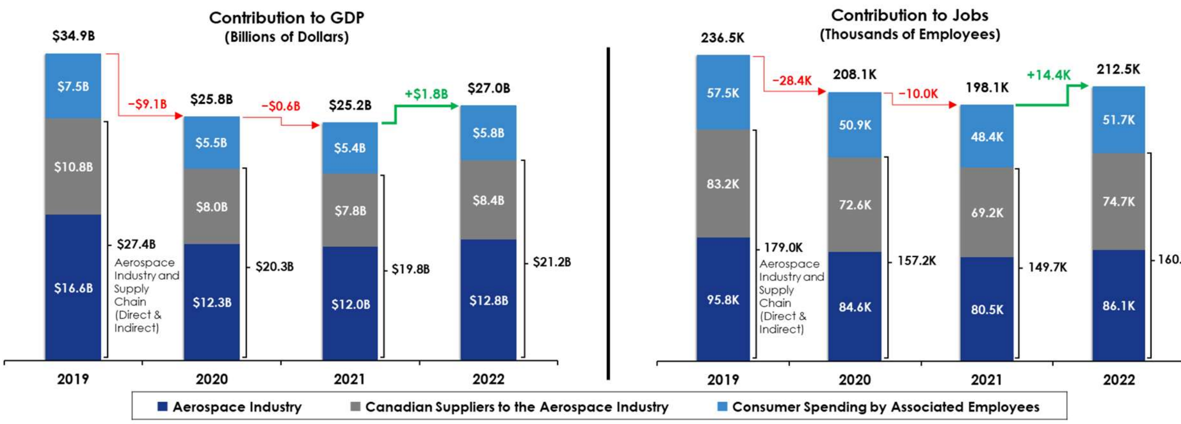

Figure 1 Aerospace Industry Contribution to the Canadian Economy (2019-2022), Source AIAC and ISED Canada 2023

Canada's aerospace sector mirrors the global market in having a small number of large dominant firms – original equipment manufacturers (OEMs, i.e., aircraft manufacturers) and Tier 1 supply chain firms – alongside a much larger number of smaller OEMs, suppliers, engineering design, and support firms. Canada's market is different from the American landscape in terms of the balance between the number of large and smaller companies competing in the space – Canada having only about 8% of large enterprises (>500 employees) in its total of about 700 industry firms compared to around 30% large firms in the US industry. Much of that may be attributed to ongoing consolidation within the US, a phenomenon that is also being observed more frequently in recent years in the Canadian experience. A significant level of merger and acquisition activity was referred to by survey respondents.

Manufacturing holds a significant focus of the industry with most of the aerospace contributions to GDP coming from production. In 2022, Canada ranked in the top five countries in the world for civil flight simulators (#1), civil aircraft engines (#3), and civil aircraft (#4). More than 80% of aerospace manufacturing is export-oriented, with close to 60% in supply chain markets. In 2022, export revenues were close to $18.7B[2]

[2] State of Canada's Aerospace Industry Report, Summer 2023, AIAC and ISED Canada 2023

Figure 2 Aerospace Exports, Source AIAC and ISED Canada 2023[3]

While overall manufacturing employment in Canada declined by about 14% from 2005 to 2019, aerospace manufacturing saw an increase in employment numbers of over 20% in the same timeframe, and nearly a doubling of production revenues. The supply-side figures belie that the industry has struggled to fill those jobs with willing and skilled employees for a decade or more.

The COVID-19 pandemic put a dent in that growth, shutting down global travel and crippling many airlines resulting in the number of jobs in the industry dramatically decreasing between 2019 and 2021. With reduced demand in the global market, revenues for civil aircraft production dropped by nearly 34% in Canada, still faring better than the global market which lost nearly 40% of its earnings in the period.

In 2022, the Canadian aerospace industry maintained its #1 R&D ranking among all Canadian manufacturing industries. Aerospace invested over $680M in R&D, a decline from 2021, furthering a trend in R&D investments since 2018 but still reflecting an investment intensity more than 2 times higher than the manufacturing average.[4]

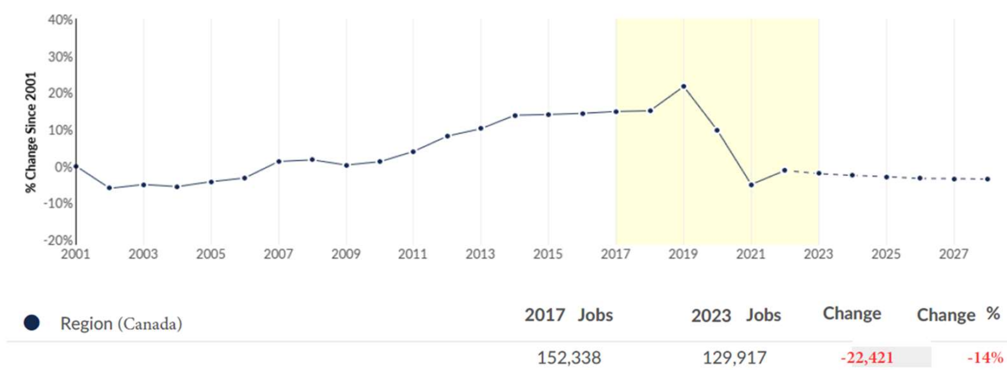

Figure 3 Aerospace Jobs 2001-2027+, highlight change 2017-2023, Source Lightcast

[3] Aircraft includes airplanes and spacecraft, Share is based on the dollar value of exports, and engines and landing gear include respective systems/components.
[4] Ibid

The industry in 2024 is already rebounding with a pronounced recovery of revenues since 2020. A panel of international subject matter experts predict a return to 2019 production revenue levels by end of 2024[5]. Jobs, however, are not predicted to rebound to 2019 levels until 2028 or later. Despite this, there is concern about the ability of the industry to meet staffing levels.

A report from the Canadian Council for Aviation and Aerospace (CCAA) shows a recruitment gap of nearly 48,000 entrants to the broader aviation and aerospace sector from 2021 to 2028.[6] Note that this gap is across multiple industry classifications including air transportation, support activities for air transportation and manufacturing for the aerospace sector (encompassing the four major NAICS codes associated with the industry)[7]. The total attributable to aerospace manufacturing is over 13,000. Of this, it is estimated that over 2,300 new entrants[8] make up only 18% of the required additional workers until 2028 and nearly 11,000 workers will be needed from other industries and jurisdictions (the recruitment gap).

The distribution of overall employment levels in aerospace is highly focused in Central Canada because the largest portion of the workforce is employed in Quebec (61%) and Ontario (24%). This distribution reflects the geographical concentration of OEMs and Tier 1 companies in those provinces. As far as total number of firms is concerned, the distribution of companies in the sector more closely resembles overall business allocation across the country, with many smaller, decentralized regional companies (SMEs with <500 employees) performing supply chain activities and specialized functions supporting both the manufacturing and the maintenance, repair, and overhaul (MRO) segments of the industry.

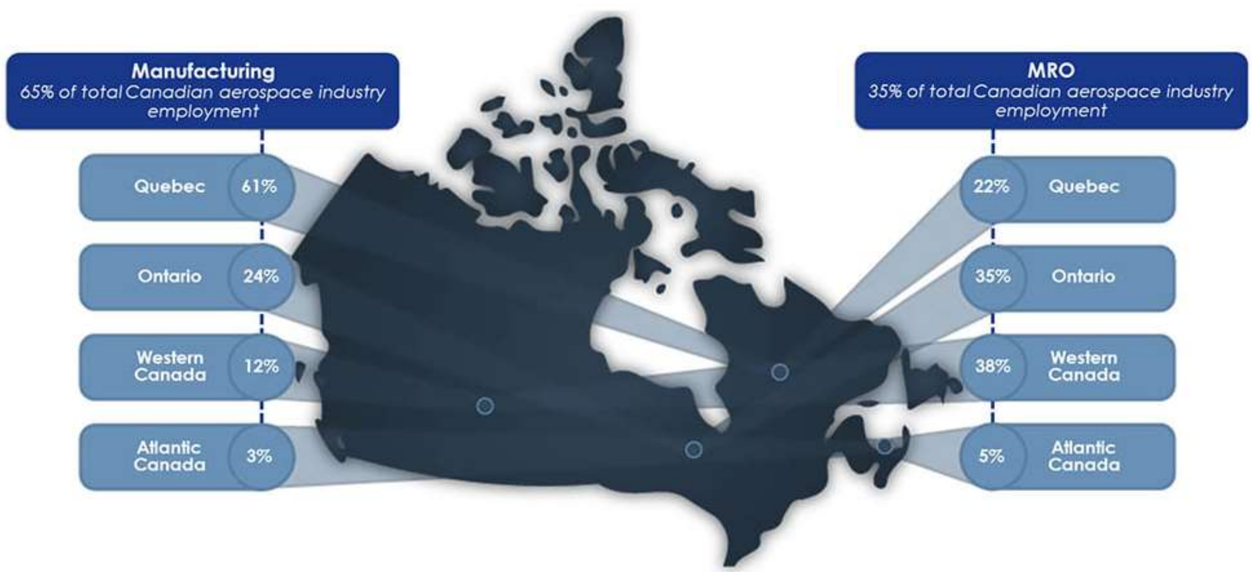

Figure 4 Share of Aerospace Industry Employment by Region, 2022, Source AIAC and ISED Canada 2023

[5] State of Canada's Aerospace Industry Report, AIAC, Summer 2022
[6] CCAA Aerospace Summit presentation, 2022
[7] North American Industry Classification System (NAICS) codes for aerospace: 3364 – Aerospace product and parts manufacture, 4811 – Scheduled air transportation, 4812 – Non-scheduled air transportation, and 4881 – Support activities for air transportation
[8] Note – New entrants are defined as the share of the population aged 15 to 30 in the labour force for each industry

While the emphasis for this research is on manufacturing, for aviation and aerospace, both manufacturers and MRO operations seek many of the same skillsets leading to high levels of competition and mobility of the skills within the overall industry.

METHODOLOGY & SAMPLING STRATEGY

Through this research project, DAIR committed to collecting survey data and statistical input from 30 companies in aerospace manufacturing. The sample was designed to reflect the distribution of manufacturing companies of various sizes from jurisdictions across Canada. A multi-phased approach was developed to ensure all regions had opportunities to participate and were made aware of the research. Most of the aircraft, parts, and related manufacturing industry is found in Central Canada with close to 85% located in Ontario and Québec. Based on an initial outreach of approximately 75 organizations (both direct and via partner associations), the final sample would, ideally, reflect similar weighting while recognizing the proportional inequities in regional distribution and company size.

Large companies represent only 5-10% of the industry's number of firms, but close to 80% of total employment. Since the intent of this research is to optimize the input in terms of overall workforce employment, engaging a slightly larger contingent of large firms ensured that the sample data would best reflect the greatest range of job titles and thus best illustrate the impact on overall employment in the sector.

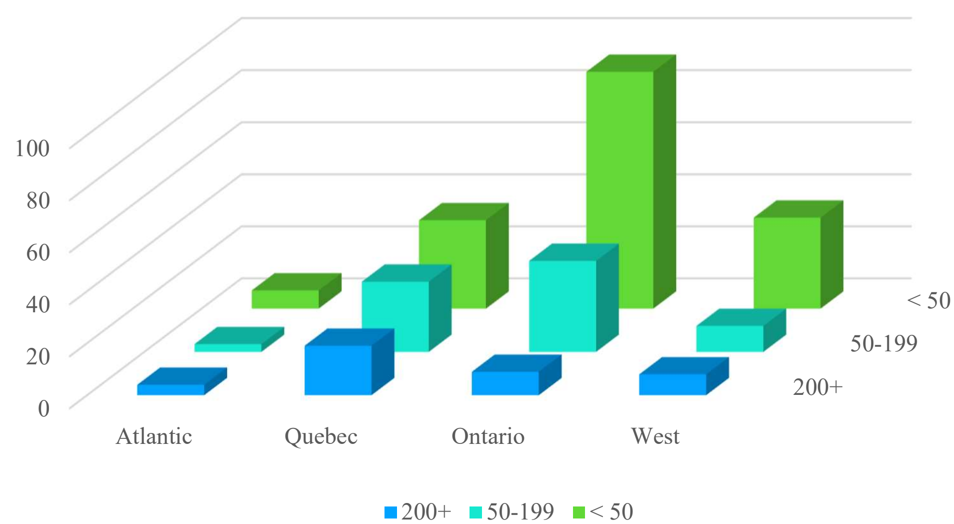

Figure 5 NAICS 3364 Establishments by Employment Size, Source Statistics Canada Table 22-10-0717-01, 2023, and provided by the Trillium Network for Advanced Manufacturing

The DAIR and InnovaIT team determined the most effective way to engage companies and encourage survey completion was through a two-part process, which included a short interview to gather workforce trends (such as growth and retirements) and an introduction to the survey tool. Initially, the plan was to enroll company representatives and begin the survey during this interview itself, but because of some challenges with validation and security, the strategy was revised to instead perform a walkthrough of the survey registration and sample questions, followed by an email with supporting information and codes for survey completion by the individual. In addition to the opportunity to collect key data on workforce trends and recruitment strategy, the interview was felt to be an important activity for several reasons including the opportunity to provide background and emphasize the importance of aerospace input into the research, address concerns about possible technology challenges related to the survey (e.g. online access or security), and ensure consistency and clarity for assessing proficiency levels. To the latter point, a key aspect of the initial meeting was to assist respondents in understanding that it was not asking about which proficiencies were most important, but rather what level of proficiency was required as minimal competency for the position at a functional entry level. A focus on skills that are perceived as most important could be valuable as the objective of further research, but it was recognized that this survey was designed to assess proficiency levels (competency), not rank them for criticality (ordinance). The process targeted individuals at the organizations in HR, training, and/or management roles.

Phase I: Review of existing DAIR Database

DAIR maintains a large database of profiles and contact coordinates for companies, associations and institutions connected to the aerospace sector. From this database, over 130 companies were identified as potential participants in the NGEN research, based on their manufacturing capabilities and operations. These were further classified for priority based on the relationship that DAIR has had with these companies with the expectation to leverage past interactions to encourage engagement in the current initiative. This filtering process also reflected the desired sample profile. More than 45 companies were identified and contacted by DAIR from this filtered listing.

Phase II: Outreach to Regional Organizations and Sector Associations

As noted in the industry profile above, the Québec industry is significant in the Canadian sector. DAIR has a close relationship with Aero Montréal who agreed to share information about the research project and its requirements with member Québec firms, not already included in DAIR's database.

DAIR's connections to sector associations in Canadian provinces in the West and East provided additional outreach via AIAC-Pacific, Manitoba Aerospace, and the Atlantic Canada Aerospace and Defence Association (ACADA). These organizations were instrumental in increasing awareness and emphasizing the value of aerospace having a voice in the skill competency requirements. The combined support of these organizations resulted in invitations to over 30 additional firms.

As Phase I and II commitments were received, DAIR and InnovaIT secured appointment dates for the initial interview with accepting firms.

Phase III: Fine-tuning and Follow-up

Follow up occurred for high-priority constituents with a unique or substantial presence in the sector and to balance representation to fairly align with the industry's profile. Recognized industry leaders were targeted to ensure representation of an optimal number of job specifications.

Final Sample

The final profile of 30 companies is a good reflection of the aerospace sector in Canada, capturing a reasonable cross-section of the industry with good operational diversity, regional representation (from 4 regions, Atlantic, Québec, Ontario, West), and range of business sizes and activities.

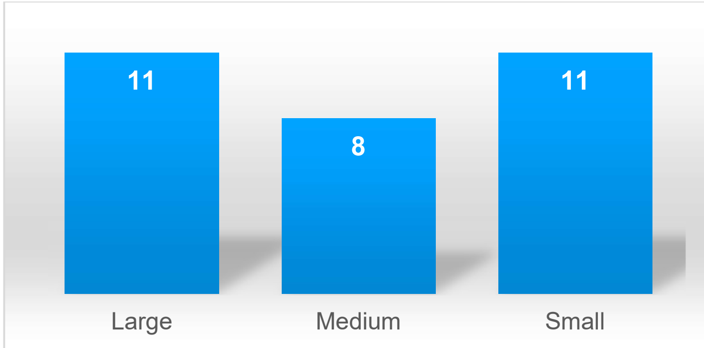

Figure 6 Final Sample, Company Size

As described in the sampling strategy, large firms (> 500 employees) were over-represented in the sample to ensure that the overall workforce and impact of recommendations is more accurately applied to labour market implications. Of the >14,000 jobs represented by the sample, approximately 11,500 are employed in large firms.

A diversity of manufacturing activities is also represented across the research participants. This includes OEMs, Tier-1 suppliers, supply chain participants, and specialized small parts producers as well as other supporting functions to manufacturing including maintenance, certification, inspection, and testing services. Different levels of maturity (new firms to more established firms) were also presented – ranging from a product research and innovation company to several multi-national OEMs.

In total interviews were held with 30 companies who provided profile and workforce trend data for the research. All 30 accessed the online skills survey providing 65 occupational assessments (mean = 2.50 occupations / per respondent). In total they generated 2,665 skill assessments over three timeframes – or nearly 8,000 data points for analysis. An example from the 41-question Vametric survey tool provided by NGen is showed below.

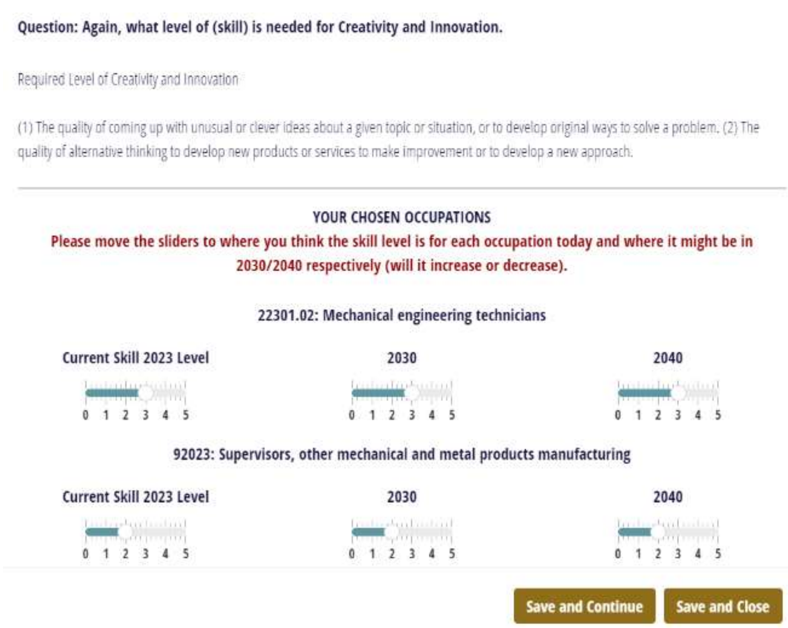

Figure 7 Vametric Survey Tool, Sample Question

During the process there were some issues experienced by a handful of companies. Aerospace firms, especially those with contracts in national security and defence have very high levels of security provisioning around their corporate networks and internal computer workstations. The requirement of the survey tool to use pop-up windows to implement the survey and a generated email for verification did cause issues for several individuals and in some cases disabled them from full participation. The pop-up issue was able to be resolved for most, but not all, of the sample, with a few respondents unable to use the URLs provided due to firewall restrictions (three individuals).

Occupations Reviewed

The skills survey covered 30 individual occupations including the following, with machinists, aircraft mechanics, and aircraft assemblers the three most selected for skills assessment.

Machinists	Tool and die makers
Aircraft assembly inspectors	Labourers in metal fabrication
Aircraft mechanics	Aerospace engineers
Aircraft assemblers	Electrical and electronics engineering technicians
Electronics assemblers and fabricators	Non-destructive testers and inspectors
Mechanical engineers	Manufacturing managers
Contractors and supervisors, electrical trades and telecommunications occupations	Industrial painters and coaters
Industrial and manufacturing engineers	Aircraft instrument technicians
Other labourers in processing, manufacturing, and utilities	Contractors and supervisors, mechanic trades
Engineering managers	Airworthiness inspectors
Chemical engineers	Civil engineering technicians
Inspectors and testers in electrical apparatus manufacturing	Industrial engineering and manufacturing technicians
Mechanical engineering technicians	Welders
Electrical and electronics engineers	Machine operators of other metal products
Mechanical assemblers	Construction millwrights and industrial mechanics

Figure 8 Occupations Selected and Reviewed by Survey Participants

FINDINGS

Workforce Trends

As noted above, the engagement of participants in the research was facilitated with a synchronous discussion to collect statistical workforce information from the aerospace company representatives. During each discussion (or in some cases, provided before or after the call), participants were asked about current and anticipated workforce levels, retirement rates, and perception of difficulty in recruiting skilled workers. The interview also captured a variety of candid comments that explained many of the conditions and factors facing these firms, their thoughts about why these conditions occur, and strategies they are taking to mitigate the resulting challenges.

Anticipated Growth

Like other sectors but with greater impact in some regards, aerospace manufacturing is sensitive to major socioeconomic events and conditions, as can be seen in the pandemic's impact on the industry and recovery timelines. Many participants identified the uncertainty that comes with such volatile conditions. As several respondents noted, plans and targets are important to direct business activity, but pandemics, international territorial and political tensions, emerging technologies, and unstable economic conditions can wreak havoc on the "best laid plans". The scope of large aircraft manufacturing projects is such that significant contracts are usually substantial enough to guarantee stable revenues and employment over long periods to both OEMs and the supply chain that supports them. This allowed most interviewees to predict numbers through 2030 and beyond. However, most participants interviewed felt that predictions as far out as 2040 were highly speculative due to the uncertainty that such global interventions can cause.

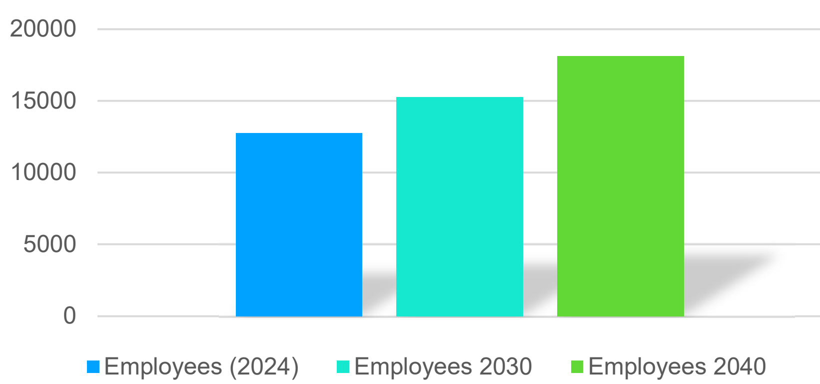

Figure 9 Anticipated Growth, Employees, 2024-2040

The input provided by the interviews shows conservative estimations of employment growth of about 18% to 2030 and an additional 19% growth in the following decade.

Anticipated Retirements

Coupled with ongoing labour shortages, requirements for replacing retirees create additional pressure on employee replacement. Many of the respondents said they were hosting a relatively young workforce and so have neither had much turnover in recent years nor expect to have in the near term. However, for many others, the pandemic saw substantial number of departures from their ranks and some also expect a sizable number of older workers to exit in the next few years before the recent crop of younger workers settle into the careers.

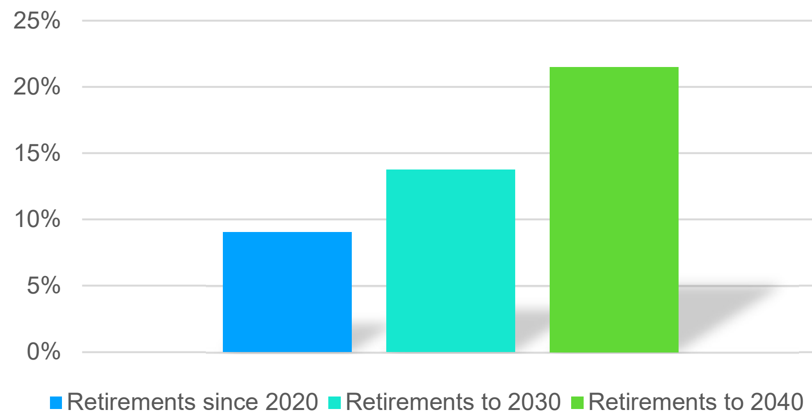

Figure 10 Retirements, 2020-2040

Annual Rates	2020-2023	2024-2030	2030-2040
Retirement	3.01%	2.29%	2.15%

The data indicates an average 3% per year rate of retirement from 2020 to present, close to a 2.3% per year rate anticipated to 2030 with some reduction of levels closer to a 2% annual rate predicted from 2030 to 2040. If this is accurate, nearly half (45%) of the existing workforce will be lost to retirement by 2040.

Recruiting Difficulty

All respondents indicated some measure of recruiting difficulty, although it is important to note that not all the challenges were identified as manufacturing jobs. Business operations, project management, human resources, supply chain management, engineering and design, and marketing roles were also seen as frequent hurdles for organizational hiring. There was a consensus that finding skilled (and particularly experienced) workers for line work, assembly, machine operations, skilled trades, and related factory-floor positions was a substantial and growing challenge, however, these were not identified as the most important by all participants. While basic assembly operations allow companies to hire unskilled workers and to train them to the specific tasks, protocols, and equipment requirements, the modern factory is increasingly evolving to an environment in which unskilled positions are diminishing in number and their value to production. Automation, robotics, advanced techniques, and technologies are pushing the work towards an Industry 4.0 environment wherein an understanding of connected technologies, digital literacy, and lifelong learning are becoming a critical skill set. Many interviewees also indicated that the industry has been suffering from a lack of attractiveness to younger workers and recent secondary and post-secondary graduates. One respondent put it succinctly “Manufacturing is just not seen as sexy enough to attract and retain Canadian youth.”

This lack of interest from young workers can be especially challenging for companies in smaller or more remote communities. A common challenge highlighted by respondents in such conditions was that they lived in communities that did not have the population base to support hiring needs; this was made more acute by the fact that there is difficulty luring young people to move to smaller towns for these aerospace opportunities.

Competition

In many markets, competition is becoming fierce for recruiters. Smaller companies are particularly challenged to attract the right employees – in part because they do not have the size to take advantage of economies of scale that allow larger companies to offer premium employment conditions such as group rates for health plans, pensions, and more competitive salaries. Meanwhile, larger firms are more likely to have a unionized workforce, and this creates pressure to meet labour demands or risk failure to deliver on essential contracts.

Post Secondary Programs

Despite the quality of programs, colleges and universities are not able to graduate enough technical individuals to meet industry demand. Some firms (dominantly larger firms) are working closely with schools to promote their career opportunities and in some cases to make early offerings to whole graduating classes to secure badly needed interns. College and university programs and related certification pathways take 2 to 4 years to complete and even then, newly graduated recruits are often estimated to be months away from full productivity with specialty equipment and proprietary systems and techniques.

Sector Appeal

Manufacturing is not seen as particularly attractive to youth in many cases. Although the prospect of lifetime employment offers great stability for some, many respondents identified a lack of commitment in domestic populations, particularly among millennials and Gen Z recruits. An emerging “gig economy” is allowing some of these workers to build more flexibility in their hours and presence or to create a “hired gun” approach allowing skilled gig workers to be more mobile with their employment.

Niche Manufacturing

Several respondents suggested that they are specialized in their product line and therefore will not only struggle with finding capable employees, but that they must also invest significantly in mentoring and training employees to be ready for their specific production systems and processes. However, it was noted that there were many overlaps in the kinds of skills that are being sought and, in some cases, they were raiding other firms – even non-aerospace companies – for needed workforce recruitment. As one respondent said, “If they can turn a wrench on an automobile engine, they can likely turn a wrench on an aircraft engine”. Upskilling, re-skilling, and cross-skilling is becoming an increasingly important component of maintaining competitiveness and productivity in the industry.

Regulations and Compliance

Regulations, both within the industry and applied externally, are noted as significant challenges in many cases, and identified as aspects that confound attempts to improve workforce mobility and skills development agility. For firms with defence and security contracts, the Controlled Goods Program (CGP) and International Traffic in Arms Regulations (ITAR) can restrict or delay the hiring of competent employees from foreign countries, or recent skilled immigrants to Canada. Meanwhile, internal regulation through mandatory certification and apprenticeship pathways can produce its own challenges including the long “seat-time-based” requirements for qualification, failure to recognize cross-occupational competencies, and limitations in recognizing competencies in shorter, skill-focused learning achievement.

Recruitment and Retention Strategies

Industry participants spoke in detail about strategies they are pursuing to improve recruitment, retention, and productivity – all with varying levels of success.

Foreign Workers

The industry players indicated a sense that the pool of suitable talent in the country is not currently sufficient to meet demand. Consequently, employers are forced to look beyond the borders and are increasingly targeting skilled talent from other jurisdictions and countries to find suitable recruits. The skills needed require a strong level of focus on mathematics, critical thinking, logic and problem-solving. These are skills that exist where strong STEM (Science, Technology. Engineering, and Math) programs are prominent. Countries specifically noted by respondents include India, Southeast Asia, Middle Eastern states, Philippines, and several European countries such as Ukraine, Serbia, and the Czech Republic. As noted above, many of these countries are subject to regulations that can frustrate rapid integration of skilled foreign workers. Some exceptions have been granted – especially where production can be segregated between controlled and non-controlled materials or where workers can be assigned to non-airframe production and assembly.

Grey Market

Several companies indicated that older workers are choosing to stay longer in the industry. This is a trend that is also being noted in other industries. It cannot be said as to whether this is an economic decision or a passion for the work environment, but statistics provided by a few large and medium-sized companies, in particular, listed a significant cohort of employees between 55 and 65 years of age who are not expected to retire soon as well as sizable groups of current workers between 65 and 75. Moreover, DAIR and InnovaIT heard of several companies who were engaging retired senior employees to act as consultants, specialists, advisors, trainers and mentors due to the lack of mastery-level skills among the existing candidate pool.

Technologies

Some companies have been adopting technologies that can relieve the pressure on human workforce recruitment, especially for repetitive low-skill tasks. Industry 4.0 has been gradually shaping the workforce exerting pressure to reduce unskilled work that can be transferred to mechanical processes (e.g. robotics and automation) while growing the market for digitally literate skills like CNC Machining and Enterprise Resource Planning (ERP) programming for advanced manufacturing. Human interaction in volatile conditions, trouble-shooting, and technical problem-solving are skills that are still seen as highly valuable for the human workforce according to respondents. However, Artificial Intelligence (AI) is making great strides in filling some of this requirement and will continue to present interesting alternatives to human knowledge-based work in the years to come.

Many new technological innovations are creating changes in workforce composition and the skills used in manufacturing. Non-destructive testing techniques as well as augmented and virtual reality wearables are some of the emerging technologies that create a whole new set of manufacturing skills required. Drones and other autonomous vehicles are and can be used for inspection and examination during manufacturing and maintenance tasks. They are also being looked at as supplements or replacements for traditional transport for small packages and even human urban conveyance. Electric and hybrid vehicles as well as unmanned aerial vehicles are presenting the potential for substantial innovation and likely whole new factory lines and many new non-traditional skills requirements for the future.

Predatory Recruitment

Several companies stated that competition is fierce for workers, especially younger workers. Some companies looking for workers in this space have been actively targeting competitors and even unrelated industries for employee groups. Other companies have been establishing academic-industry collaborations designed to allow the industry partner to have "first shot" at graduates through job fairs, work terms, and employment guarantees. A couple of large or medium-sized firms moved operations from urban cores where competition is high, to suburban and even rural settings where they might be able to control or dominate the job market and avoid this sort of predatory recruitment. While this does eliminate one problem, it seems to create a new one in that it is more difficult to attract significant workforce recruits to rural communities and the local market offers less opportunity to recruit from the sparser rural population.

Incentives

Both attracting and retaining workers are seen as challenges by most poll respondents. Different forms of incentives to improve recruitment efforts were identified by those firms contacted. Larger firms, often unionized, can create expectations across local markets regarding salaries and benefits. Recruitment by smaller companies is often challenged by an inability to compete on this basis and so these companies resort to other, mostly non-salary incentives. Another challenge for smaller companies is their focus on smaller niches, which can make it harder for new graduates to apply varied skills or have opportunities to work on functions required for certification. This is one of the reasons that young workers often see smaller companies as a short-term or *stepping-stone* position. Rapid advancement, job enrichment, varied work and training, and more social engagement within company ranks are included in strategies to create a positive working environment.

Flex-work/ Remote Work

The pandemic affected respondents in different ways, but one that emerged as prevalent among interviewees was the move towards increased flexibility for workers – hours of work, days of work, and even intensity of work as well as, where appropriate, remote work or teleworking. Informants noted that manufacturing work – as far as machining, assembly and inspection-type of activity is concerned – requires presence in the factory setting, but there are some work efforts that can allow for a measure of off-site activity, such as training activity, documentation, and reporting, as examples. One respondent noted that he anticipated that by 2030 up to 20% of his non-floor workers will be working from home partly or fully. And in this regard, an emerging "gig economy" has created a level of mobility that also sees some workers choosing to contract their services in a less committed format than a traditional weekday employment. Gig workers, along with those seeking better work-life balance, have driven a demand for more flexible working schedules.

Work Environment

Occupational health and safety were identified as a critical focus for many of the company representatives which were interviewed. Over and above the basics of safe workspaces and work practices, increasing vigilance for fatigue, cyclical downtime, and provision of at-work personal services (e.g. daycare, cafeterias, etc.) and entertainment have been pointed out as ways to ensure positive work experience and potentially improved retention and reputational attractiveness.

Observations

The interviews provided an opportunity to hear many diverse opinions, experiences, and creative solutions – many of which are addressed elsewhere in this report. Through the research process, DAIR and InnovaIT were informed of several planned facility developments, acquisitions, and other corporate expansion plans being deferred or cancelled by the worldwide downturn of 2020-2022. Even before the pandemic, whether by contracts drying up or worldwide events intervening, companies were already struggling to recruit, retain, or rebuild workforces and so they were and continue to be, reticent to lay off employees and in many cases are finding it less painful to keep employees on at financial loss than to try to recover a lost workforce.

The trends that were identified from all these observations are likely those which affect many manufacturing firms and across sectors. As Huw Lloyd-Ellis of Queen's University wrote and then discussed at the 2023 *DAIR To Innovate* conference, "The dramatic increase in market tightness in 2021 and 2022 is, in large part, a result of the rebound in demand … The labour shortfall due to the ongoing retirement of skilled and experienced workers will remain a significant factor in key industries for some time to come. And as competition for the remaining workers heats up, it is likely to result in wage increases and further inflationary pressure … structural labour shortages can only be relieved by either discouraging retirement of skilled and experienced workers or replacing them in some way. For a country like Canada, a major source of skilled and experienced workers could come from immigration. We already have ambitious targets in this regard, but achieving these goals is currently being undermined by application processing times that themselves appear to be exacerbated by labour shortages."

Key trends include the challenging demographics of an aging workforce (based around the baby-boom retirement exit) and a shrinking candidate pool, rapid technological change, unstable socio-economic and socio-political conditions, and necessary – but challenging – regulatory environments. Companies are anticipating growth in production of around 40%, and a need for replacement from retirements around 45% of current workforce by 2040. As noted in CCAA's 2022 report, only a small portion, potentially less than 20% of demand, are anticipated to come from projections of new entrants to the industry. Filling the gap will require getting 80% of the workforce requirements from new jurisdictions.

The deferral of acquisitions and mergers, product development, facility construction illustrate lost opportunities to address issues of productivity and capacity and presents a picture of an industry which is robust in scale but can be fragile and tentative in some critical aspects.

A common theme heard through this process (and supported through the reports referenced in the Appendix and past work) is a common complaint of the lack of a national strategy for the aerospace sector similar to that of the country's Oceans Strategy, for example. Several participants commented that the lack of support for this sector is a missed opportunity. One shared his thought that "every Canadian town seems to have an airport and there is a strong connection to avionics and aerospace. There is a chance to capitalize on that support if we act with a strategy." Several related observations came from a different perspective, expressing concern that the OEMs – which form the highest level in the ecosystem's "food chain" and who drive the economic engine that feeds the rest of the market – are in some trouble. Failing these OEMs (and Tier-1 suppliers), it was indicated, could signal a devastating impact for the industry.

SKILLS ASSESSMENT

The full list of assessed positions appears in Figure 8 as previously shown. Analysis of skills and proficiencies will focus on the three top occupational categories noted in the table of top frequency values, in Figure 11 below.

Three occupations dominated the selection of positions for skills evaluation: *Machinists, Aircraft Mechanics, and Aircraft Assemblers*. NOCs did not always have a direct relationship to position titles for the responding firms and so, as part of the interview process, DAIR and InnovaIT tried to provide suitable NOCs to every participant following the discussion and based on their suggested job titles. Some positions noted by participants were unavailable from the potential NOC selection. The interviewed representatives were encouraged to select any position they wanted whether concentration in current workforce, difficulty recruiting, changing skills requirements or any other reason they chose. Based on this, the frequency of NOC selection should not be used to interpret any particular importance of these positions to the sector.

Occupation[9]	Frequency
Machinists	8
Aircraft mechanics	7
Aircraft assemblers	6
Aerospace engineers*	4
Aircraft instrument technicians*	4
Electronics assemblers and fabricators	3
Industrial and manufacturing engineers	3
Non-destructive testers and inspectors	3
Contractors and supervisors, mechanic trades	3
Aircraft assembly inspectors	2
Mechanical assemblers	2
Tool and die makers	2

Figure 11 Occupational selection by respondents

Tabular data relating to skills assessments for three leading occupations (and all occupations, in aggregate) appears in the Appendix. Analysis and interpretation of the data is provided in the following sections for those assessed occupations and for the overall sample.

[9] Note – a few NOCs were not initially available in the selection process of the survey until later in the collection process. Therefore, there was a challenge in identifying the first-choice NOCs for some early participants. Missing NOCs from the earliest submissions included Aerospace Engineers and Avionics Technicians (the latter largely covered above in aircraft instrument technicians). These were inserted at the request of DAIR and InnovaIT, however not for several participants to select and without skill values from the OASiS database. Accordingly, these inserted NOCs were presented at neutral skill levels due to issues relating to methods of calculation from the O-Net and OASiS databases. This results in limitation to data analytics related to adjustments against base levels.

NOC 72100.01 Machinists (Trades)

Machinists set up and operate a variety of machine tools to cut and grind metal, plastic, and other materials to make and modify parts and products with precise dimensions and tolerances. Machinists are common among many manufacturing sectors and a key contributor to the Canadian aerospace industry.

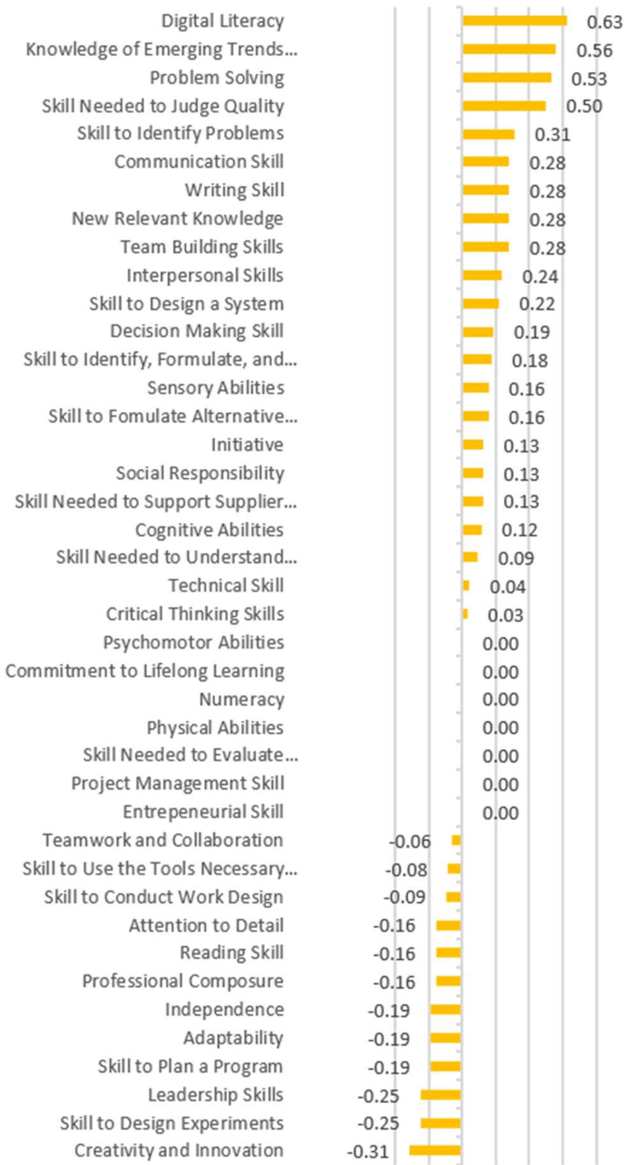

Figure 12 Change from Base Levels - Machinist

Benchmark & Current Levels

Survey respondents found the benchmark proficiency levels for the Machinist NOC to be generally in line with their experience although a small number of proficiencies showed significant adjustments to the base rates indicated in the OASiS[10] records. These include digital literacy, knowledge of emerging trends, problem-solving, and the skill needed to judge quality. Large standard deviations for Trades across the sample indicate that digital literacy and emerging trends may be specific to certain types of operations or regional conditions.[11]

Few proficiencies were marked as significantly overestimated in OASiS, but notably creativity and innovation, leadership skills, and adaptability were adjusted downward by survey participants.

Standard Deviation, s: 0.22902816953166
Count, N: 41[12]
Sum, Σx: 3.38
Mean, x̄: 0.082439024390244
Variance, s^2: 0.052453902439024

Future Expectations

Building on a revised base of 2023 proficiency levels, the input of survey participants indicated that high proficiency levels for machinists continue for attention to detail, independence, skills to use the tools necessary for the job, and psychomotor abilities. These are also noted as overall high-proficiency areas post-assessment across the spectrum of trades occupations as may be seen in the section on "Type of Occupation" later in this document. Paralleling the promotion of emerging technologies noted in the base change data, reading skill, technical ability and adaptability are also promoted by adjustments to 2030 and 2040 expectations.

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[10] Occupational and Skills Information System
[11] For more detail, see occupation-type standard deviations in the Appendix
[12] Standard deviation based on average change for the occupation for the 41 proficiencies

The job of a machinist has changed substantially in the past few years and is anticipated to transform in the coming decade. Transitioning from a largely manual process of controlling milling and sheet metal forming machines, the modern machinist is increasingly required to program manufacturing equipment using digital interfaces and, in some cases, using Enterprise Resource Planning (ERP) and other sophisticated computerized tools to control the job and to do much of this independently. Psychomotor abilities and teamwork and collaboration become skills requiring less proficiency according to survey results.

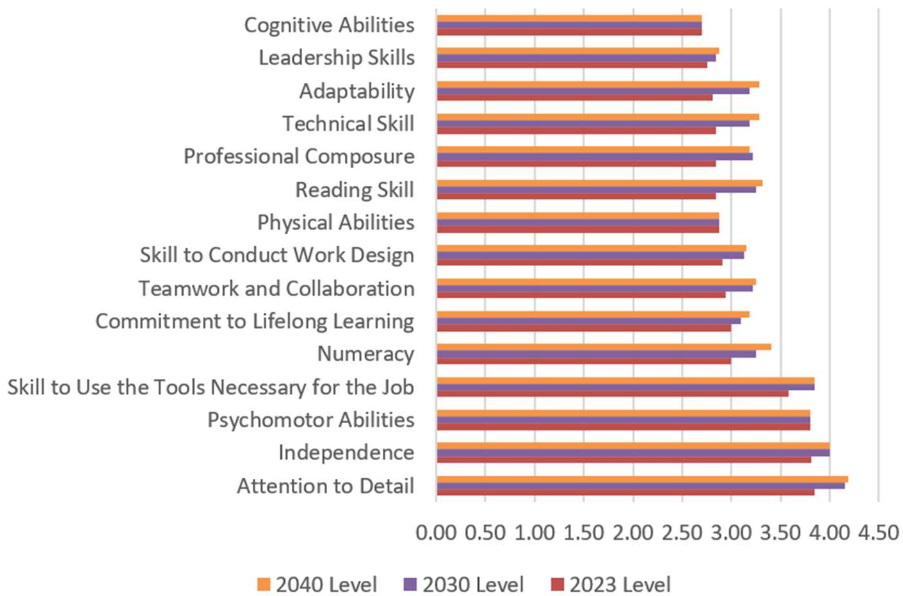

Figure 13 Top Proficiency Levels 2023-2040 – Machinist

2023	2030	2040
Attention to Detail	Attention to Detail	Attention to Detail
Independence	Independence	Independence
Psychomotor Abilities	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job
Skill to Use the Tools Necessary for the Job	Psychomotor Abilities	Psychomotor Abilities
Commitment to Lifelong Learning	Numeracy	Numeracy
Numeracy	Reading Skill	Reading Skill
Teamwork and Collaboration	Teamwork and Collaboration	Technical Skill
Skill to Conduct Work Design	Professional Composure	Adaptability
Physical Abilities	Technical Skill	Teamwork and Collaboration
Technical Skill	Adaptability	Professional Composure

Figure 14 Proficiency Rankings 2023-2040 – Machinists

YELLOW = same as previous period
GREEN = new or promoted from previous period
RED = demoted from previous period

NOC 72404.01 Aircraft Mechanics (Trades)

Aircraft mechanics troubleshoot aircraft structural, mechanical, or hydraulic systems to identify problems and set up, adjust, and repair systems according to specifications, technical drawings, manuals, and established procedures. They also repair and overhaul aircraft structural, mechanical, or hydraulic systems.

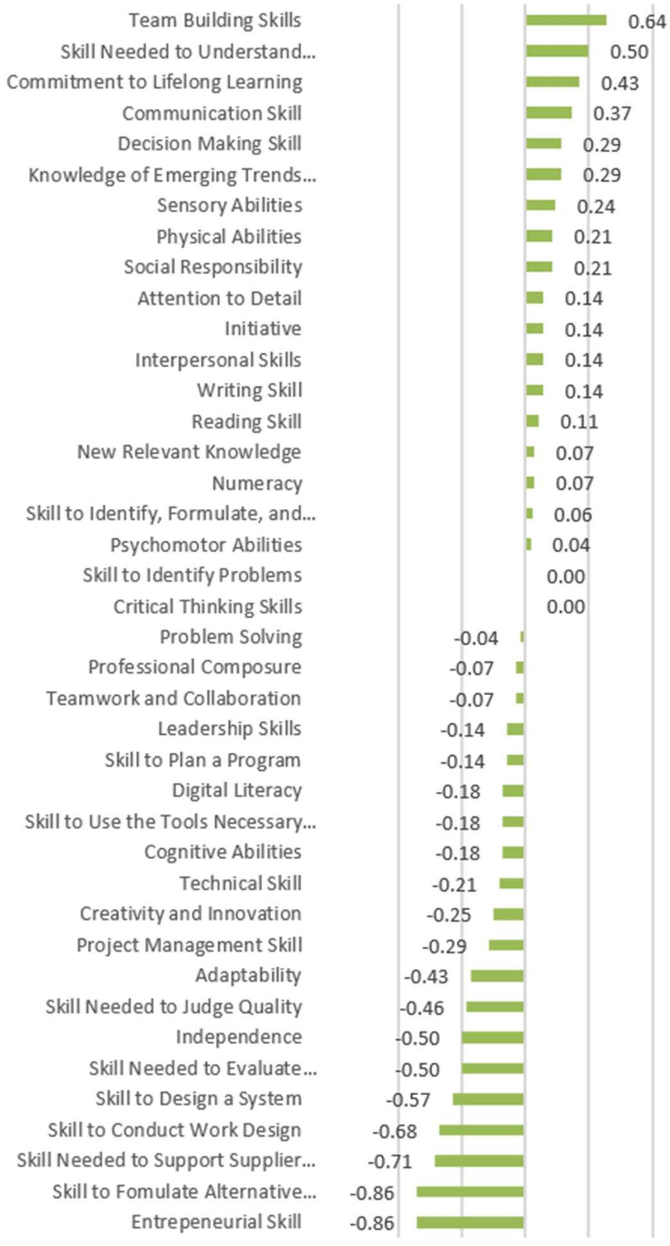

Figure 15 Change from Base Levels – Aircraft Mechanics

Benchmark & Current Levels

Overall, adjustments to the benchmark scores were not particularly dramatic. Team building skills and skills needed to understand the business were the most significant elevations of proficiency expectations by the survey results, although neither of these, post assessment, indicate a very high level of proficiency requirement across the trades. The downgrading of skills proficiency from the base was more prominent than increased competency. Respondents diminished the proficiency levels of skills to design a system and to design work packages, skills to formulate alternatives, and entrepreneurial skills. Notably, these already reported low skill levels in the base records. However, relatively larger standard deviations associated with assessments of these skills indicate that some organizations or jurisdictions have alternate views of the required levels.

Standard Deviation, s: 0.38080434768988

Count, N: 41
Sum, Σx: -4.13
Mean, x̄: -0.10073170731707
Variance, s2: 0.14501195121951

Future Expectations

The skills requiring highest proficiencies in 2023 tend to remain those needing greatest mastery in the foreseeable future. Skills needed to judge quality, to select the right tools for the job, and attention to detail all remain in the highest tiers of competency for aircraft mechanics. All of 2023's top-level 15 skills remain as needing significant mastery and all, but a couple, indicate a need to increase mastery in these proficiencies. Several skills require increased proficiency in the near-term (to 2023) with reduced levels acceptable beyond that period (to 2040). These include professional composure, technical skill, and adaptability.

Digital literacy and commitment to lifelong learning emerge and require increased levels of proficiency in the coming years, shifting relative rankings from adaptability, sensory abilities, and independence.

Similar in some respects to the machinist, aircraft mechanics are increasingly required to interact with computers and numerically controlled systems. Automation and robotics, and other Industry 4.0 technologies are having increasing presence requiring whole new skill sets and understanding of revised processes with lower levels of autonomy. The replacement of many mechanical systems with electronic and digital components in aircraft assembly reduces the amount of wrench-turning in favour of integrated mechanical-digital installations. Up-skilling and cross-skilling is a constant for the modern aircraft mechanic.

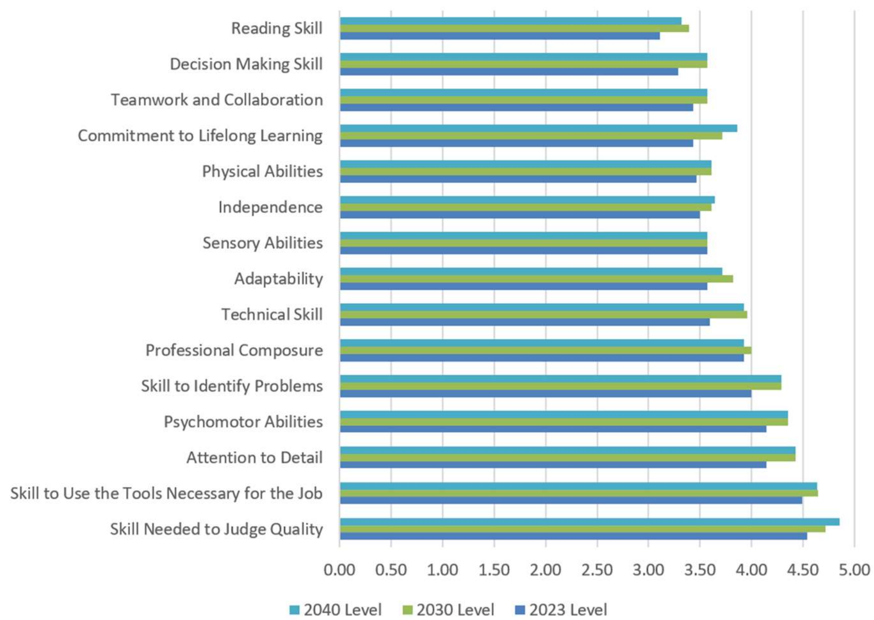

Figure 16 Top Proficiency Levels 2023-2040 – Aircraft Mechanic

2023	2030	2040
Skill Needed to Judge Quality	Skill Needed to Judge Quality	Skill Needed to Judge Quality
Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job
Attention to Detail	Attention to Detail	Attention to Detail
Psychomotor Abilities	Psychomotor Abilities	Psychomotor Abilities
Skill to Identify Problems	Skill to Identify Problems	Skill to Identify Problems
Professional Composure	Professional Composure	Digital Literacy
Technical Skill	Technical Skill	Professional Composure
Adaptability	Digital Literacy	Technical Skill
Sensory Abilities	Adaptability	Commitment to Lifelong Learning
Independence	Commitment to Lifelong Learning	Adaptability

Figure 17 Proficiency Rankings 2023-2040 – Aircraft Mechanic

YELLOW = same as previous period
GREEN = new or promoted from previous period
RED = demoted from previous period

NOC 93200.01 Aircraft Assemblers (Production)

Aircraft assemblers assemble, fit, and install prefabricated parts to manufacture fixed wing or rotary wing aircraft or aircraft subassemblies. Aircraft assembly inspectors inspect aircraft assemblies for adherence to engineering specifications. They are employed by aircraft and aircraft subassembly manufacturers.

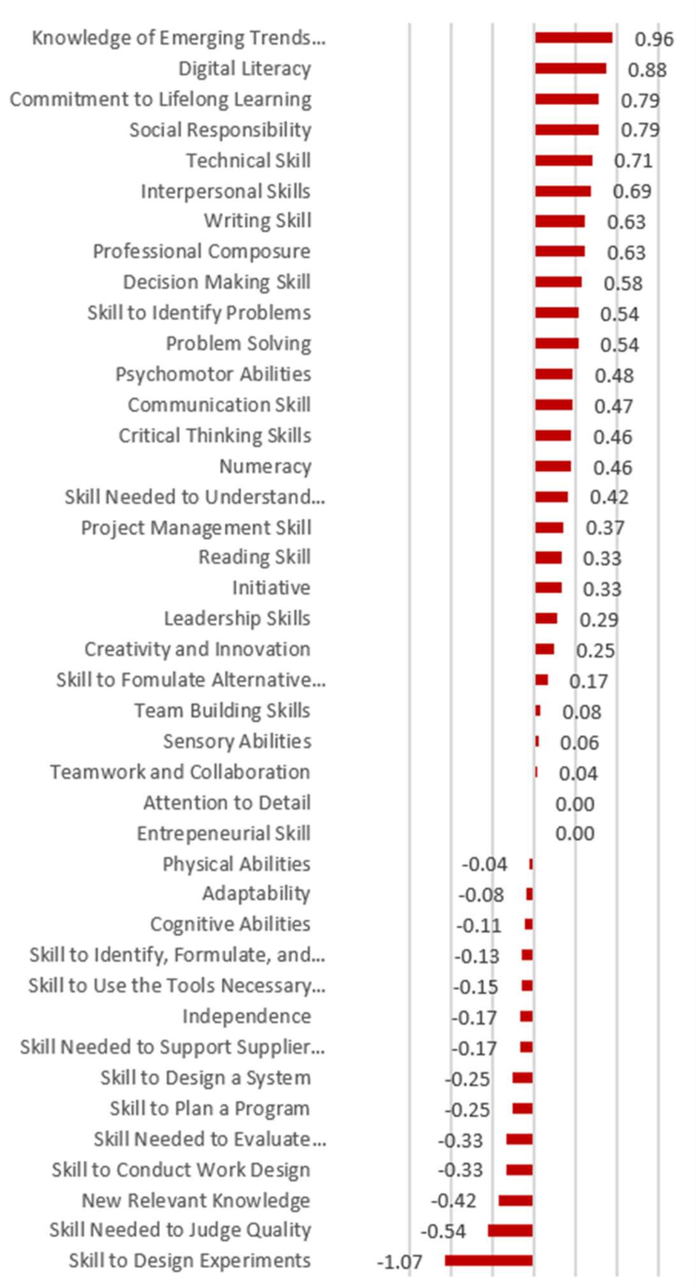

Figure 18 Change from Base Levels – Aircraft Assemblers

Benchmark & Current Levels

Of the three occupations analyzed in this report, the position of Aircraft Assembler had the most dramatic upgrading of skill levels with more than ten proficiencies seeing increased levels adjusted over 0.5 points within the 1-5 (novice to mastery) range. Prominent increases were noted in required knowledge of emerging trends, digital literacy, commitment to lifelong learning, and social responsibility, as well as to several essential skills like writing, decision-making and problem-solving for aircraft assemblers. In overall levels, digital literacy notably climbed into the ten highest required skill levels by 2040 from a position in the bottom ten in base year requirements.

Fewer downgrades of skill levels were noted for this occupation, but skill to design experiments was reduced on average by 1.07 (in a range from 1-5 representing novice to mastery in the skill).

Standard Deviation, s: 0.4408546300971

Count, N: 41
Sum, Σx: 7.85
Mean, x̄: 0.19146341463415
Variance, s2: 0.19435280487805

Future Expectations

The survey input indicates a volatile future for proficiency levels for this occupation. Like all the technical occupations chosen for analysis, attention to detail holds and maintains a high level of proficiency requirement. Several skills noted in the top 15 in 2023 are anticipated to increase in the short term and then diminish beyond 2030. These include high-ranked skills like alternative evaluation, sensory, psychomotor (e.g. hand-eye coordination), and physical abilities (strength, dexterity). Robotics and automation have been changing the factory line's look, and this trend will continue, resulting in less physical human assembly towards machine-assistance or robotic assembly. New forms of metrology, and virtual and augmented reality will also reduce errors and provide new forms of quality assurance. This will require increased adaptability for these workers to adjust to new work patterns, tools, and tasks.

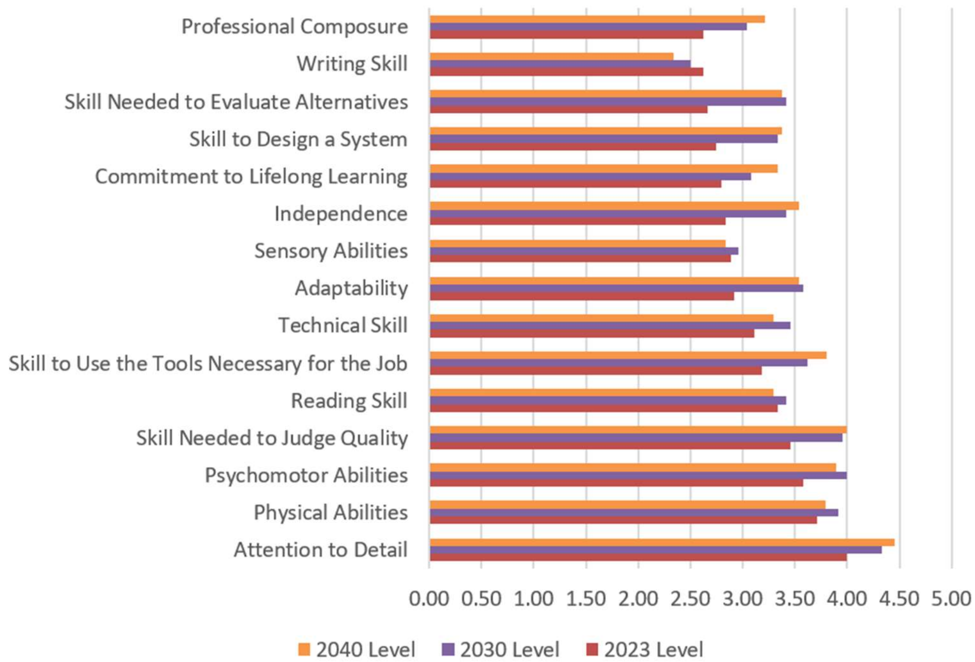

Figure 19 Top Proficiency Levels 2023-2040 – Aircraft Assemblers

2023	2030	2040
Attention to Detail	Attention to Detail	Attention to Detail
Physical Abilities	Psychomotor Abilities	Skill Needed to Judge Quality
Psychomotor Abilities	Skill Needed to Judge Quality	Psychomotor Abilities
Skill Needed to Judge Quality	Physical Abilities	Skill to Use the Tools Necessary for the Job
Reading Skill	Skill to Use the Tools Necessary for the Job	Physical Abilities
Skill to Use the Tools Necessary for the Job	Adaptability	Adaptability
Technical Skill	Technical Skill	Independence
Adaptability	Reading Skill	Numeracy
Sensory Abilities	Independence	Skill to Identify Problems
Independence	Skill Needed to Evaluate Alternatives	Teamwork and Collaboration

Figure 20 Proficiency Rankings 2023-2040 – Aircraft Assemblers

YELLOW = same as previous period
GREEN = new or promoted from previous period
RED = demoted from previous period

All Occupations: NAICS 3364 – Aircraft Product & Part Manufacturing

<u>Benchmark & Current Levels</u>

On average, results from survey respondents indicate that the aggregated baseline (benchmark) estimation of proficiency levels for all occupations assessed is a little lower than industry experience but overall, reasonably close to actual requirements (mean +0.11, std dev 0.235). By the data shown at left, some of the skills that were most substantially underestimated for proficiency among all occupations included knowledge of emerging technologies, digital literacy, technical skill and sensory abilities along with essential skills like communication, writing and interpersonal skills. This data indicates that skill levels most overestimated in the benchmark numbers are for proficiencies such as leadership, adaptability, and entrepreneurial skills.

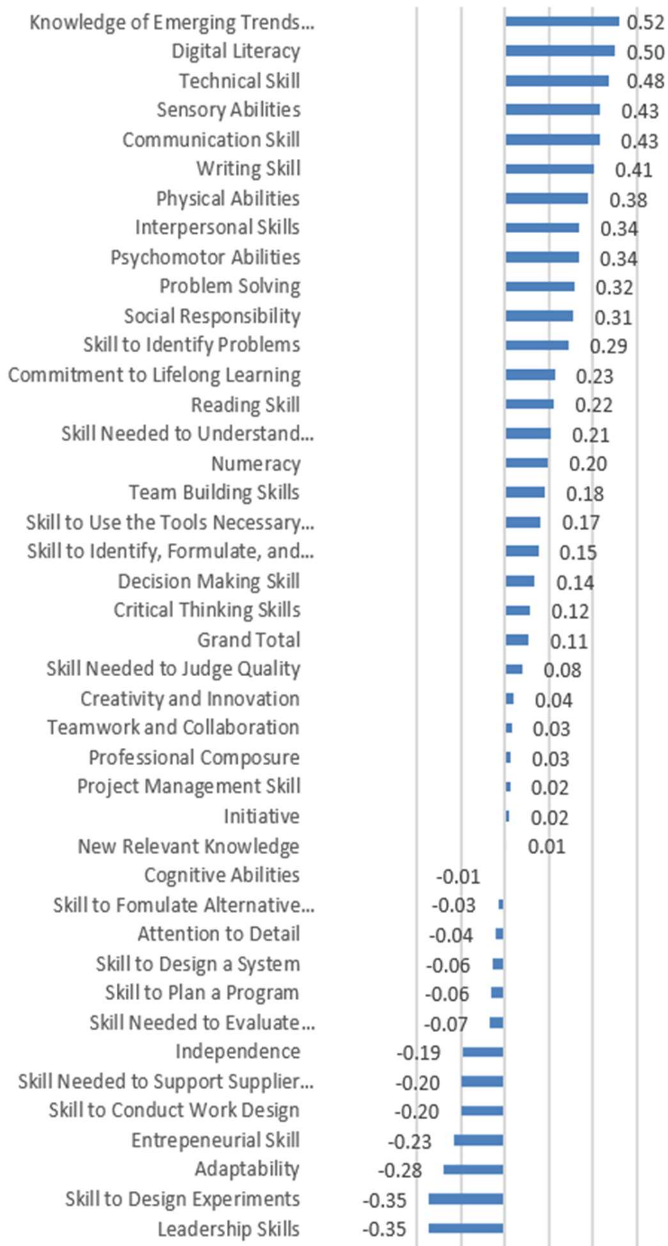

Figure 21 Change from Base Levels – All Occupations

Standard Deviation, s: 0.23808560665769
Count, N: 41
Sum, Σx: 4.53
Mean, x̄: 0.11048780487805
Variance, s2: 0.056684756097561

<u>Future Expectations</u>

The proficiencies requiring the highest level of skill across all locations remain largely consistent from current (2023) assessment to anticipated requirements in 2040 (some will switch rank by level). These top 15 proficiencies are all expected to require even higher general levels in the future although a few competencies, including adaptability, reading, critical thinking and physical abilities are seen to need higher degree of proficiency in the short run (to 2030) and then slightly diminished levels by 2040.

Figure 22 Top Proficiency Levels 2023-2040 – All Occupations

Type of Occupation[13]

The following is a proficiency analysis based on a grouping of the Occupations into three categories - Engineer, Production, and Trades[14]. This additional perspective is useful in that it provides a more fulsome view of the skill ratings for each broad employment type within the sector than the more focused single-occupation views above. Error bars on the following graphs along with standard deviations listed in the appendix indicate relative confidence and ranges of agreement/dissension in the endpoint levels shown by occupational type.

For all occupations in aerospace manufacturing, attention to detail is a skill requiring a high level of mastery. Little or no adjustment to the base level is suggested by many respondents. The potential human impact of errors due to poor documentation, observation, and attention is of great significance to this industry. Digital literacy shows significant increases in anticipated levels across the full grouping, particularly in engineering and production.

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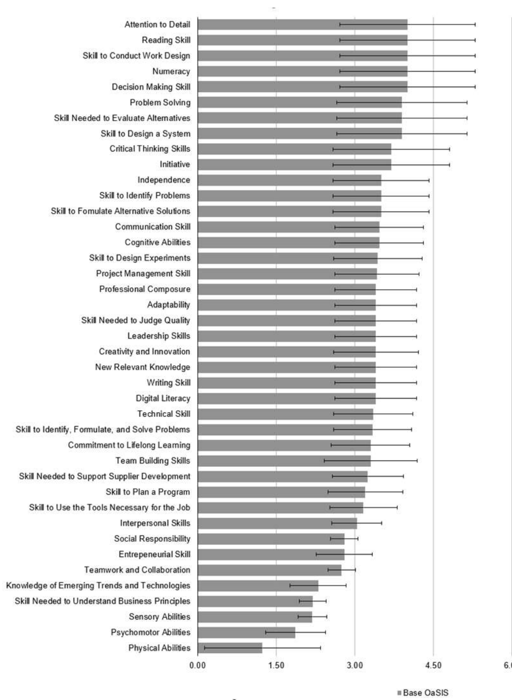
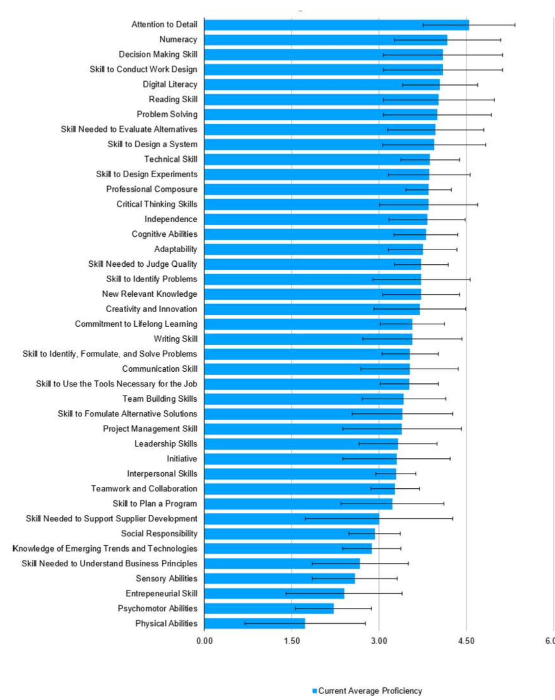
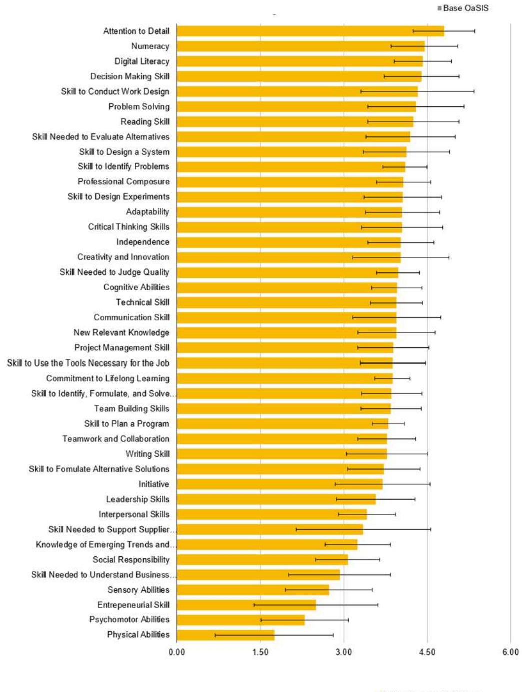
[13] Groupings of occupations based on NGen full manufacturing report. *Production* category includes the presented Aircraft Assemblers NOC, *Trades* includes the presented Machinists and Aircraft Mechanics NOCs.
An area for future research would be a full type of occupation categorization which includes all assessed occupations, and through a consultation with industry on the organization of categories.
[14] The assignment of positions to each category was not validated through aerospace industry consultation but are acceptable for the current analysis and consistent with similar occupations across the broader manufacturing sector.

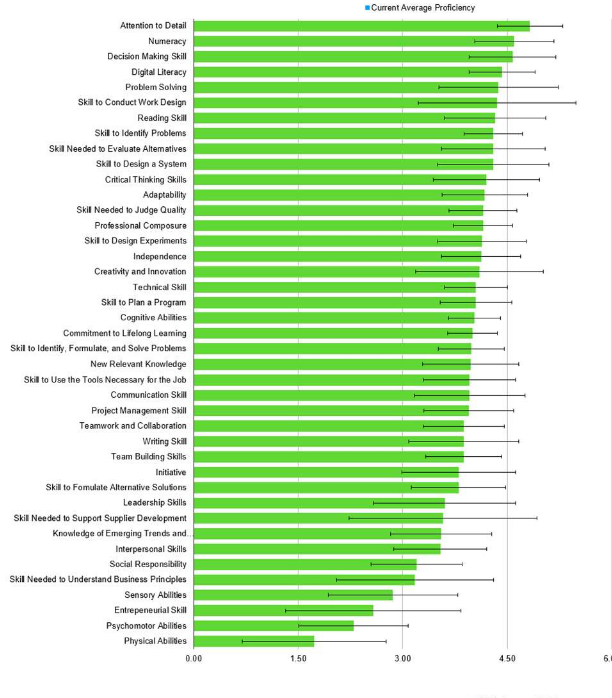
Engineer

For engineering occupations, the top 10-12 skill levels remain largely unchanged, other than, perhaps, slight changes in rank. There is some disparity in opinions around the levels needed for work design, and this is likely related to size and project type undertaken by responding firms. Organizations that have full industrial engineering departments more often have specialists who design standard operating procedures and formats of work packages than those who have engineers doing both product design and work design.





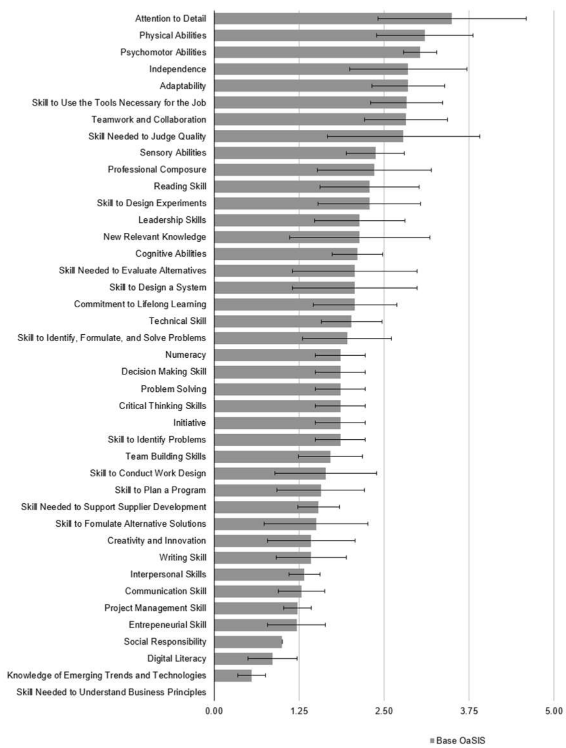


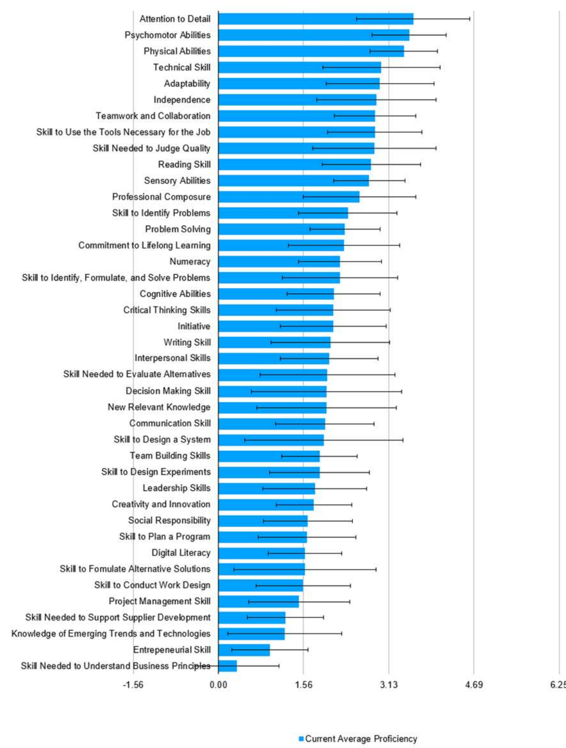


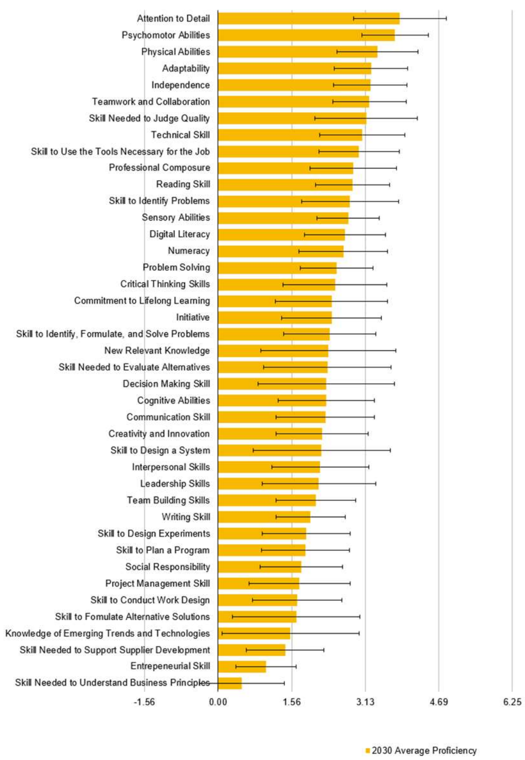
Production

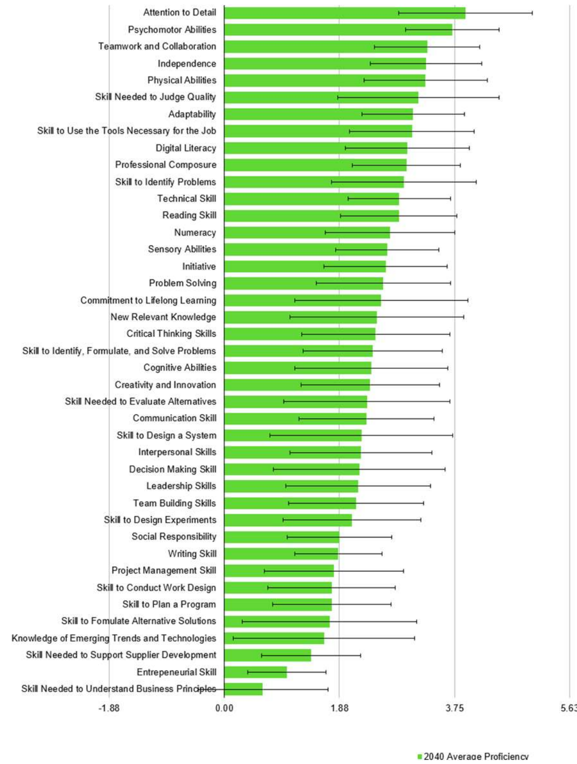
Production, likewise, shows little dramatic change in the top ten or twelve skill levels. The observations of the production proficiencies over time indicate a general expectation of higher levels of almost all skills in future, suggesting that this historic area for unskilled workers is becoming less accessible for those with limited essential skills – reading and numeracy are good illustrations of proficiencies that will require higher levels into the foreseeable future.

For production positions (as noted in the section above on assemblers) the increasing automation of assembly processes and digitization of interfaces for production, metrology, quality control, etc. are quickly being felt in the factory assembly line. It is worth noting that responses for production proficiencies had overall higher standard deviations across many of the skill sets than engineering or trades. Through the process, it was heard that many companies count on on-the-job training to bring new hires to minimal proficiency in these occupations, so the disparity may suggest an anticipation of continuing recruitment and workplace development of relatively untrained employees for some companies and conditions.



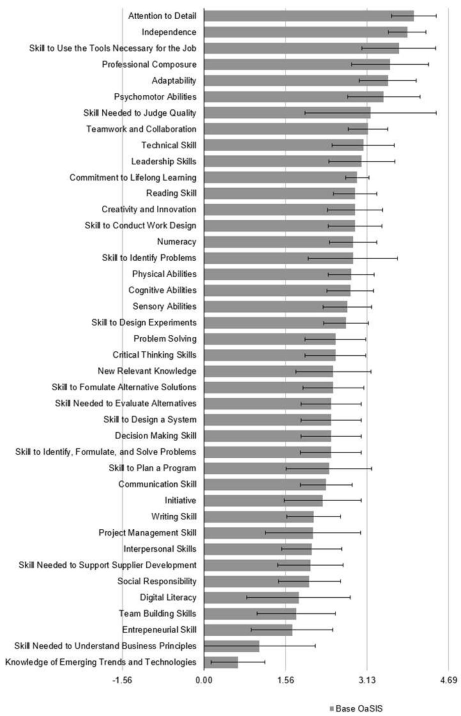


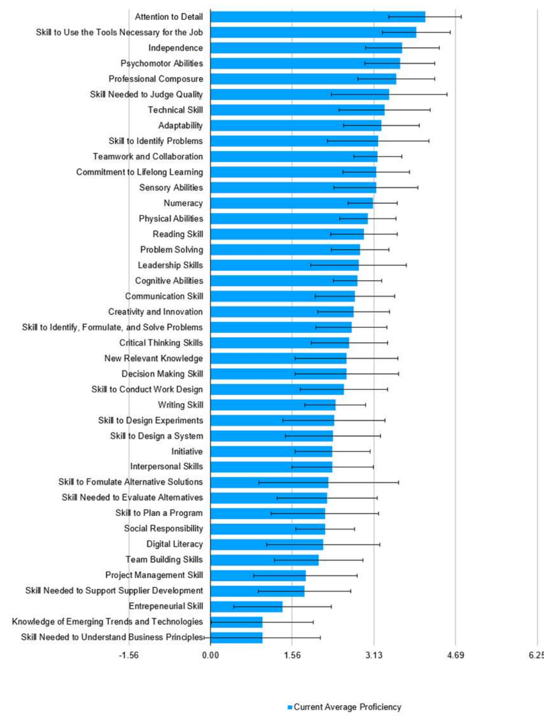

Attention to Detail
Psychomotor Abilities
Physical Abilities
Adaptability
Independence
Teamwork and Collaboration
Skill Needed to Judge Quality
Technical Skill
Skill to Use the Tools Necessary for the Job
Professional Composure
Reading Skill
Skill to Identify Problems
Sensory Abilities
Digital Literacy
Numeracy
Problem Solving
Critical Thinking Skills
Commitment to Lifelong Learning
Initiative
Skill to Identify, Formulate, and Solve Problems
New Relevant Knowledge
Skill Needed to Evaluate Alternatives
Decision Making Skill
Cognitive Abilities
Communication Skill
Creativity and Innovation
Skill to Design a System
Interpersonal Skills
Leadership Skills
Team Building Skills
Writing Skill
Skill to Design Experiments
Skill to Plan a Program
Social Responsibility
Project Management Skill
Skill to Conduct Work Design
Skill to Fomulate Alternative Solutions
Knowledge of Emerging Trends and Technologies
Skill Needed to Support Supplier Development
Entrepeneurial Skill
Skill Needed to Understand Business Principles
-1.56
0.00
1.56
3.13
4.69
6.25
2030 Average Proficiency

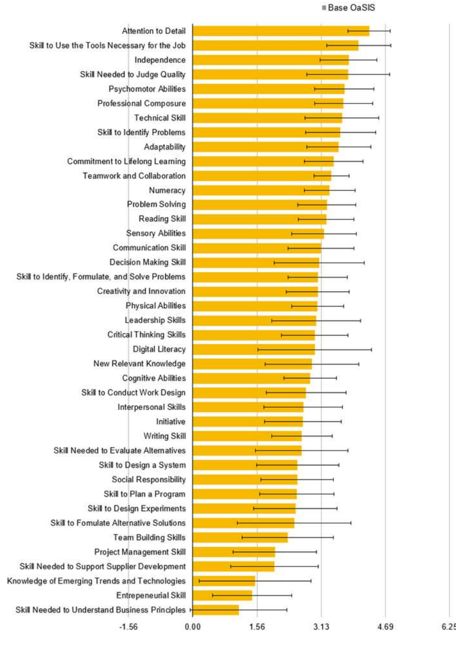

Attention to Detail
Psychomotor Abilities
Teamwork and Collaboration
Independence
Physical Abilities
Skill Needed to Judge Quality
Adaptability
Skill to Use the Tools Necessary for the Job
Digital Literacy
Professional Composure
Skill to Identify Problems
Technical Skill
Reading Skill
Numeracy
Sensory Abilities
Initiative
Problem Solving
Commitment to Lifelong Learning
New Relevant Knowledge
Critical Thinking Skills
Skill to Identify, Formulate, and Solve Problems
Cognitive Abilities
Creativity and Innovation
Skill Needed to Evaluate Alternatives
Communication Skill
Skill to Design a System
Interpersonal Skills
Decision Making Skill
Leadership Skills
Team Building Skills
Skill to Design Experiments
Social Responsibility
Writing Skill
Project Management Skill
Skill to Conduct Work Design
Skill to Plan a Program
Skill to Fomulate Alternative Solutions
Knowledge of Emerging Trends and Technologies
Skill Needed to Support Supplier Development
Entrepeneurial Skill
Skill Needed to Understand Business Principles
-1.88
0.00
1.88
3.75
5.63
2040 Average Proficiency

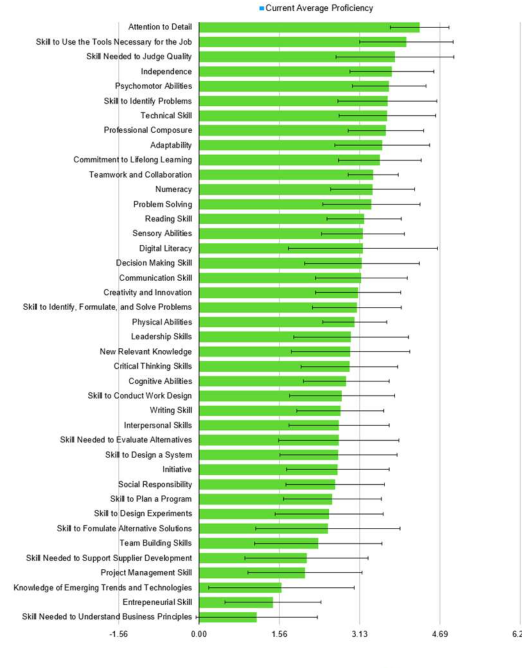
Trades

The trades category was similar in that the top skill levels remained mostly the same for the top dozen or so proficiencies. The emergence of digital literacy and diminishing of leadership skills is well in line with the Industry 4.0 forecasts of a skilled force that will increasingly interface with digital instruments and will have somewhat less autonomy in their own work design. Like production occupation responses, there is some disparity in opinions in both areas, so these impacts will not be the same for all companies and jurisdictions.









DISCUSSION AND RECOMMENDATIONS

In general, there were very few surprising discoveries in the data, but rather validation and confirmation of recent workforce research into the aerospace sector. Demographics inherent in the migration of the baby-boom generation has impacted many industries and sectors in Canada. This large cohort is aging out of the workforce in substantial numbers with a much smaller domestic population to replace the retirees. This aerospace sector is still dominated by an older, and mostly white male, demographic and will need to expand its pool of candidates dramatically if it will come close to filling the retirement gaps while at the same time dealing with anticipated growth as well. The quickly increasing gap between worker supply and demand is creating intense competition not only within this industry but across industries, companies, communities, and regions.

While Canada is welcoming record numbers of new immigrants and foreign workers, there is a lack of coordinated targeting for skillsets that will support aerospace. Where effective targeting is being done well by individual companies, regulation and bureaucratic protocols mean that the potential is stymied. Processing delays and paper-intensive complex processes put a burden on firms and in the long run can impact productivity and potential contribution to GDP by aerospace.

Industry 4.0 (and the continuing impact of digital technologies writ large) has had a substantial impact on manufacturing generally and specifically, the aerospace industry. Technology advances, robotics and automation, connected networks, and the need for efficiency and productivity in advanced manufacturing have paradoxically put pressure on companies to locate the skills needed in sufficient quantity to maintain manufacturing schedules and contract commitments. As one of the survey participants expressed "It's not so much a lack of people to work, it's that they are not coming fast enough with the skills we need".

Worldwide health events and socio-political conditions have further de-stabilized the market and deferred or diverted innovation and economic progress. Acquisitions, research, and innovation are being challenged and with not enough support. In some regards, there is a tentativeness in the industry rather than the resilience a leading national manufacturing sector ought to expect.

With quickly emerging new skills and advancing competency level requirements in an environment of niche manufacturing products and processes, firms are finding they need to train (re-skill, up-skill, and cross-skill) incoming recruits for some time before they can be made productive in their factories and workshops. Meanwhile, traditional credential and certification preparation and the bureaucracy and regulation that exists in existing training and assessment regimes can frustrate mobility and advancement into work, especially for the required skilled immigrants and foreign workers.

Therefore, the results are not surprising, and the hypothesis presented by globalEdge is supported by the results presented herein. The aerospace manufacturing sector is challenged by a set of conditions that could result in setbacks that threaten thousands of jobs and billions of dollars in lost work, exports and domestic contracts. Several recruitment and retention strategies have been shared by participants in this research, but they are not enough to address the underlying issues. The lack of a cohesive national strategy for aerospace has been talked about for many years – initiated well before the COVID-19 pandemic. Governments promise strategic support to the sector, but programming is often time-limited with few sustained and ongoing support offered. The industry has seen the Federal Aerospace Review in 2012 led by David Emerson and the Vision 2025 consultations and report of 2019 led by Jean Charest, with neither leading to a national aerospace strategy or implementation of key recommendations. Earlier this year, the AIAC held its "Aerospace on the Hill 2024" event and the following day responding to calls from members of the parliamentary aerospace caucus, Minister for Innovation, Science, and Industry, the Honourable Francois Phillippe Champagne, expressed his willingness to work on a national strategy with the industry and it is the hope that aerospace will be given the support required to begin the design of a significant strategic initiative, including responses to the understood labour challenges.

To be effective in resolving both the workforce gaps and the skills development challenges, the strategy should include the creation of several non-partisan government-industry working groups and forums (including Employment and Social Development Canada (ESDC) and Immigration, Refugees and Citizenship Canada (IRCC)) with an eye to retaining and growing a healthy aerospace sector encompassing civil, defence, and space projects. Export excellence must be maintained while domestic production and transportation is protected and nurtured. Areas (within the training and workforce competency) that a strategy would seek to address include:

> **Occupational classification**: As learned through this project, the current National Occupational Classification (NOC) system has gaps in identifying, tracking, and supporting both current and emerging occupational groups in aerospace. Without the ability to properly track and follow the groups, it will be difficult to see measured advances.
>
> **Immigrant and Foreign worker transition**: Reducing application, duplication, and administrative requirements for processes such as the Temporary Foreign Worker Program and Labour Market Impact Assessments will assist in expediting access to international skilled talent. Fast tracking applications and supporting companies with education and administrative support is critical to closing the widening gap between skilled workers' supply and demand.
>
> **Research & Innovation**: Increasing support to research and innovation, specifically into efforts focused on increasing training efficacy.
>
> **Diversity & Inclusion**: Supporting industry in effort to attract and retain a diverse population including skilled immigrants, women, and members of Canada's indigenous nations; Promoting the opportunities to engage in well-paid and stable careers across a variety of job classifications in aerospace.
>
> **Training and certification**: Removing barriers to more dynamically presented and modern deliveries for aerospace training including STD-566[15] content based on competencies rather than seat-time; Modularizing and developing micro-credentials and other shorter training experiences to re-skill, up-skill and cross-skill workers to both industry standards and emerging technologies; Finding ways to recognize prior learning and achieved competencies with portfolio or national qualifications records to expedite conversion and certification of competencies; Support for centralized training hubs devoted to required hands-on training, common to industry requirements. Collaboration between industry, academic and training organizations will be key to achieving these standards and helping Canada continue to hold a strong leadership role in global Aerospace opportunities.

[15] Airworthiness Chapter 566 – Aircraft Maintenance Engineer (AME) Licensing and Training - Canadian Aviation Regulations (CARs)

REFERENCES

The following are recent publications from the Aerospace Sector with relevance to the research topic and which were reviewed for additional qualitative and quantitative data supporting the findings of this research:

1. ***Addressing current and future labour market gaps within the aerospace and aviation industries***, AIAC, December 2023
2. ***Aerospace and Aviation Opportunity Analysis, Final Report***, DAIR/ InnovaIT/ OAC, April 2023
3. ***Ontario Aerospace & Aviation Industry Critical Strategic Skills Priority Survey***, OAC, 2022
4. ***AIAC Aerospace Summit Presentation***, CCAA, 2022

APPENDIX

<u>Aggregated Competency Data by Selected Occupational Codes</u>

<u>Occupation:</u> **<u>Aircraft assemblers</u>**

Skill/ Proficiency	Base	Base Change	2023 Level	2030 Change	2030 Level	2040 Change	2040 Level
Attention to Detail	4.00	0.00	4.00	0.33	4.33	0.46	4.46
Skill Needed to Judge Quality	4.00	-0.54	3.46	-0.04	3.96	0.00	4.00
Physical Abilities	3.75	-0.04	3.71	0.17	3.92	0.04	3.79
Skill to Use the Tools Necessary for the Job	3.33	-0.15	3.18	0.29	3.62	0.48	3.81
Skill to Design Experiments	3.10	-1.07	2.03	-0.90	2.20	-0.68	2.43
Psychomotor Abilities	3.10	0.48	3.58	0.89	3.99	0.79	3.89
Skill to Design a System	3.00	-0.25	2.75	0.33	3.33	0.38	3.38
Reading Skill	3.00	0.33	3.33	0.42	3.42	0.29	3.29
New Relevant Knowledge	3.00	-0.42	2.58	0.21	3.21	0.38	3.38
Skill Needed to Evaluate Alternatives	3.00	-0.33	2.67	0.42	3.42	0.38	3.38
Independence	3.00	-0.17	2.83	0.42	3.42	0.54	3.54
Adaptability	3.00	-0.08	2.92	0.58	3.58	0.54	3.54
Sensory Abilities	2.83	0.06	2.89	0.13	2.96	0.00	2.83
Skill to Identify, Formulate, and Solve Problems	2.60	-0.13	2.47	0.35	2.95	0.58	3.18
Teamwork and Collaboration	2.50	0.04	2.54	0.83	3.33	0.96	3.46
Cognitive Abilities	2.47	-0.11	2.36	0.40	2.87	0.69	3.16
Technical Skill	2.40	0.71	3.11	1.06	3.46	0.89	3.29
Initiative	2.00	0.33	2.33	0.88	2.88	1.17	3.17
Writing Skill	2.00	0.63	2.63	0.50	2.50	0.33	2.33
Skill to Identify Problems	2.00	0.54	2.54	1.29	3.29	1.50	3.50
Critical Thinking Skills	2.00	0.46	2.46	1.29	3.29	1.33	3.33
Professional Composure	2.00	0.63	2.63	1.04	3.04	1.21	3.21
Numeracy	2.00	0.46	2.46	1.38	3.38	1.50	3.50
Skill to Formulate Alternative Solutions	2.00	0.17	2.17	0.29	2.29	0.42	2.42
Decision Making Skill	2.00	0.58	2.58	1.21	3.21	0.96	2.96
Skill to Plan a Program	2.00	-0.25	1.75	0.50	2.50	0.42	2.42
Leadership Skills	2.00	0.29	2.29	0.96	2.96	0.96	2.96
Team Building Skills	2.00	0.08	2.08	0.63	2.63	0.83	2.83
Problem Solving	2.00	0.54	2.54	1.00	3.00	1.17	3.17
Commitment to Lifelong Learning	2.00	0.79	2.79	1.08	3.08	1.33	3.33
Skill to Conduct Work Design	2.00	-0.33	1.67	-0.08	1.92	0.04	2.04
Communication Skill	1.67	0.47	2.14	1.19	2.86	1.40	3.07
Creativity and Innovation	1.50	0.25	1.75	1.17	2.67	1.46	2.96
Skill Needed to Support Supplier Development	1.50	-0.17	1.33	0.04	1.54	-0.04	1.46
Interpersonal Skills	1.40	0.69	2.09	1.15	2.55	1.32	2.72
Project Management Skill	1.40	0.37	1.77	0.94	2.34	1.07	2.47
Entrepreneurial Skill	1.00	0.00	1.00	0.17	1.17	0.17	1.17
Social Responsibility	1.00	0.79	1.79	1.21	2.21	1.33	2.33

Digital Literacy	1.00	0.88	1.88	2.21	3.21	2.38	3.38
Knowledge of Emerging Trends and Technologies	0.75	0.96	1.71	1.63	2.38	1.75	2.50
Skill Needed to Understand Business Principles	0.00	0.42	0.42	0.71	0.71	0.96	0.96
Grand Total	2.23	0.19	2.42	0.69	2.92	0.77	3.00

Occupation: Aircraft mechanics

Skill/ Proficiency	Base	Base Change	2023 Level	2030 Change	2030 Level	2040 Change	2040 Level
Skill Needed to Judge Quality	5.00	-0.46	4.54	-0.29	4.71	-0.14	4.86
Skill to Use the Tools Necessary for the Job	4.67	-0.18	4.49	-0.03	4.64	-0.04	4.63
Psychomotor Abilities	4.10	0.04	4.14	0.26	4.36	0.26	4.36
Attention to Detail	4.00	0.14	4.14	0.43	4.43	0.43	4.43
Skill to Identify Problems	4.00	0.00	4.00	0.29	4.29	0.29	4.29
Independence	4.00	-0.50	3.50	-0.39	3.61	-0.36	3.64
Adaptability	4.00	-0.43	3.57	-0.18	3.82	-0.29	3.71
Professional Composure	4.00	-0.07	3.93	0.00	4.00	-0.07	3.93
Technical Skill	3.80	-0.21	3.59	0.16	3.96	0.12	3.92
Teamwork and Collaboration	3.50	-0.07	3.43	0.07	3.57	0.07	3.57
Sensory Abilities	3.33	0.24	3.57	0.24	3.57	0.24	3.57
Cognitive Abilities	3.26	-0.18	3.08	-0.08	3.18	0.07	3.33
Physical Abilities	3.25	0.21	3.46	0.36	3.61	0.36	3.61
Skill to Design Experiments	3.10	-0.90	2.20	-0.89	2.21	-0.91	2.19
Critical Thinking Skills	3.00	0.00	3.00	0.00	3.00	-0.14	2.86
New Relevant Knowledge	3.00	0.07	3.07	0.57	3.57	0.57	3.57
Numeracy	3.00	0.07	3.07	0.36	3.36	0.36	3.36
Digital Literacy	3.00	-0.18	2.82	0.93	3.93	1.04	4.04
Skill Needed to Evaluate Alternatives	3.00	-0.50	2.50	-0.21	2.79	-0.21	2.79
Skill to Conduct Work Design	3.00	-0.68	2.32	-0.68	2.32	-0.75	2.25
Skill to Design a System	3.00	-0.57	2.43	-0.43	2.57	-0.43	2.57
Problem Solving	3.00	-0.04	2.96	0.36	3.36	0.57	3.57
Skill to Formulate Alternative Solutions	3.00	-0.86	2.14	-0.79	2.21	-0.79	2.21
Commitment to Lifelong Learning	3.00	0.43	3.43	0.71	3.71	0.86	3.86
Leadership Skills	3.00	-0.14	2.86	0.14	3.14	0.00	3.00
Decision Making Skill	3.00	0.29	3.29	0.57	3.57	0.57	3.57
Reading Skill	3.00	0.11	3.11	0.39	3.39	0.32	3.32
Creativity and Innovation	3.00	-0.25	2.75	0.07	3.07	0.07	3.07
Skill to Identify, Formulate, and Solve Problems	2.80	0.06	2.86	0.26	3.06	0.19	2.99
Communication Skill	2.67	0.37	3.04	0.90	3.57	0.83	3.50
Skill Needed to Support Supplier Development	2.50	-0.71	1.79	-0.71	1.79	-0.71	1.79
Team Building Skills	2.00	0.64	2.64	0.71	2.71	0.71	2.71
Social Responsibility	2.00	0.21	2.21	0.57	2.57	0.79	2.79
Initiative	2.00	0.14	2.14	0.75	2.75	0.86	2.86
Entrepreneurial Skill	2.00	-0.86	1.14	-0.71	1.29	-0.71	1.29

Interpersonal Skills	2.00	0.14	2.14	0.71	2.71	0.71	2.71
Writing Skill	2.00	0.14	2.14	0.68	2.68	0.75	2.75
Skill to Plan a Program	2.00	-0.14	1.86	0.21	2.21	0.18	2.18
Project Management Skill	2.00	-0.29	1.71	-0.11	1.89	-0.14	1.86
Knowledge of Emerging Trends and Technologies	0.50	0.29	0.79	0.86	1.36	0.93	1.43
Skill Needed to Understand Business Principles	0.00	0.50	0.50	0.57	0.57	0.57	0.57
Grand Total	2.94	-0.10	2.84	0.16	3.10	0.17	3.11

Occupation **Machinists**

Skill/ Proficiency	Base	Base Change	2023 Level	2030 Change	2030 Level	2040 Change	2040 Level
Attention to Detail	4.00	-0.16	3.84	0.16	4.16	0.19	4.19
Independence	4.00	-0.19	3.81	0.00	4.00	0.00	4.00
Psychomotor Abilities	3.80	0.00	3.80	0.00	3.80	0.00	3.80
Skill to Use the Tools Necessary for the Job	3.67	-0.08	3.59	0.18	3.85	0.18	3.85
Adaptability	3.00	-0.19	2.81	0.19	3.19	0.28	3.28
Reading Skill	3.00	-0.16	2.84	0.25	3.25	0.31	3.31
Creativity and Innovation	3.00	-0.31	2.69	0.03	3.03	0.16	3.16
Commitment to Lifelong Learning	3.00	0.00	3.00	0.09	3.09	0.19	3.19
Skill to Conduct Work Design	3.00	-0.09	2.91	0.13	3.13	0.16	3.16
Numeracy	3.00	0.00	3.00	0.25	3.25	0.41	3.41
Teamwork and Collaboration	3.00	-0.06	2.94	0.22	3.22	0.25	3.25
Leadership Skills	3.00	-0.25	2.75	-0.16	2.84	-0.13	2.88
Professional Composure	3.00	-0.16	2.84	0.22	3.22	0.19	3.19
Physical Abilities	2.88	0.00	2.88	0.00	2.88	0.00	2.88
Technical Skill	2.80	0.04	2.84	0.39	3.19	0.48	3.28
Cognitive Abilities	2.58	0.12	2.70	0.12	2.70	0.12	2.70
Skill to Design Experiments	2.50	-0.25	2.25	-0.03	2.47	0.06	2.56
Sensory Abilities	2.50	0.16	2.66	0.28	2.78	0.28	2.78
Decision Making Skill	2.00	0.19	2.19	0.81	2.81	0.94	2.94
Communication Skill	2.00	0.28	2.28	0.66	2.66	0.72	2.72
Skill to Identify Problems	2.00	0.31	2.31	0.97	2.97	1.06	3.06
Initiative	2.00	0.13	2.13	0.44	2.44	0.50	2.50
Skill to Design a System	2.00	0.22	2.22	0.38	2.38	0.56	2.56
Problem Solving	2.00	0.53	2.53	1.00	3.00	1.09	3.09
Skill to Formulate Alternative Solutions	2.00	0.16	2.16	0.28	2.28	0.38	2.38
Social Responsibility	2.00	0.13	2.13	0.41	2.41	0.44	2.44
Skill to Plan a Program	2.00	-0.19	1.81	0.25	2.25	0.34	2.34
Writing Skill	2.00	0.28	2.28	0.47	2.47	0.56	2.56
Critical Thinking Skills	2.00	0.03	2.03	0.66	2.66	0.66	2.66
New Relevant Knowledge	2.00	0.28	2.28	0.66	2.66	0.78	2.78
Skill Needed to Evaluate Alternatives	2.00	0.00	2.00	0.59	2.59	0.69	2.69
Skill Needed to Judge Quality	2.00	0.50	2.50	1.00	3.00	1.00	3.00
Skill to Identify, Formulate, and Solve Problems	1.90	0.18	2.08	0.86	2.76	0.92	2.82
Interpersonal Skills	1.80	0.24	2.04	0.58	2.38	0.64	2.44

Project Management Skill	1.60	0.00	1.60	0.11	1.71	0.18	1.78
Skill Needed to Support Supplier Development	1.50	0.13	1.63	0.25	1.75	0.34	1.84
Digital Literacy	1.00	0.63	1.63	1.28	2.28	1.66	2.66
Entrepreneurial Skill	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Skill Needed to Understand Business Principles	1.00	0.09	1.09	0.22	1.22	0.19	1.19
Team Building Skills	1.00	0.28	1.28	0.47	1.47	0.47	1.47
Knowledge of Emerging Trends and Technologies	0.50	0.56	1.06	1.13	1.63	1.19	1.69
Grand Total	2.32	0.08	2.40	0.38	2.70	0.45	2.77

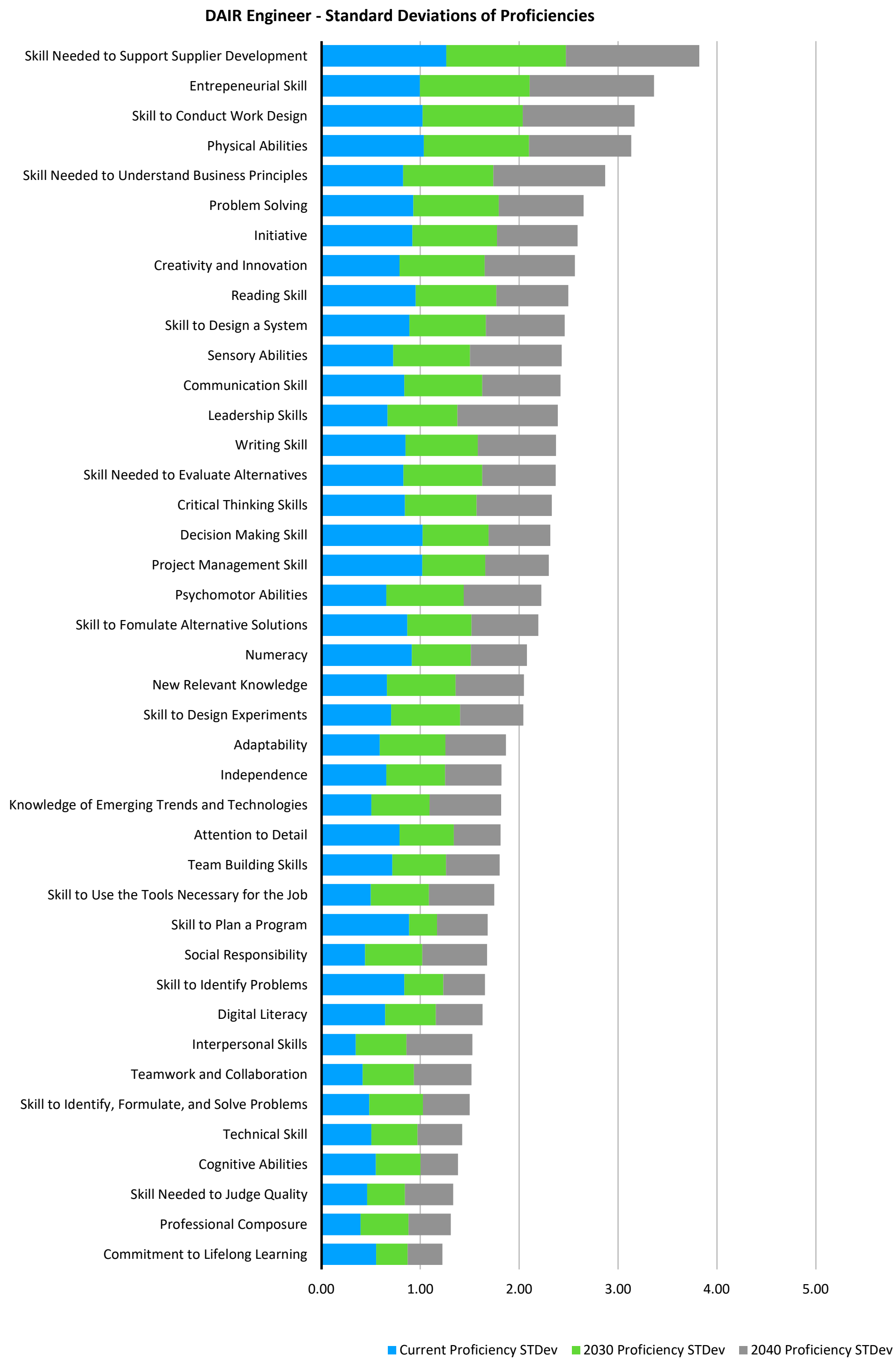
Occupation **(All)**

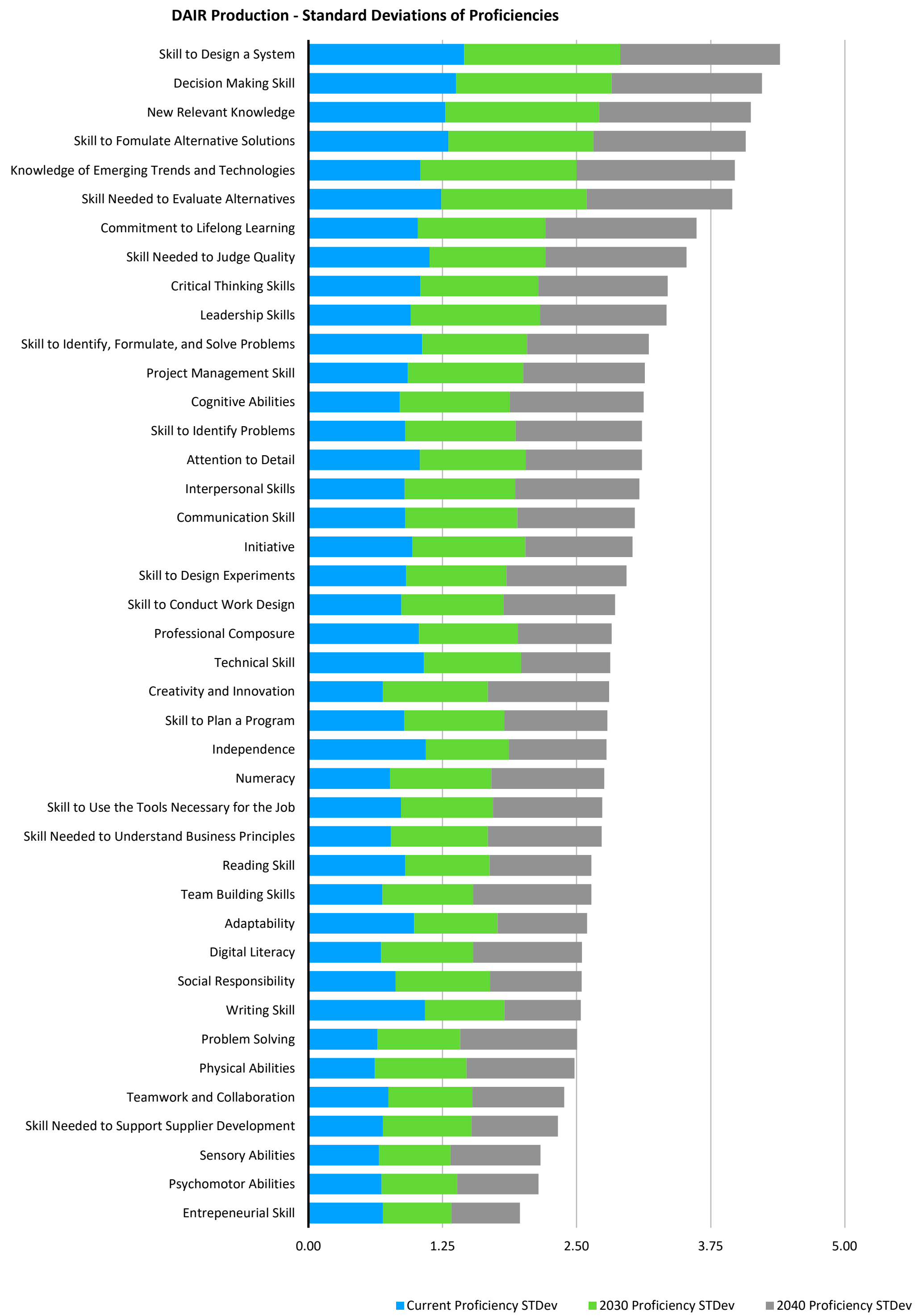
Skill/ Proficiency	Base	Base Change	2023 Level	2030 Change	2030 Level	2040 Change	2040 Level
Attention to Detail	4.21	-0.04	3.59	0.19	3.79	0.21	3.81
Independence	3.59	-0.19	2.93	0.05	3.14	0.07	3.15
Adaptability	3.52	-0.28	2.79	0.05	3.07	0.03	3.06
Skill to Use the Tools Necessary for the Job	3.41	0.17	3.08	0.27	3.16	0.29	3.18
Professional Composure	3.39	0.03	2.95	0.20	3.09	0.20	3.10
Skill Needed to Judge Quality	3.32	0.08	2.93	0.33	3.15	0.41	3.22
Teamwork and Collaboration	3.06	0.03	2.67	0.32	2.92	0.36	2.95
Leadership Skills	3.04	-0.35	2.32	-0.08	2.54	-0.08	2.55
Reading Skill	3.00	0.22	2.78	0.41	2.94	0.40	2.93
Numeracy	2.98	0.20	2.74	0.44	2.95	0.47	2.97
Commitment to Lifelong Learning	2.93	0.23	2.72	0.39	2.86	0.49	2.94
Skill to Design Experiments	2.93	-0.35	2.22	-0.24	2.32	-0.16	2.39
Psychomotor Abilities	2.91	0.34	2.79	0.45	2.89	0.45	2.89
Skill to Identify Problems	2.88	0.29	2.73	0.63	3.02	0.70	3.08
Cognitive Abilities	2.82	-0.01	2.42	0.10	2.51	0.14	2.55
Technical Skill	2.81	0.48	2.83	0.66	2.98	0.65	2.98
Skill to Conduct Work Design	2.79	-0.20	2.23	-0.09	2.32	-0.07	2.34
Skill to Design a System	2.79	-0.06	2.35	0.12	2.50	0.20	2.57
New Relevant Knowledge	2.77	0.01	2.39	0.30	2.64	0.35	2.69
Skill Needed to Evaluate Alternatives	2.77	-0.07	2.33	0.22	2.57	0.26	2.61
Problem Solving	2.71	0.32	2.61	0.60	2.86	0.69	2.93
Creativity and Innovation	2.71	0.04	2.37	0.36	2.65	0.45	2.73
Decision Making Skill	2.70	0.14	2.44	0.49	2.74	0.53	2.78
Critical Thinking Skills	2.70	0.12	2.42	0.42	2.68	0.41	2.67
Skill to Identify, Formulate, and Solve Problems	2.66	0.15	2.42	0.40	2.63	0.44	2.67
Initiative	2.54	0.02	2.20	0.36	2.50	0.48	2.60
Sensory Abilities	2.51	0.43	2.53	0.47	2.57	0.48	2.57
Skill to Formulate Alternative Solutions	2.50	-0.03	2.13	0.07	2.22	0.08	2.22
Skill to Plan a Program	2.45	-0.06	2.05	0.23	2.31	0.26	2.33
Communication Skill	2.37	0.43	2.41	0.74	2.68	0.77	2.70
Physical Abilities	2.31	0.38	2.32	0.38	2.32	0.35	2.30

Skill Needed to Support Supplier Development	2.26	-0.20	1.78	-0.02	1.93	0.03	1.97
Writing Skill	2.25	0.41	2.29	0.51	2.38	0.52	2.39
Team Building Skills	2.21	0.18	2.07	0.38	2.23	0.40	2.25
Project Management Skill	2.15	0.02	1.88	0.16	1.99	0.19	2.02
Interpersonal Skills	2.15	0.34	2.14	0.58	2.35	0.61	2.37
Digital Literacy	1.93	0.50	2.10	1.22	2.71	1.41	2.88
Social Responsibility	1.89	0.31	1.90	0.58	2.13	0.70	2.23
Entrepreneurial Skill	1.79	-0.23	1.34	-0.21	1.36	-0.21	1.35
Skill Needed to Understand Business Principles	0.88	0.21	0.93	0.41	1.11	0.47	1.16
Knowledge of Emerging Trends and Technologies	0.86	0.52	1.19	0.94	1.55	0.98	1.59
Grand Total	2.64	0.11	2.37	0.34	2.57	0.38	2.60

Standard Deviation by Type of Occupation

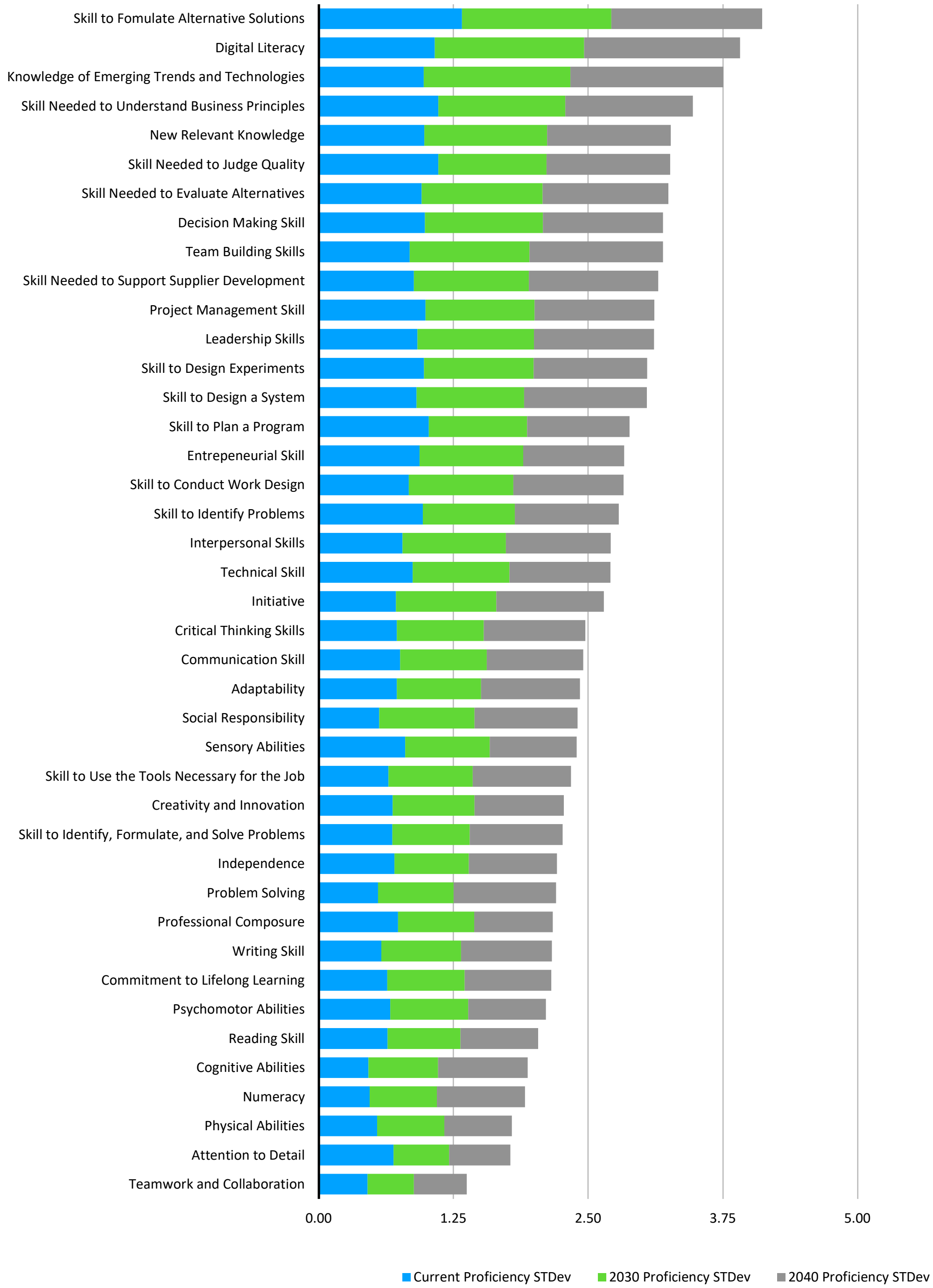
Please note that these calculations are presented **as cumulative.** The endpoint on scale does not signify any particular level of proficiency, but adding the standard deviations in this way provides a relative indication of the level of agreement on proficiency (larger deviation – wider bar – meaning more variation and less agreement and vice versa).





DAIR Production - Standard Deviations of Proficiencies
Skill to Design a System
Decision Making Skill
New Relevant Knowledge
Skill to Fomulate Alternative Solutions
Knowledge of Emerging Trends and Technologies
Skill Needed to Evaluate Alternatives
Commitment to Lifelong Learning
Skill Needed to Judge Quality
Critical Thinking Skills
Leadership Skills
Skill to Identify, Formulate, and Solve Problems
Project Management Skill
Cognitive Abilities
Skill to Identify Problems
Attention to Detail
Interpersonal Skills
Communication Skill
Initiative
Skill to Design Experiments
Skill to Conduct Work Design
Professional Composure
Technical Skill
Creativity and Innovation
Skill to Plan a Program
Independence
Numeracy
Skill to Use the Tools Necessary for the Job
Skill Needed to Understand Business Principles
Reading Skill
Team Building Skills
Adaptability
Digital Literacy
Social Responsibility
Writing Skill
Problem Solving
Physical Abilities
Teamwork and Collaboration
Skill Needed to Support Supplier Development
Sensory Abilities
Psychomotor Abilities
Entrepeneurial Skill
0.00
1.25
2.50
3.75
5.00
Current Proficiency STDev
2030 Proficiency STDev
2040 Proficiency STDev

DAIR Trades - Standard Deviations of Proficiencies



Appendix 5

Food Processing Skills Canada Report

FPSC Report for the NGen Workforce Research Project

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Food Processing Skills Canada • Compétences Transformation Alimentaire Canada

Table of Contents

About Food Processing Skills Canada

Food Processing Skills Canada (FPSC) is the food and beverage manufacturing industry's workforce development organization. As a non-profit, located in Ottawa with representatives across Canada, we support food and beverage manufacturing businesses from coast to coast in developing skilled and professional employees and workplace environments.

Our work directly and positively impacts industry talent attraction, workforce retention and employment culture. We care about assisting the industry with funding, training, and retaining the very best people for the job. Through our partnerships with industry, associations, educators, and all levels of governments in Canada, FPSC has developed exceptional resources for the sector including the Food Skills Library, Canadian Food Processors Institute, FoodCert, The Learning and Recognition Framework, and Labour Market Information Reports.

About the Food and Beverage Processing Industry

The food and beverage processing industry generated over $153.6 billion in sales annually as of 2022, with Meat product manufacturing generating more sales than any other subsector. As of 2021, there were approximately 13,150 food and beverage processing establishments in Canada, with the majority of establishments concentrated in Ontario, Quebec or British Columbia.

The food and beverage processing industry is a significant contributor to the Canadian labour market, employing approximately 300,000 workers in 2022, with most food processing establishments employing less than 100 people.

We define the food and beverage processing sector as those businesses engaged in Food Manufacturing (NAICS8 Code 311), Beverage Manufacturing (NAICS 3121) and Cannabis Product Manufacturing (NAICS 3123), which includes Cannabis edibles and infused beverages.

Food and beverage processing is the transformation of agricultural products into food or beverages, or of one form of food or beverage into other forms for consumption by humans or animals.

The food and beverage manufacturing industry is made up of 11 subsectors covering the following NAICS codes:

3111 – Animal food manufacturing
3112 – Grain and oilseed milling
3113 – Sugar and confectionery product manufacturing
3114 – Fruit and vegetable preserving and specialty food manufacturing
3115 – Dairy product manufacturing
3116 – Meat product manufacturing
3117 – Seafood product preparation and packaging
3118 – Bakeries and tortilla manufacturing
3119 – Other food manufacturing
3121 – Beverage manufacturing
3123 - Cannabis product manufacturing

Sub-sector Snapshots

The following graphics provide a summary of each sector by export value, establishments, GDP, sales, and employment:

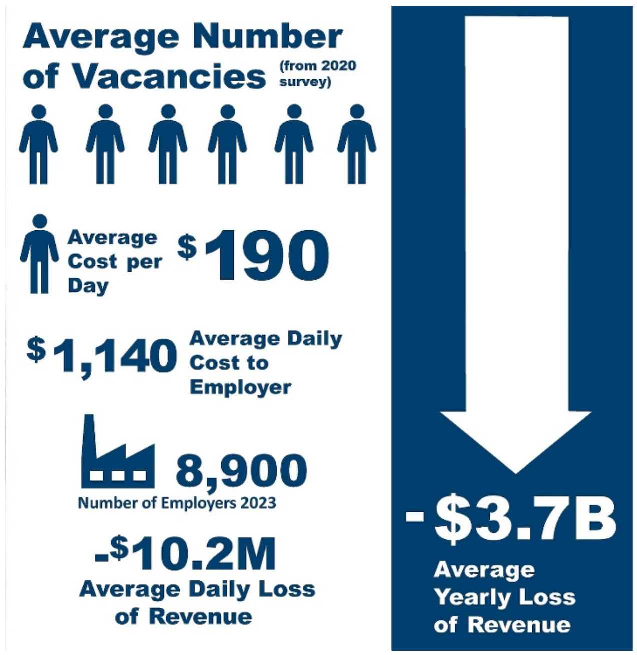
	NAICS 3121	NAICS 3115	NAICS 3116	NAICS 3117	NAICS 3118	NAICS 3112
	Profile Summary	Profile Summary	Profile Summary	Profile Summary	Profile Summary	Profile Summary
Export Value, 2022:	$1.5B	$1.2B	$11.3B	$5.5B	$6.2B	$13.1B
Establishments, 2022:	1,808	407	695	381	2,246	189
GDP (in 2021):	6.1B	3B	5.6B	1.4B	4.7B	4.7B
Sales 2022:	$11.8B	$17.4B	$39.1B	$5.6B	$15.9B	$20.5B
Employment, 2022:	49,941	27,486	64,060	20,264	51,134	7,163

	NAICS 3111	NAICS 3114	NAICS 3123	NAICS 3119	NAICS 3113
	Profile Summary	Profile Summary	Profile Summary	Profile Summary	Profile Summary
Export Value, 2022:	$1.7B	$5.4B	Cannabis Imports, 2022: $0.84M	$4.3B	$4.1B
Establishments, 2022:	431	369	152	1,671	325
GDP (in 2021):	1.6B	2.3B	8.5B	4.5B	1.7B
Sales 2022:	$11.9B	$9.7B	$1B	$16.5B	$5.3B
Employment, 2022:	10,737	20,361	5,184	37,684	10,755

Overview

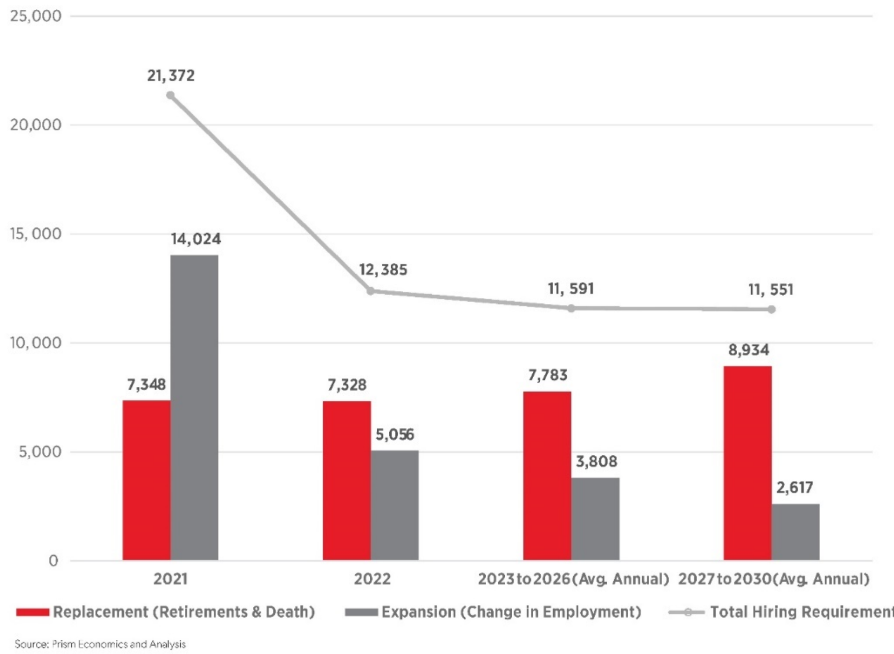
NGEN are conducting research on Canada's manufacturing sector and the core competencies of the manufacturing workforce today and in the future. Food Processing Skills Canada (FPSC) has taken responsibility to gather input and provide insight for the food and beverage manufacturing sector.

The food and beverage manufacturing sector is the largest manufacturing employer accounting for approximately 20% of Canada's manufacturing workforce. The sector is made up of 11 sub-sectors and has more than 14,000 establishments and over 300,000 people working in the sector.



The age demographic of Canadian food and beverage manufacturing is also worrying as there are expected to be approximately 67,000 current workers retiring from the sector by 2030. The hiring challenge and demand for new labour is accelerated as the sector is predicted to continue growing resulting in a further 25,000 jobs by 2030. When the 50,000 vacancies mentioned previously are considered as well, the hiring demand rises to 142,000 new people by 2030 or approximately 50% of today's workforce.

National Hiring Requirements: 2023 to 2030



The food and beverage manufacturing sector are unique within the manufacturing sector as it is more labour intensive than other forms of manufacturing and grew both in terms of employment and establishments throughout the pandemic. During the same period the rest of the manufacturing sector contracted. This research will provide valuable insight into core competencies now and into the future and see if the skills needs of food and beverage manufacturers align with other manufacturing sectors.

Despite the sector growth it is still carrying approximately 50,000 vacancies nationwide. These vacancies have an enormous economic impact on the sector with the annual cost of these vacancies being a $3.7B loss in revenue.

Executive summary

FPSC surveyed food and beverage manufacturing employers from almost all of industry sub-sectors, sizes of operations, and regions of Canada. The results were largely in line with what was expected. Employers indicated an expected increase in the skill level of the workforce for 2030 and 2040. They also indicated that their current workforce was more skilled than the base levels provided by OaSIS.

The largest differences in expected skill levels observed were in Production roles where respondents indicated that the current skill level required was much higher than the OaSIS level. The indicated skill level for Production roles continued to grow for 2030 and 2040. What was interesting was that employers indicated this across the skill levels including in many roles that a non-industry observer might expect to be replaced by technology rather than work with it. This matches what the sector is talking about as co-working with robots is discussed at more conferences and industry events than any technology, greatly reducing the need for a skilled workforce. Previous research from FPSC indicated that a fully integrated workplace to an Industry 4.0 standard would only reduce the amount of labour needed by 20%.

Connected to this was an across the board increase in Communication, Reading, Writing, and Digital Literacy Skills. Respondents indicated that the skill level required in these areas is higher than the OaSIS level and will continue to be an important suite of skills into the future. This speaks to both the current importance of communication and associated skills in today's food and beverage manufacturing industry and how these skill levels will need to increase as there is more technological integration into the workplace.

Hiring for the current roles and skill levels is a consistent challenge for the sector and as the skill level increases for all roles into the future the challenge for employers within the sector will be greater. More collaborative efforts to talk about the skills needed, training, and career opportunities within the sector will help to deal with this increased challenge. As will highlighting the skills needed in the future and indicating to job seekers how roles in the sector currently operate and how they will change as more technology gets integrated.

The need to combat perceptions and a lack of knowledge about Canada's food and beverage manufacturing sector is highlighted the significant gap between some of the OaSIS base levels and Respondents' current skill levels for these roles, especially in Production roles which form the bulk of the food and beverage manufacturing workforce. The sector is already more skilled than it is recognized to be from outside, increasing awareness of the sector will help improve perceptions of working in this sector which is vitally important to Canada.

Methodology & Sampling Strategy

FPSC approached over 300 food and beverage manufacturing employers from across the country to participate in this research. Employers were approached in person at industry events, over the phone, and by individual emails. These employers represented all 11 NAICS codes in food and beverage manufacturing, every province in Canada, and every employment size classification.

From the outreach there were respondents from 10 of the 11 food and beverage manufacturing NAICS codes, with no respondent from Cannabis product manufacturing. Respondents came from 8 of the 10 provinces, with no responses from employers in Alberta or Saskatchewan. The province with the most responses was Ontario. Respondents represented 7 of the 8 employer size categories, with no responses from employers at a facility with 500 or more staff. 3 of the size categories (1-4 employees, 20-49 employees, and 100-199 employees) represented the majority of respondents, with each of them accounting for 22% of the total.

The responses were analyzed by looking at the various aspects of the respondents to identify similarities and differences. This allows us to identify how respondent's various aspects may affect the way that a particular role or skill was viewed and then determine commonalities with other respondents that share aspects such as size, location, or sub-sector.

Respondents indicated that there were 37 relevant NOC codes to their operations now and in the future. Of these 37, there were 3 sets of NOC codes that share the same 5-digit NOC code, for some analysis they were combined to represent the 5-digit NOC code level. Of the 37 codes 18 were selected by multiple respondents. The top 5 codes selected by respondents were:

92012 – Supervisors, food and beverage processing (56.5% of respondents)
94140 – Process control and machine operators, food and beverage processing (56.6% of respondents)*
95106 – Labourers in food and beverage processing (43.5% of respondents)
94141 – Industrial butchers and meat cutters, poultry preparers and related workers (26.1% of respondents)*
90010 – Manufacturing managers (26.1% of respondents))

*-indicates 2 sets of 7-digit level data merged to the 5-digit level.

The food and beverage manufacturing sector is incredibly diverse in terms of employment options. Two-thirds of all NOC codes are represented in the sector. The top 5 NOC codes selected by respondents are very much in line with our expectations as they represent 5 of the top 6 NOC codes in terms of sector wide employment. The only NOC code in the top 6 that didn't make the top 5 from respondents was 63202 – Bakers, which was selected as a key occupation by 100% of our respondents from NAICS 3118 – Bakeries and tortilla manufacturing. The top 5 NOC codes selected by respondents represent 40% of all food and beverage processing employment.

To provide a more accurate depiction of the skills required, the NOC codes were grouped into 3 categories for analysis, Production, Managers, and Trades. Due to the diversity of NOC codes selected by the respondents these combinations allowed us to analyze similar skill sets among NOC codes that provide a similar function in their respective facilities.

The following table indicates the assignment of the NOC codes under the groupings of Production, Managers, and Trades:

NAICS Codes	Occupational Grouping	No. of Responses
	Manager	0
90010	Manufacturing managers	6
18	Senior Managers - public and private sector	1
92012	Supervisors, food and beverage processing	13
12013	Supervisors, supply chain, tracking and scheduling coordination occupations	1
70012	Facility operation and maintenance managers	2
10012	Purchasing managers	2
	Production	
63202	Bakers	3
94142.02	Fish and seafood plant cutters and cleaners	3
94142.01	Fish and seafood plant machine operators	3
94141.02	Industrial meat cutters	3
95106	Labourers in food and beverage processing	10
94140.02	Machine operators, food and beverage processing	7
95109	Other labourers in processing, manufacturing and utilities	2
94141.03	Poultry preparers	1
13201	Production and transportation logistics coordinators	1
14400	Shippers and receivers	2
94143	Testers and graders, food and beverage processing	2
95107	Labourers in fish and seafood processing	2
94140.01	Process control operators, food and beverage processing	6
75101	Material handlers	1
	Trades	
72400	Construction millwrights and industrial mechanics	1
72422	Electrical mechanics	1
72402	Heating, refrigeration and air conditioning mechanics	1
72201	Industrial electricians	1
73300	Transport truck drivers	1
63200	Cooks	1

Findings

Food and Beverage Manufacturing Sector Trends

The main trend that has been affecting the food and beverage manufacturing sector for decades is labour and labour availability. Beyond this significant concern, there are five key trends are impacting and expected to impact the future of food and beverage processing in Canada:

- Changing consumer preferences, for example the desire to make healthier and more ethical food and beverage choices.
- The regulatory environment, for example changes in regulations around packaging and labelling.
- Industry 4.0 - e-commerce, technological innovation, and the rise of "smart manufacturing".
- Legalization of cannabis edibles and infused beverages and continued societal acceptance of cannabis as mainstream.
- Challenges (and some opportunities) presented by climate change.

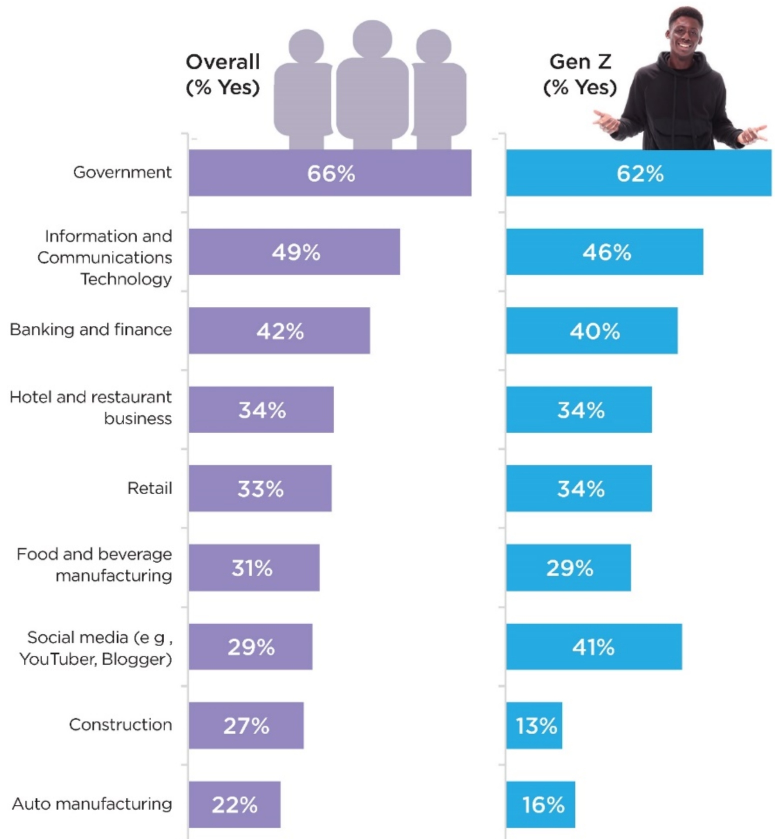
Recruitment, Retention, and Retirement Trends

As an overall sector the food and beverage manufacturing has had to direct significant resources to recruitment and retention, and these resources have had to increase to deal with increased retirements. FPSC predicts that 67,000 people currently working in the sector will retire by 2030. There will also be 25,000 new positions created due to industry expansion in that same period. That means that there will be a need to recruit 92,000 new workers in the next 6 years. This is on top of the approximately 50,000 positions that are currently vacant. Meaning that there is a need to recruit 142,000 new workers by 2030 while retaining everyone currently in the sector.

These hiring challenges are not felt equally across the various sub-sectors. NAICS 3117 – Seafood product preparation and packaging has both the highest percentage of its workforce above the age of 55 and the lowest percentage of its workforce under 30. While NAICS 3118 – Bakeries and tortilla manufacturing, NAICS 3121 – Beverage manufacturing, and NAICS 3123 Cannabis product manufacturing all have a higher percentage of their workforce that is under 30 than the percentage of their workforce that is over 55.

A challenge shared with the Auto manufacturing sector, and possibly others, is the lack of interest in working in these sectors. Food Processing Skills Canada conducted perceptions research and asked members of different generations about their openness to working in various sectors. The following chart displays a sampling of this data:

Openness to working in Various Sectors



Q. Would you consider working in any of the following sectors?
Base: All Respondents, n=1,500

The general public response indicated that approximately one third of respondents would be open to working in food and beverage manufacturing, which is in line with other FPSC research on this subject. Gen Z responses were only slightly lower at 29%. For context, Boomers were the lowest at 26%, while Older Millennials and Gen X were the highest at 34%. While interest in food and beverage manufacturing is measurably more than auto manufacturing, it presents a significant challenge for replacing retiring workers when Gen Z, who are the incoming cohort to the workforce, have among the lowest openness to working in the sector. One opportunity for employers is to highlight the connections between information and communications technology and the manufacturing sector, which is why studies such as this are valuable to all stakeholders.

A unique aspect of the food and beverage manufacturing sector is the relative inability compared to other private sector businesses to pass on costs to other parts of the supply chain or end consumers. This limits the industry's ability to compete with other sectors directly in wages. On average food and beverage manufacturers pay over $2.60/hr above their provinces minimum wage for frontline workers as this graphic from our first Rapid Results report from 2023 indicates:

Average **Starting Wages** are higher than minimum wages in every province.

$17.50
Panelists' **AVERAGE NATIONAL** starting wage

$2.63
Panelists' **AVERAGE ABOVE** minimum wage

Province	Panelists Average Starting Wage	Provincial Minimum Wage	Amount above Minimum Wage
British Columbia	$17.60	$16.75	$0.85
Alberta	$18.50	$15.00	$3.50
Saskatchewan	$16.20	$13.00	$3.20
Manitoba	$16.10	$14.15	$1.95
Ontario	$17.90	$15.50	$2.40
Quebec	$17.90	$15.25	$2.65
New Brunswick	$17.00	$14.75	$2.25
Nova Scotia	$16.70	$14.50	$2.20
Prince Edward Island	$16.50	$14.50	$2.00
Newfoundland and Labrador	$17.90	$14.50	$3.40

Another challenge is the location of the processing facilities. Food and beverage manufacturing is often located in rural and semi-rural areas which limits their ability to recruit local (within a 50km radius) workers, as there usually isn't the population base to support their workforce demand. As mentioned previously, the sector dedicates significant time and resources to recruitment and has been able to navigate these challenges and has grown the sector workforce by 6.2% (2022 employment compared to 2019 employment).

Trends Impact on the Sector

Labour has a major impact on the sector. The vacancies currently carried by the sector equate to a net revenue loss of over $3 Billion annually. This is the cost of the vacancies alone and does not account for the time and effort spent on recruitment.

Consumer preferences have an enormous impact on the sector, especially when there is a wholesale shift in the types of products desired. This can affect the viability of businesses or necessitate changes within a production facility, or the creation of a new production facility such as specific gluten-free operations.

The lack of coordination in the regulatory environment is a major factor in why this is a challenge for the sector. Quite often there are regulatory changes that are brought from one area of government that conflict with existing regulations from another area of government. An example of this is the changes in regulations around the use of plastics which conflict with food safety regulations. Food and beverage manufacturers then need to re-direct time and resources from other areas to both figuring out how to implement new regulations and communicate with authorities about the conflicts with other regulations.

Technology, and the availability of technology, have impacts that are felt unequally across the sub-sectors and regions. Starting with regionally, rural employers are still dealing with a lack of infrastructure, such as reliable high-speed internet, which may impact their ability to implement available technology and compete on equal footing. Similarly, many of the sub-sectors do not have access to technology that is specifically designed for their sub-sector and operations. Food and beverage manufacturing has always been more labour intensive than other aspects of the manufacturing sector, and the lack of technology and the ability to create or invest in the creation of that technology limits those sub-sector's ability to expand to meet demand in the same way as the sub-sectors that do have access to technology. The other aspect that this impacts is productivity; the way that productivity is calculated does not look favourably on labour intensive sectors, as it is calculated on a per worker basis.

The legalization of cannabis, and especially the legalization of edibles and infused beverages, meant that cannabis product manufacturers entered the sector with a significant requirement for labour to meet product demands, and wanted to hire people with experience in manufacturing food and beverage products, causing significant disruption in other sectors. Their entry was even more disruptive as they were recruiting almost exclusively domestic Canadians, because many immigrants were worried about the impact on their ability to visit their home country and/or send money to relatives if they were working in an industry that their home country considered illegal.

Climate change has also had an outsized impact on food and beverage manufacturing due to their reliance on agricultural inputs. Impacts can be direct, such as the flooding witnessed in British Columbia or wildfires across the country, but it can also be less obvious to the public, such as a massively decreased yield due to late frosts etc. Some of these severe climate events have immediate impacts on supply chains but can also have lasting impacts on crop yields or quality. Some of the impacts are also creating new opportunities such as more varieties of seafood being found in Canadian waters due to their search for colder water. The labour impact caused by climate change and severe weather events is felt the hardest by seasonal manufacturers as their workforce will find work in a different sector, which makes it much more difficult to bring them back for a subsequent season.

Skills Assessment

The following skills assessment examines the 3 categories of NOC codes; production, managers, and trades, and highlights the top ten critical skills for each group. Identifying the critical skills for each category will support the development of focused training and recruitment strategies to assist employers in their workforce development.

Current Skill Level - Production

There was a significant agreement between the OaSIS baseline and respondents in terms of the top skills needed for production roles, as 9 of the 10 top skills identified by OaSIS were also in the top 10 for the respondents. The one skill that was not in the respondents to top 10 was Commitment to Lifelong Learning, which was 17th.

Top 10 Skills for Production Category

Rank	OaSIS	Current	Change	2030	Change	2040	Change
1	Adaptability	Physical Abilities	▲ 2	Adaptability	▲ 3	Adaptability	0
2	Psychomotor Abilities	Psychomotor Abilities	0	Psychomotor Abilities	0	Teamwork and Collaboration	▲ 2
3	Physical Abilities	Attention to Detail	▲ 1	Attention to Detail	0	Attention to Detail	0
4	Attention to Detail	Adaptability	▼ -3	Teamwork and Collaboration	▲ 2	Psychomotor Abilities	▼ -2
5	Skill Needed to Judge Quality	Independence	▲ 2	Physical Abilities	▼ -4	Skill Needed to Judge Quality	▲ 1
6	Teamwork and Collaboration	Teamwork and Collaboration	0	Skill Needed to Judge Quality	▲ 2	Reading Skill	▲ 7
7	Independence	Sensory Abilities	▲ 2	Independence	▼ -2	Communication Skill	▲ 1
8	Skill to Use the Tools Necessary for the Job	Skill Needed to Judge Quality	▼ -3	Communication Skill	▲ 2	Skill to Identify Problems	▲ 4
9	Sensory Abilities	Skill to Use the Tools Necessary for the Job	▼ -1	Problem Solving	▲ 3	Physical Abilities	▼ -4
10	Commitment to Lifelong Learning	Communication Skill	▲ 24	Skill to Use the Tools Necessary for the Job	▼ -1	Problem Solving	▼ -1

Respondents indicated that the 10th most important current skill was Communication Skill, which OaSIS listed as 34th. This difference is significant and indicates that respondents identified strong communication skills as critical to production workers in the sector.

This difference in skill was not unique. In addition to Communication Skills, which had the highest average change when compared to OaSIS skill levels, there were 13 other skills that respondents rated at least 0.5 higher than OaSIS. These were:
Digital Literacy, Reading Skill, Writing Skill, Problem Solving, Interpersonal Skills, Sensory Abilities, New Relevant Knowledge, Creativity and Innovation, Skill to Identify Problems, Skill to Plan a Program, Team Building Skills, Numeracy, and Technical Skill.

Of these 14 skills, 8 of them were within 5 places in the current skills ranking. For these 8 there were a mix of skills identified as important (ex. Sensory Abilities, 9 on OaSIS and 7 for respondents) and not important (ex. Creativity and Innovation, 39 on OaSIS and 38 for Respondents). There were 3 skills identified that all had significant place differences in the rankings; Writing Skill (33 OaSIS and 19 Respondent), Reading Skill (26 OaSIS and 15 Respondent), and Interpersonal Skills (32 OaSIS and 22 Respondent), these skills are all connected to Communication Skills, which underscores the importance that respondents placed on their current production workforce having this skill set.

The second highest difference that was observed after Communication Skills was Digital Literacy. This speaks to the pace of change in the sector. Digital Literacy was identified to grow in importance throughout the future and respondent's high delta in this category indicates that this increase in importance and skill level required has already started.

This is in line with what we have learned from employers in other studies. Given communication's role in workplace safety, retention, and good workplace culture, it is not surprising that communication skills would be viewed as more valuable in this sectors people intensive workplaces.

Current Skill Level - Managers

There was less of an agreement between OaSIS and respondents in terms of the top skills needed for manager roles than with the production group, as 7 of the 10 top skills identified by OaSIS were also in the top 10 for the respondents. The biggest discrepancy between the two lists is the Respondent's number one skill, Skill to Identify Problems, was 11th on the OaSIS list. The other skills that respondents identified as more important than OaSIS for managers were Skill Needed to Judge Quality (Respondents has this 10th and OaSIS 19th) and Communication Skills (Respondents had this 8th and OaSIS 20th). This highlights again the increased importance of Communication Skills in food and beverage manufacturing.

Top 10 Skills for Managers Category

Rank	OaSIS	Current	Change	2030	Change	2040	Change
1	Leadership Skills	Skill to Identify Problems	▲ 10	Team Building Skills	▲ 1	Team Building Skills	0
2	Team Building Skills	Team Building Skills	0	Leadership Skills	▲ 1	Teamwork and Collaboration	▲ 2
3	Project Management Skill	Leadership Skills	▼ -2	Adaptability	▲ 1	Leadership Skills	▼ -1
4	Adaptability	Adaptability	0	Teamwork and Collaboration	▲ 3	Skill to Plan a Program	▲ 3
5	Attention to Detail	Project Management Skill	▼ -2	Project Management Skill	0	Adaptability	▼ -2
6	Independence	Independence	0	Skill to Identify Problems	▼ -5	Project Management Skill	▼ -1
7	Initiative	Teamwork and Collaboration	▲ 2	Skill to Plan a Program	▲ 8	Skill to Identify Problems	▼ -1
8	Skill to Plan a Program	Communication Skill	▲ 12	Skill Needed to Judge Quality	▲ 2	Problem Solving	▲ 1
9	Teamwork and Collaboration	Attention to Detail	▼ -4	Problem Solving	▲ 3	Skill Needed to Judge Quality	▼ -1

10	Professional Composure	Skill Needed to Judge Quality	▲ 9	Initiative	▲ 3	Initiative	0

Looking at the changes in actual rankings between some of the skills within the managers skill set, there were only 6 skills identified as having a skill level more than 0.5 higher than OaSIS, on average. These were Digital Literacy (0.7), Communication Skill (0.58), Technical Skill (0.55), Skill to Identify Problems (0.54), Creativity and Innovation (0.51) and Writing Skill (0.51).

Of these 6 skills only Creativity and Innovation and Technical Skill (5 & 3 respectively) were within 5 places of the OaSIS skill ranking. The other 4 skills were all 10 or more places different than the OaSIS list.

Management roles in food and beverage manufacturing are quite varied, depending on the size of their operation. This is why it isn't surprising to see that respondents stated higher skill level in areas like Skill to Identify Problems, Technical Skill, and Creativity and Innovation. As mentioned previously, Communication Skill plays a critical role in workplace safety, recruitment, and retention so it was expected to be among respondents top 10 skills.

As with the production work, there is more technology in food and beverage manufacturing today which necessitates a higher skill level in Digital Literacy as the sector is already innovating and adding more technology and digital solutions.

Current Skill Level - Trades

Looking at the top skills identified for roles in the Trades, 7 of the OaSIS top 10 are shared with the Respondents. Of the 3 skills OaSIS has ranked in their top 10 that respondents did not, 2 were just outside the top 10 (11 and 14). These were Independence and Leadership Skills. The 3rd was Teamwork and Collaboration which ranked 24th for the Respondents.

Top 10 Skills for Trades Category

Rank	OaSIS	Current	Change	2030	Change	2040	Change
1	Attention to Detail	Attention to Detail	0	Skill to Use the Tools Necessary for the Job	▲ 1	Digital Literacy	▲ 5
2	Adaptability	Skill to Use the Tools Necessary for the Job	▲ 4	Technical Skill	▲ 1	Skill to Use the Tools Necessary for the Job	▼ -1
3	Independence	Technical Skill	▲ 5	Adaptability	▲ 1	Technical Skill	▼ -1
4	Leadership Skills	Adaptability	▼ -2	Attention to Detail	▼ -3	Adaptability	▼ -1
5	Professional Composure	Skill to Conduct Work Design	▲ 18	Professional Composure	▲ 3	Professional Composure	0
6	Skill to Use the Tools Necessary for the Job	Physical Abilities	▲ 4	Digital Literacy	▲ 27	Attention to Detail	▼ -2
7	Teamwork and Collaboration	Skill to Plan a Program	▲ 12	Problem Solving	▲ 12	Reading Skill	▲ 6
8	Technical Skill	Professional Composure	▼ -3	Independence	▲ 3	Teamwork and Collaboration	▲ 4
9	Psychomotor Abilities	Psychomotor Abilities	0	Commitment to Lifelong Learning	▲ 4	Independence	▼ -1
10	Physical Abilities	Sensory Abilities	▲ 7	Skill to Identify, Formulate, and Solve Problems	▲ 7	Numeracy	▲ 1

The skills that the Respondents had in their top ten that OaSIS did not were; Skill to Plan a Program (7th – OaSIS had 19th), Skill to Conduct a Work Design (5th – OaSIS had 23rd), and Sensory Abilities (10th – OaSIS had 17th).

Only one of the ranking differences between respondents and OaSIS was surprising. Independence ranked 3rd for OaSIS and 11th for the Respondents. This was surprising because the other skills differences related to independence; Skill to Plan a Program and Skill to Conduct a Work Design, were ranked higher. In many small facilities the people working in roles associated with the trades are often working alone, so the need for them to plan programs and conduct work designs isn't surprising. This is also connected to the low rank (24th) Respondents provided for Teamwork and Collaboration, which is why Independence being ranked lower than OaSIS by respondents seems out of place.

At the individual skill level, there were 5 skills with a delta equal or greater than 0.5 from the OaSIS base level. These were Reading Skill (0.58), Skill Needed to Understand Business Principles (0.58), Skill to Conduct Work Design (0.58), Knowledge of Emerging Trends and Technologies (0.54), and Skill to Plan a Program (0.50). Each of these skills is connected to the unique nature of food and beverage manufacturing. With the variety of products being manufactured employers want the people working in trades to have a better understanding of the nature of the business, trends, emerging technologies, and planning skills than Trades at large.

These extra skill sets are an asset as they provide a more engaging workplace for recruits and allow for a wider range of activities, however it also means that finding and training the right people is important and potentially challenging.

Future Skill Levels - Production

Looking toward 2030 and 2040, no group is predicted to see a bigger increase in skill level than Production. Looking at the Respondents total skill level change from current levels across all groups, 9 of 10 biggest changes are in Production. Expanding the scope only highlights this more with 25 or the 30 biggest skill level increases to 2040 recorded in Production. Each and every one of the 41 skills looked at in this survey shows an increase in 2030 and 2040.

Top 10 Skills for Production Category

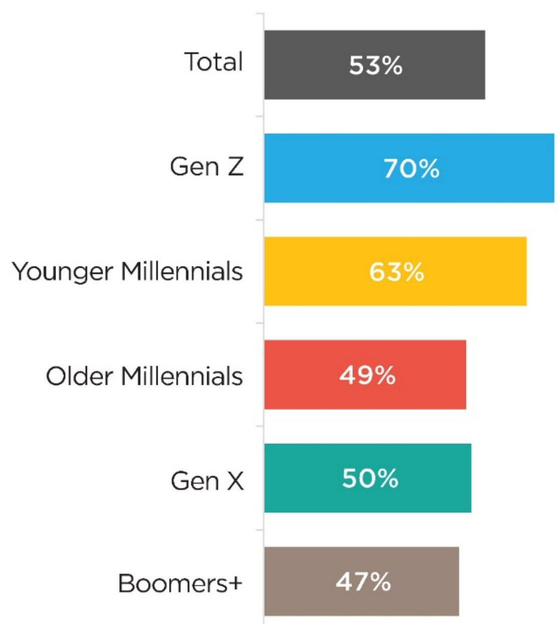
Rank	OaSIS	Current	Change	2030	Change	2040	Change
1	Adaptability	Physical Abilities	▲ 2	Adaptability	▲ 3	Adaptability	0
2	Psychomotor Abilities	Psychomotor Abilities	0	Psychomotor Abilities	0	Teamwork and Collaboration	▲ 2
3	Physical Abilities	Attention to Detail	▲ 1	Attention to Detail	0	Attention to Detail	0
4	Attention to Detail	Adaptability	▼ -3	Teamwork and Collaboration	▲ 2	Psychomotor Abilities	▼ -2
5	Skill Needed to Judge Quality	Independence	▲ 2	Physical Abilities	▼ -4	Skill Needed to Judge Quality	▲ 1
6	Teamwork and Collaboration	Teamwork and Collaboration	0	Skill Needed to Judge Quality	▲ 2	Reading Skill	▲ 7
7	Independence	Sensory Abilities	▲ 2	Independence	▼ -2	Communication Skill	▲ 1
8	Skill to Use the Tools Necessary for the Job	Skill Needed to Judge Quality	▼ -3	Communication Skill	▲ 2	Skill to Identify Problems	▲ 4
9	Sensory Abilities	Skill to Use the Tools Necessary for the Job	▼ -1	Problem Solving	▲ 3	Physical Abilities	▼ -4
10	Commitment to Lifelong Learning	Communication Skill	▲ 24	Skill to Use the Tools Necessary for the Job	▼ -1	Problem Solving	▼ -1

The Production roles that respondents indicated as becoming more skilled in the future are many of roles that some observers outside the industry view as vulnerable to automation. This reflects a lack of understanding about the sector's labour requirements. It also indicates that respondents did not view these roles as being replaced by technology in the future, but simply requiring a higher level of skill. This is in line with what FPSC is hearing from employers, that they think there is a greater chance that workers currently on the floor will work alongside robots in the future rather than simply be replaced by them.

Future Skill Levels - Managers

As with Production workers, all of the Manager skills are predicted to increase between now and 2040. However, one aspect that sets the managers apart is that the bulk of the predicted skill level changes are happening between now and 2030. There are still increases between 2030 and 2040, but they are not as steep as some of the changes heading into 2030. Two that stand out are Digital Literacy and Social Responsibility. Digital Literacy, as there is expected to be more technology in the facility and managers need to be able to understand the concepts, if not necessarily the technology itself. Social Responsibility is interesting as respondents see that skill set needing to improve for managers in the next 6 years. This is in line with FPSC's research in the area, as demonstrated in the chart below.

Importance of Solving Social and/or Environmental Challenges (% Important)



In FPSC's generational survey we looked at how important working towards solving social and environmental challenges was to respondents' career aspirations. The younger generations answered quite strongly, which shows the role that an improved manager skill set in Social Responsibility will play in recruiting the next generation into the workforce. In a separate survey conducted in January 2024, 75% of food and beverage manufacturing employers who responded to the survey said they thought environmental sustainability would become more of a priority for their company in the next 5 years. This again highlights the need for improved Social Responsibility Skills from Managers, so the responses to this survey met expectations.

Top 10 Skills for Managers Category

Rank	OaSIS	Current	Change	2030	Change	2040	Change
1	Leadership Skills	Skill to Identify Problems	▲ 10	Team Building Skills	▲ 1	Team Building Skills	0
2	Team Building Skills	Team Building Skills	0	Leadership Skills	▲ 1	Teamwork and Collaboration	▲ 2
3	Project Management Skill	Leadership Skills	▼ -2	Adaptability	▲ 1	Leadership Skills	▼ -1
4	Adaptability	Adaptability	0	Teamwork and Collaboration	▲ 3	Skill to Plan a Program	▲ 3
5	Attention to Detail	Project Management Skill	▼ -2	Project Management Skill	0	Adaptability	▼ -2
6	Independence	Independence	0	Skill to Identify Problems	▼ -5	Project Management Skill	▼ -1
7	Initiative	Teamwork and Collaboration	▲ 2	Skill to Plan a Program	▲ 8	Skill to Identify Problems	▼ -1
8	Skill to Plan a Program	Communication Skill	▲ 12	Skill Needed to Judge Quality	▲ 2	Problem Solving	▲ 1
9	Teamwork and Collaboration	Attention to Detail	▼ -4	Problem Solving	▲ 3	Skill Needed to Judge Quality	▼ -1
10	Professional Composure	Skill Needed to Judge Quality	▲ 9	Initiative	▲ 3	Initiative	0

Looking and which Skills were most important to Managers in 2030 and 2040, the importance of Teamwork and Collaboration grew steadily as did the Skill to Plan a Program, while the Skill to Identify problems decreased in importance in relation to the other Managerial Skills. This is somewhat surprising, especially given that the Skill of Problem Solving grew in importance and made the top 10 for both 2030 and 2040. It is clear that Respondents expect their managers to build and work with teams in the future more than they do now, and to be more involved in planning or at least have a higher level of skill when Planning a Program.

Future Skill Levels - Trades

The biggest story in Trades skills for the future is Digital Literacy. Respondents indicated that the skill would become much more important, and the skill level required to carry out trade roles would increase significantly. The other skill that becomes more important is reading skill. The growth in Reading Skill isn't as drastic as with Digital Literacy, but it does climb in the top 10 skills needed for 2040. The connection between Reading Skill and Digital Literacy is easy to make, the assumption being that there will be more technology that roles in the Trades will have to deal with and given the nature of food and beverage manufacturing, it may be proprietary technology, so there will need to be a high level of reading and Digital Literacy to ensure the smooth integration of these technologies.

Top 10 Skills for Trades Category

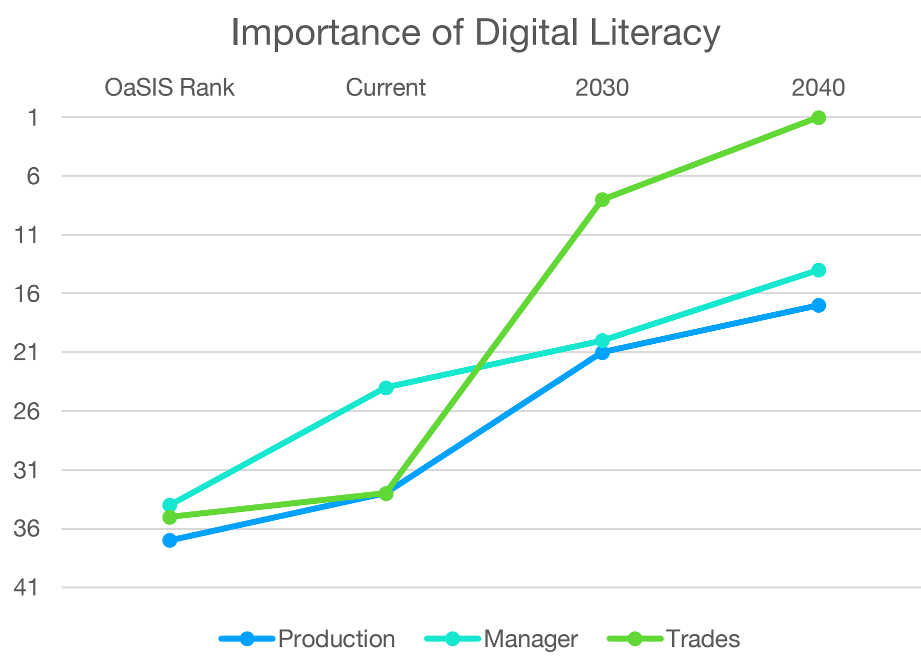
Rank	OaSIS	Current	Change	2030	Change	2040	Change
1	Attention to Detail	Attention to Detail	0	Skill to Use the Tools Necessary for the Job	▲ 1	Digital Literacy	▲ 5
2	Adaptability	Skill to Use the Tools Necessary for the Job	▲ 4	Technical Skill	▲ 1	Skill to Use the Tools Necessary for the Job	▼ -1
3	Independence	Technical Skill	▲ 5	Adaptability	▲ 1	Technical Skill	▼ -1
4	Leadership Skills	Adaptability	▼ -2	Attention to Detail	▼ -3	Adaptability	▼ -1
5	Professional Composure	Skill to Conduct Work Design	▲ 18	Professional Composure	▲ 3	Professional Composure	0
6	Skill to Use the Tools Necessary for the Job	Physical Abilities	▲ 4	Digital Literacy	▲ 27	Attention to Detail	▼ -2
7	Teamwork and Collaboration	Skill to Plan a Program	▲ 12	Problem Solving	▲ 12	Reading Skill	▲ 6
8	Technical Skill	Professional Composure	▼ -3	Independence	▲ 3	Teamwork and Collaboration	▲ 4
9	Psychomotor Abilities	Psychomotor Abilities	0	Commitment to Lifelong Learning	▲ 4	Independence	▼ -1
10	Physical Abilities	Sensory Abilities	▲ 7	Skill to Identify, Formulate, and Solve Problems	▲ 7	Numeracy	▲ 1

For 2030 Digital Literacy increased 27 places in the Skills ranking for Trades roles. For many of the skills in Trades that increased their skill level in the future, the bulk of the increase occurs between now and 2030. This tells us that this is a critical time for Trades skills as they are under pressure to increase their skill level across many skill sets at the same time.

Some Skill levels also decreased going into the future, one of these is Physical Abilities which saw a slight decline to 2030 and then stayed constant into 2040. This shows that Respondents believe that some of the physical tasks undertaken by Trades will be replaced by technology in the future, thus lowering the required level of Physical Skills.

Future Skill Levels - Digital Literacy

Consistently, in each of the four groups, an increase in the current skill level of Digital Literacy was observed. Looking ahead to 2030 and 2040, Digital Literacy continues to increase in importance across all the groupings, as visualized in the chart below.



Digital Literacy becomes the top skill for Trades in 2040, while steadily increasing for Production and Managers Trades saw the largest increase from current levels to 2030 and from 2030 to 2040. Production was 2nd in each segment. The large increases for Trades and Production are likely in response to perceived technological advancements that are on the horizon for 2030 and 2040. The skill level increase required for roles in Trades and Production are the two largest skill increases from current levels predicted by the Respondents.

This is not surprising as technology will continue to play a larger role in manufacturing than it does today, and digital skills will become increasingly necessary throughout every role in a facility.

Discussion and Summary

Across the 3 groups studied, the biggest gap between Respondents current level of skills required and OaSIS was in Production. Only 7 of the 41 skills in Production fell within 0.1 of the OaSIS level for that skill. Skills such as Communication Skill, Writing Skill, Reading Skill, and Digital Literacy were all more than 0.7 higher than the OaSIS base level. This indicates that employers already expect a higher level of these skills in their current production workforce and that the sector is moving into the workforce of the future faster than OaSIS competency levels. Especially since Respondents had all of these skills continuing to improve their required skill level into the future.

Manager roles were the most similar to the OaSIS level overall, with Digital Literacy proficiency a notable exception. Though Trades was the only group that matched current Skills levels on OaSIS doing so 7 times. This may be due to the fact that some of the roles in Trades are regulated by governing bodies so there is a better understanding of some of the skills required both by employers and OaSIS.

Another interesting area was the question looking at the Skill to Identify, Formulate, and Solve Problems. There was a lot of variation in the responses between groups. All 3 groups had a higher current level than OaSIS. Also, OaSIS levels had the skill for the groups ranked:

1. Manager
2. Trades
3. Production

Production had the largest increase in required skill level in both 2030 and 2040. The 2040 skill level indicated by Respondents (2.4) is nearly equal to the OaSIS level for Trades.

Among the individual responses in the Production roles there were some large differences in the required skill level for this skill. Looking into the numbers more closely, the main difference between respondents was the size of their establishments. The smaller employers need their employees in this role to have this skill as they are smaller and need their employees to take on more responsibilities, whereas the larger employers (more than 100 people in a facility) do not need this skill set in this role as they will have supervisors whom they expect to provide this skill set.

The difference between expectations of skill sets between small and large employers was expected as it has been apparent in other research. In 2020, FPSC conducted a large industry survey and asked how employers would describe the Educational Programming designed to produce graduates for their sector; only 39% indicated that these were excellent or adequate. The common thread connecting employers that responded this way was the size of their operations, suggesting that larger operations had the onboarding capability to incorporate and train recent graduates. This survey found 59% of respondents had an HR department or dedicated HR staff. Respondents with HR staff were more likely to be more integrated with technology which speaks to the capacity of employers that have the ability to employ dedicated HR staff. While smaller employers require staff to have a more diverse skillset as there are still all of the same tasks that need to be completed to ensure products are manufactured.

In terms of competitiveness and productivity, having access to a highly skilled workforce will be key for all food and beverage manufacturers. Given there is a high number of rural manufacturers, being able to train new hires to have the required skill set for each operation will be the determinate in the competitiveness of each business. Respondents indicated the growing need for digital literacy and staying up to date with technical changes, now and in the future, across all roles. FPSC predicts that if all food and beverage manufacturers were fully integrated in Industry 4.0 there would be a 20% reduction in the amount of workforce needed to operate. This underscores the need for these skills in all roles within the food and beverage manufacturing sector as there will still be a need for a large workforce, regardless of the level of tech integration in any facility.

FPSC has been in communication with employers and employees within the sector for years to develop a learning and recognition framework to help all industry stakeholders understand the skills, competencies, and career progression opportunities within the sector. The information from this survey aligns with what we have learned about how skilled the workforce already is and will need to be in the future. The responses to this survey in particular will help to guide training opportunities and programs to upskill Canada's food and beverage manufacturing workforce.

Recent surveys from FPSC's Rapid Results Employer Opinion Panel indicate that employers are struggling to find staff that already have the required skill levels.

For both production (Production and Trades) and non-production roles (Manager) employers listed lack of applicants with the proper experience or proper training as among their top challenges. As the need to recruit a more skilled workforce increases going forward this will continue to be a major issue for the sector. It is a larger issue for rural employers who do not have the same population base to recruit from. Another aspect of this challenge is the ability to retain the staff that have the skills required, as the food and beverage manufacturing sector cannot compete on wages with some other sectors in the economy and will be vulnerable to having their staff recruited away, which is an issue that has affected all roles in the sector.

Employers continue to work with academic institutions, training institutions, and non-profits like FPSC, to provide the requisite skills training to ensure that there is a highly skilled workforce in the Canadian food and beverage manufacturing sector. Stakeholders are also dedicated to working with people currently outside the workforce to train and recruit these people to the sector. Given the impact of the long-standing labour shortage, the sector is exploring every option to find people that can work in the sector and provide them with the skills training they need to contribute effectively.

One challenge that is highlighted in the responses from this survey is rural infrastructure. Without access to reliable high-speed internet, it will be a challenge for some employers to integrate available technology into their operations. We know from the responses that all respondents view the workplaces of 2030 and 2040 as being more tech integrated than they are today. Infrastructure such as high-speed internet is outside an employers' area of influence but is holding them back from being able to implement the technology required to move forward alongside their competitors. Similar challenges will exist in recruiting as there are employers that have a closer proximity to training institutions which will give them better exposure in recruiting recent graduates that have the latest technical training.

The sector can address these challenges by communicating results from surveys such as this with other stakeholders, especially training providers, to ensure that the skills that are needed today and tomorrow are being taught. In addition to this, the sector needs to speak about the opportunities within the sector to have a meaningful career. Perception research conducted by FPSC showed that a vast number of the public (40%) don't know anything about the sector. This is a space that needs to be filled, as it is much harder to recruit for roles when people are unaware of the sector.

A sector wide approach to addressing challenges and highlighting opportunities is the best strategy to changing perceptions of the industry. However, given the wide variety of sub-sectors and roles within the sector, it is difficult to coordinate such an activity. There are groups working for specific sub-sectors or specific regions as well as larger groups representing the entire value-chain as well, but each of these groups has slightly different goals. Research like this can help to highlight the similarities and differences that can help all stakeholders move forward with common interests to achieve better outcomes for the Canadian workforce. After all, at the end of the day we all need to eat.

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Your Next Worker: What You Need to Know – https://lmi.fpsc-ctac.com/all-reports/
Future Skills in Food Processing Round Table Report – https://lmi.fpsc-ctac.com/all-reports/
Rapid Results Survey 1 Report - https://rapidresults.ca/reports/
Various FPSC Regional Reports - https://lmi.fpsc-ctac.com/all-reports/

Appendices

Appendix A: Occupation Breakdown

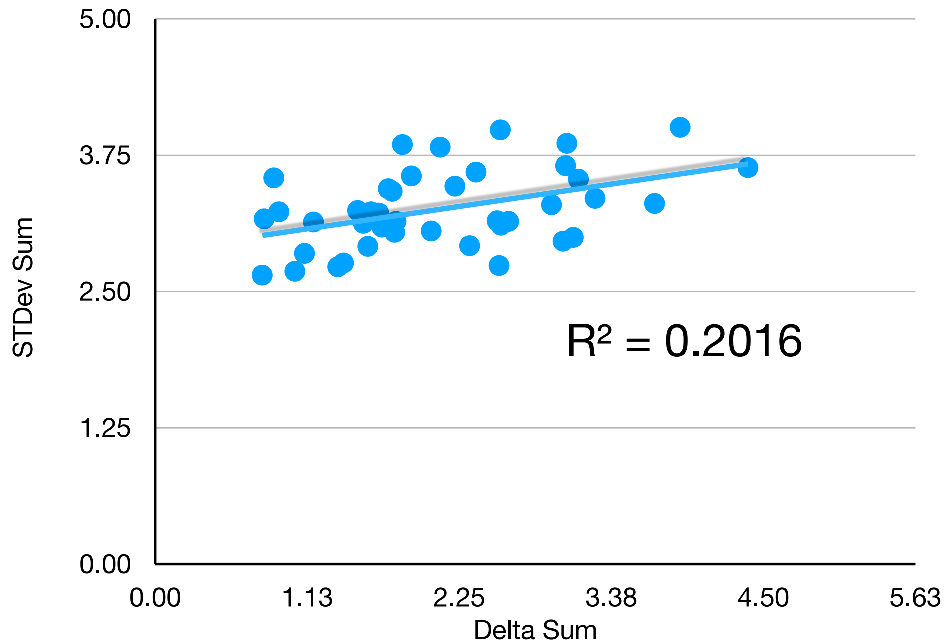
All NOC codes indicated as important by respondents:

Occupation Code	Occupation
18	Senior Managers - public and private sector
10011	Human resources managers
10012	Purchasing managers
12013	Supervisors, supply chain, tracking and scheduling coordination occupations
12200	Accounting technicians and bookkeepers
13100	Administrative officers
13110	Administrative assistants
13201	Production and transportation logistics coordinators
14400	Shippers and receivers
21321	Industrial and manufacturing engineers
22110.02	Biological technicians
22302.02	Industrial engineering and manufacturing technicians
63200	Cooks
63202	Bakers
64101	Sales and account representatives - wholesale trade (non-technical)
64409	Other customer and information services representatives
70012	Facility operation and maintenance managers
72201	Industrial electricians
72400	Construction millwrights and industrial mechanics
72402	Heating, refrigeration and air conditioning mechanics
72422	Electrical mechanics
73201	General building maintenance workers and building superintendents
73300	Transport truck drivers
75101	Material handlers
90010	Manufacturing managers
92012	Supervisors, food and beverage processing
94140.01	Process control operators, food and beverage processing
94140.02	Machine operators, food and beverage processing
94141.02	Industrial meat cutters
94141.03	Poultry preparers
94142.01	Fish and seafood plant machine operators
94142.02	Fish and seafood plant cutters and cleaners
94143	Testers and graders, food and beverage processing
94219.02	Product inspectors
95106	Labourers in food and beverage processing
95107	Labourers in fish and seafood processing
95109	Other labourers in processing, manufacturing and utilities

Appendix B: Production

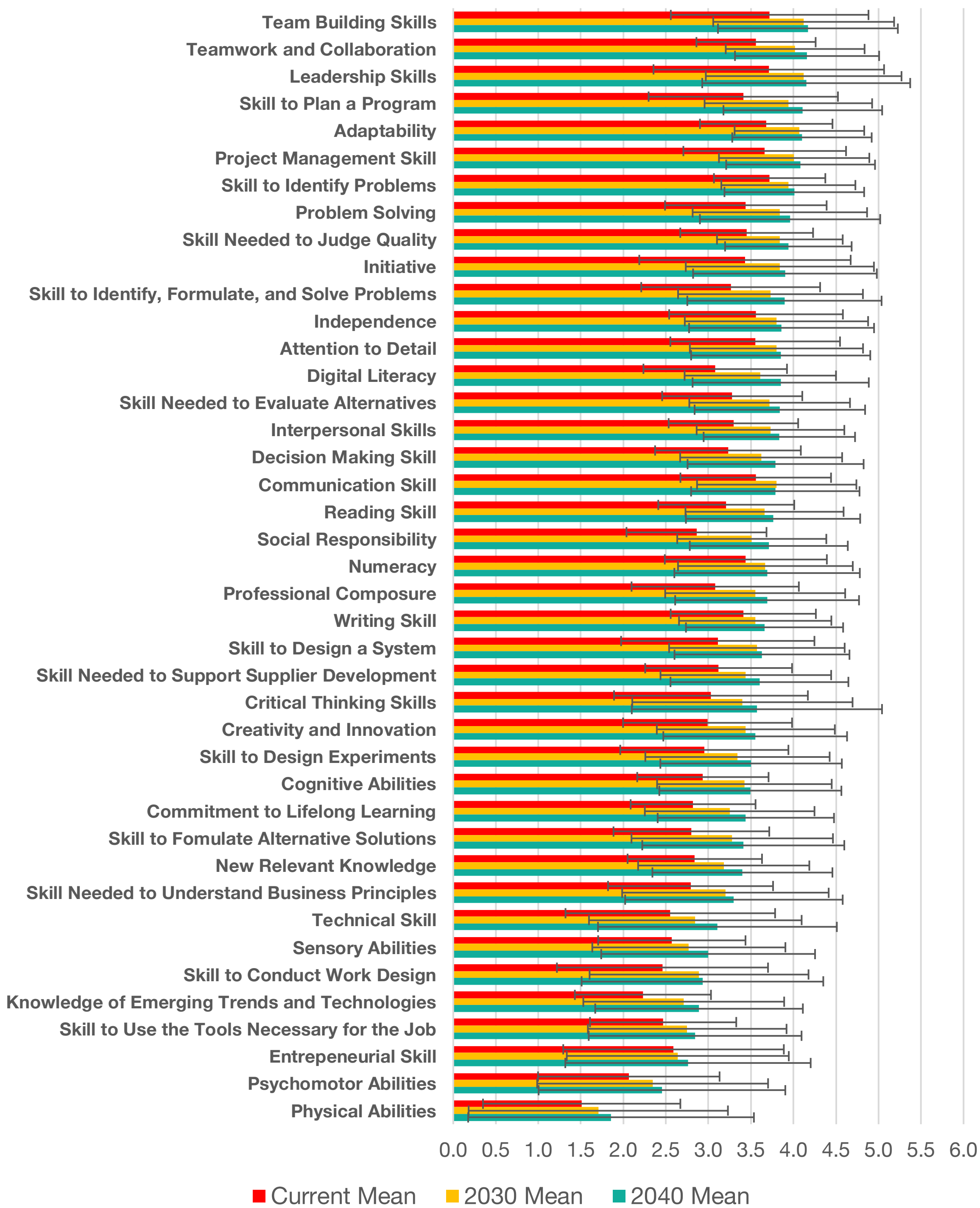
All 41 Skills for Production Category

Production Category - Sum of Proficiency Standard Deviation vs Sum of Proficiency Delta

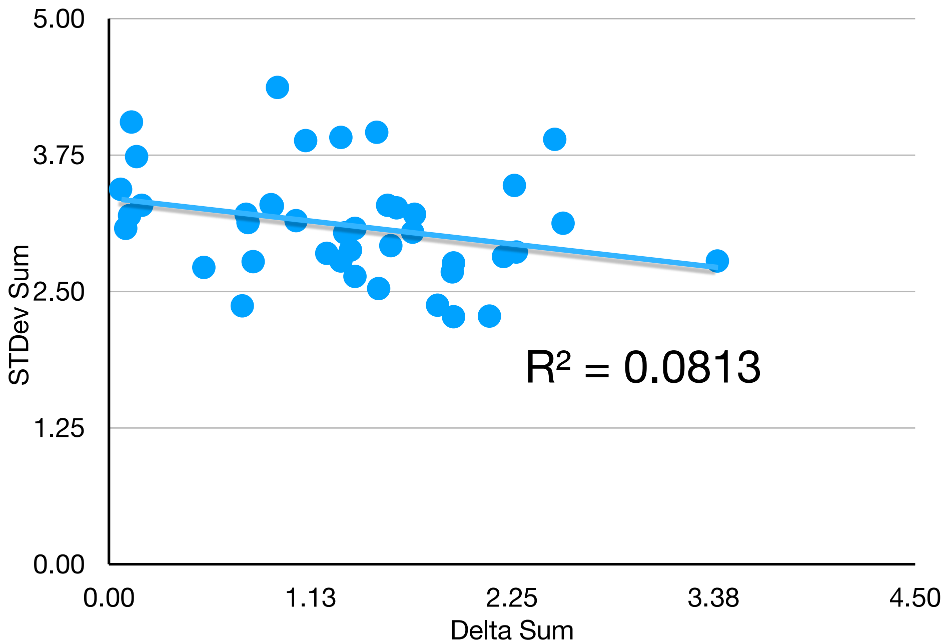


Appendix C: Managers

All 41 Skills for Managers Category

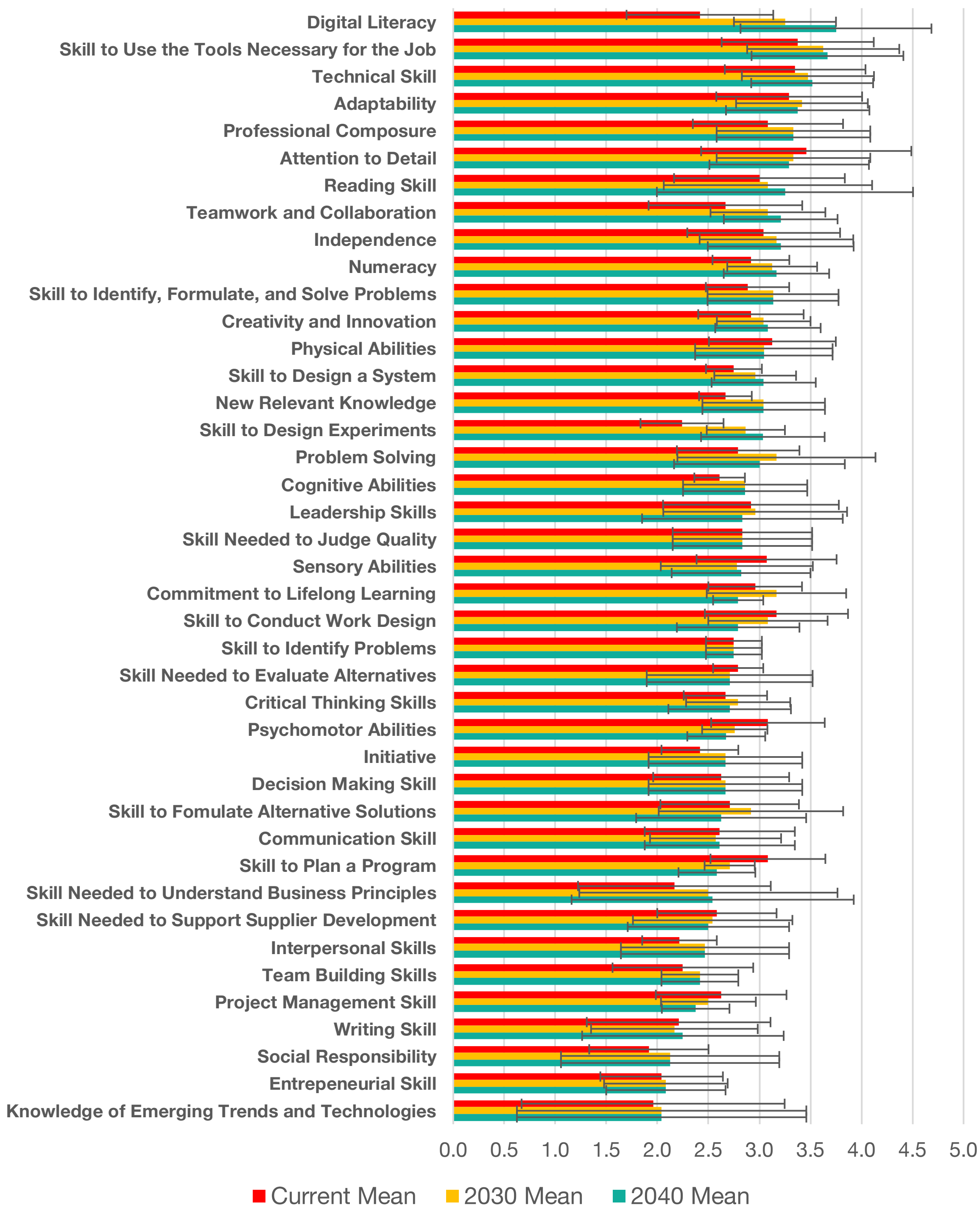


Managers Category - Sum of Proficiency Standard Deviation vs Sum of Proficiency Delta

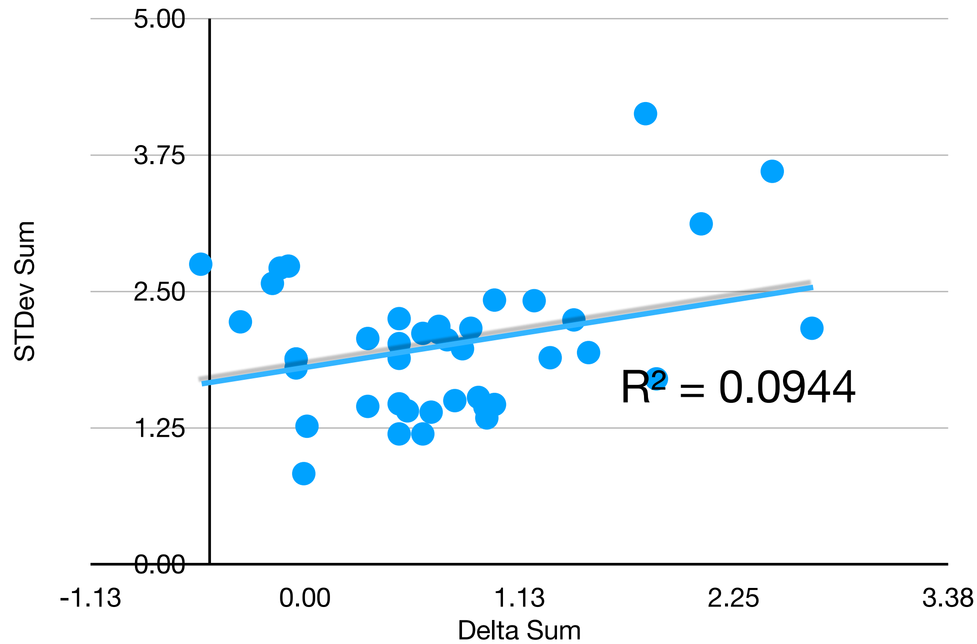


Appendix D: Trades

All 41 Skills for Trades Category



Trades Category - Sum of Proficiency Standard Deviation vs Sum of Proficiency Delta

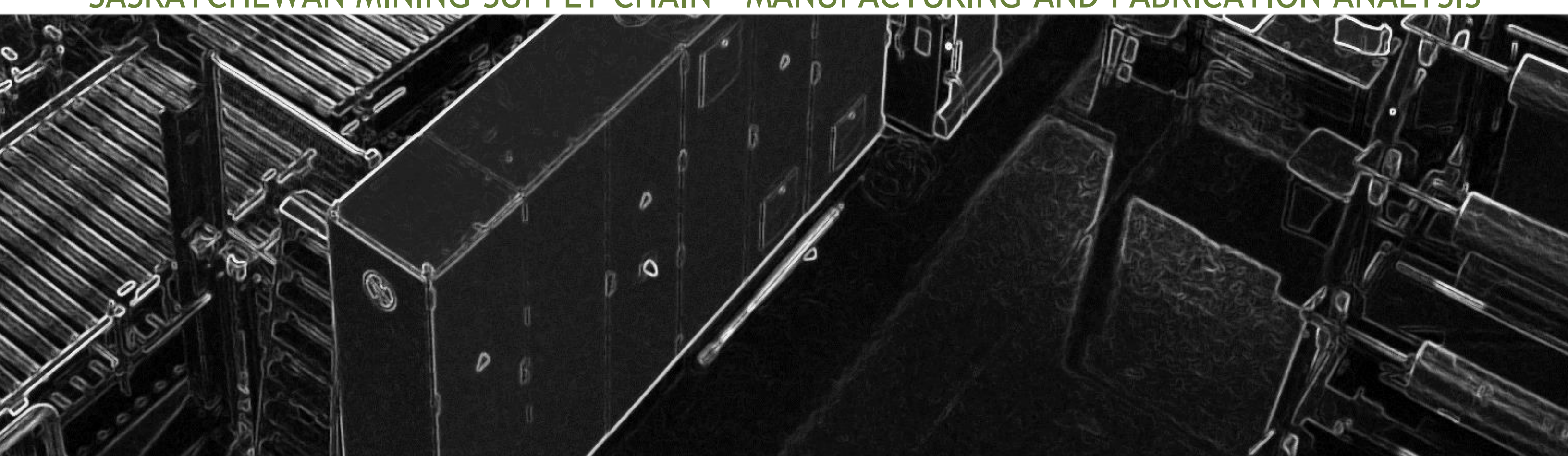


Appendix 6

Saskatchewan Industrial and Mining Suppliers Association Report

Saskatchewan Labour Market Research

SASKATCHEWAN MINING SUPPLY CHAIN – MANUFACTURING AND FABRICATION ANALYSIS



Contents

Disclaimer

The study is based on publicly and non-publicly available information, which has not been independently verified by SIMSA or any other contributing party. Any assessments, assumptions and projections in this study solely represent the views of the authors. Neither SIMSA, nor it's employees, provide any guarantee or warranty (express or implied) or assumes any responsibility or liability for any errors or omissions.

About the Saskatchewan Industrial and Mining Suppliers Association

Who we are:

SIMSA (the Saskatchewan Industrial and Mining Suppliers Association) is a nonprofit organization representing more than 340 Saskatchewan-based supplier-members who provide goods and services to the industrial, mining, and energy sectors.

Our memberships' Saskatchewan sales currently total over $14-billion, with over 34,000 employees.

SIMSA is currently the only organization that represents suppliers that have a physical presence in Saskatchewan, with most also having their global headquarters in the province.

What we do:

SIMSA supports, promotes, and represents the interests of Saskatchewan-based suppliers who serve large-scale industrial, mining, and energy businesses both in and out of province.

We actively market our members to procurement professionals through in-person events and via the Saskatchewan Supplier Database, working to increase sales, educate stakeholders, and advocate for the members and industries we serve.

We strive to engage members, their customers, government agencies, and other stakeholders to build sustainable, productive, and transparent relationships.

Where our members work:

Our supplier-members provide world-class solutions used by resource and industrial companies in Saskatchewan and around the world. Our specialists can be found providing goods and services for the potash, oil, gas, uranium, nuclear, coal, gold, agriculture, base metals, steel production and other industries.

What we believe:

At SIMSA,

- We believe in **collaboration** in all our actions
- We believe in seeking **wisdom** in our decisions by considering the needs and capabilities of our members and the customers they serve
- We believe that **Saskatchewan companies are world class**
- We believe that a **diverse and inclusive** workforce benefits everyone

SIMSA.CA

Overview

The report aims to tackle the critical issue of labor shortages in the manufacturing sector, a problem posing a substantial threat to manufacturing GDP globally and specifically in Canada.

It is projected that by 2030, demand for skilled workers will outstrip supply, resulting in a global talent shortage of more than 85.2 million people[i], potentially leading to a revenue loss of $8.452 trillion USD. Canada is already feeling the sting, with a reported loss of $13 billion CAD attributed to labor shortages[ii], manifesting in lost or rejected orders and postponed or canceled projects in 2022 alone.

[1] Korn Ferry, "Future of Work: The Global Talent Crunch," 4
[2] Alan Arcand, Canadian Manufacturers & Exporters, "CME 2022 Labour and Skills Survey", 5

Several factors are contributing to this labor shortfall. A significant portion of the workforce is aging, with a sizeable portion of Canada's manufacturing workforce is expected to retire by 2030. Concurrently, there is a lack of younger individuals entering the manufacturing sector to replace and supplement this aging workforce. Furthermore, structural shifts in key sectors, like automotive and oil and gas, risk disconnecting a pool of highly skilled Canadian workers from future manufacturing roles.

Despite these challenges, the labor shortages present an opportunity for Canada to increase exports, attract foreign direct investment, and grow its manufacturing GDP. Achieving this requires a highly trained, agile, and flexible workforce capable of producing world-class goods competitively and in sync with market demands. Recognizing the Canadian manufacturing workforce as a crucial national asset is vital, necessitating a concerted effort to develop and enhance worker skills. Encouraging more young Canadians to join the manufacturing sector is also crucial, possibly aided by a better understanding of the roles in advanced manufacturing.

The overall objective of the exercise is to develop a cross-sector pan-Canadian database of the skills and competencies of the current manufacturing workforce and to identify the critical new skills and competencies that will be required in five and ten years.

Executive Summary

With over $58 billion worth of projects in the pipeline in Saskatchewan, primarily in the mining and energy sectors, and an already existing labour shortage, there will be a significant shortfall of workers to fulfill these projects should things not change significantly. This report is designed to analyze the necessary skills required to complete this work through to 2040.

The Context

Saskatchewan is a critical component of Canada's economic framework, distinguished by its leadership in agriculture, mining, energy, and manufacturing sectors. Its status as a top potash and uranium producer underscores its significance in the global supply chain, enhancing both local and international market contributions. This economic diversity, backed by robust agricultural practices and forward-thinking manufacturing, establishes Saskatchewan as a significant entity globally.

Particularly, the mining sector stands out as a significant pillar of Saskatchewan's GDP and labor market, bolstering worldwide agricultural and energy frameworks. This sector's economic impact is profound, driving tax revenue and stimulating local enterprises through extensive supplier interactions. The distinct nature of the mining supply chain, characterized by demands for high-value, specialized products, drives expansion within the local manufacturing sector, particularly favoring custom solution demands.

However, Saskatchewan is confronting notable challenges, especially in its labor market. The province is bracing for the impact of significant capital projects and the evolving demands of a greener economy, necessitating a strategic approach to workforce management and development. The looming shortfall in skilled labor, particularly in the mining sector, accentuates the urgency for targeted interventions.

Additionally, the transition towards a decarbonized energy grid – especially the multi-billion-dollar nuclear industry - signals a transformative period for Saskatchewan's industries, demanding adaptability and skill development within the workforce. The aging demographic, combined with low unemployment rates and evolving job market demands, poses additional hurdles, particularly in attracting and retaining the necessary skilled labor.

Conclusions and Recommendations

The skill trend analysis underscores a dynamic shift in occupational competencies, highlighting the move from solely technical skills to more a more broadly skilled and adaptable workforce across various sectors. This evolution reflects broader industry trends towards complex, technology-driven environments, necessitating an increased emphasis on technical skills, digital proficiency, and soft skills like communication and teamwork as projects become increasingly multidisciplinary. There are 8 forecasted trends and conclusions outlined in this report on page 37; they are:

1. Shifting Priorities Across Occupations
2. Increased Emphasis on Technical Skills and Digital Proficiency
3. The Rise of Soft Skills
4. Specialization and Problem-Solving in Niche Areas
5. Stability vs. Evolution in Skill Demands
6. Rise of Adaptability as a required Skill
7. Communication Skills as a Core Competency
8. Integration of Digital Tools and Analytics

In response, the following recommendations noted below are proposed on page 38 of the report:

- Utilise Opportunities in Sectoral Shifts
- Adopt a Skills-based Approach
- Promote Diversity and Inclusion for Growth
- Embrace Innovative Solutions to Skill Development

The Saskatchewan Mining Industry and Supply Chain at a glance.

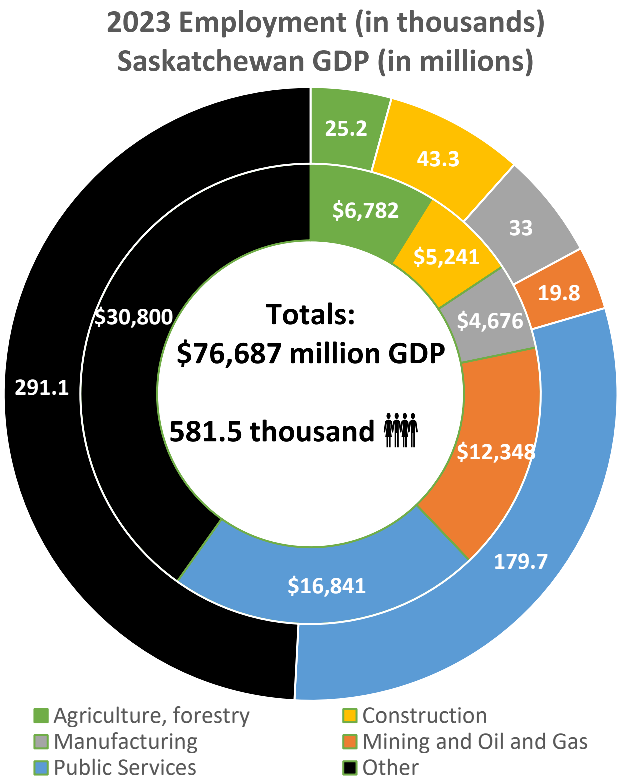


Figure 1https://dashboard.saskatchewan.ca/business-economy - Saskatchewan

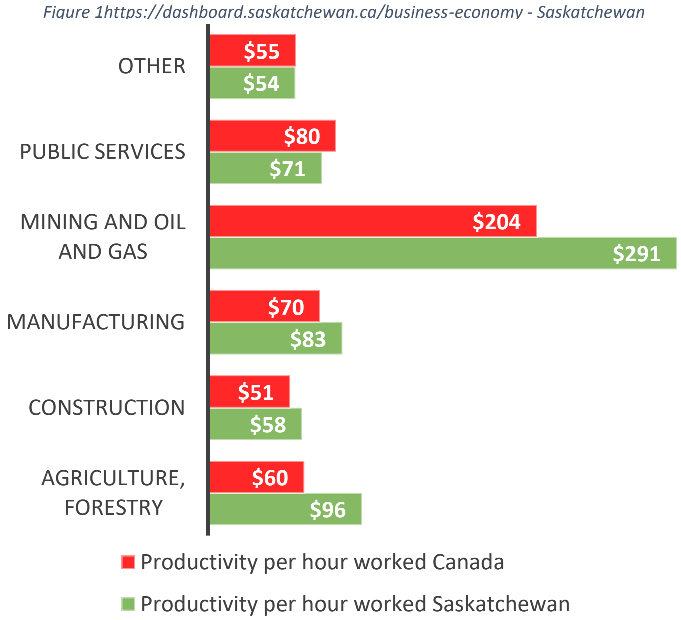


Figure 2: Statistics Canada. Table 36-10-0480-01 Labour productivity and related measures by business sector industry and by non-commercial activity consistent with the industry accounts

Provincial Overview

Saskatchewan's economy is a dynamic and diverse ecosystem, anchored by its strong agricultural, mining, energy, and manufacturing sectors.

One of Canada's largest mining provinces by mineral sales, the province leverages its rich natural resources to fuel its economy.

Agriculture remains a cornerstone, with Saskatchewan being a global breadbasket, thanks to its vast expanses of arable land and innovative farming techniques.

The diverse manufacturing sector, adds significant value to the province's natural resources, creating a wide range of products for both domestic and international markets.

Productivity

Saskatchewan's productivity is dominated by the mining, energy, forestry, and manufacturing sectors. The productivity in these areas indicates a significant step change over the national average, indicating a high value market. The mining supply chain is dominated by high mix, low volume work.

Mining

The province of Saskatchewan is the premier producer of potash globally, a mineral indispensable for the creation of fertilizers. These fertilizers are essential in augmenting crop yields, thereby playing a critical role in bolstering agricultural productivity worldwide. In addition, Saskatchewan has is the second-largest producer of uranium on the international stage. This distinction underscores the province's abundant mineral endowments and the robustness of its mining infrastructure, highlighting its pivotal role in the nuclear energy sector.

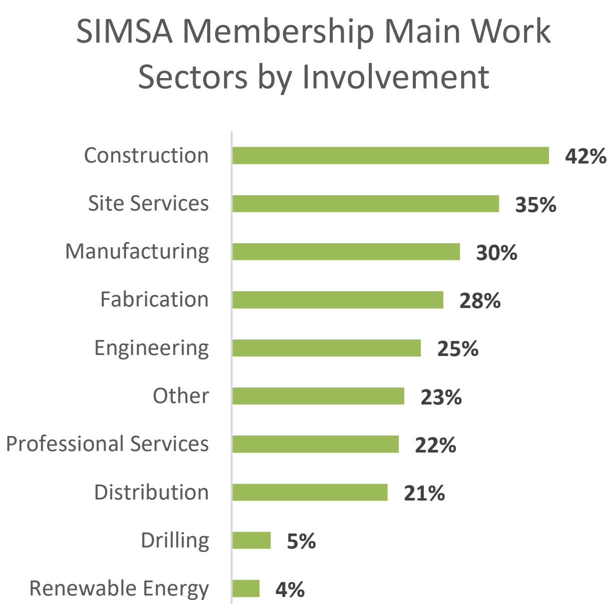
Beyond its leadership in potash and uranium production, the province is home to 23 of the 31 critical minerals identified by the Government of Canada as essential for the nation's economic success[iii]. This fact not only emphasizes Saskatchewan's strategic importance to Canada's economic security but also its contribution to the global supply chain of critical minerals.

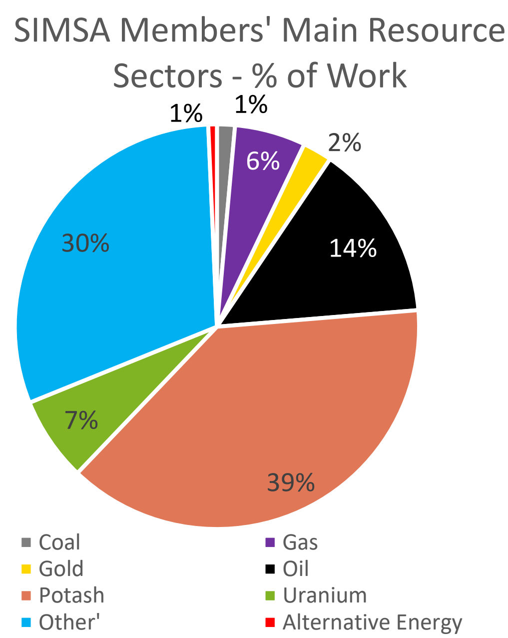
The economic impact of the mining sector in Saskatchewan is significant, contributing approximately 12% to the provincial Gross Domestic Product (GDP). The industry plays a critical role in the employment landscape, providing over 27,000 individuals with jobs in both direct and indirect roles in the year 2022[iv]. This employment contribution underscores the sector's significance in fostering employment opportunities and promoting community development within the province.

The fiscal year of 2023 marked a period of notable achievements for the Saskatchewan mining sector. The industry reported total mineral sales amounting to $12.9 billion, an indicator of its strong performance and substantial contribution to both the provincial and national economies by contributing nearly 5.6 billion in provincial, federal, and municipal taxes in 2022. Additionally, the sector's engagement with local suppliers, evidenced by an expenditure of $3.8 billion[v], reflects a commitment to fostering partnerships with local businesses, thereby supporting the provincial economy's broader ecosystem.

Mining Supply Chain

The high-value market of mining, particularly in potash and uranium, has a profound trickle-down effect on the local economy. In recent years, this impact has been notably quantified, with the sector spending approximately $3.8 billion with local suppliers. This substantial investment underscores the symbiotic relationship between the mining industry and the local economy, fostering growth and development within the community and beyond.





The nature of spending within the mining sector benefits the manufacturing industry, particularly those involved in contract fabrication and manufacturing work. This segment of the manufacturing sector has flourished, primarily due to the specific needs of the mining industry, which tends to require specialized, custom-made products rather than mass-produced items. This demand aligns with the industry's predominance for high-mix/low-volume work, contrasting significantly with industries that produce high volumes of identical products, such as the automotive industry.

Furthermore, the cyclical nature of commodity markets plays a crucial role in shaping the dynamics of the local economy and its industries. In such an environment, the ability to adapt and maintain operational efficiency becomes paramount. The principle that 'the lean survive' becomes particularly relevant, as companies must navigate the fluctuations in demand and pricing inherent to commodity markets. This necessitates a flexible approach to business operations, emphasizing cost-efficiency, and adaptability.

Future Sector Developments and Labour Headwinds

The Saskatchewan labour market is very competitive, and manufacturing market has a time competing with other booming, high productivity markets such as mining, energy and tech.

Future Sector Developments

SIMSA is currently tracking over $58B in major capital projects expected in the pipeline in Saskatchewan by 2040. One of the largest includes the BHP Jansen mine slated at $13.9 billion[vi] and the expansion and decarbonization of the local electrical grid, which according to the provincial government is slated at 28 billion[vii].

In addition to the above, there will likely be further developments that will cause the already strained businesses in Saskatchewan further issues in attracting and retaining skilled labour.

Labour Headwinds

According to Saskatchewan mining and metal labour market report by Deloitte[viii], without intervention, nearly the mining industry is short 5000, or around 18% of the current direct and indirect mining workforce, by 2030:

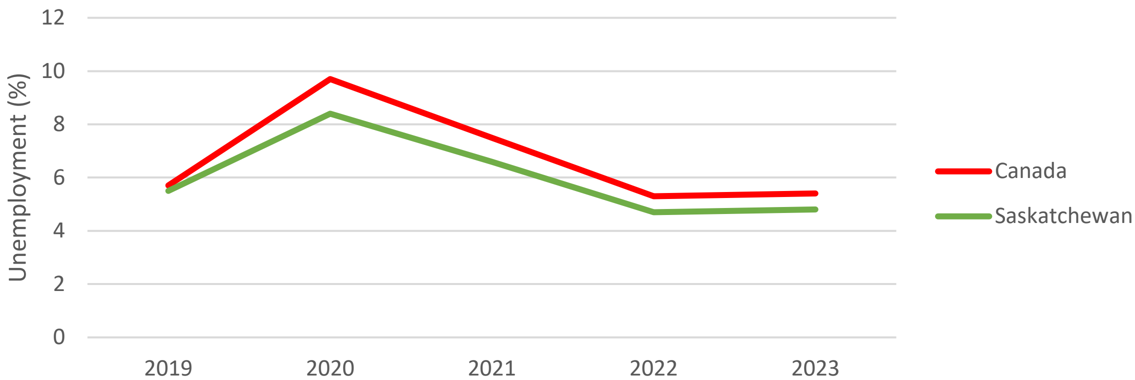
NOCS Codes	Description	Shortage (-) or Surplus (+)
83100	Underground production and development miners	-251
83101	Oil and gas well drillers, services, testers and related workers	+293
73400	Heavy equipment operators (except crane)	-151
72400	Construction millwrights and industrial mechanics	-929
72401	Heavy-duty equipment mechanics	-255
72201	Industrial electricians	-785
85111	Oil and gas drilling, servicing and related labourers	-201
72106	Welders and related machine operators	-2090
84100	Underground mine service and support workers	-187
21330	Mining Engineers	-183

Table 1: Deloitte, 17, Saskatchewan mining and metal labour market report

Contributing Factors

Aging Workforce Managing the transition as older employees retire, and recruiting younger, skilled workers to fill the gap. Around 22% of the Saskatchewan workforce is over 55[ix].

Low Unemployment:



Attracting Talent: Offering competitive wages, benefits, and conditions to attract and retain skilled workers in a challenging industry, that do not want to live in smaller, sometimes remote places.

Shifting Workforce Demand: the next generation of works values different things than their predecessors. Namely the desire to find deep meaning in their work, as well as a focus on their own lifestyle and family needs.

Technological Advancements: Adapting the workforce to new technologies through upskilling and managing technological transitions. As the industry adopts autonomous (not automated) machines and processes, digital skills become more important.

Shifting Skills-demand: Addressing the mismatch between industry needs and available skills through targeted training and education. In-demand skills are changing as digitization propagates through the supply chain.

Economic Fluctuations: Navigating the cyclical nature of the mining industry, which affects job stability and workforce planning.

Methodology

The study's purpose is to understand the fundamental skills, aptitudes and competencies (herein referred to as skills and competencies) of the existing manufacturing workforce as well as the specific new skills that will be required to support new and emerging sectors and the general application of advance manufacturing technologies and practices.

The approach is to identify at a sectoral level the composition of the current manufacturing industry to a level of North American Industry Classification Codes (NAICS), to identify the principal occupations of workers within those NAICS codes on the basis of National Occupation Codes (NOC's) (representing 80% of the total production workforce.) and then to map these NOC codes to the underlying skills and competencies of the workforce by matching them to skills and competencies in the OaSIS and ONET databases.

The following Table shows the skills and what data is collected for each occupation from SIMSA members:

Table 2: Survey collection tool simplification

Sector	Ex) Machinery manufacturing			
Occupation	Ex) Welder			
	Proficiencies (out of 5)			
Skill	**Base OaSIS**	**2024**	**2030**	**2040**
Adaptability	(precollected)			
Attention to Detail				
Cognitive Abilities				
Commitment to Lifelong Learning				
Communication Skill				
Creativity and Innovation				
Critical Thinking Skills				
Decision Making Skill				
Digital Literacy				
Entrepeneurial Skill				
Independence				
Initiative				
Interpersonal Skills				
Knowledge of Emerging Trends and Technologies				
Leadership Skills				
New Relevant Knowledge				
Numeracy				
Physical Abilities				
Problem Solving				
Professional Composure				
Project Management Skill				
Psychomotor Abilities				
Reading Skill				
Sensory Abilities				
Skill Needed to Evaluate Alternatives				
Skill Needed to Judge Quality				

Skill Needed to Support Supplier Development				
Skill Needed to Understand Business Principles				
Skill to Conduct Work Design				
Skill to Design Experiments				
Skill to Design a System				
Skill to Formulate Alternative Solutions				
Skill to Identify Problems				
Skill to Identify, Formulate, and Solve Problems				
Skill to Plan a Program				
Skill to Use the Tools Necessary for the Job				
Social Responsibility				
Team Building Skills				
Teamwork and Collaboration				
Technical Skill				
Writing Skill				

Sectors/Subsectors Represented in Study – Trend Analysis

To provide a list of the different sectors, sub-sectors, and their respective codes, this will help understand the variety and scope of sectors and sub-sectors covered in the survey.

Here are the lists of unique sectors and sub-sectors, along with their respective codes, extracted from the survey data:

Sectors	Sector Code	Responses
Miscellaneous manufacturing	339	23
Machinery manufacturing	333	21
Fabricated metal product manufacturing	332	20
Non-metallic mineral product manufacturing	327	6
Primary metal manufacturing	331	5
Electrical equipment, appliance and component manufacturing	335	3
Petroleum and coal product manufacturing	324	2

Sub-Sectors	Sub-Sector Code	Responses
Other miscellaneous manufacturing	3399	23
Agricultural, construction and mining machinery manufacturing	3331	12
Other non-metallic mineral product manufacturing	3279	6
Machine shops, turned product, and screw, nut and bolt manufacturing	3327	6
Architectural and structural metals manufacturing	3323	6
Industrial machinery manufacturing	3332	5
Other fabricated metal product manufacturing	3329	4
Other general-purpose machinery manufacturing	3339	4
Boiler, tank and shipping container manufacturing	3324	2
Other electrical equipment and component manufacturing	3359	2
Petroleum and coal product manufacturing	3241	2
Electrical equipment manufacturing	3353	1

Occupational spread across sub-sectors and number of different NOCS represented in Appendix A.

Occupations

Due to the responses dispersion the following occupations were grouped as per below by the report:

NAICS Codes	Occupation Groupings	Number of Responses
	Engineering	
21301	Mechanical engineers	1
21310	Electrical and electronics engineers	1
21330	Mining engineers	1
22211	Industrial designers	1
	Engineering Technologists	
22101.01	Geological and mineral technologists	1
22301.01	Mechanical engineering technologists	1
22302.01	Industrial engineering and manufacturing technologists	1
22310.01	Electrical and electronics engineering technologists	2
	Electrical Technicians and Mechanics	
22310.02	Electrical and electronics engineering technicians	2
22312	Industrial instrument technicians and mechanics	1
72201	Industrial electricians	1
72200	Electricians (except industrial and power system)	2
72422	Electrical mechanics	2
	Development Miners	
73402.01	Drillers - surface mining, quarrying and construction	1
83100	Underground production and development miners	1
	Assemblers, electrical and mechanical	
94202.01	Assemblers, electrical appliance, apparatus and equipment manufacturing	1
94204.01	Mechanical assemblers	1
	Contractors and Supervisors	
72020	Contractors and supervisors, mechanic trades	3
72010	Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	2
72011	Contractors and supervisors, electrical trades and telecommunications occupations	2
	Machine Operators and Industrial painters	
94100	Machine operators, mineral and metal processing	2
94103.01	Concrete products forming and finishing machine operators and workers	2
94213.01	Industrial painters and coaters	2
72401	**Heavy-duty equipment mechanics**	2
	Helpers and Labourers	
75110	Construction trades helpers and labourers	5
75119	Other trades helpers and labourers	1
95101	Labourers in metal fabrication	7
85110	Mine labourers	1
72100.01	**Machinists**	6
72106.01	**Welders**	16

Skill Trend Analysis

The skill trend analysis examines all 41 skills outlined in the methodology, highlighting the top ten critical skills for each occupational category. The aim is to identify essential skills that should be prioritized for future training and infrastructure development to meet evolving workforce demands.

Additionally, this analysis is designed to align workforce development strategies with market needs, ensuring that educational programs and training initiatives are tailored to the evolving demands of the industry. By focusing on these key skills, organizations can better prepare their employees for future challenges and opportunities, enhancing overall industry competitiveness and productivity.

Welders

The following section includes the top 10 skills for welders:

Table 3: Top 10 skills for welders

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Attention to Detail	Attention to Detail	0	Attention to Detail	0	Attention to Detail	0
2	Independence	Independence	0	Independence	0	Independence	0
3	Adaptability	Reading Skill	4	Reading Skill	0	Reading Skill	0
4	Commitment to Lifelong Learning	Psychomotor Abilities	5	Teamwork and Collaboration	1	Teamwork and Collaboration	0
5	Physical Abilities	Teamwork and Collaboration	3	Technical Skill	6	Technical Skill	0
6	Professional Composure	Physical Abilities	-1	Psychomotor Abilities	-2	Psychomotor Abilities	0
7	Reading Skill	Commitment to Lifelong Learning	-3	Skill to Use the Tools Necessary for the Job	1	Skill to Use the Tools Necessary for the Job	0
8	Teamwork and Collaboration	Skill to Use the Tools Necessary for the Job	2	Adaptability	2	Adaptability	0
9	Psychomotor Abilities	Professional Composure	-3	Professional Composure	0	Professional Composure	0
10	Skill to Use the Tools Necessary for the Job	Adaptability	-7	Communication Skill	2	Communication Skill	0

The number of datapoints in this dataset above is the most comprehensive in this study, consistent with prior 'oasis' data yet exhibiting a significant shift. Previously, adaptability was a key focus; however, the current trend leans towards enhancing the ability to understand and interpret complex diagrams and engage in more sophisticated tasks. This change reflects a broader trend in the industry, where the emphasis is gradually moving away from simple, adaptable skills to more specialized, technical competencies.

One of the most notable trends highlighted by the data is the increasing importance of psychomotor abilities and technical skills. Over time, there has been a clear shift towards tasks that require intricate welding techniques, indicating that the industry is moving towards more complex welding tasks. This shift is likely due to several factors, including the introduction of new materials and technologies in the welding field. These advancements require welders to possess a higher level of technical proficiency to work effectively with these new materials and apply the latest techniques.

Lastly, although digital literacy is not one of the top 10 skills, it should be noted that in the oasis data there is a 0 marked for proficiency. Notably, digital literacy had one of the largest changes in the mean value and increased consistently over time. However, the skill was marked by largest standard deviations of all the 41 skills: 2040 mean value of 2.73 (out of 5) with a standard deviation of 1.80.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Heavy Duty Mechanics

The following section includes the top 10 skills for heavy duty equipment mechanics:

Table 4: Top 10 skills for heavy duty equipment mechanics

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Skill to Use the Tools Necessary for the Job	Critical Thinking Skills	24	Team Building Skills	6	Team Building Skills	0
2	Psychomotor Abilities	Skill to Identify Problems	31	Critical Thinking Skills	-1	Critical Thinking Skills	0
3	Physical Abilities	Decision Making Skill	23	Reading Skill	1	Reading Skill	0
4	Adaptability	Reading Skill	27	Problem Solving	5	Problem Solving	0
5	Attention to Detail	Communication Skill	19	Skill to Identify Problems	-3	Skill to Identify Problems	0
6	Independence	Social Responsibility	29	Social Responsibility	0	Social Responsibility	0
7	Professional Composure	Team Building Skills	32	Decision Making Skill	-4	Decision Making Skill	0
8	Technical Skill	Knowledge of Emerging Trends and Technologies	32	Skill to Design Experiments	3	Skill to Design Experiments	0
9	Sensory Abilities	Problem Solving	21	Digital Literacy	14	Digital Literacy	0
10	Commitment to Lifelong Learning	Skill Needed to Judge Quality	6	Skill Needed to Judge Quality	0	Skill Needed to Judge Quality	0

There seems to be little to no direct link between the OaSIS data and the findings from the recent survey. Nevertheless, a noteworthy shift is observed from 2024 to 2030 and beyond, highlighting an increasing emphasis on teamwork, problem-solving, and digital proficiency. This shift is particularly seen in the context of Predictive Maintenance, which emphasizes the use of sensors and data analytics to foresee and prevent equipment failures before they happen, significantly reducing operational downtime.

Furthermore, the need to understand and interpret technical documents and schematics is becoming increasingly crucial as machinery grows in complexity. This trend is in line with the advancements in machinery and equipment, demanding a more profound knowledge of specific systems such as hydraulics and pneumatics.

The move towards analytics in maintenance marks a transition to a more efficient and data-oriented approach in managing equipment. Additionally, the intricate nature of contemporary machinery requires a solid grasp of technical documentation to ensure effective operation and maintenance. This evolution in skills and knowledge underscores the changing landscape of industry practices and technological integration.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Machinists

The following section includes the top 10 skills for machinists:

Table 5: Top 10 skills for machinists

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Attention to Detail	Attention to Detail	0	Attention to Detail	0	Attention to Detail	0
2	Independence	Independence	0	Skill to Use the Tools Necessary for the Job	2	Skill to Use the Tools Necessary for the Job	0
3	Psychomotor Abilities	Psychomotor Abilities	0	Independence	-1	Independen ce	0
4	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job	0	Psychomotor Abilities	-1	Psychomot or Abilities	0
5	Adaptability	Technical Skill	10	Technical Skill	0	Technical Skill	0
6	Commitment to Lifelong Learning	Numeracy	3	Numeracy	0	Numeracy	0
7	Creativity and Innovation	Reading Skill	4	Reading Skill	0	Reading Skill	0
8	Leadership Skills	Adaptability	-3	Adaptability	0	Adaptability	0
9	Numeracy	Leadership Skills	-1	Leadership Skills	0	Leadership Skills	0
10	Professional Composure	Creativity and Innovation	-3	Teamwork and Collaboration	2	Teamwork and Collaboratio n	0

The primary skill shift noted here is in technical abilities, spotlighting the emphasis on managing complex elements within the supply chain, which suggests a greater importance placed on technical proficiency rather than a commitment to ongoing education. Skills in detailed machining and precise measurement are becoming increasingly vital as manufacturing specifications grow more stringent and products more complex. A comprehensive knowledge of a broad spectrum of materials, from metals to composites, becomes critical as the materials utilized in manufacturing diversify.

The movement towards greater precision in parts for the nuclear sector and other fields demands that machinists maintain exceptional levels of skill on tools. The rising prevalence of automation and digital fabrication methods calls for machinists to keep pace with evolving technologies. Furthermore, the incorporation of sophisticated and varied materials in production requires an extensive understanding of the characteristics of materials and the methods for machining them.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Machine Operators and Industrial Painters

The following section includes the top 10 skills for the machine operators and industrial painters group of occupations below:

- 94100 Machine operators, mineral and metal processing
- 94103.01 Concrete products forming and finishing machine operators and workers
- 94213.01 Industrial painters and coaters

Table 6: Top 10 skills from machine operators and industrial painters group of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Adaptability	Independence	2	Independence	0	Independence	0
2	Attention to Detail	Adaptability	-1	Adaptability	0	Adaptability	0
3	Independence	Attention to Detail	-1	Attention to Detail	0	Attention to Detail	0
4	Professional Composure	Professional Composure	0	Professional Composure	0	Professional Composure	0
5	Physical Abilities	Physical Abilities	0	Psychomotor Abilities	1	Psychomotor Abilities	0
6	Psychomotor Abilities	Psychomotor Abilities	0	Physical Abilities	-1	Physical Abilities	0
7	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job	0	Skill to Use the Tools Necessary for the Job	0	Skill to Use the Tools Necessary for the Job	0
8	Sensory Abilities	Sensory Abilities	0	Teamwork and Collaboration	5	Teamwork and Collaboration	0
9	Leadership Skills	Numeracy	9	Sensory Abilities	-1	Sensory Abilities	0
10	Skill Needed to Judge Quality	Leadership Skills	-1	Numeracy	-1	Numeracy	0

Two key observations can be drawn from the data provided. Firstly, there is a noticeable shift towards valuing numeracy and autonomy, moving away from a previous emphasis on the skills required for quality assessment. Secondly, as time evolves, the significance of teamwork and collaboration is becoming more pronounced. The potential ramifications of these trends include an enhanced focus on digitalization, which could bolster team collaboration and collective work dynamics.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Helpers and Labourers

The following section includes the top 10 skills for the helpers and labourers group of occupations below:

- 75110 Construction trades helpers and labourers
- 75119 Other trades helpers and labourers
- 95101 Labourers in metal fabrication

Table 7: Top 10 skills for the helpers and labourers group of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Physical Abilities	Physical Abilities	0	Physical Abilities	0	Physical Abilities	0
2	Psychomotor Abilities	Psychomotor Abilities	0	Teamwork and Collaboration	1	Teamwork and Collaboratio n	0
3	Teamwork and Collaboration	Teamwork and Collaboration	0	Psychomotor Abilities	-1	Psychomot or Abilities	0
4	Adaptability	Adaptability	0	Reading Skill	4	Reading Skill	0
5	Sensory Abilities	Sensory Abilities	0	Adaptability	-1	Adaptability	0
6	Skill to Use the Tools Necessary for the Job	Communication Skill	15	Skill to Use the Tools Necessary for the Job	5	Skill to Use the Tools Necessary for the Job	0
7	Cognitive Abilities	Writing Skill	23	Communication Skill	-1	Communica tion Skill	0
8	Professional Composure	Reading Skill	19	Technical Skill	1	Technical Skill	0
9	Commitment to Lifelong Learning	Technical Skill	5	Problem Solving	4	Problem Solving	0
10	Skill Needed to Judge Quality	Professional Composure	-2	Writing Skill	-3	Writing Skill	0

The current data trends reveal an increasing focus on communication skills, such as speaking, writing, and reading capabilities. This development indicates a shifting preference towards individuals who can manage complex communication tasks over those who merely have the technical skills and equipment necessary for the role. This shift underscores the critical role of communication skills, particularly in areas like workplace safety, which involves understanding and implementing safe operating procedures, gaining a thorough knowledge of safety guidelines, and consistently following safety protocols.

Furthermore, the evolving job landscape requires workers to be both versatile and adaptable, as they may need to handle a diverse array of tasks within projects. The growing intricacy of construction and fabrication projects demands the ability to address unique challenges that arise.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Engineering Technologists

The following section includes the top 10 skills for the engineering technologist group of occupations below:

- 22101.01 Geological and mineral technologists
- 22301.01 Mechanical engineering technologists
- 22302.01 Industrial engineering and manufacturing technologists
- 22310.01 Electrical and electronics engineering technologists

Table 8: Top 10 skills for the engineering technologists group of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Attention to Detail	Attention to Detail	0	Attention to Detail	0	Attention to Detail	0
2	Adaptability	Adaptability	0	Digital Literacy	4	Digital Literacy	0
3	Numeracy	Numeracy	0	Skill to Use the Tools Necessary for the Job	2	Skill to Use the Tools Necessary for the Job	0
4	Skill to Use the Tools Necessary for the Job	Skill Needed to Evaluate Alternatives	1	Adaptability	-2	Adaptability	0
5	Skill Needed to Evaluate Alternatives	Skill to Use the Tools Necessary for the Job	-1	Creativity and Innovation	6	Creativity and Innovation	0
6	Skill to Conduct Work Design	Digital Literacy	17	Numeracy	-3	Numeracy	0
7	Skill to Design a System	Skill to Conduct Work Design	-1	Skill Needed to Evaluate Alternatives	-3	Skill Needed to Evaluate Alternatives	0
8	Technical Skill	Skill to Design a System	-1	Reading Skill	9	Reading Skill	0
9	Independence	New Relevant Knowledge	2	Problem Solving	1	Problem Solving	0
10	Leadership Skills	Problem Solving	15	Skill to Conduct Work Design	-3	Skill to Conduct Work Design	0

There are two notable developments in the realm of engineering technologies that warrant attention. Firstly, digital literacy and problem-solving skills are becoming increasingly important in manufacturing environments, signifying a significant shift towards digitalization and the complexities it introduces to the workplace.

Although not shown on this table, other significant changes in comparison to the OaSIS data is a significant increase in importance of reading and communication skills.

Regarding technical skills and specialization: As technology evolves, having specialized knowledge in domains such as data analysis, CAD software, or particular engineering instruments is becoming more essential.

Additionally, the escalating complexity of engineering projects necessitates enhanced creativity and innovation as well as the ability to read and understand complicated project documentation.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Engineering

The following section includes the top 10 skills for the engineering grouping of occupations below:

- 21301 Mechanical engineers
- 21310 Electrical and electronics engineers
- 21330 Mining engineers
- 22211 Industrial designers

Table 9: Top 10 skills for the engineering grouping of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Attention to Detail	Attention to Detail	0	Attention to Detail	0	Attention to Detail	0
2	Skill to Conduct Work Design	Skill to Conduct Work Design	0	Skill to Conduct Work Design	0	Skill to Conduct Work Design	0
3	Numeracy	Numeracy	0	Numeracy	0	Numeracy	0
4	Critical Thinking Skills	Decision Making Skill	1	Problem Solving	2	Problem Solving	0
5	Decision Making Skill	Critical Thinking Skills	-1	Skill to Design a System	2	Skill to Design a System	0
6	Reading Skill	Problem Solving	4	Critical Thinking Skills	-1	Critical Thinking Skills	0
7	Skill to Design a System	Skill to Design a System	0	Decision Making Skill	-3	Decision Making Skill	0
8	Creativity and Innovation	Skill Needed to Evaluate Alternatives	3	Creativity and Innovation	1	Creativity and Innovation	0
9	Independence	Creativity and Innovation	-1	Skill Needed to Evaluate Alternatives	-1	Skill Needed to Evaluate Alternatives	0
10	Problem Solving	Reading Skill	-4	Technical Skill	4	Technical Skill	0

The table presented does not show any significant departure from the standard OaSIS data concerning engineering skills, suggesting that companies might not anticipate substantial changes in the engineering field over time. However, there are some significant changes outside of the top 10 skills that deserve mention:

- Skill to Identify Problems at (+8) over 2024 values;
- Skill to Design Experiments at (+8) over 2024 values;
- Skill Needed to Support Supplier Development at (+7) over 2024 values; and
- Skill to Use the Tools Necessary for the Job (+9) over 2024 values.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Electrical Technicians and Mechanics

The following section includes the top 10 skills for the electrical technicians and mechanics grouping of occupations below:

- 22310.02 Electrical and electronics engineering technicians
- 22312 Industrial instrument technicians and mechanics
- 72201 Industrial electricians
- 72200 Electricians (except industrial and power system)
- 72422 Electrical mechanics

Table 10: Top 10 skills for the electrical technicians and mechanics grouping of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Attention to Detail	Attention to Detail	0	Digital Literacy	21	Digital Literacy	0
2	Adaptability	Technical Skill	3	Skill to Use the Tools Necessary for the Job	6	Skill to Use the Tools Necessary for the Job	0
3	Skill to Use the Tools Necessary for the Job	Independence	1	Attention to Detail	-2	Attention to Detail	0
4	Independence	Leadership Skills	2	Adaptability	2	Adaptability	0
5	Technical Skill	Professional Composure	2	Reading Skill	5	Reading Skill	0
6	Leadership Skills	Adaptability	-4	Technical Skill	-4	Technical Skill	0
7	Professional Composure	Commitment to Lifelong Learning	4	Teamwork and Collaboration	2	Teamwork and Collaboratio n	0
8	Numeracy	Skill to Use the Tools Necessary for the Job	-5	Independence	-5	Independen ce	0
9	Teamwork and Collaboration	Teamwork and Collaboration	0	Skill Needed to Evaluate Alternatives	3	Skill Needed to Evaluate Alternatives	0
10	Creativity and Innovation	Reading Skill	11	Creativity and Innovation	4	Creativity and Innovation	0

The table highlights notable shifts for electrical technicians and mechanics, underlining the growing importance of digital skills in the electronics sector. As the industry continues to digitize, digital proficiency is becoming increasingly critical, evidenced by the highest significance scale climbing 21 positions from 2024 to 2030.

Beyond digital literacy, there is a heightened focus on acquiring the skills required to utilize essential tools on the job. This suggests that companies are recognizing the need for more specialized tools to troubleshoot a broader range of products as original equipment manufacturers (OEMs) become more product-centric. Consequently, reading and communication skills become more necessary to read manuals and communicate with OEMs.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Development Miners

The following section includes the top 10 skills for the Development miners grouping of occupations below:

- 73402.01 Drillers - surface mining, quarrying and construction
- 83100 Underground production and development miners

Table 11: Top 10 skills for the development miners grouping of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Adaptability	Adaptability	0	Problem Solving	19	Problem Solving	0
2	Attention to Detail	Attention to Detail	0	Adaptability	-1	Adaptability	0
3	Independence	Independence	0	Attention to Detail	-1	Attention to Detail	0
4	Professional Composure	Professional Composure	0	Independence	-1	Independence	0
5	Skill to Use the Tools Necessary for the Job	Skill to Use the Tools Necessary for the Job	0	Professional Composure	-1	Professional Composure	0
6	Psychomotor Abilities	Psychomotor Abilities	0	Communication Skill	4	Communication Skill	0
7	Physical Abilities	Physical Abilities	0	Skill to Use the Tools Necessary for the Job	-2	Skill to Use the Tools Necessary for the Job	0
8	Teamwork and Collaboration	Skill to Identify Problems	7	Psychomotor Abilities	-2	Psychomotor Abilities	0
9	Leadership Skills	Teamwork and Collaboration	-1	Physical Abilities	-2	Physical Abilities	0
10	Sensory Abilities	Communication Skill	15	Decision Making Skill	1	Decision Making Skill	0

The data presented shows minimal deviation from the standard OaSIS benchmarks for development miners. Yet, there is a noticeable shift towards valuing skills necessary for problem identification and communication over sensory abilities and leadership qualities.

This shift reflects a broader industry anticipation that underground and mining conditions will become more intricate and challenging. Consequently, the most notable change from 2024 to 2030 highlighted in the data is the heightened importance placed on problem-solving skills, suggesting a strategic industry response to the expected complexities in future mining environments. Supporting this view, digital literacy, critical thinking, skills to plan a program, all make significant increases outside of the top 10.

Lastly, of note the following also made significant increases in importance outside of the top 10: social responsibility (+21), writing skills (+17), and reading skills (+17).

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Contractors and Supervisors

The following section includes the top 10 skills for the Contractors and supervisors grouping of occupations below:

- 72020 Contractors and supervisors, mechanic trades
- 72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations
- 72011 Contractors and supervisors, electrical trades and telecommunications occupations

Table 12: Top 10 skills for the contractors and supervisors grouping of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Professional Composure	Professional Composure	0	Professional Composure	0	Professional Composure	0
2	Adaptability	Adaptability	0	Adaptability	0	Adaptability	0
3	Attention to Detail	Attention to Detail	0	Attention to Detail	0	Attention to Detail	0
4	Independence	Independence	0	Independence	0	Independence	0
5	Leadership Skills	Leadership Skills	0	Leadership Skills	0	Leadership Skills	0
6	Project Management Skill	Project Management Skill	0	Project Management Skill	0	Project Management Skill	0
7	Teamwork and Collaboration	Teamwork and Collaboration	0	Skill to Conduct Work Design	1	Skill to Conduct Work Design	0
8	Initiative	Skill to Conduct Work Design	4	Teamwork and Collaboration	-1	Teamwork and Collaboration	0
9	Skill to Use the Tools Necessary for the Job	Initiative	-1	Technical Skill	3	Technical Skill	0
10	Creativity and Innovation	Skill to Use the Tools Necessary for the Job	-1	Communication Skill	8	Communication Skill	0

The table above suggests that the roles of contractors and supervisors are expected to remain relatively stable over the years. However, there is a notable trend towards the increasing importance of strong communication skills as time progresses.

In terms of leadership and communication, the ability to effectively lead teams, communicate clearly, and manage conflicts is becoming increasingly crucial as work environments evolve to be more cooperative.

Lastly, other significant increases in importance outside of the top 10 are: reading skills (+8), writing skills at (+13), and digital literacy at (+14)

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Assemblers – electrical and mechanical

The following section includes the top 10 skills for the electrical and mechanical grouping of occupations below:

- 94202.01 Assemblers, electrical appliance, apparatus and equipment manufacturing
- 94204.01 Mechanical assemblers

Table 13: Top 10 skills for the electrical and mechanical grouping of occupations

Top 10	OaSIS	2024	Change in Position	2030	Change in Position from 2024	2040	Change in Position from 2030
1	Attention to Detail	Problem Solving	14	Adaptability	3	Adaptability	0
2	Independence	Reading Skill	14	Problem Solving	-1	Problem Solving	0
3	Teamwork and Collaboration	Teamwork and Collaboration	0	Reading Skill	-1	Reading Skill	0
4	Psychomotor Abilities	Adaptability	3	Teamwork and Collaboration	-1	Teamwork and Collaboration	0
5	Professional Composure	Attention to Detail	-4	Technical Skill	11	Technical Skill	0
6	Skill to Use the Tools Necessary for the Job	Communication Skill	26	Attention to Detail	-1	Attention to Detail	0
7	Adaptability	Writing Skill	32	Communication Skill	-1	Communication Skill	0
8	Physical Abilities	Psychomotor Abilities	-4	Digital Literacy	9	Digital Literacy	0
9	Sensory Abilities	Sensory Abilities	0	Psychomotor Abilities	-1	Psychomotor Abilities	0
10	Commitment to Lifelong Learning	Creativity and Innovation	25	Skill Needed to Judge Quality	13	Skill Needed to Judge Quality	0

The significant prevalence of high-mix, low-volume work within the supply chain has led to notable deviations from the standard OaSIS data for both electrical and mechanical assemblers. There is a marked preference for skills such as adaptability, problem-solving, effective communication, writing, and notably, creativity and innovation. These competencies are particularly beneficial for roles that vary daily, unlike repetitive assembly line tasks. Interestingly, there was a lesser focus on lifelong learning and independence, which could be attributed to the continued emphasis on teamwork and collaboration.

Concerning quality control, the rising standards for products, and increasing complexity of parts, necessitate a deeper understanding and implementation of stringent quality control protocols by assemblers.

Regarding technical literacy, the ability to comprehend technical documentation and specifications is becoming increasingly vital as the complexity of products and processes escalates.

For a detailed breakdown of the 41 skills and their respective proficiencies, please see the corresponding appendix.

Conclusions

The skill trend analysis presents an insightful view into the evolving landscape of workforce competencies across various occupational categories. Here are some key conclusions and trends drawn from the analysis:

1. **Shifting Priorities Across Occupations**: There's a clear shift from basic, adaptable skills to more specialized technical competencies across occupations. This reflects a broader industry trend towards embracing complex, technology-driven environments, particularly noticeable in fields like welding and heavy-duty mechanics.

2. **Increased Emphasis on Technical Skills and Digital Proficiency**: Nearly all sectors show a growing importance of technical skills, underlining the need for workers to keep pace with technological advancements. This is particularly evident in roles such as machinists, where understanding specifications and precision in manufacturing are becoming increasingly crucial.

3. **The Rise of Soft Skills**: Despite the technological tilt, there's an evident rise in the value of soft skills such as communication, problem-solving, and teamwork. These skills are becoming essential across the board, from helpers and labourers to engineering technologists, indicating a shift towards more collaborative and versatile workplace dynamics.

4. **Specialization and Problem-Solving in Niche Areas**: Certain fields are experiencing a more pronounced shift towards specialized knowledge and problem-solving abilities, especially where predictive maintenance, digital fabrication, and complex project management are concerned.

5. **Stability vs. Evolution in Skill Demands**: While some areas like engineering show a stable demand for existing skills, others like electrical technicians and mechanics are undergoing significant changes, emphasizing the need for ongoing learning and adaptation.

6. **Rise of Adaptability as a required Skill**: Assemblers, both electrical and mechanical, highlight a departure from routine tasks towards roles requiring adaptability, creativity, and problem-solving, pointing towards a flexible and innovative approach to work.

7. **Communication as a Core Competency**: Across various occupational categories, effective communication is increasingly recognized as a critical skill, essential for safety, teamwork, and efficiency. This trend underscores the importance of interpersonal skills in a technologically advancing world.

8. **Integration of Digital Tools and Analytics**: The incorporation of digital tools, analytics, and data-driven maintenance strategies is reshaping the skillsets required in sectors like heavy-duty mechanics and engineering technologies, aligning with the broader digital transformation trends.

Recommendations

The Skill Trend Analysis highlights the shifting requirements of the workforce, emphasizing the growing need for advanced, specialized skills, particularly in digital areas, alongside the enduring importance of interpersonal abilities. Business, academic, and governmental entities must respond to these changes by tailoring their training and development programs to meet the anticipated needs of the market, thus boosting industry competitiveness. The looming retirement of a large segment of the workforce, especially those from the baby boomer generation, is expected to result in a significant gap in skilled labor, adding urgency to this issue. In light of these factors, the following recommendations are proposed:

Utilise Opportunities in Sectoral Shifts: Changes in the automotive industry, especially the transition towards electric vehicle production, are anticipated to streamline manufacturing processes, which is expected to reduce part counts and impact traditional manufacturing methods[x]. These present opportunities to encourage workforce migration to areas with more affordable living costs, such as Saskatchewan. The integration of technologies like machine learning and AI offers a chance to alter the traditional perceptions of the manufacturing and mining sectors, making them more attractive to a broader demographic that previously might not have considered such careers.

Adopt a skills-based approach: Adopting a skills-based approach to workforce development, as recommended in various industry studies such as "Saskatchewan mining and metals labour market report", is essential for meeting the evolving demands of the supply chain.

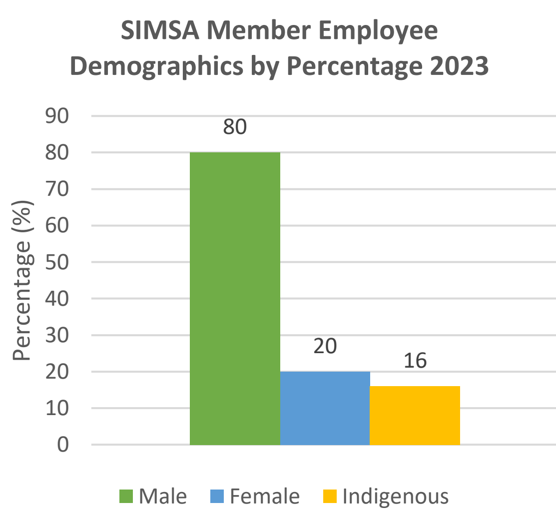


Figure 3: Source SIMSA member survey 2022

Promote Diversity and Inclusion for Growth: The sectors' labor needs could be alleviated, at least partially, by increasing the involvement of underrepresented groups, such as Indigenous peoples and women, in manufacturing and mining workforce as shown in Figure 3.

Embrace Innovative Solutions to Skill Development: The industry must embrace a culture that promotes innovation and creative solutions to the looming crisis. The increasing value placed on problem-solving and adaptability across various job roles necessitates a united effort from all industry stakeholders to cultivate these skills within the workforce, ensuring readiness to meet future challenges in the supply chain.

Appendices

Appendix A: Sector Occupation Breakdown

Table 14: Breakdown of occupations by sector

Sector Codes	Sector Descriptions	Occupation Description	Actual
335	Electrical equipment, appliance and component manufacturing	Assemblers, electrical appliance, apparatus and equipment manufacturing	1
		Contractors and supervisors, electrical trades and telecommunications occupations	2
332	Fabricated metal product manufacturing	Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	2
		Industrial painters and coaters	1
		Labourers in metal fabrication	5
		Machinists	2
		Welders	8
333	Machinery manufacturing	Electrical and electronics engineering technicians	1
		Electrical and electronics engineering technologists	1
		Electrical and electronics engineers	1
		Electrical mechanics	2
		Heavy-duty equipment mechanics	1
		Industrial designers	1
		Industrial electricians	1
		Industrial engineering and manufacturing technologists	1
		Industrial instrument technicians and mechanics	1
		Labourers in metal fabrication	1
		Machine operators, mineral and metal processing	1
		Machinists	2
		Mechanical assemblers	1
		Mechanical engineers	1
		Welders	3
339	Miscellaneous manufacturing	Concrete products forming and finiching machine operators and workers	2
		Construction trades helpers and labourers	3
		Contractors and supervisors, mechanic trades	2
		Electrical and electronics engineering technicians	1
		Electricians (except industrial and power system)	2
		Heavy-duty equipment mechanics	1

		Machine operators, mineral and metal processing	1
		Machinists	1
		Mechanical engineering technologists	1
		Mining engineers	1
		Underground production and development miners	1
		Welders	3
327	Non-metallic mineral product manufacturing	Construction trades helpers and labourers	1
		Contractors and supervisors, mechanic trades	1
		Drillers - surface mining, quarrying and construction	1
		Electrical and electronics engineering technologists	1
		Geological and mineral technologists	1
		Mine labourers	1
324	Petroleum and coal product manufacturing	Construction trades helpers and labourers	1
		Welders	1
331	Primary metal manufacturing	Industrial painters and coaters	1
		Labourers in metal fabrication	1
		Machinists	1
		Other trades helpers and labourers	1
		Welders	1

Appendix B: Welders

72106.01 Welders

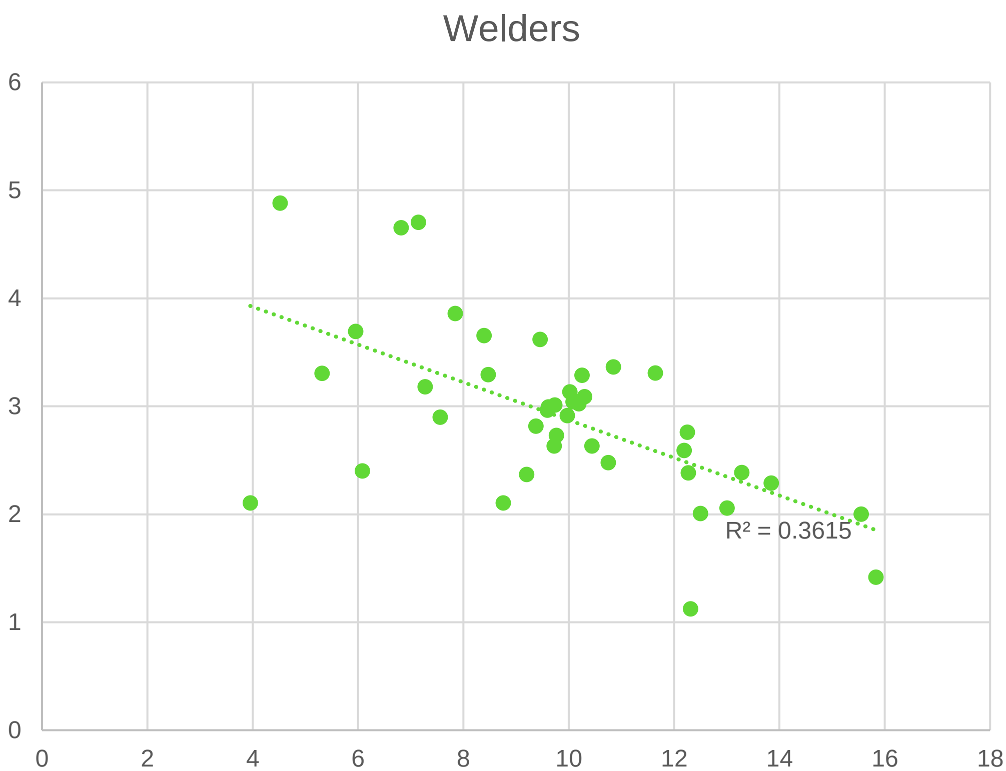


Figure 4: Sum of proficiencies versus sum of standard deviation for welders

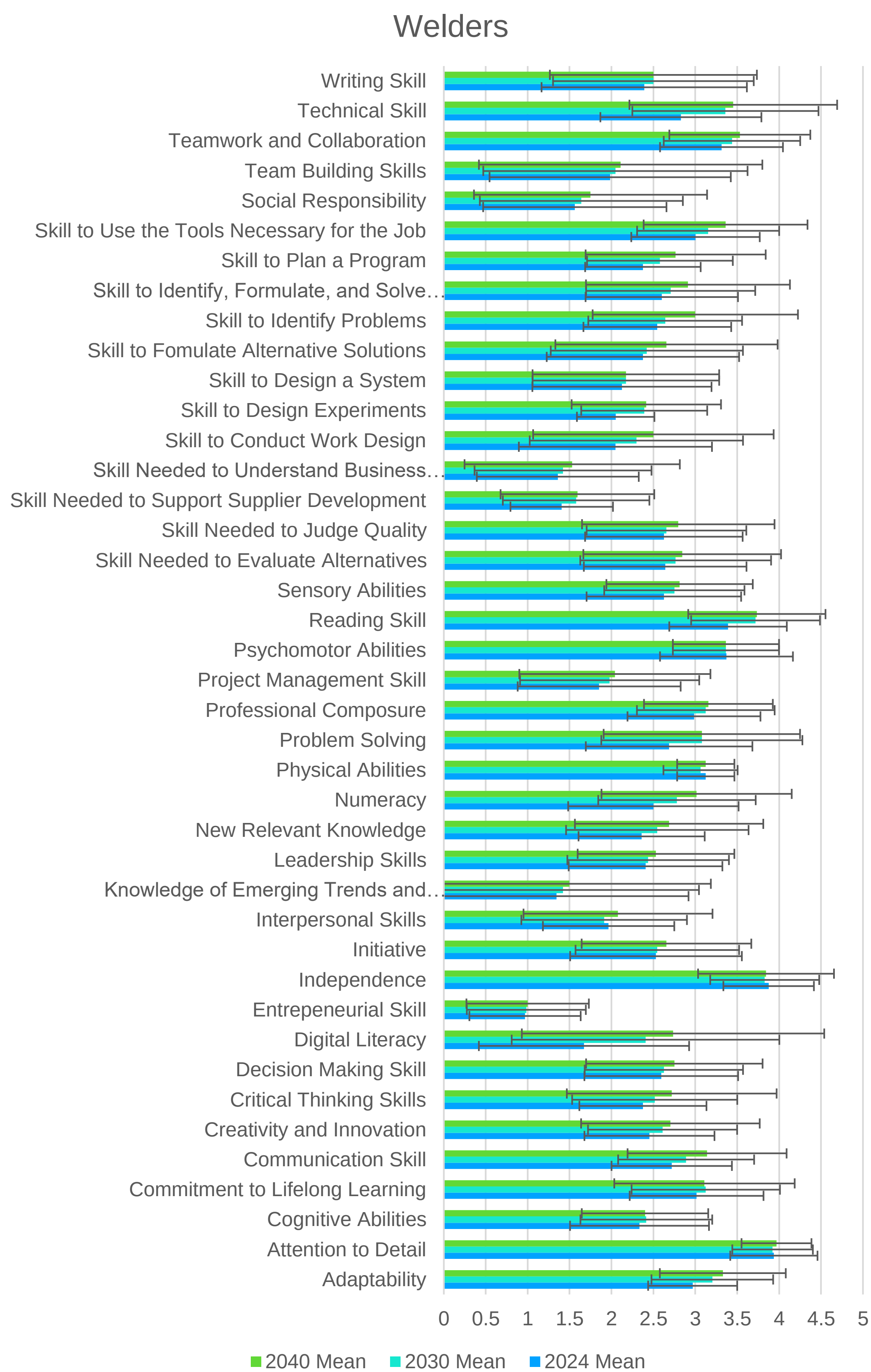


Figure 5: All 41 skills for welders by year

Appendix C: Heavy-Duty Mechanics

72100.01 Machinists

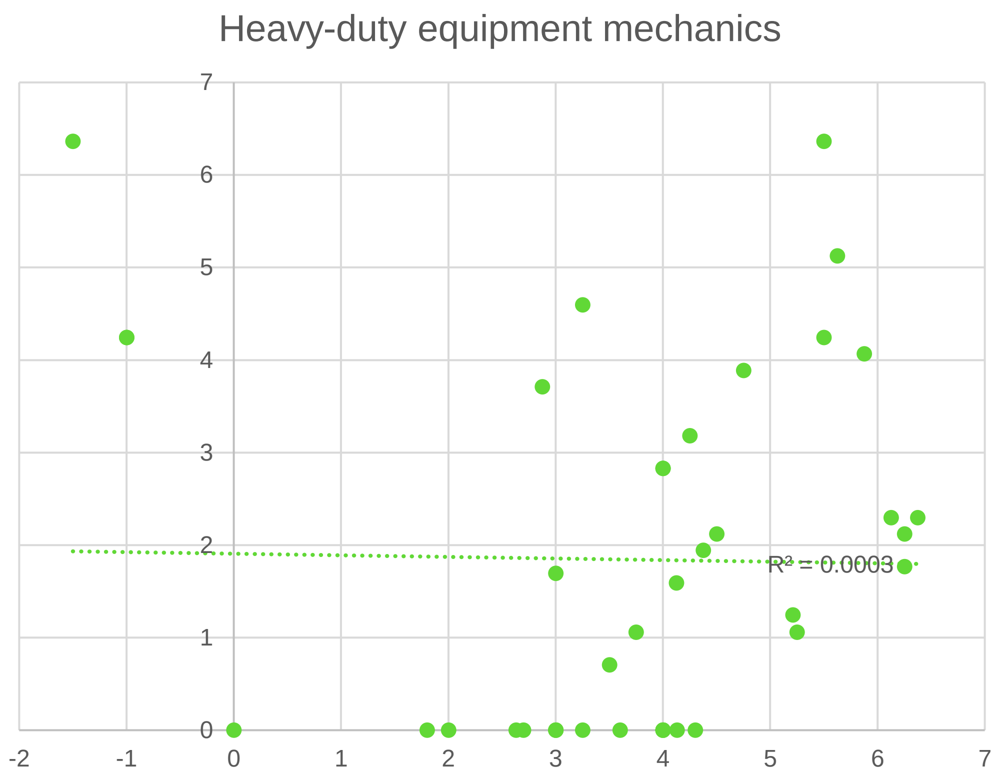


Figure 6: Sum of the proficiencies versus sum of standard deviation heavy-duty equipment mechanics

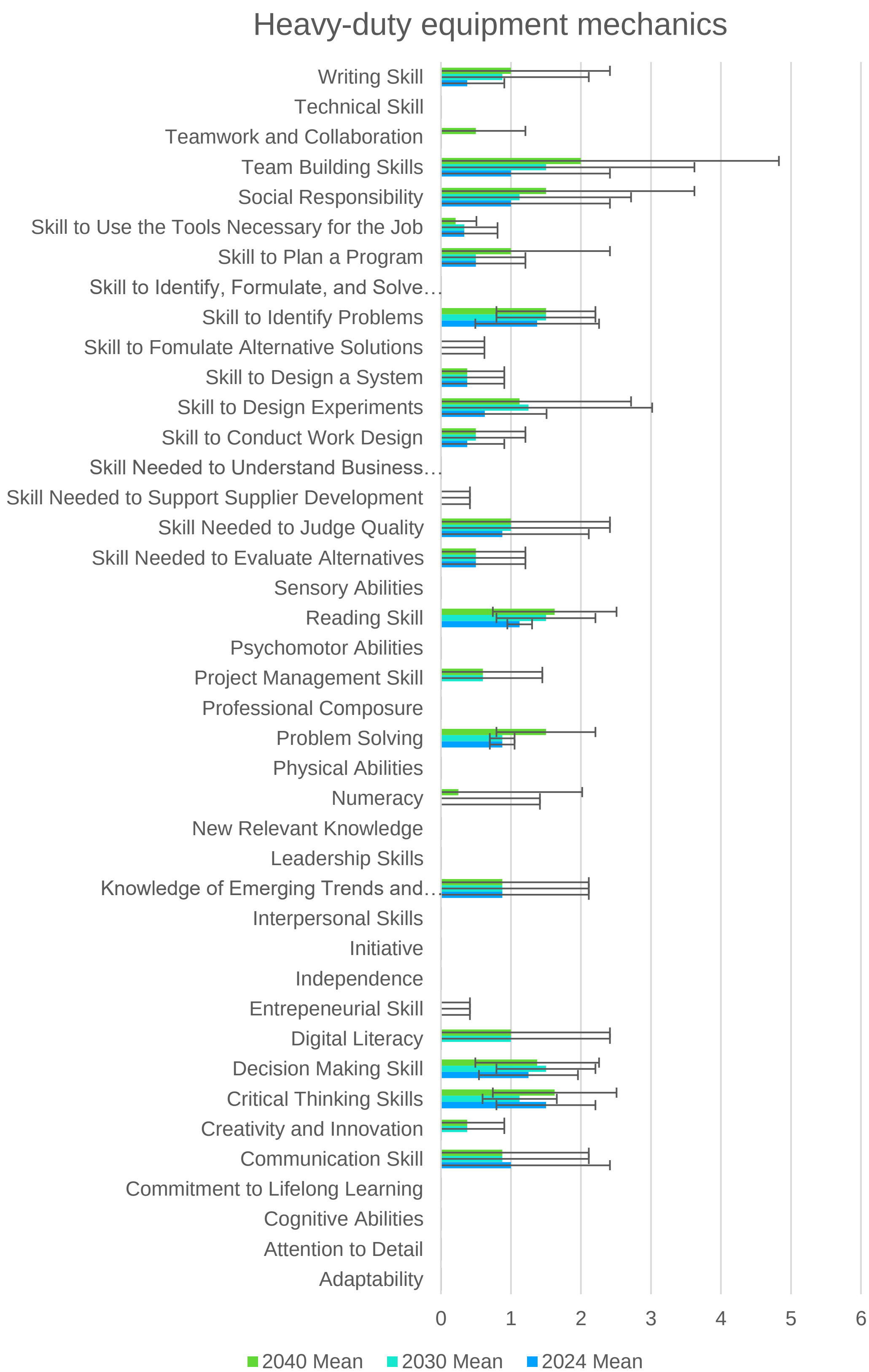


Figure 7: All 41 skills for heavy-duty equipment mechanics

Appendix D: Machinists

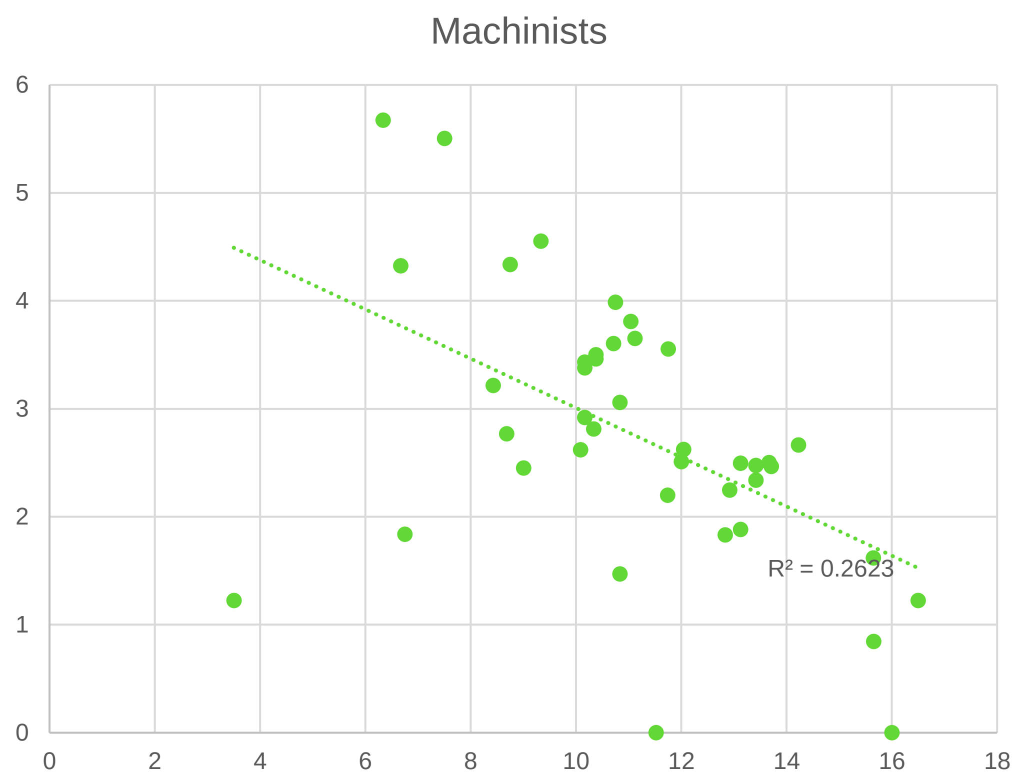


Figure 8: Sum Of proficiencies versus sum of standard deviation machinists

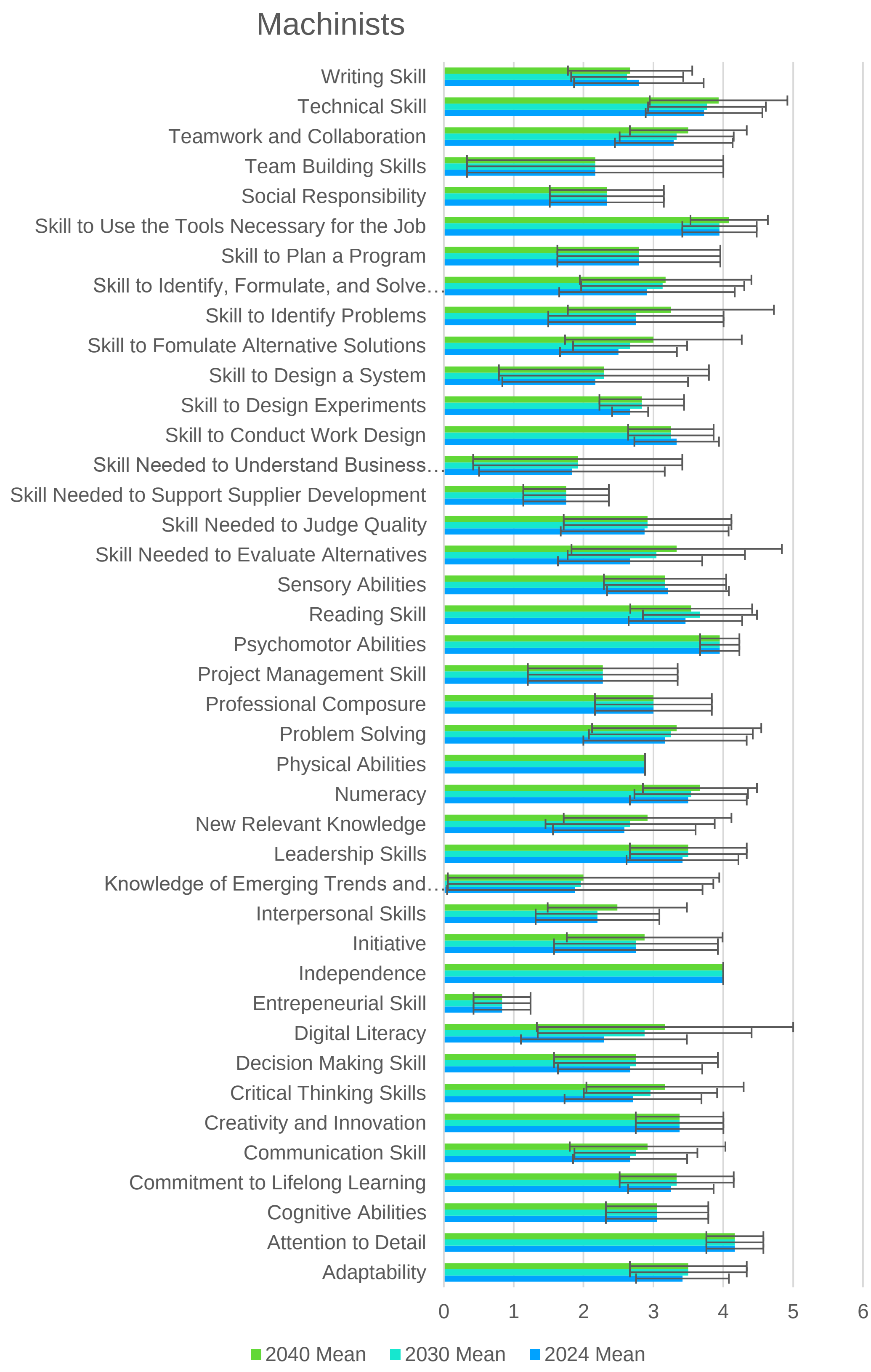


Figure 9: All 41 skills for machinists

Appendix E: Machine Operators and Industrial Painters

Machine Operators and Industrial painters group occupations:

- 94100 Machine operators, mineral and metal processing
- 94103.01 Concrete products forming and finishing machine operators and workers
- 94213.01 Industrial painters and coaters

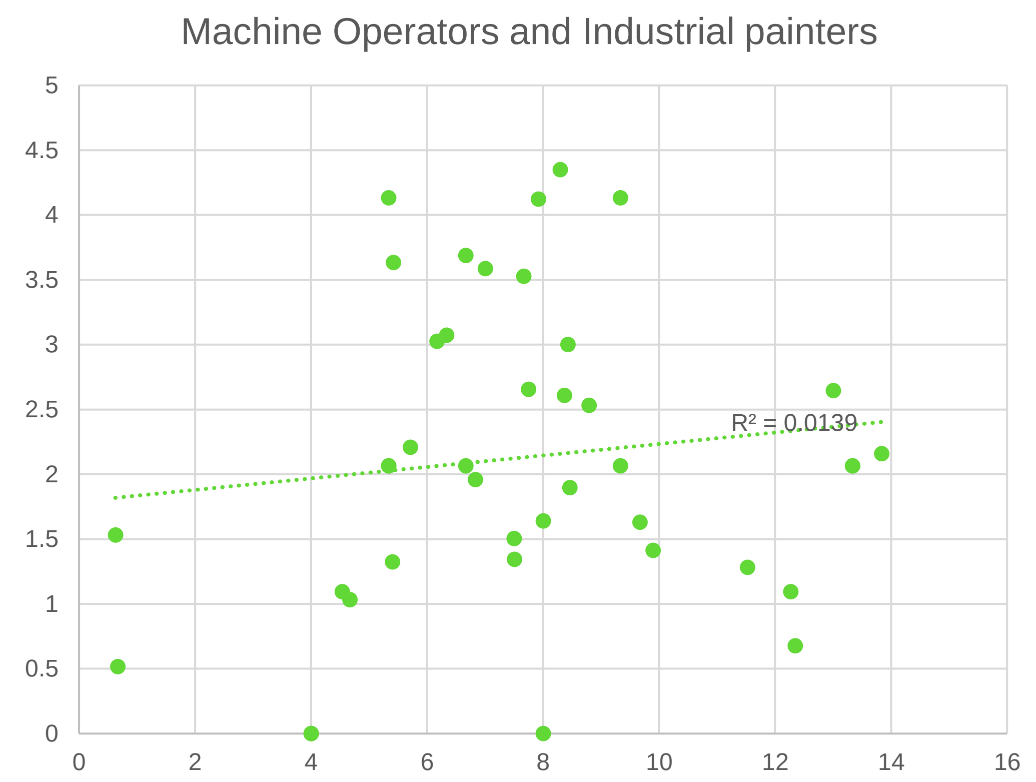


Figure 10: Sum of proficiencies versus sum of standard deviation for machine operators and industrial painters

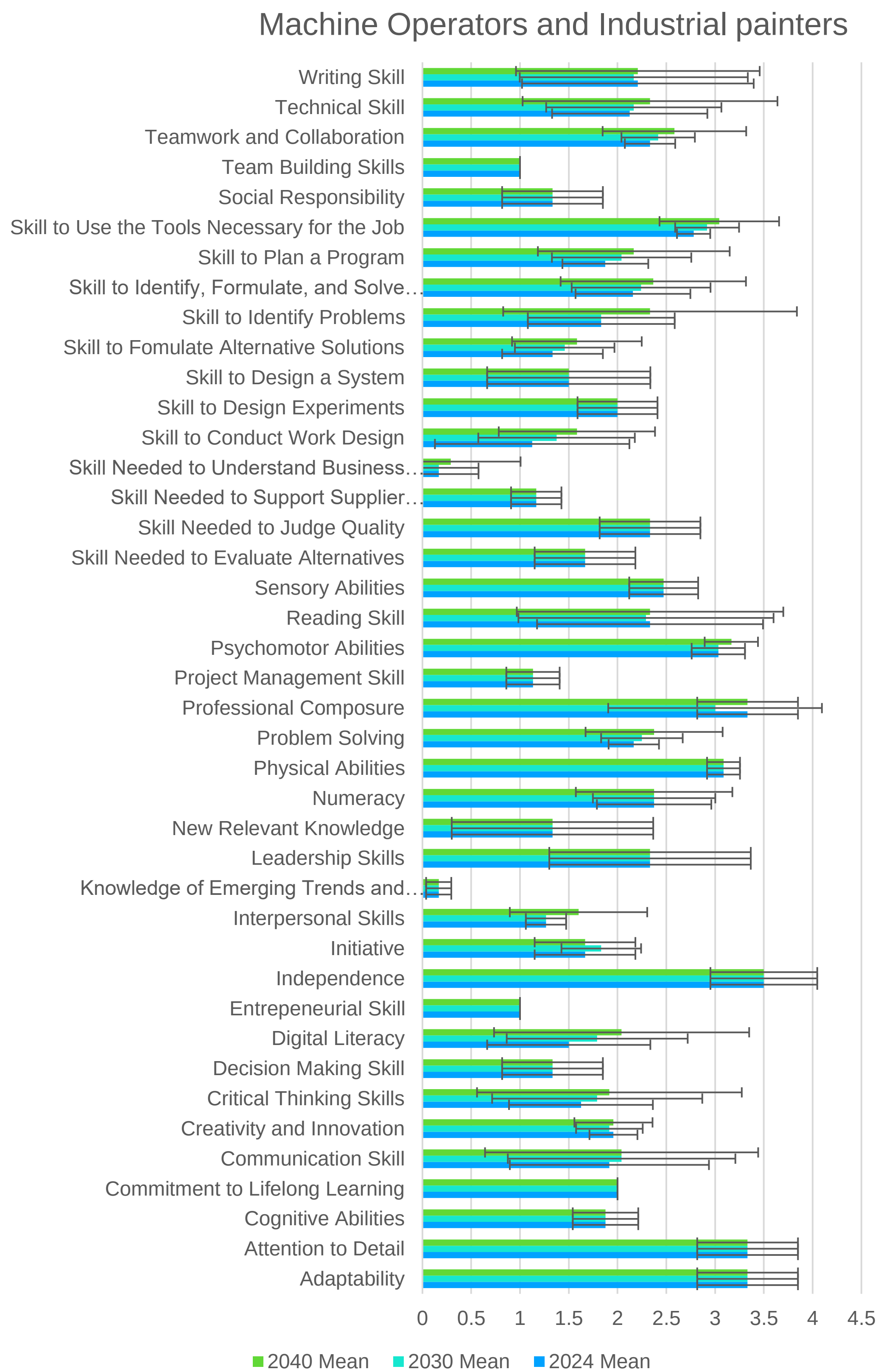


Figure 11: All 41 skills for machine operators and industrial painters

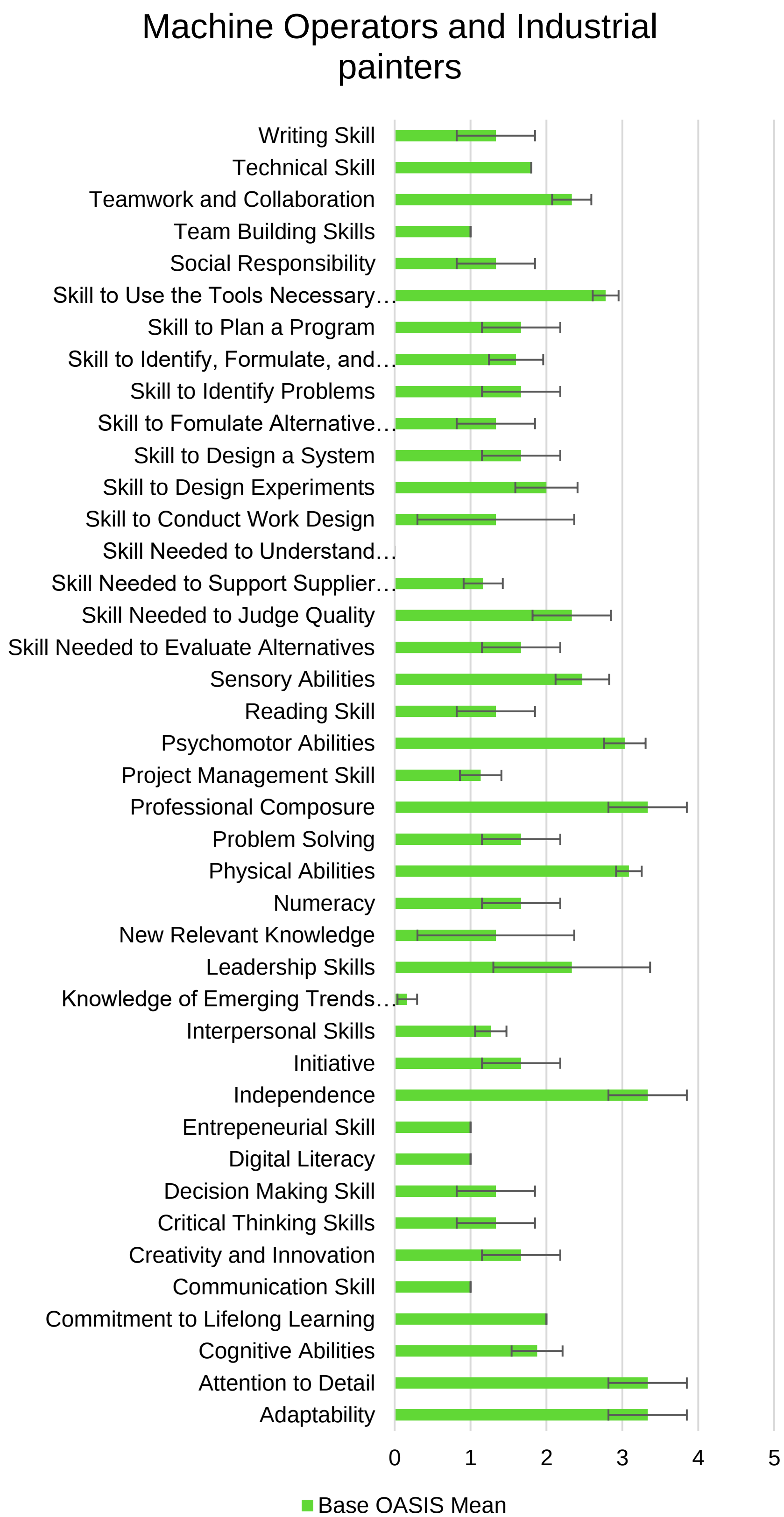


Figure 12: Standard deviation for all 41 skills at OaSIS base data For machine operators and industrial painters

Appendix F: Helpers and Labourers

Helpers and Labourers group occupations:

- 75110 Construction trades helpers and labourers
- 75119 Other trades helpers and labourers
- 95101 Labourers in metal fabrication

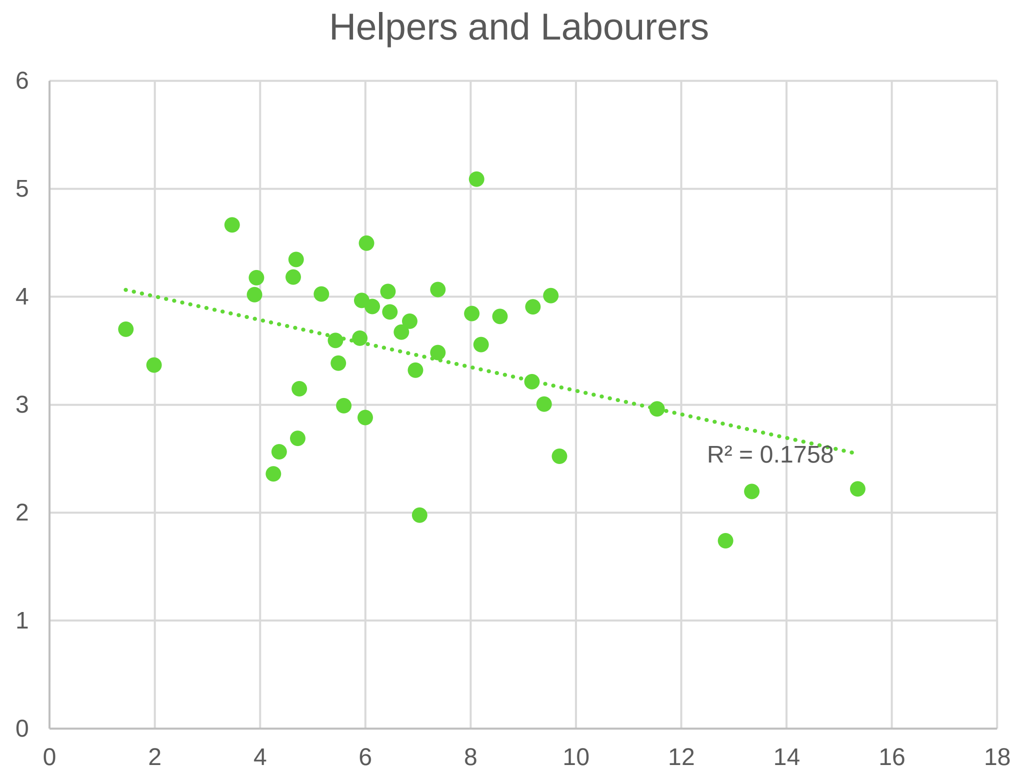


Figure 13: Sum of proficiencies versus sum of standard deviation for helpers and laborers

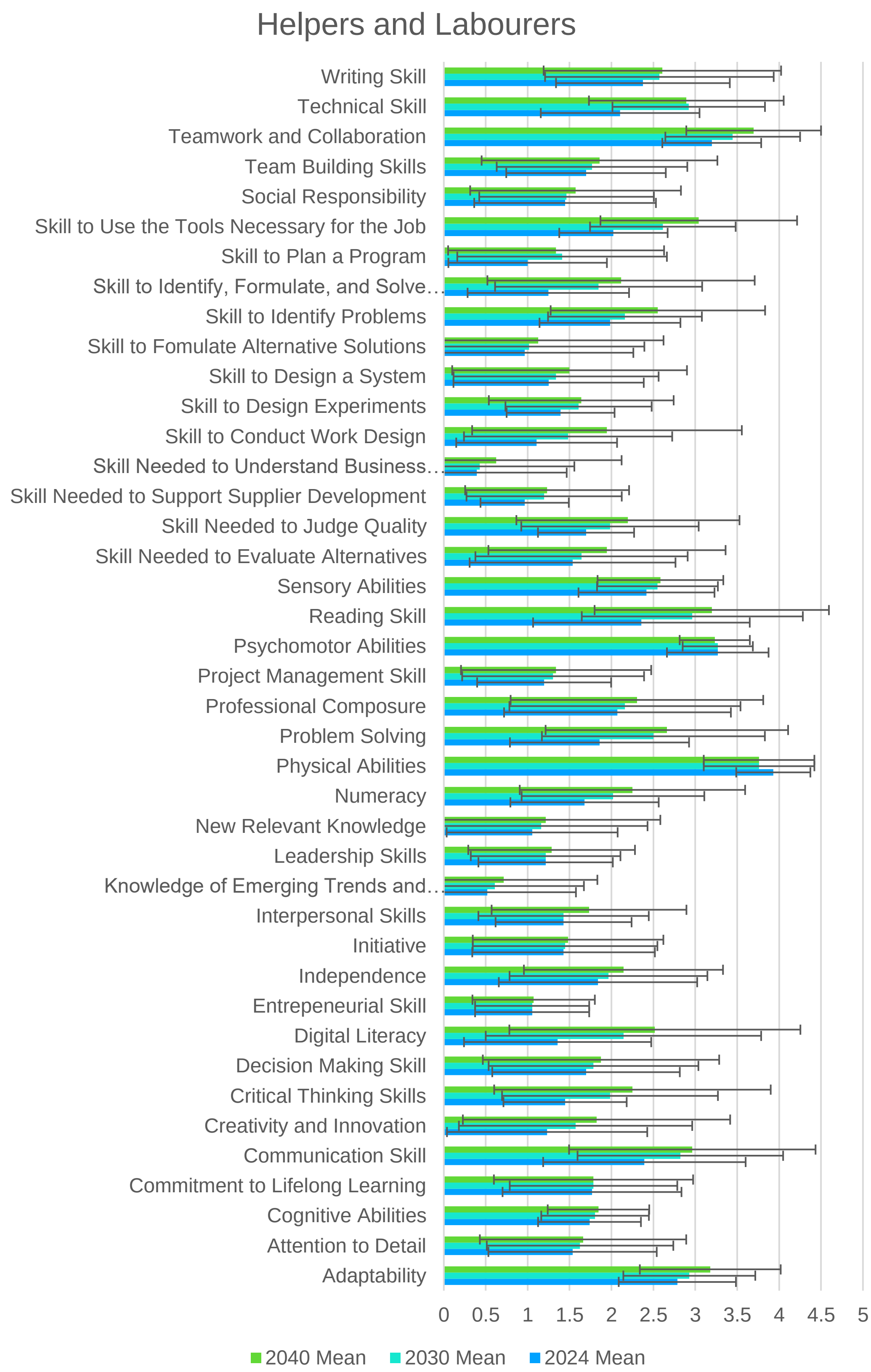


Figure 14: All 41 skills for helpers and laborers

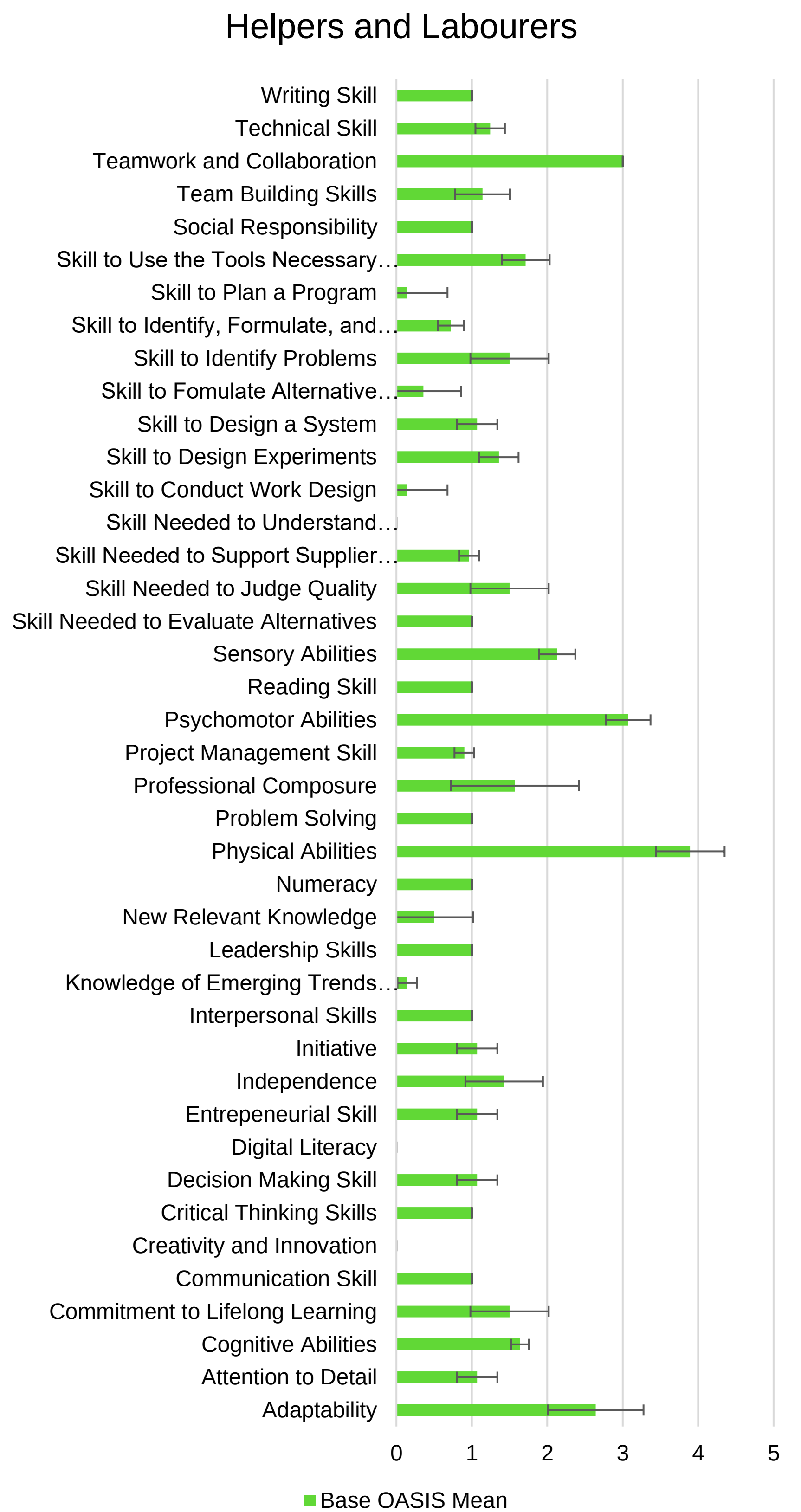


Figure 15: Standard deviation for all 41 skills at OaSIS based data for helpers and labourers

Appendix G: Engineering Technologists

Engineering Technologists group occupations:

- 22101.01 Geological and mineral technologists
- 22301.01 Mechanical engineering technologists
- 22302.01 Industrial engineering and manufacturing technologists
- 22310.01 Electrical and electronics engineering technologists

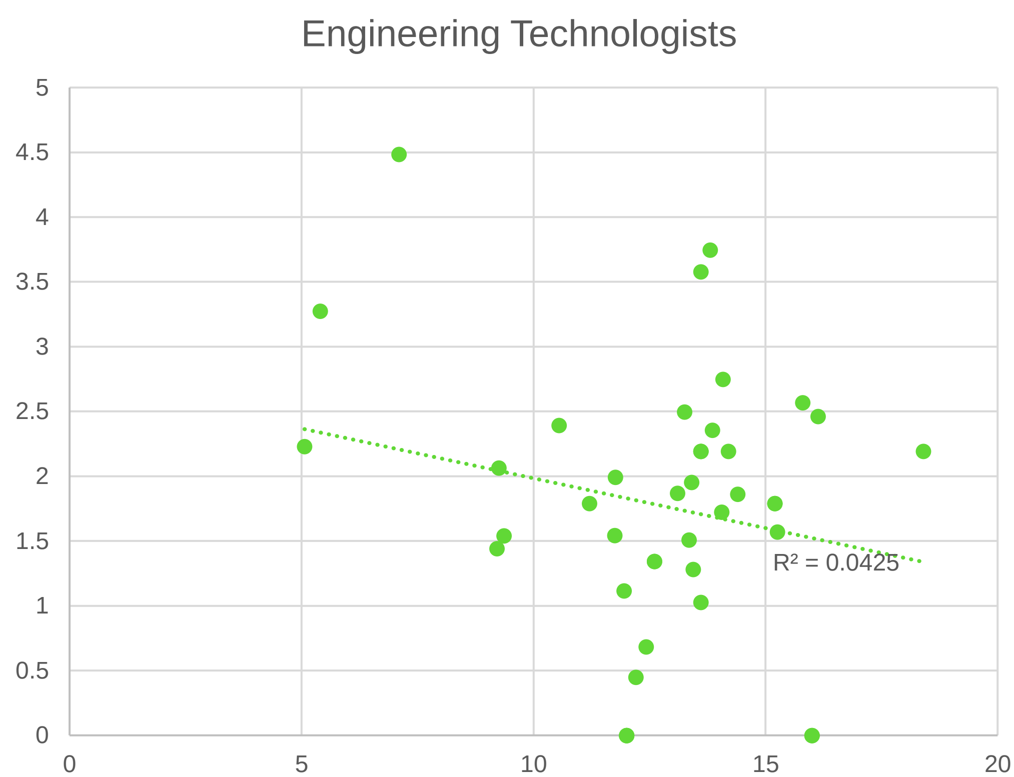


Figure 16: Sum of proficiencies versus sum of standard deviation for engineering technologists

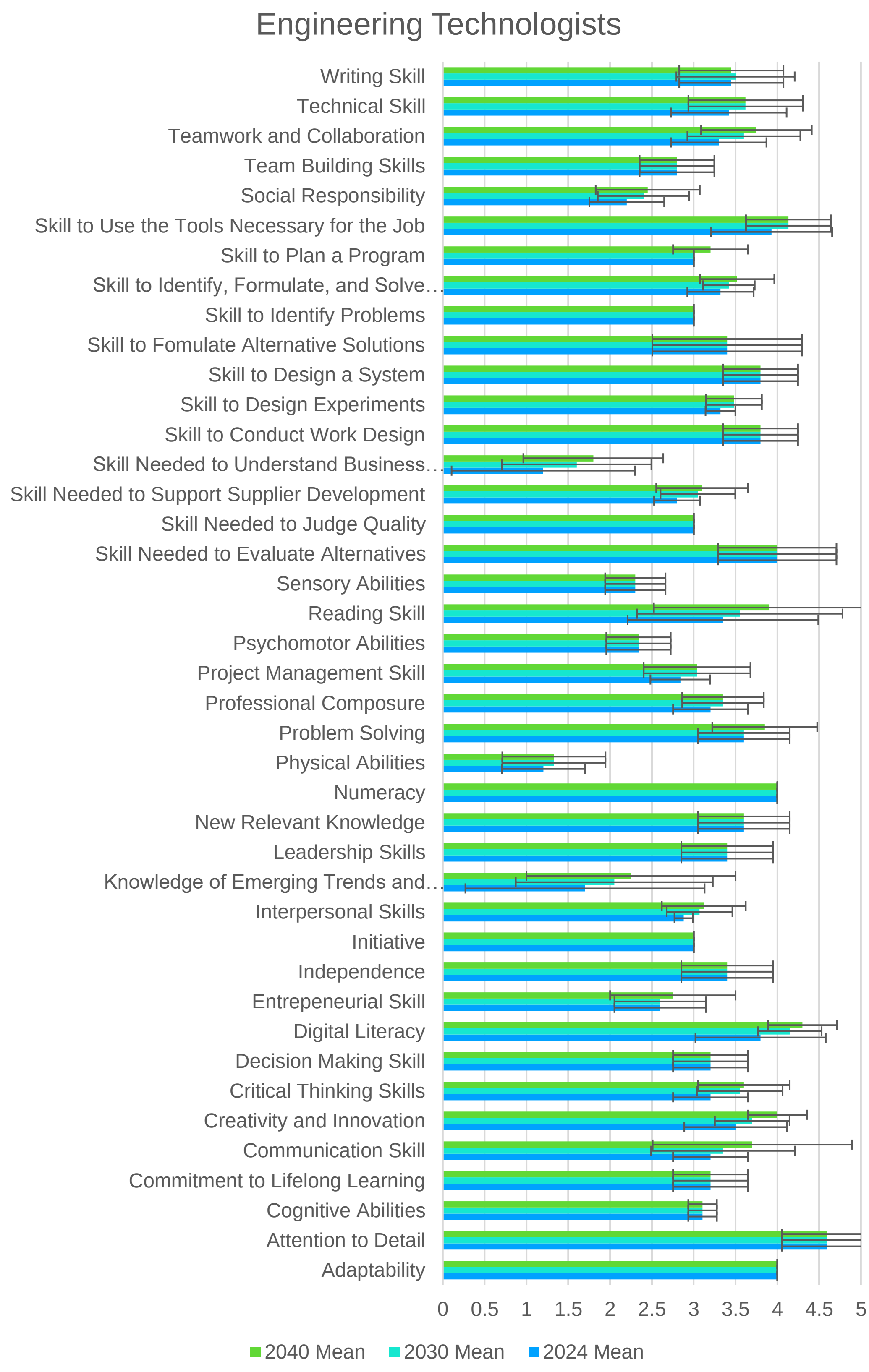


Figure 17: All 41 skills for engineering technologists

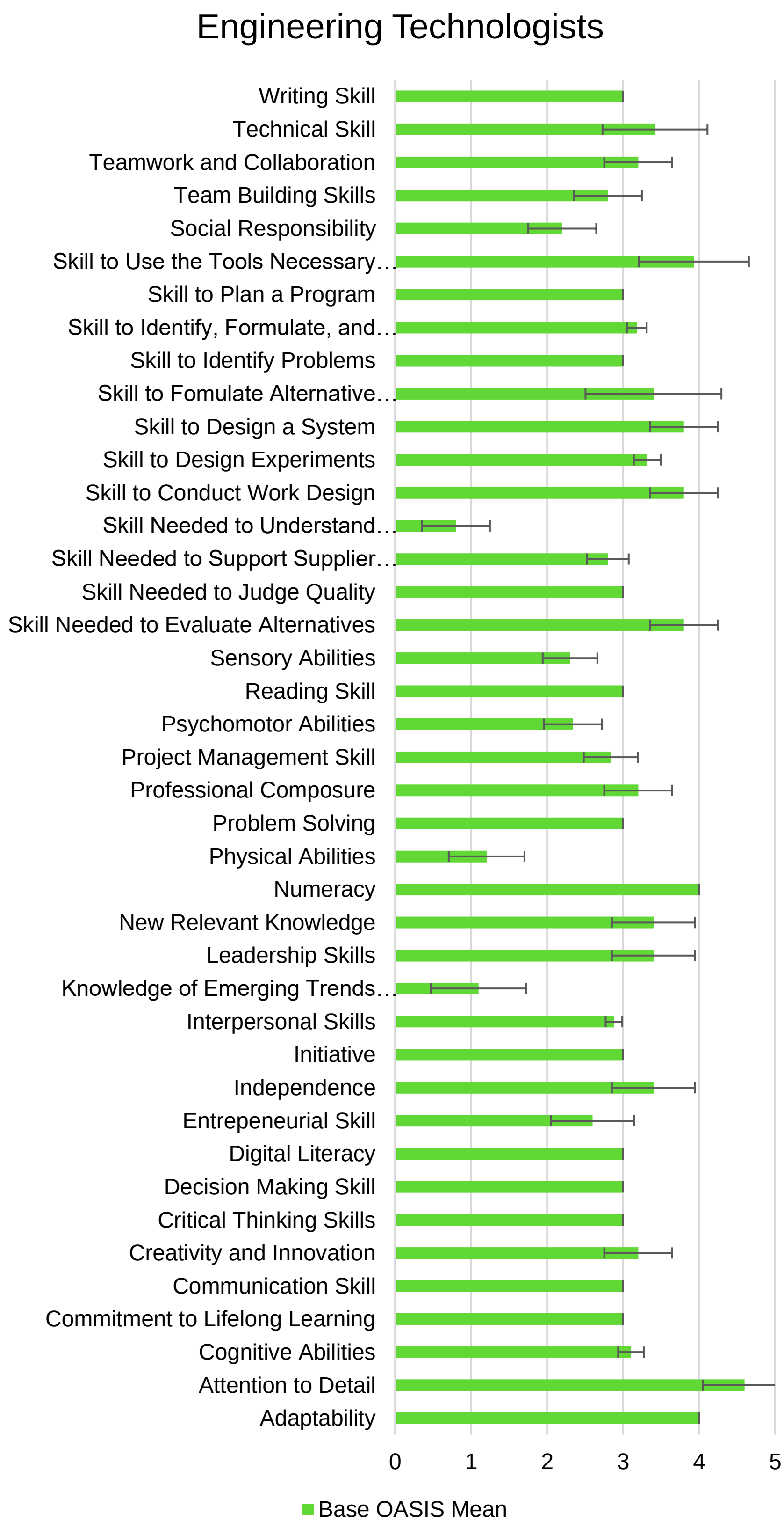


Figure 18: Standard deviation for all 41 skills at OaSIS based data for engineering technologists

Appendix H: Engineering

Engineering group occupations:

- 21301 Mechanical engineers
- 21310 Electrical and electronics engineers
- 21330 Mining engineers
- 22211 Industrial designers

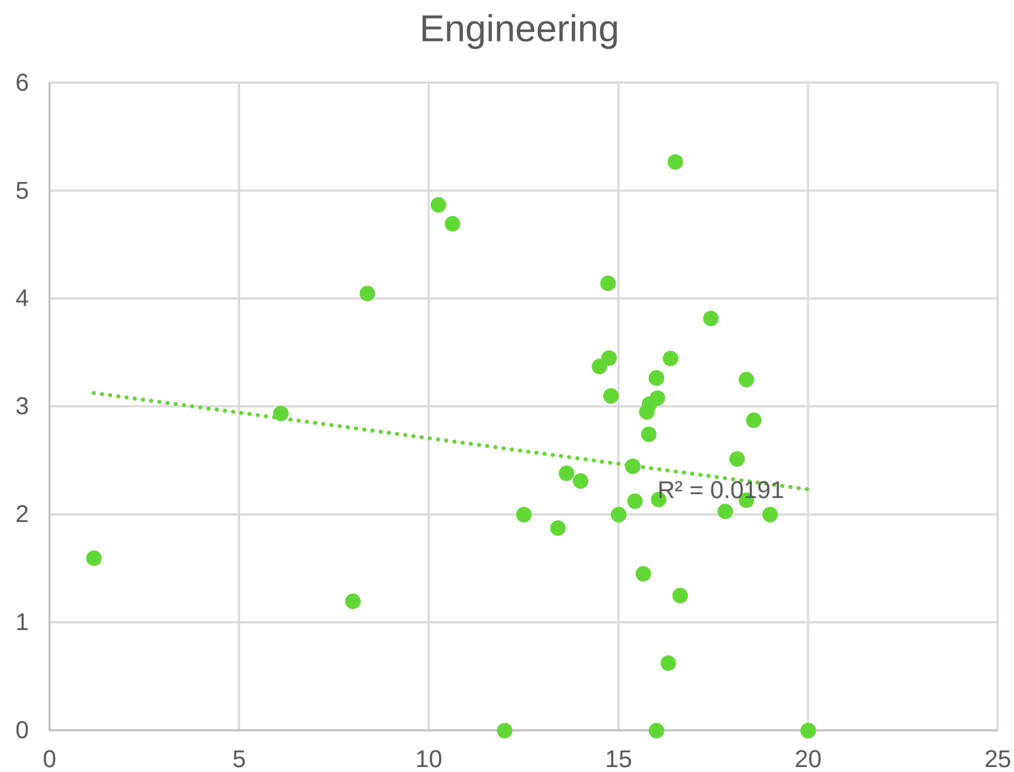


Figure 19: Sum of proficiencies versus sum of standard deviation for engineering

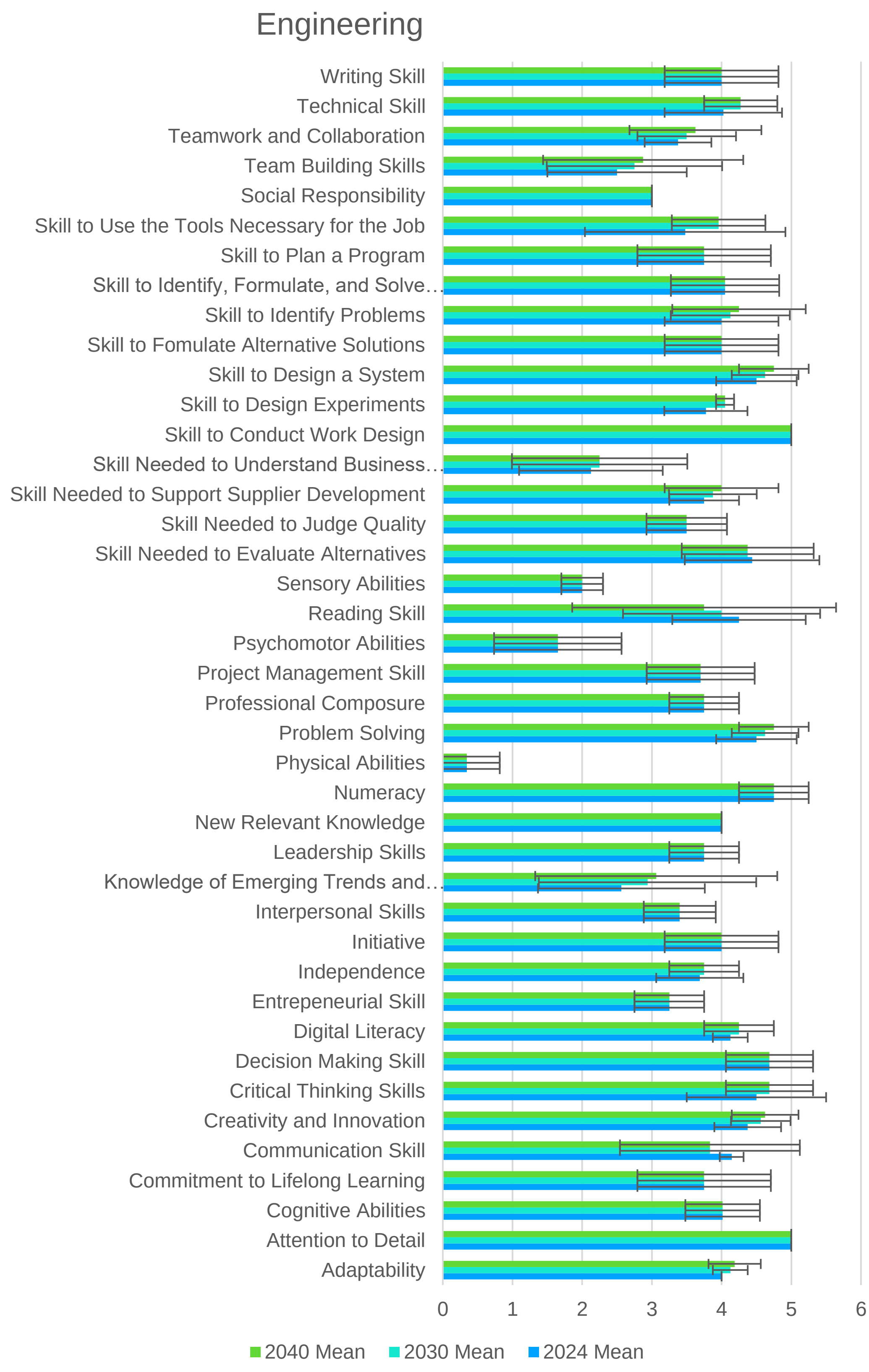


Figure 20: All 41 skills for engineering

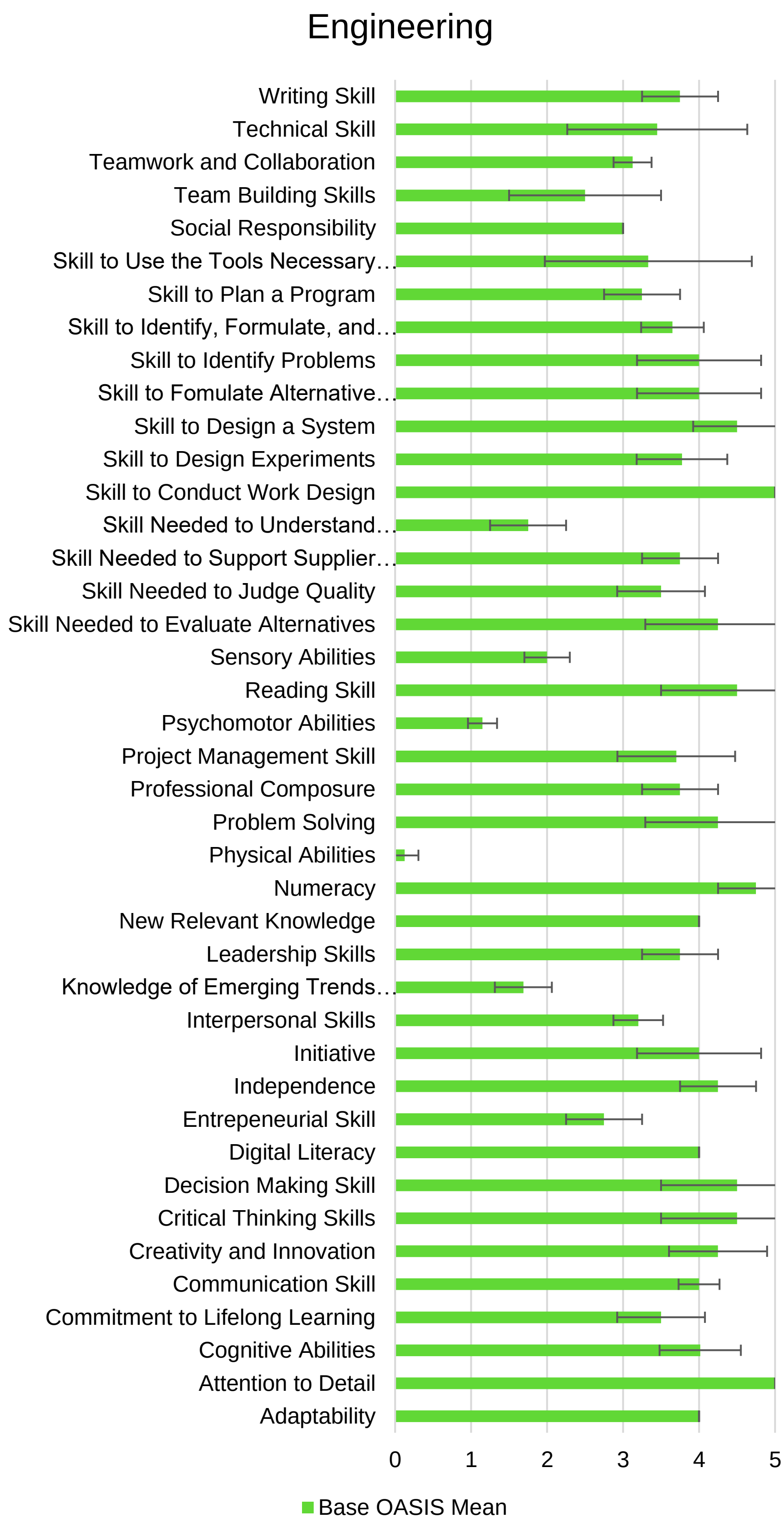


Figure 21: Standard deviation for all 41 skills at OaSIS based data for engineering

Appendix I: Electrical Technicians and Mechanics

Electrical Technicians and Mechanics group occupations:

- 22310.02 Electrical and electronics engineering technicians
- 22312 Industrial instrument technicians and mechanics
- 72201 Industrial electricians
- 72200 Electricians (except industrial and power system)
- 72422 Electrical mechanics

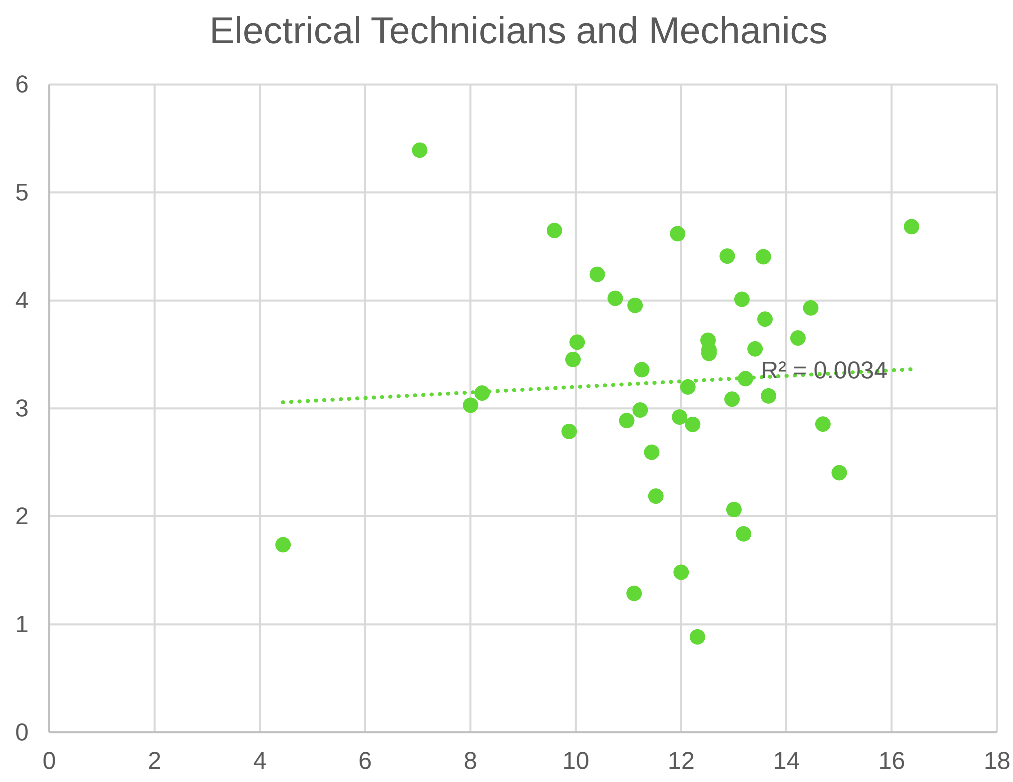


Figure 22: Sum of proficiencies versus sum of standard deviation for electrical technicians and mechanics

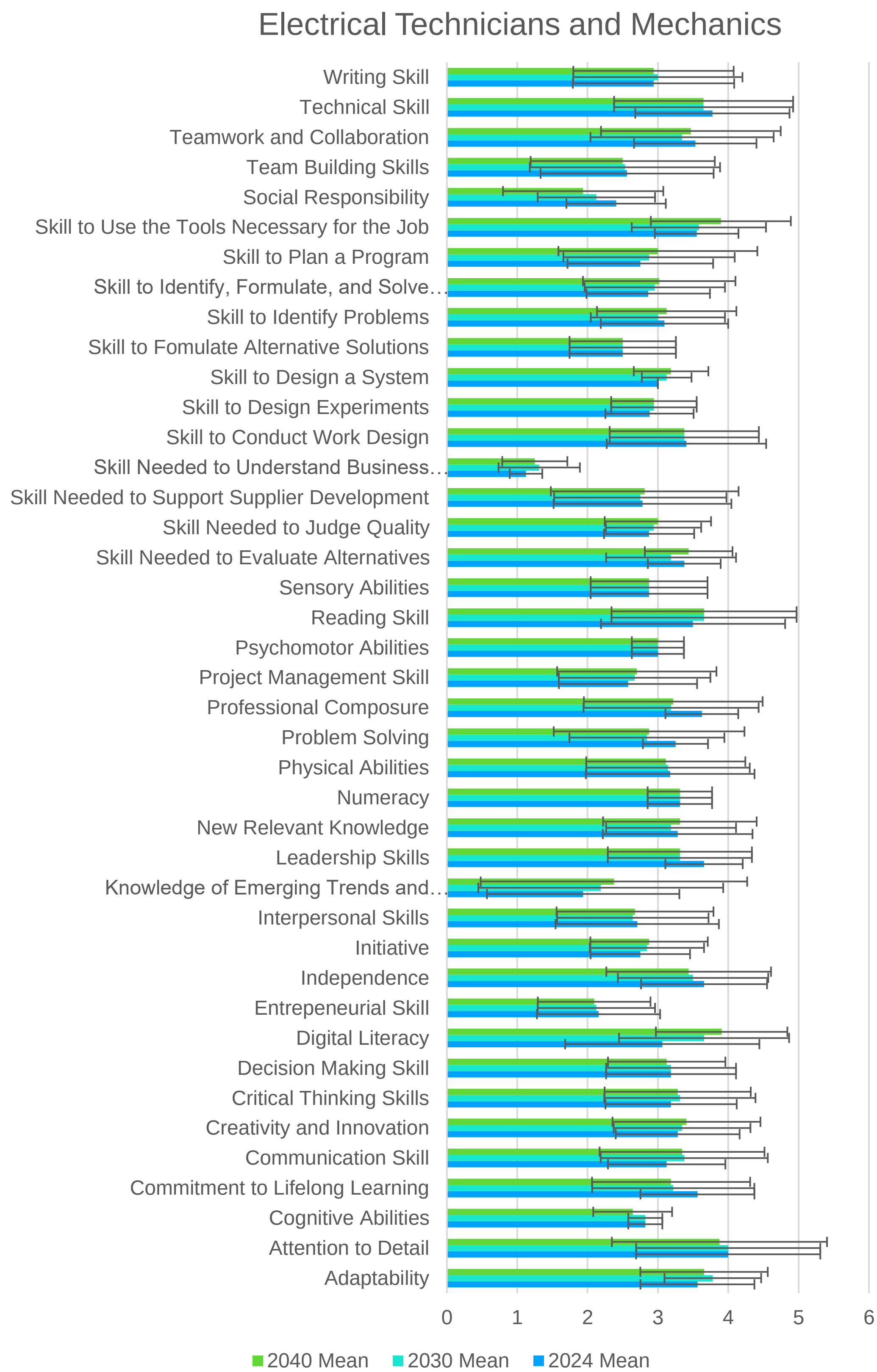


Figure 23: All 41 skills for electrical technicians and mechanics

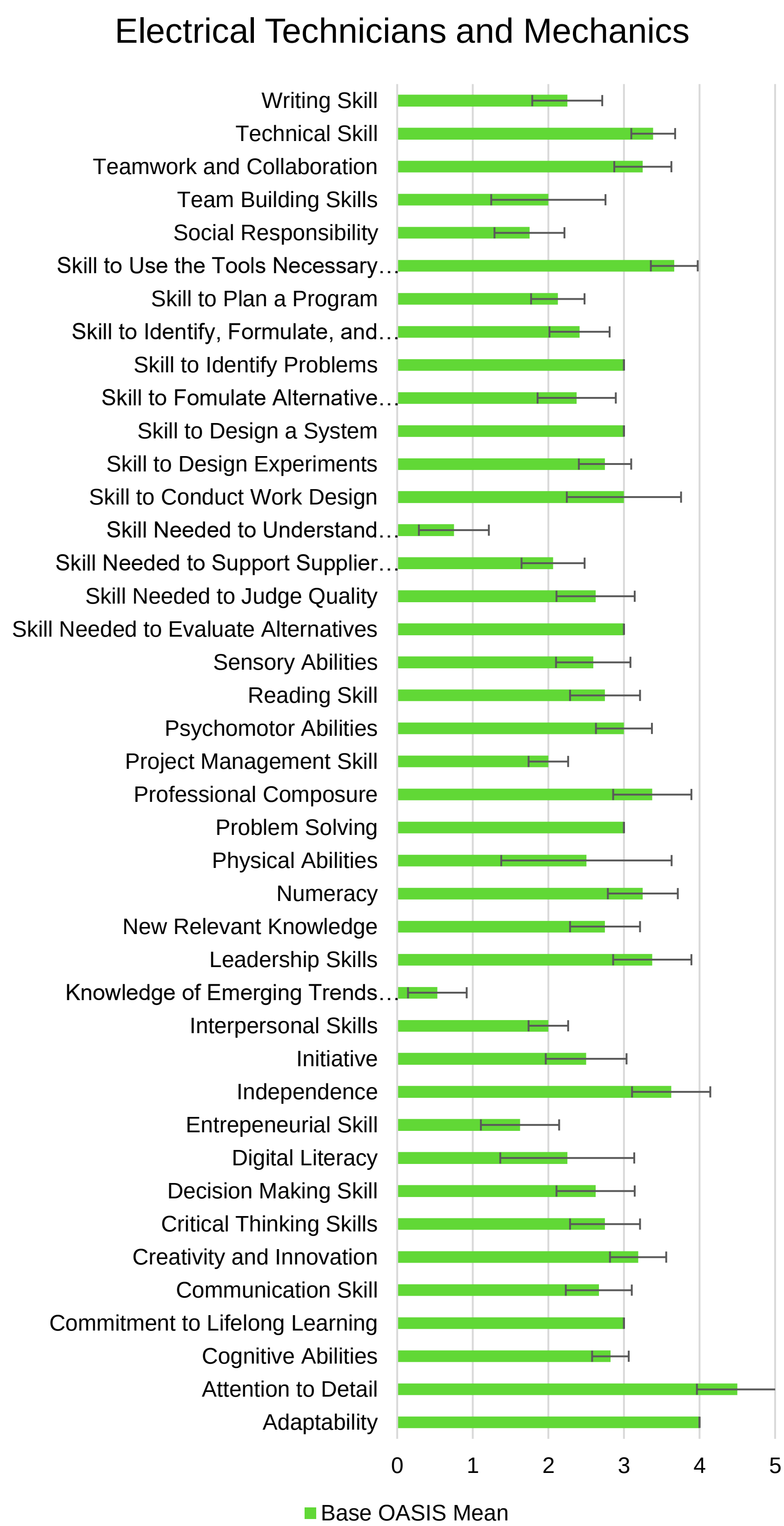


Figure 24: Standard deviation for all 41 skills at OaSIS based data for electrical technicians and mechanics

Appendix J: Development Miners

Development Miners group occupations:

- 73402.01 Drillers - surface mining, quarrying and construction
- 83100 Underground production and development miners

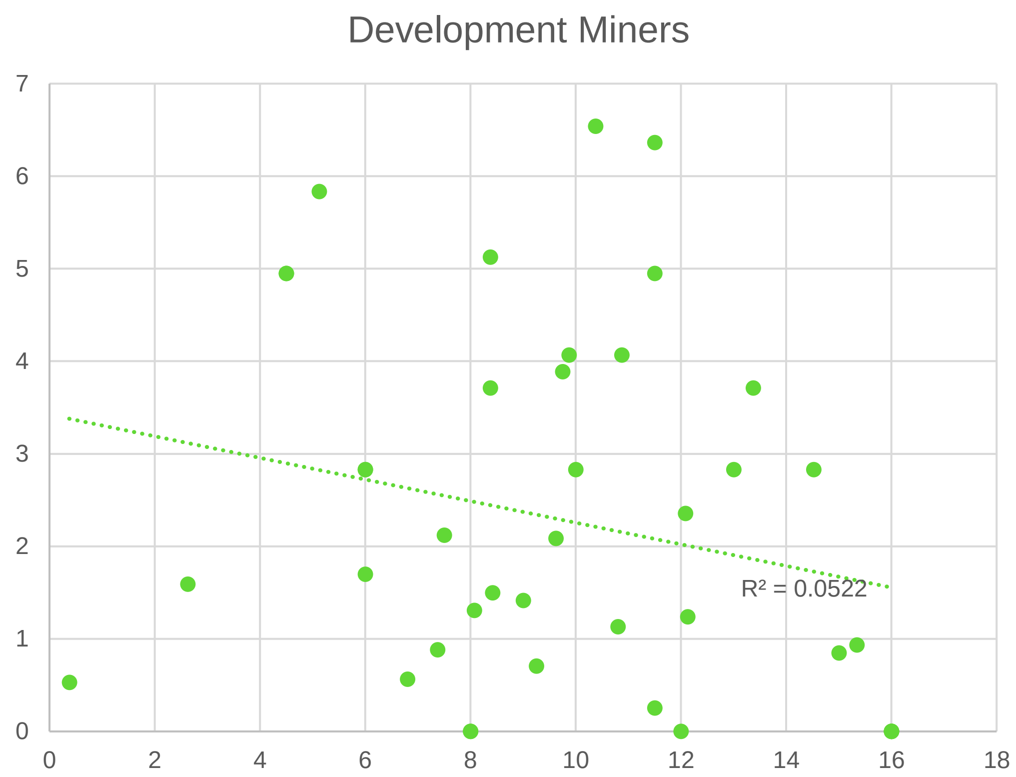


Figure 25: Sum of proficiencies versus sum of standard deviation for development miners

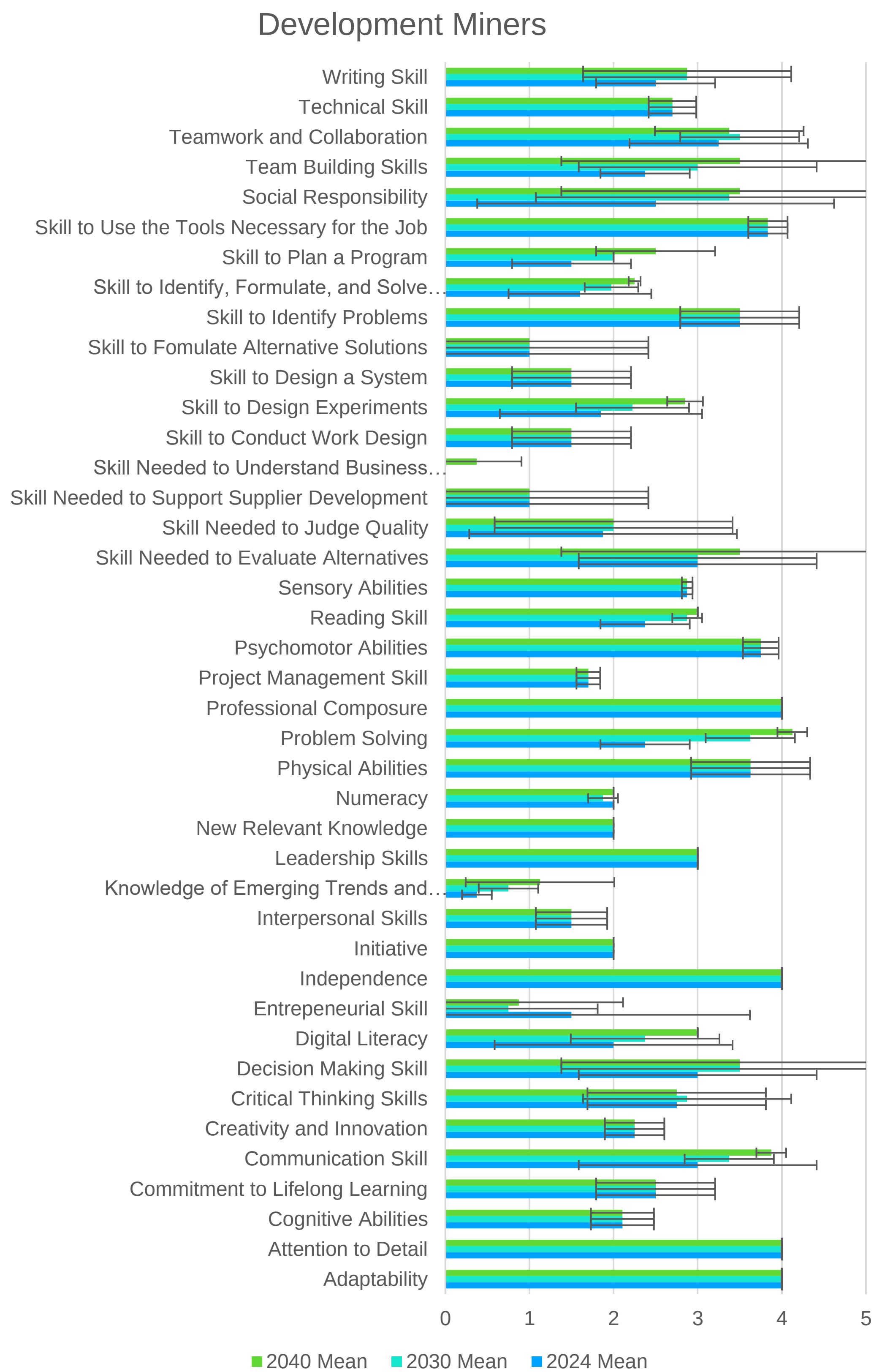


Figure 26: All 41 skills for development miners

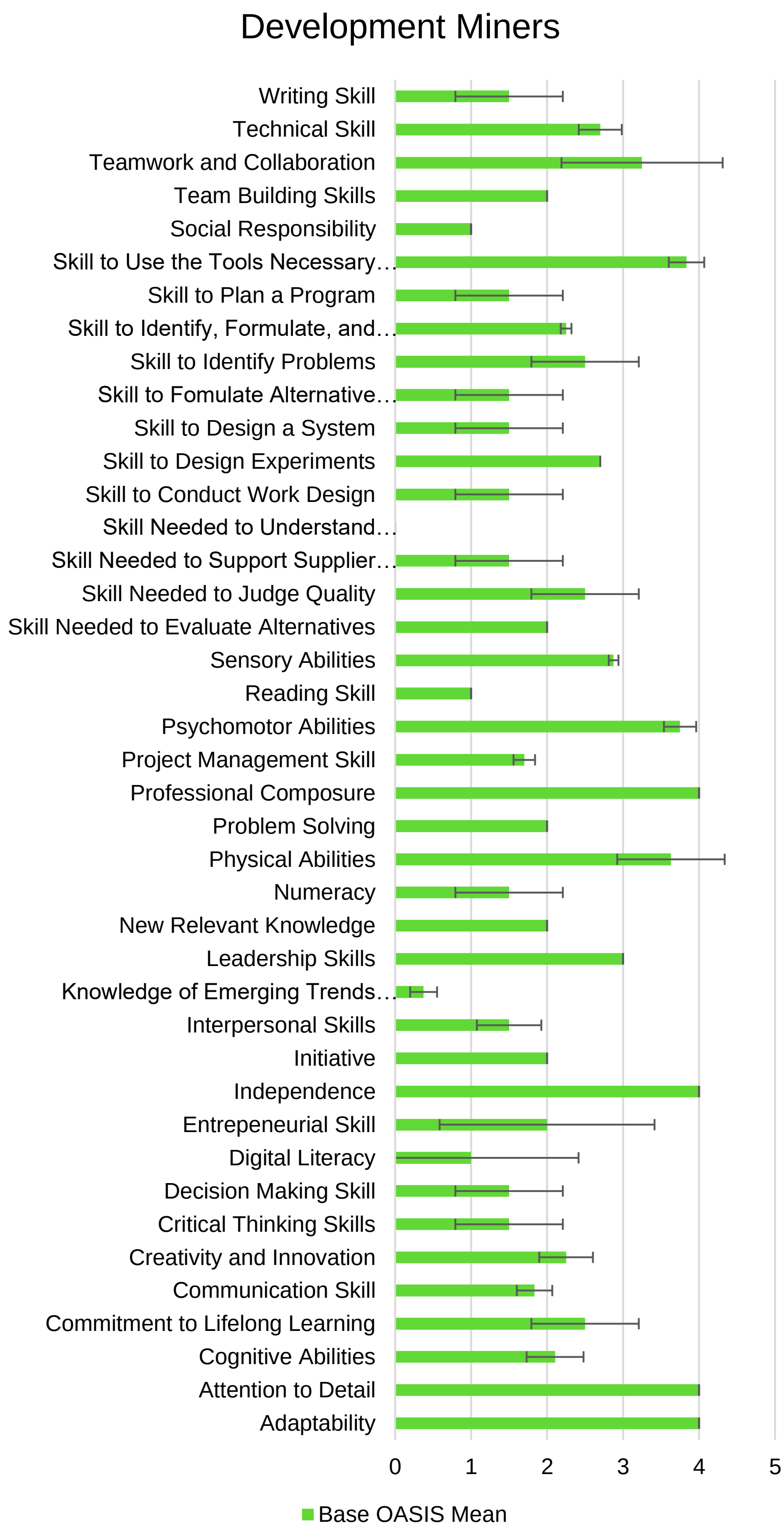


Figure 27: Standard deviation for all 41 skills at OaSIS based data for development miners

Appendix K: Contractors and Supervisors

Contractors and Supervisors group occupations:

- 72020 Contractors and supervisors, mechanic trades
- 72010 Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations
- 72011 Contractors and supervisors, electrical trades and telecommunications occupations

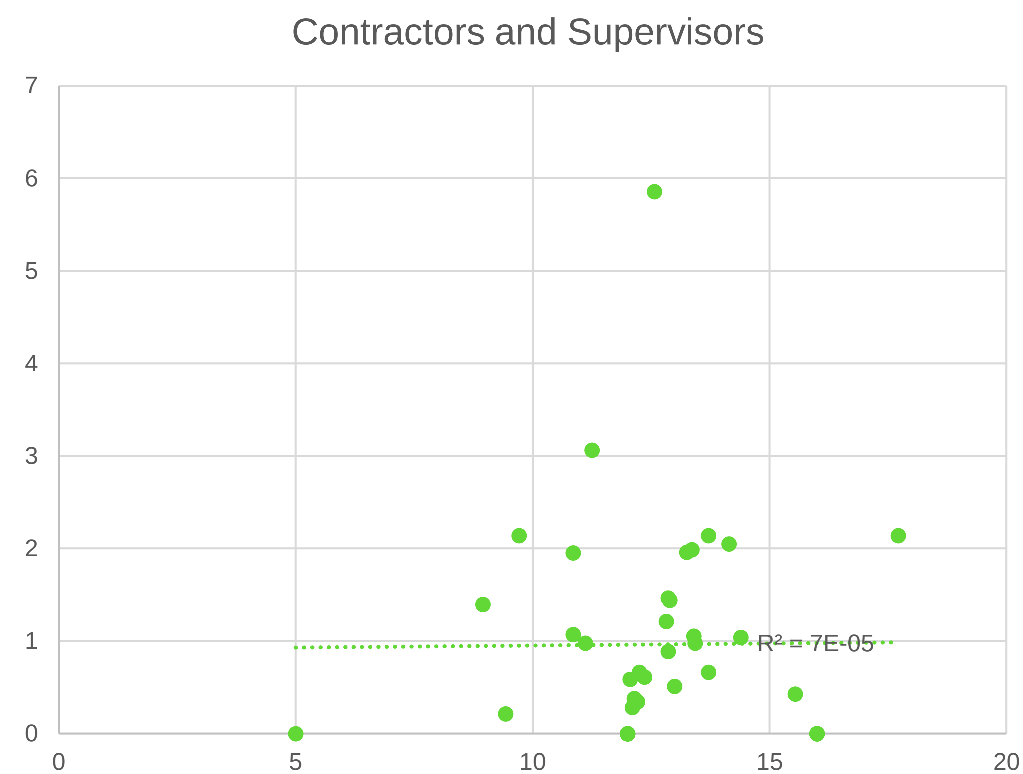


Figure 28: Sum of proficiencies versus sum of standard deviation for contractors and supervisors

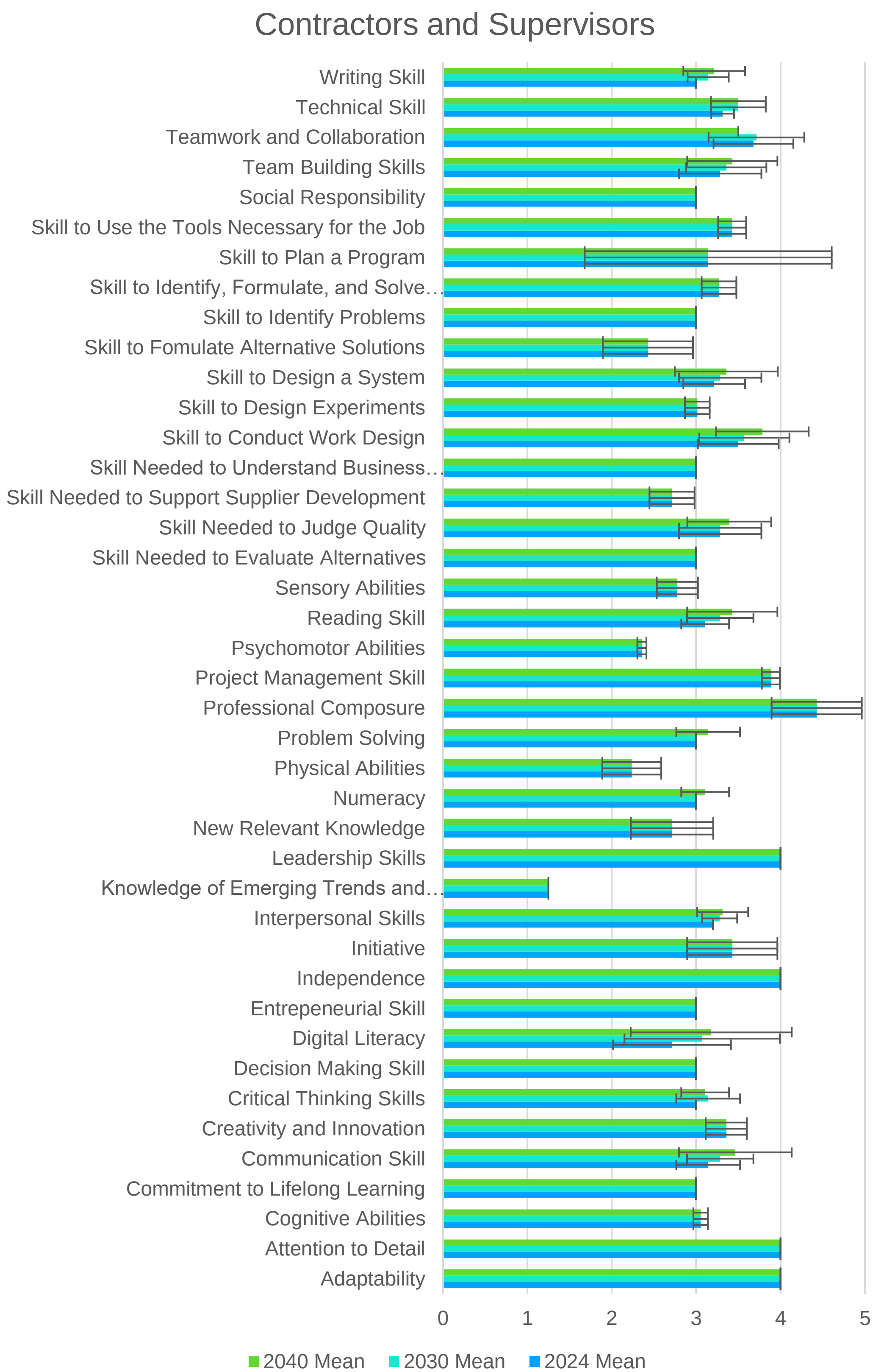


Figure 29: : All 41 skills for contractors and supervisors

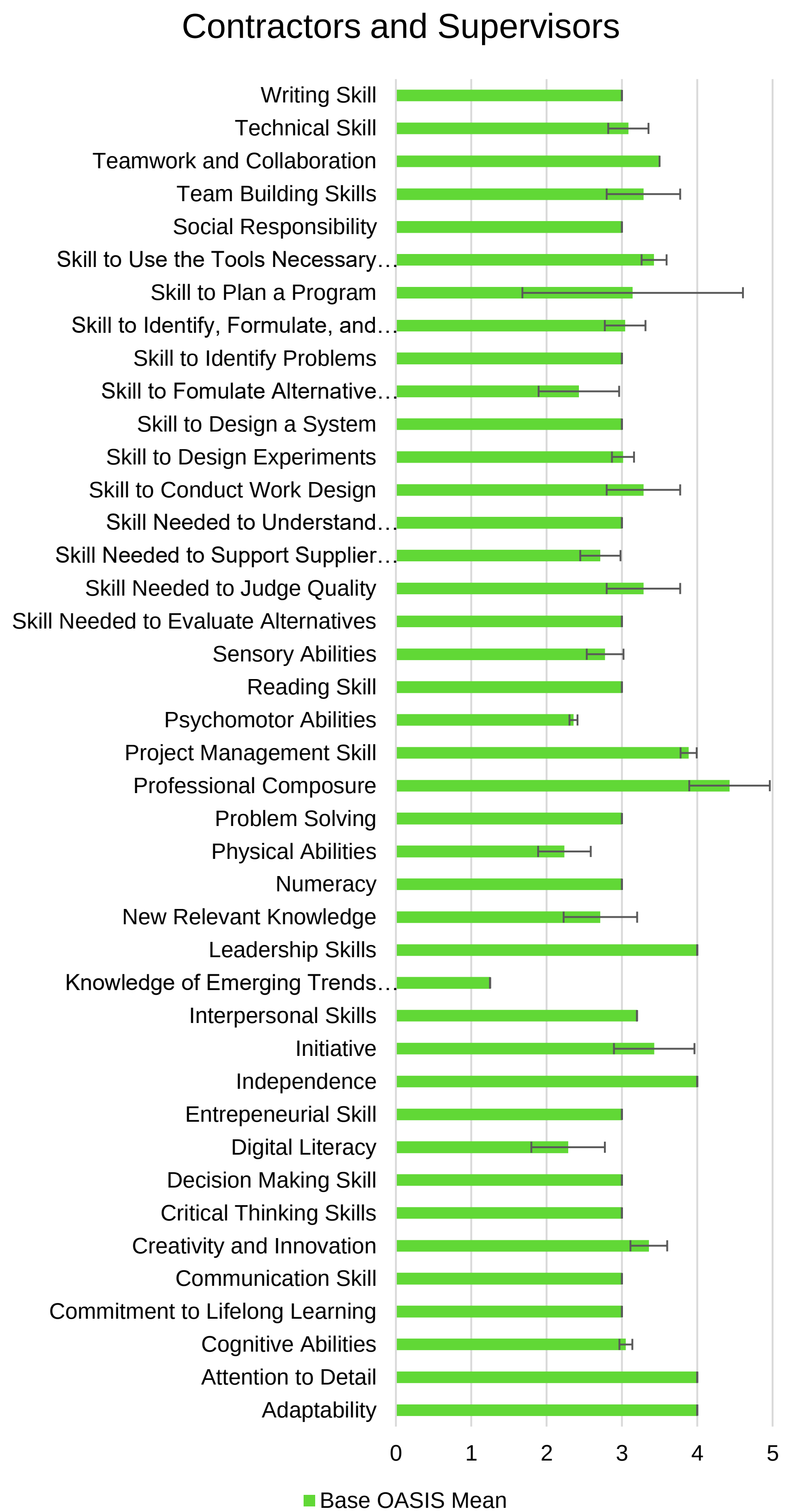


Figure 30: Standard deviation for all 41 skills at OaSIS based data for contractors and supervisors

Appendix L: Assemblers - electrical and mechanical

Assemblers, electrical and mechanical group occupations:

- 94202.01 Assemblers, electrical appliance, apparatus and equipment manufacturing
- 94204.01 Mechanical assemblers

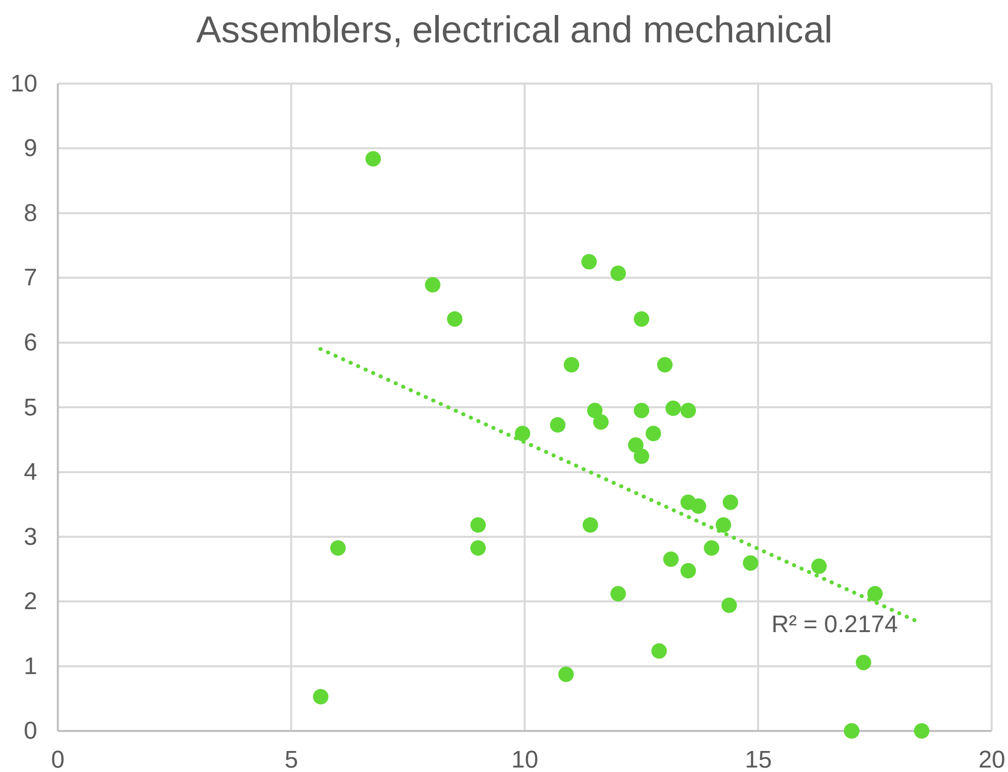


Figure 31: Sum of proficiencies versus sum of standard deviation for assemblers - electrical and mechanical

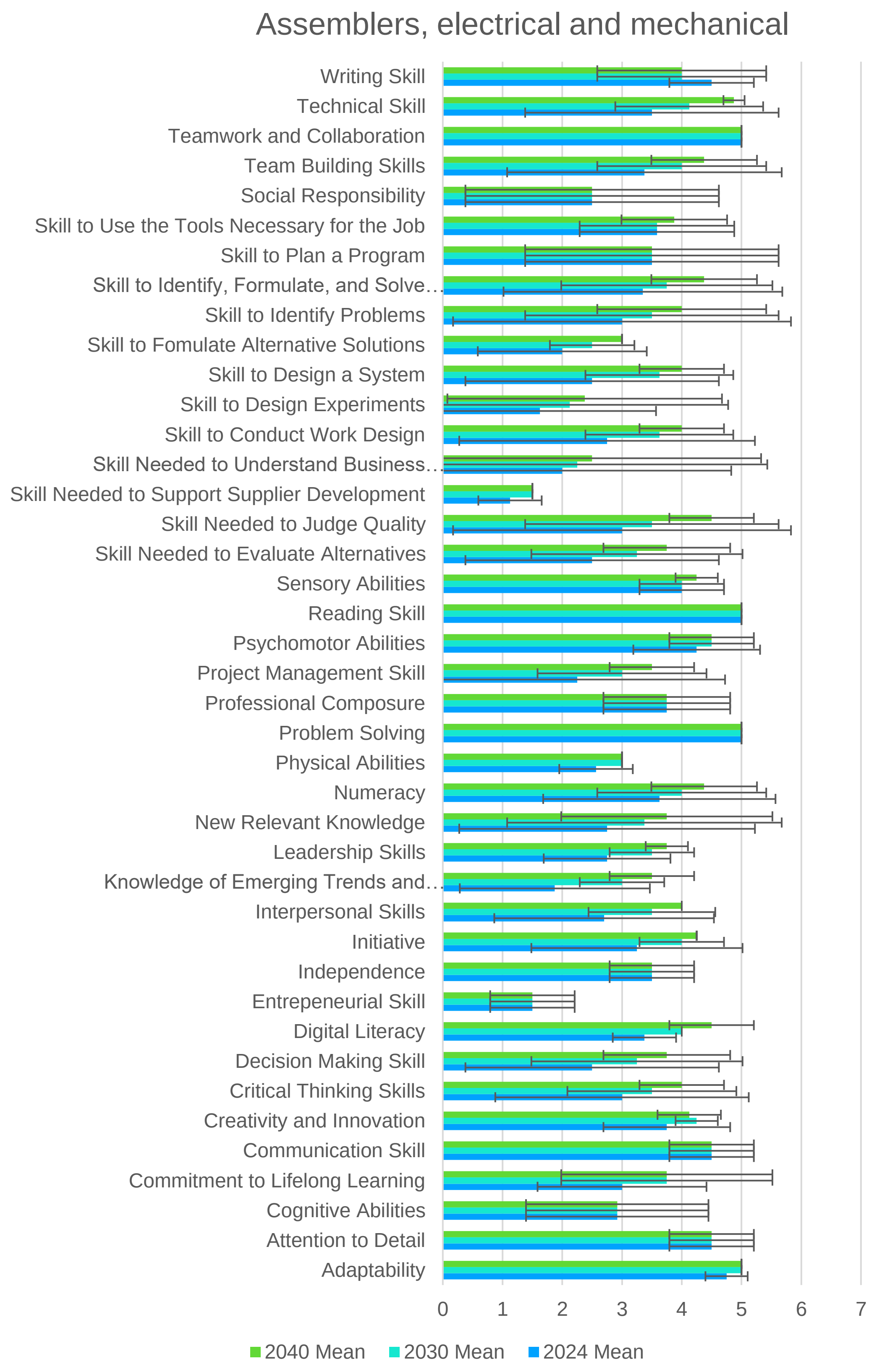


Figure 32: All 41 skills for assemblers - electrical and mechanical

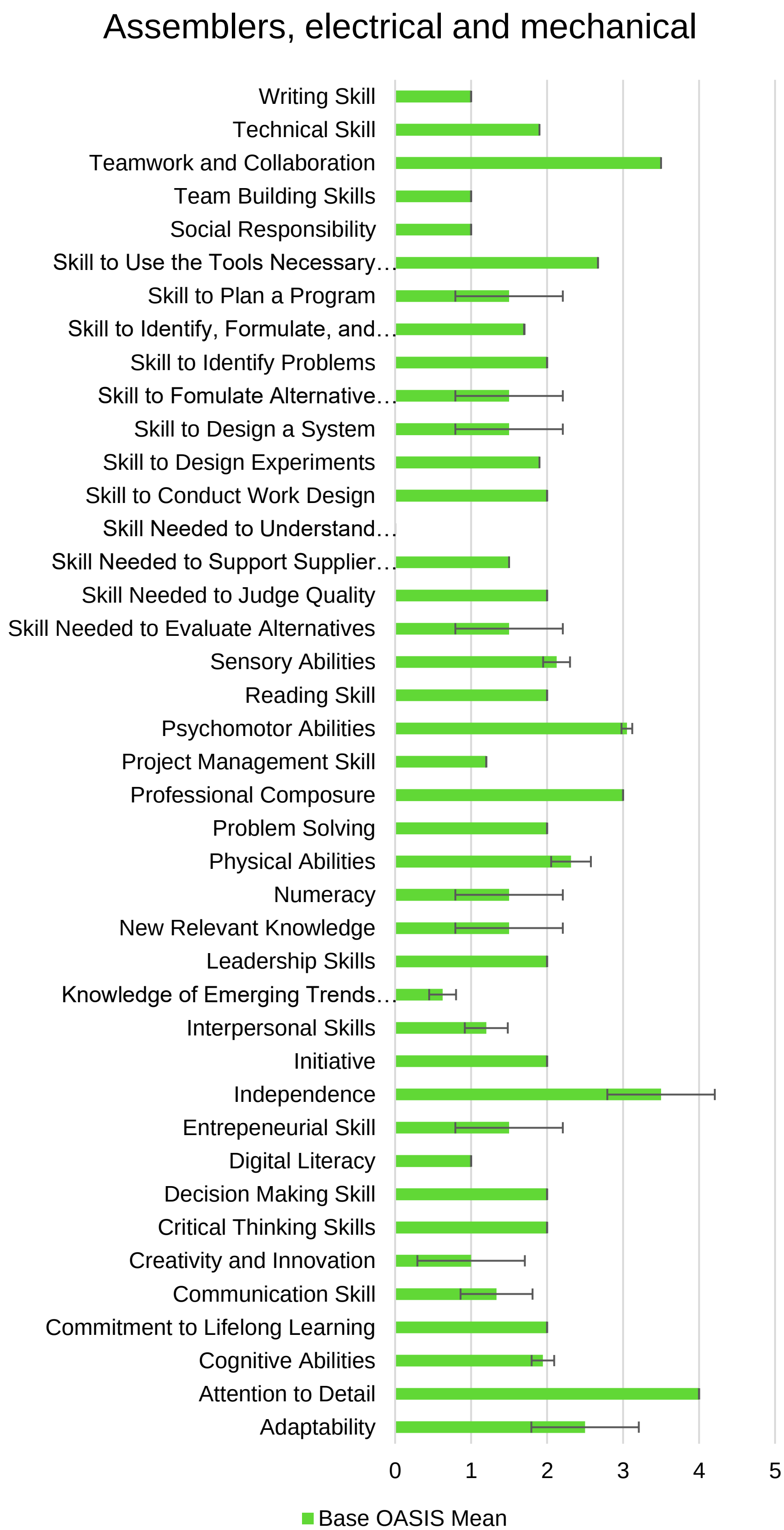


Figure 33: Standard deviation for all 41 skills at OaSIS based data for assemblers - electrical and mechanical

Sources

[i] Korn Ferry, "Future of Work: The Global Talent Crunch," 4
[ii] Alan Arcand, Canadian Manufacturers & Exporters, "CME 2022 Labour and Skills Survey", 5
[iii] Province of Saskatchewan. Critical Minerals. Retrieved from Province of Saskatchewan web site: https://www.saskatchewan.ca/
[iv] Saskatchewan Mining Association. (2023). *Publications: Fact Sheets*. Retrieved from Saskatchewan Mining Association web site: http://saskmining.ca/Mines-in-Saskatchewan/Fact-Sheets

[v] Saskatchewan Mining Association. (2023). *Publications: Fact Sheets*. Retrieved from Saskatchewan Mining Association web site: http://saskmining.ca/Mines-in-Saskatchewan/Fact-Sheets

[vi] BHP. (2023). BHP approves investment in stage two of Jansen Potash Project. Retrieved from https://www.bhp.com/news/media-centre/releases/2023/10/bhp-approves-investment-in-stage-two-of-jansen-potash-project
[vii] Government of Saskatchewan. (2023). SK Power Presentation (p. 8). Retrieved from https://www.saskatchewan.ca/-/media/news-release-backgrounders/2023/may/sk-power-presentation.pdf
[viii] Deloitte, pg 17, Saskatchewan mining and metal labour market report
[ix] Statistics Canada. Table 14-10-0287-03 Labour force characteristics by province, monthly, seasonally adjusted
[x] Pwc, pg.7, Merge ahead: Electric vehicles and the impact on the automotive supply chain

Appendix 7

Developing the NGEN41 Competencies and Survey Description

The 900 occupations in the OaSIS system include ratings for over 240 descriptors, made up of the categories; Skills, Abilities, Personal Attributes, Knowledge, Interests, Work Activities, and Work context. Standardized measuring scales adopted for the components of each of these descriptors depend on the category of the descriptor. Skills and Abilities have proficiency ratings required by an occupation on a scale of 1 to 5. Personal attributes are measured by importance on a scale of 1 to 5. Knowledge descriptors are measured on a knowledge level scale from 1 to 3. Work Activities are measure by complexity on a 1 to 5 scale. Interests are measured using Holland codes. Work Context is measured, typically on a 1-5 scale (although some dimensions are on a scale of 1-3), based on several dimensions, which include frequency, duration, responsibility, error consequence, impact, freedom, automation, and more.

It was quickly realized that asking a member of a manufacturing organization to rank competencies for an occupation using the 240+ descriptors in the OaSIS database would be quite onerous, let alone asking them to also do it for two dates in the future. In addition to this concern, there is also the problem of a lack of familiarity with the descriptors in the OaSIS database by members of manufacturing organizations. This is likely to change over time, once people become more familiar with the system, but it presents another current barrier to successfully gathering the needed information.

Accordingly, decisions were made to adjust the approach to using a survey tool to gather the time-based competency information. The decision was taken to survey members of the manufacturing sector on a subset of the OaSIS descriptors. Specifically, survey questions were organized around a version of the Knowledge, Skills, Abilities, and Other (KSAO) framework, originally developed by the American government to assess an individuals potential for success in a particular occupation. This approach to the research carried out by Next Generation Manufacturing Canada, led to the creation of 41 survey questions that map on to 41 competencies, that are referred to here as the NGEN41. The survey questions are found in Table 1, along with the associated 'skill explanation'.

Table 1: Survey Questions and Associated NGEN41 Skill Explanation

	Survey Question	Skill Explanation (NGEN41)
1	With respect to the occupations listed below, what would be the level of reading skill for each one.	Reading Skill
2	Again, what would be the level of writing ability for each one.	Writing Skill
3	What would be the level of communication needed for each Job role below.	Communication Skill
4	Again referring to the occupations below, what would be the level of Digital skills and awareness needed.	Digital Literacy
5	What would you indicate as the right level of skill needed for working in teams / collaboration	Teamwork and Collaboration

	Survey Question	Skill Explanation (NGEN41)
6	With respect to problem solving, what skill level would you think is appropriate for each job listed.	Problem Solving
7	Again, what level of (skill) is needed for Creativity and Innovation.	Creativity and Innovation
8	Working with numbers, and calculations, what level of skill would you assign against each job role below.	Numeracy
9	Being adaptable and react to unexpected changes or new processes, what skill level would you allocate to each job.	Adaptability
10	Applied technical skills, what level of skill importance would you assign to each job role listed.	Technical Skill
11	So, not using software, what skill level would you assign to the jobs listed below, for someone to construct and implement a work process or design.	Skill to Conduct Work Design
12	What skill level would you assign to the jobs listed below, for someone to design and explain a work process or design of a new system.	Skill to Design a System
13	Indicate the skill level needed to use logic and reasoning to question, discern, interpret and analyze various types of information to form an evidence-based conclusion for the job roles listed.	Critical Thinking Skills
14	Please indicate the skill level you think is relevant for the processing, planning, problem solving, and decision-making activities that are necessary for the overall completion of a job.	Skill to Identify, Formulate, and Solve Problems
15	For the job roles listed, thinking about the level of practical skill and understanding needed to carry out a job, please see the guidance for a detailed explanation.	Skill to Use the Tools Necessary for the Job
16	What level of skill for someone to plan and prioritize task to complete the work.	Skill to Plan a Program
17	You might want to reference to the guidance on this one (to the right), so please indicate the level of support an employee would need to support supplier relationships.	Skill Needed to Support Supplier Development
18	Information and data management and processing activities that are necessary to meet the requirements of the job are important, so what skill level would you say is relevant to each job role below.	Skill to Design Experiments
19	Also assessing the value, importance or quality of materials, products, services or people, and to that end, please indicate the level of skill you think is appropriate.	Skill Needed to Judge Quality
20	For those nominated individuals, what skill level around the capabilities to plan, organize, monitor or control the resources to achieve goals.	Project Management Skill
21	What level of skill, for an employee to identify (not actually fix) a problem in the workplace.	Skill to Identify Problems
22	What skill level is needed for the job roles, to come up with a plan to design a new application or product for the organization.	Skill to Fomulate Alternative Solutions
23	Please indicate the level of skill needed to evaluate potential outcomes or alternative ways to carry out a given task	Skill Needed to Evaluate Alternatives
24	What cognitive skill level, would be indicated in order to carry out decision making for that given role.	Decision Making Skill
25	With reference to the jobs listed, what would be the appropriate level of skill be needed for understanding the business principles for that role.	Skill Needed to Understand Business Principles
26	Please indicate what level of team building skills would be needed	Team Building Skills

	Survey Question	Skill Explanation (NGEN41)
27	If relevant, the skill level around Convincing others to buy goods or services, or to change their minds or actions.	Entrepeneurial Skill
28	What skill level around recognizing your unspoken actions and behaviors, and that of others too.	Social Responsibility
29	What skill level for the ability to interact with others, and to help others achieve goals.	Interpersonal Skills
30	Please indicate the relevant skill level to be aware of staying up to date with the relevant changes at work, both organizationally and technically.	New Relevant Knowledge
31	With respect to behaviors, what skill level would you think best describes the job role around the importance of staying calm, and dealing with stressful situations.	Professional Composure
32	Please indicate a skill level for someone to identify and monitor / evaluate the performance of themselves, other individuals or the organization to make improvements or take corrective action.	Initiative
33	Indicate the skill level around paying attention to detail.	Attention to Detail
34	In relation to the job roles, what level would be best indicated for the commitment to lifelong learning and staying current in that job role.	Commitment to Lifelong Learning
35	Please indicate the level around the requirement to work independently and working safely without supervision.	Independence
36	Do the roles indicated, have a skill level relevant to leadership skills, and if so, what level would you indicate.	Leadership Skills
37	Can you indicate what skill level, should an employee have when considering knowledge around emerging trends and Technologies in respect to each job role below.	Knowledge of Emerging Trends and Technologies
38	Again, with respect to cognitive understanding, what skill level would be needed to be aware of what might influence their ability to acquire knowledge at work.	Cognitive Abilities
39	Almost at the end, so another question in relation to abilities around being aware of their surroundings at work and what skill level would be indicative for that role (Visual and Audio)	Sensory Abilities
40	With respect to physical capabilities, what skill level would you assign to the job for them to carry out that job effectively, considering strength, endurance, flexibility and endurance.	Physical Abilities
41	Last question, so we thank you for your participation. Therefore in respect of dexterity and Psychomotor abilities, what level of skill using that 1 to 5 scale, would you assign to the job role.	Psychomotor Abilities

The skill explanations either map directly to competencies that can be found in the OaSIS database, or they are made up of compound competencies from the OaSIS database.

Theoretical Basis: The alignment between NGEN constructs and OaSIS proficiencies was informed by several resources, specifically:

- A comprehensive review of a report entitled, “ESDC Skills and Competencies Taxonomy” (listed as for “Temporary Limited Distribution: 11th November 2022”), from which were drawn the definitions of knowledge, skill, abilities, and other attributes (KSAOs) that appeared the target of NGEN constructs. These have been uploaded to the most recent iteration of the OaSIS database: <Taxonomy - canada.ca (esdc.gc.ca)>.

- A coauthored working paper by Roberts, Myers, and Murray, entitled “Skills for Success: A Cross Walk to the Skills and Competencies Taxonomy” (completed 31st March 2023, under contract to ESDC and distribution status unknown).
- The entire online OaSIS system, as it existed on March 1, 2024: <Welcome to the Occupational and Skills Information System - canada.ca (esdc.gc.ca)>.

Methodology: The alignment was done using the expert judgements of two trained psychologists from Research and Assessment Design: Science Solution (hereafter, RAD Science), and review by principals at VAMETRIC and DataAngel. Key assumptions of this alignment were:

A. If there appeared a direct alignment between the NGEN and OaSIS construct, one and only one construct from the latter was identified as a proxy for the former. For example, NGEN Adaptability is considered the equivalent of OaSIS Adaptability (even though a myriad of other constructs might be subsumed under this label [see Roberts et al., 2023]). As a result of this rule-of-thumb, 25 of the 41 NGEN constructs have a direct 1-to-1 mapping to OaSIS constructs. (Note, it is very important to read the definitions in Tab 3 to fully understand some of these mappings, because alignment may seem unusual if just the terms are compared [e.g., see Initiative-Monitoring]).
B. NGEN constructs often included several instances where there were two descriptors (e.g., Creativity and Innovation, Teamwork and Collaboration), thus both were aggregated (and to make them comparable with [a]), a mean score derived. (Note, this applies to only three instances).
C. NGEN constructs also appeared to subsume major headings within the OaSIS system. For example, Technical Skills, Cognitive Ability, Project Management, and Psychomotor Skills are each composed of many different sub-components. In these instances, composites were formed from each of the lower-level proficiencies, and to provide correspondence with (a) and (b), divided by the number of such sub-skills forming the composite. As a result of this rationale, 12 of the 41 NGEN constructs were derived as the mean of these composite scores.
D. There is one additional instance that bears brief mention. The foundational skill Communication is rather idiosyncratic as it is represented by three constructs in OaSIS: Active Listening, Oral Comprehension, and Oral Expression. As a result, a mean composite score for this construct was also derived.

In terms of the KSAO framework, the NGEN 41 map according to Table 2. Specific knowledge competencies such as scientific or engineering knowledge are not represented in the NGEN41. These specifics are an occupation dependent requirement that are typically captured in formal educational programming and certifications. Instead, the knowledge component here represents the activities of staying current in ones knowledge domain and being aware of new knowledge, trends and technologies that are relevant to the occupation and the firm.

For the most part, the Skills category contains competencies that can be thought of as hard skills, or some combination of hard skills and soft skills. Abilities have been promoted up the hierarchy used in the OaSIS database, which limits the amount of detail, but significantly reduces the survey completion time. The competencies found under Work Activities are compounds of OaSIS competencies that reflect work tasks for a variety of manufacturing occupations. The ‘Other’ in this version of the KSAO framework is the category ‘Soft Skills’. These are generally not captured in formal education assessments, or in recruitment assessment regimens, but have received much attention with respect to workplace performance.

Table 2: NGEN41 Competencies with the KSAO Framework

NGEN41 in KSAO Framework				
Knowledge	**Cognitive Skills**	**Abilities**	**Soft Skills**	**Work Skills**
Knowledge of Emerging Trends and Technologies	Reading Skill	Cognitive Abilities	Team Building Skills	Skill to Use the Tools Necessary for the Job
New Relevant Knowledge	Writing Skill	Sensory Abilities	Entrepeneurial Skill	Skill Needed to Support Supplier Development
	Communication Skill	Physical Abilities	Interpersonal Skills	Skill Needed to Understand Business Principles
	Digital Literacy	Psychomotor Abilities	Leadership Skills	Skill Needed to Judge Quality
	Numeracy		Professional Composure	Skill to Conduct Work Design
	Problem Solving		Teamwork and Collaboration	Skill to Fomulate Alternative Solutions
	Creativity and Innovation		Initiative	Skill Needed to Evaluate Alternatives
	Technical Skill		Attention to Detail	Skill to Identify, Formulate, and Solve Problems
	Critical Thinking Skills		Commitment to Lifelong Learning	Project Management Skill
	Skill to Design Experiments		Social Responsibility	Skill to Design a System
	Skill to Identify Problems		Independence	Skill to Plan a Program
	Decision Making Skill		Adaptability	

The OaSIS database was used to compute proficiency ratings for all of the NGEN41 competencies for 115 manufacturing sector National Occupation Codes. Each of the NGEN41 attributes were then calculated using code aligned with Table 3, yielding a 157 (155 jobs, plus label and NOC Codes) x 41 matrix. These became the anchor values (for 2023) used in subsequent analysis.

Table 3: Computation of the NGEN41 from OaSIS Descriptors

NGEN#	Survey Competency	Computed Composites: SPSS Code
1	Reading Skills	COMPUTE Reading_Skills = ReadingComprehension.
2	Writing Skills	COMPUTE Writing_Skills = Writing.
3	Communication Skill	COMPUTE Communication = (OralCommunicationActiveListening + OralCommunicationOralComprehension + OralCommunicationOralExpression) / 3 .
4	Digital Skills	COMPUTE Digital_Skills = DigitalLiteracy .
5	Teamwork and Collaboration	COMPUTE Teamwork = (ConcernforOthers + Collaboration) / 2 .
6	Problem Solving	COMPUTE Problem_Solving = ProblemSolving .
7	Creativity and Innovation	COMPUTE Creativity_Skills = (Creativity + Innovation) / 2 .
8	Numeracy	COMPUTE Numeracy_Skills = Numeracy .
9	Adaptability	COMPUTE Adaptability_Skills = Adaptability .
10	Technical Skills	COMPUTE Technical_Skills = (DigitalProduction + EquipmentandToolSelection + OperationandControl + OperationMonitoringofMachineryandEquipment + PreventativeMaintenance + ProductDesign + QualityControlTesting + Repairing + SettingUp + Troubleshooting) / 10 .
11	Skill to Conduct Work Design	COMPUTE Work_Design = ProductDesign .

NGEN#	Survey Competency	Computed Composites: SPSS Code
12	Skill to Design a System	COMPUTE System_Design = SystemsAnalysis .
13	Critical Thinking Skills	COMPUTE Critical_Thinking = CriticalThinking .
14	Skill to Identify, Formulate, and Solve Problems	COMPUTE Mental_Processes = (DevelopingObjectivesandStrategies + EvaluatingInformationtoDetermineCompliance + JudgingQuality + MakingDecisions + PlanningandOrganizing + SchedulingWorkandActivities + ThinkingCreatively + UsingNewRelevantKnowledge + AnalyzingDataorInformation + ProcessingInformation) / 10.
15	Skill to Use the Tools Necessary for the Job	COMPUTE ToolUse_Skills = (EquipmentandToolSelection + OperationandControl + OperationMonitoringofMachineryandEquipment) / 3 .
16	Skill to Plan a Program	COMPUTE Program_Planning = PlanningandOrganizing .
17	Skill Needed to Support Supplier Development	COMPUTE Support_Skills = (ProvidingConsultationandAdvice + CommunicatingwithPersonsOutsideOrganization) / 2 .
18	Skill to Design Experiments	COMPUTE Experimental_Skills = (AnalyzingDataorInformation + ClericalActivities + DevelopingTechnicalInstructions + EstimatingtheQuantifiableCharacteristicsofProductsEventsorInform + ProcessingInformation + GettingInformation + IdentifyingObjectsActionsandEvents + InspectingEquipmentStructuresorMaterial + MonitoringProcessesMaterialsorSurroundings) / 9 .
19	Skill Needed to Judge Quality	COMPUTE Quality_Skills = JudgingQuality .
20	Project Management Skill	COMPUTE Project_Skills = (ManagementofFinancialResources + ManagementofMaterialResources + ManagementofPersonnelResources + Monitoring + TimeManagement) / 5 .
21	Skill to Identify Problems	COMPUTE Problem_Identification = ProblemIdentification .
22	Skill to Fomulate Alternative Solutions	COMPUTE Alternate_Solutions = ThinkingCreatively .
23	Skill Needed to Evaluate Alternatives	COMPUTE Evaluate_Solution = Evaluation .
24	Decision Making Skill	COMPUTE Decision_Making = DecisionMaking .
25	Skill Needed to Understand Business Principles	COMPUTE Business_Principles = Business_Management .
26	Team Building Skills	COMPUTE Team_Building = TeamBuilding .
27	Entrepeneurial Skill	COMPUTE Entrepeneurial_Skill = SellingorInfluencingOthers.
28	Social Responsibility	COMPUTE Social_Responsibility = SocialPerceptiveness .
29	Interpersonal Skills	COMPUTE Interpersonal_Skills = (Coordinating + Instructing + Negotiating + Persuading + SocialPerceptiveness) / 5.
30	New Relevant Knowledge	COMPUTE New_Knowledge = UsingNewRelevantKnowledge .
31	Professional Composure	COMPUTE Professional_Composure = StressTolerance .
32	Initiative	COMPUTE Intiative = Monitoring .
33	Attention to Detail	COMPUTE Attention_Detail = AttentiontoDetail .
34	Commitment to Lifelong Learning	COMPUTE Lifelong_Learning = ActiveLearning .
35	Independence	COMPUTE Independence_Level = Independence .
36	Leadership Skills	COMPUTE Leadership_Skills = Leadership .

NGEN#	Survey Competency	Computed Composites: SPSS Code
37	Knowledge of Emerging Trends and Technologies	COMPUTE Knowledge_Logistics = (Logistics + Manufacturing + Performance_Measurement + Technical_Design) / 4.
38	Cognitive Abilities	COMPUTE Cognitive_Abilities = (Categorization_Flexibility + Deductive_Reasoning + FluencyofIdeas + InductiveReasoning + InformationOrdering + MathematicalReasoning + Memorizing + Multitasking + NumericalAbility + PatternIdentification + PatternOrganizationSpeed + PerceptualSpeed + ProblemIdentification + SelectiveAttention + SpatialOrientation + SpatialVisualization + VerbalAbility + WrittenComprehension + WrittenExpression) / 19 .
39	Sensory Abilities	COMPUTE Sensory_Abilities = (Auditory_Attention + Colour_Perception + DepthPerception + FarVision + GlareTolerance + HearingSensitivity + NearVision + NightVision + PeripheralVision + SoundLocalization + SpeechClarity + SpeechRecognition) / 12 .
40	Physical Abilities	COMPUTE Physical_Abilities = (Body_Flexibility + DynamicStrength + ExplosiveStrength + GrossBodyCoordination + GrossBodyEquilibrium + Stamina + StaticStrength + TrunkStrength) / 8 .
41	Psychomotor Abilities	COMPUTE Psychomotor_Abilities = (Arm_Hand_Steadiness + ControlOFSettings + FingerDexterity + FingerHandWristMotion + ManualDexterity + MultiLimbCoordination + MultiSignalResponse + RateControl + ReactionTime + SpeedofLimbMovement) / 10 .

This data was compiled into a database and used to set up a survey tool. The survey tool was an online tool that was accessed on a mobile device (mobile phone or tablet). Survey participants would log in, provide their email, organization name, and the North American Industry Classification System (NAICS) code for their organization, and they would chose occupations from a drop down list of preloaded occupations. They would then be presented with the survey questions sequentially and asked to rate competency changes using a set of three slider scales (see Figure ~~X~~1). This was carried out for each occupation that they chose to enter.

The scales in the survey tool were initially set to the computed proficiency rating (based on the OaSIS database) for a particular competency for a particular occupation. There were three sets of scales for each competency. Participants were asked to adjust the sliders to capture:

1. The value of proficiency that they believed was currently needed to perform the job.
2. The value of proficiency that they believed would be required to perform the job in 2030.
3. The value of proficiency that they believed would be required to perform the job in 2040.

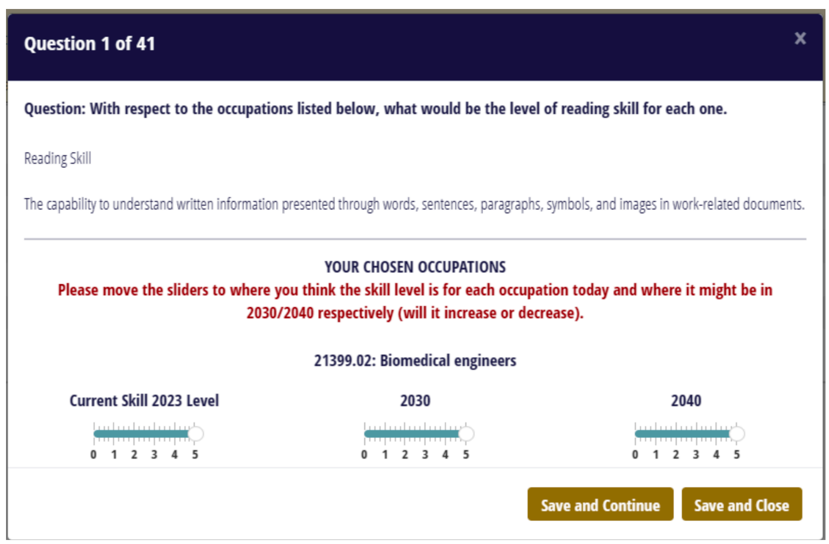


Figure ~~X~~1: Screen capture online survey tool

It is important to note that for all of competencies included in the survey, it was assumed that the level of proficiency was on a five point scale (zero being not relevant and 5 being expertise level), regardless of whether or not a five point scale was used in the OaSIS database. Competencies in the OaSIS database that were part of this survey and that did not have a five point scale were adjusted to score on a five point scale. This was done to facilitate ease of use of the survey by participants (not having to go through scale explanation for every competency) while consuming a minimum amount of their time in completing the survey. On average, the survey delivered in this way took about 7 minutes to complete per occupation.

The following table provides definitions of the NGEN41 skills.

Table 4: Definition of the NGEN41 Skills

Definition of Key Skills	**Definition**	**K, S, A, or O**	**Comments re Survey**
Skills	***Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.***	***Cognitive Skill***	
Foundational Skills	*Developed capabilities that facilitate the more rapid acquisition of other skills and knowledge.*	*Cognitive Skill*	
Oral Communication: Active Listening	The capability to give full attention to what other people are saying, take time to understand the points being made, ask questions as appropriate, and not interrupt at inappropriate times.	Cognitive Skill	Summed to form Communication in the Survey
Oral Communication: Oral Comprehension	The capability to listen to and understand information and ideas presented through spoken words and sentences.	Cognitive Skill	Summed to form Communication in the Survey
Oral Communication: Oral Expression	The capability to talk to others to convey information effectively.	Cognitive Skill	Summed to form Communication in the Survey
Reading Comprehension	The capability to understand written information presented through words, sentences, paragraphs, symbols, and images in work-related documents.	Cognitive Skill	Reading in the Survey
Writing	The capability to communicate in writing by using written words, sentences, paragraphs, symbols, and images and adapted for the needs of the audience.	Cognitive Skill	Writing in the Survey
Numeracy	The capability to understand, use and report numbers and other mathematical information presented through words, numbers, symbols, and graphics.	Cognitive Skill	Numeracy in the Survey
Digital Literacy	The capability to understand and use digital devices and tools to obtain, exchange, create or process digital information in a secure manner.	Cognitive Skill	Digital Literacy in the Survey
Analytical Skills	*Developed capability that people need to process information and data logically to produce useable results.*	*Cognitive Skill*	
Critical Thinking	The capability to use logic and reasoning to question, discern, interpret and analyze various types of information to form an evidence-based conclusion or judgment.	Cognitive Skill	Critical Thinking in the Survey
Decision Making	The capability to analyze information among a set of alternatives, to evaluate potential outcome and choose the most appropriate solutions to achieve a predetermined objective.	Cognitive Skill	Decision Making in the Survey
Evaluation	The capability to systematically assess products, services or processes using measurable indicators with the goal of ensuring or improving performance.	Cognitive Skill	Evaluation in the Survey
Problem Solving	The capability to identify problems and review related information to develop solutions or feasible options to achieve the desired end state.	Cognitive Skill	Problem Solving in the Survey
Systems Analysis	The capability to determine how a system should work and how changes in conditions, operations, and the environment will affect outcomes.	Cognitive Skill	Systems Design in the Survey
Technical Skills	*Developed capabilities that relate to the practical or mechanical side of an activity, the application of a set of technical processes and its required know-how.*	*Cognitive Skill*	*Major subconstructs used to form Technical Skills in the Survey*
Digital Production	The capacity to design, develop, adapt, or integrate hardware, software applications, electronic devices or digital technologies while adhering to cybersecurity standards.	Cognitive Skill	Summed to form Technical Skills in the Survey
Equipment and Tool Selection	The capability to choose between two or more types of tools, equipment or, machinery to perform a job.	Cognitive Skill	Summed to form Technical Skills in the Survey. Also summed to form Tool Selection
Operation and Control	The capability to maneuver and control operations of equipment, machines, vehicles or systems.	Cognitive Skill	Summed to form Technical Skills in the Survey. Also summed to form Tool Selection

Definition of Key Skills	Definition	K, S, A, or O	Comments re Survey
Operation Monitoring of Machinery and Equipment	The capability to watch gauges, dials, digital displays or other indicators to ensure a machine or piece of equipment is working according to specifications.	Cognitive Skill	Summed to form Technical Skills in the Survey. Also summed to form Tool Selection
Preventative Maintenance	The capability to perform maintenance on equipment, devices, building or machinery to keep them in functional and to prevent damage or failures.	Cognitive Skill	Summed to form Technical Skills in the Survey
Product Design	The capacity to design and develop layouts for the construction of objects, equipment, machinery, structures, or engineering systems (excluding software and hardware).	Cognitive Skill	Summed to form Technical Skills in the Survey. Also a standalone construct called Work Design
Quality Control Testing	The capability to conduct tests or inspections of prototypes, products, services, or processes to ensure their quality.	Cognitive Skill	Summed to form Technical Skills in the Survey
Repairing	The capability to replace, restore or adjust defective or deficient components in equipment, machines, and technical systems and test for function, appearance, operation and safety.	Cognitive Skill	Summed to form Technical Skills in the Survey
Setting Up	The capability to set up, adjust, install and assemble equipment, machines, parts or to prepare them for their functioning and use.	Cognitive Skill	Summed to form Technical Skills in the Survey
Troubleshooting	The capability to determine causes of operating errors in equipment, machinery, or technological systems and decide how to resolve the issues.	Cognitive Skill	Summed to form Technical Skills in the Survey
Resource Management Skills	*Developed capabilities to plan, organize, monitor or control the resources to achieve goals.*	*Cognitive Skill*	*Major subconstructs used to form Project Skills in the Survey*
Management of Financial Resources	The capability to plan, organize, direct, control or monitor financial resources and activities and account for the use of theses resources to ensure their utilization are conform to the objectives and purposes.	Cognitive Skill	Summed to form Project Skills in the Survey
Management of Material Resources	The capability to plan and manage purchasing, inventory, warehousing, transportation, distribution of products or materials and their use.	Cognitive Skill	Summed to form Project Skills in the Survey
Management of Personnel Resources	The capability to recruit, train, motivate, develop and direct employees, identify the best person for the tasks to be performed and establish their work objectives in relation to the objectives of the organization.	Cognitive Skill	Summed to form Project Skills in the Survey
Monitoring	The capability to monitor and assess the performance of yourself, other individuals or the organization to make improvements or take corrective action.	Cognitive Skill	Summed to form Project Skills in the Survey. Also used to measure Initative in the Survey.
Time Management	The capability to manage one's own time and the time of others.	Cognitive Skill	Summed to form Project Skills in the Survey
Interpersonal Skills	*Developed capabilities used to work with people to achieve goals.*	*Cognitive Skill*	*Major subconstructs used to form Interpersonal Skills in the Survey*
Coordinating	The capability to organise people or groups by adjusting activities in relation to others' activities so that they work effectively as a whole.	Cognitive Skill	Summed to form Interpersonal Skill in the Survey
Instructing	The capability to teach others knowledge, or how to do something.	Cognitive Skill	Summed to form Interpersonal Skill in the Survey
Negotiating	The capability to participate in, or facilitate communication between parties, in order to resolve differences, and reach a mutually acceptable or viable agreement.	Cognitive Skill	Summed to form Interpersonal Skill in the Survey
Persuading	The capability to convince others to change their minds, beliefs, intentions or behaviours.	Cognitive Skill	Summed to form Interpersonal Skill in the Survey
Social Perceptiveness	The capability to be aware of others' reactions, unspoken communication, body language cues and feelings and discern the reasons behind their behaviours.	Cognitive Skill	Summed to form Interpersonal Skill in the Survey. Also used to measure Social Responsibility for the Report
Abilities	***Innate and developed aptitudes that facilitate the acquisition of knowledge and skills to carry out expected work.***	***Ability***	
Cognitive Abilities	*Abilities that influence the acquisition and application of knowledge in performing various mental processes at work.*	*Ability*	*Major subconstructs used to form Cognitive Abilities in the Survey*
Categorization Flexibility	The ability to generate or use different sets of rules for combining or grouping things in different ways.	Ability	Summed to form Cognitive Abilities in the Survey
Deductive Reasoning	The ability to apply general rules to produce logical answers for specific problems.	Ability	Summed to form Cognitive Abilities in the Survey

Definition of Key Skills	Definition	K, S, A, or O	Comments re Survey
Fluency of Ideas	The ability to come up with multiple ideas about a topic.	Ability	Summed to form Cognitive Abilities in the Survey
Inductive Reasoning	The ability to combine pieces of information to form general rules or conclusions, which includes finding a relationship among seemingly unrelated events.	Ability	Summed to form Cognitive Abilities in the Survey
Information Ordering	The ability to arrange things or actions in a certain order or pattern according to a specific rule or set of rules (e.g., patterns of numbers, letters, words, pictures, mathematical operations).	Ability	Summed to form Cognitive Abilities in the Survey
Mathematical Reasoning	The ability to choose the right mathematical methods or formulas to solve a problem.	Ability	Summed to form Cognitive Abilities in the Survey
Memorizing	The ability to remember information such as words, numbers, pictures, or procedures.	Ability	Summed to form Cognitive Abilities in the Survey
Multitasking	The ability to shift back and forth between two or more activities or sources of information during the same time period (such as speech, sounds, touch, or other sources).	Ability	Summed to form Cognitive Abilities in the Survey
Numerical Ability	The ability to carry out arithmetical processes accurately such as addition, subtraction, multiplication or division.	Ability	Summed to form Cognitive Abilities in the Survey
Perceptual Speed	The ability to compare, quickly and accurately, similarities and differences among sets of letters, numbers, objects, pictures, or patterns. The things to be compared may be presented at the same time, one after the other, or with a remembered object.	Ability	Summed to form Cognitive Abilities in the Survey
Pattern Identification	The ability to identify or detect a known pattern such as a figure, object, word, or sound that is hidden in other information or material.	Ability	Summed to form Cognitive Abilities in the Survey
Pattern Organization Speed	The ability to quickly combine and organize information into meaningful patterns.	Ability	Summed to form Cognitive Abilities in the Survey
Problem Identification	The ability to identify an existing or potential problem. It is not about solving the problem, but only about recognizing its presence.	Ability	Summed to form Cognitive Abilities in the Survey. Also used to derive score called Problem Identification.
Selective Attention	The ability to concentrate on a task over a period of time without being distracted.	Ability	Summed to form Cognitive Abilities in the Survey
Spatial Orientation	The ability to know your location in relation to the environment or know where objects are in relation to you.	Ability	Summed to form Cognitive Abilities in the Survey
Spatial Visualization	The ability to think visually about geometric forms, comprehend the two-dimensional representation of three-dimensional objects and recognize the relationships resulting from the movement of objects in space.	Ability	Summed to form Cognitive Abilities in the Survey
Verbal Ability	The ability to understand the meaning, precise use, associated ideas, and relationships of spoken words; and to use them in the proper context when presenting information or ideas.	Ability	Summed to form Cognitive Abilities in the Survey
Written Comprehension	The ability to read and understand information and ideas presented in written form.	Ability	Summed to form Cognitive Abilities in the Survey
Written Expression	The ability to communicate information and ideas in writing and adapting the writing style to the audience so that they can understand.	Ability	Summed to form Cognitive Abilities in the Survey
Physical Abilities	*Abilities to perform physical activities that require strength, endurance, flexibility, balance or coordination.*	*Ability*	*Major subconstructs used to form Physical Abilities in the Survey*
Body Flexibility	The ability to bend, stretch, twist, or reach with your body, arms, and/or legs.	Ability	Summed to form Physical Abilities in the Survey
Dynamic Strength	The ability to exert muscle force repeatedly or continuously over time. This involves muscular endurance and resistance to muscle fatigue.	Ability	Summed to form Physical Abilities in the Survey
Explosive Strength	The ability to us short bursts of muscle force to propel oneself (as in jumping or sprinting), or to throw an object.	Ability	Summed to form Physical Abilities in the Survey
Gross Body Coordination	The ability to coordinate the movement of your arms, legs, and torso together when the whole body is in motion.	Ability	Summed to form Physical Abilities in the Survey
Gross Body Equilibrium	The ability to keep or regain your body balance or stay upright when in an unstable position.	Ability	Summed to form Physical Abilities in the Survey

Definition of Key Skills	Definition	K, S, A, or O	Comments re Survey
Stamina	The ability to perform intense physical activities over long periods of time without becoming winded or out of breath.	Ability	Summed to form Physical Abilities in the Survey
Static Strength	The ability to exert muscle force to lift, push, pull, or carry objects.	Ability	Summed to form Physical Abilities in the Survey
Trunk Strength	The ability to use your abdominal and lower back muscles to support part of the body repeatedly or continuously over time without "giving out" or fatiguing.	Ability	Summed to form Physical Abilities in the Survey
Psychomotor Abilities	*Abilities needed to manipulate and control objects.*	*Ability*	*Major subconstructs used to form Psychomotor Abilities in the Survey*
Arm-Hand Steadiness	The ability to keep your hand and arm steady while moving or holding them in one position.	Ability	Summed to form Psychomotor Abilities in the Survey
Control of Settings	The ability to adjust the controls of a machine or a vehicle to exact positions.	Ability	Summed to form Psychomotor Abilities in the Survey
Finger Dexterity	The ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate, or assemble small objects.	Ability	Summed to form Psychomotor Abilities in the Survey
Manual Dexterity	The ability to move your hand, your hand together with your arm, or your two hands to grasp, manipulate, or assemble objects or tools.	Ability	Summed to form Psychomotor Abilities in the Survey
Motor Coordination	The ability to coordinate eyes, hands and fingers accurately to respond with precise movements.	Ability	Summed to form Psychomotor Abilities in the Survey
Multi-Signal Response	The ability to choose quickly between one or more movements with the hand, finger, or foot in response to the appearance of two or more different signals such as lights, sounds, or images.	Ability	Summed to form Psychomotor Abilities in the Survey
Rate Control	The ability to time your movements or the movement of a piece of equipment in anticipation of changes in the speed and/or direction of a moving object.	Ability	Summed to form Psychomotor Abilities in the Survey
Reaction Time	The ability to respond quickly with one or more limbs to a stimulus such as noise, light or image.	Ability	Summed to form Psychomotor Abilities in the Survey
Speed of Limb Movement	The ability to quickly move the arms and legs.	Ability	Summed to form Psychomotor Abilities in the Survey
Finger-Hand-Wrist Motion	The ability to make fast, simple, and repeated movements of the fingers, hands, and wrists	Ability	Summed to form Psychomotor Abilities in the Survey
Sensory Abilities	*Abilities needed to perform activities that require visual, auditory, tactile, olfactory or speech perception.*	*Ability*	*Major subconstructs used to form Sensory Abilities in the Survey*
Auditory Attention	The ability to give full attention on a single source of sound in the presence of other distracting sounds.	Ability	Summed to form Sensory Abilities in the Survey
Colour Perception	The ability to match or detect differences or similarities between colours, including shades of colour and brightness.	Ability	Summed to form Sensory Abilities in the Survey
Depth Perception	The ability to discern which of several objects is closer or farther away from you, or to estimate the distance between you and an object.	Ability	Summed to form Sensory Abilities in the Survey
Far Vision	The ability to see details of objects and people at a distance.	Ability	Summed to form Sensory Abilities in the Survey
Glare Tolerance	The ability to see objects or people, in the presence of glare or bright lighting.	Ability	Summed to form Sensory Abilities in the Survey
Hearing Sensitivity	The ability to detect or distinguish the differences between sounds in terms of pitch and volume.	Ability	Summed to form Sensory Abilities in the Survey
Near Vision	The ability to see details at close range.	Ability	Summed to form Sensory Abilities in the Survey
Night Vision	The ability to see under low light conditions.	Ability	Summed to form Sensory Abilities in the Survey
Peripheral Vision	The ability to see objects, people or their movement in the peripheral field of vision when looking ahead.	Ability	Summed to form Sensory Abilities in the Survey
Speech Clarity	The ability to articulate and pronounce words clearly, so others can understand you when you speak.	Ability	Summed to form Sensory Abilities in the Survey

Definition of Key Skills	Definition	K, S, A, or O	Comments re Survey
Speech Recognition	The ability to identify and understand the speech of another person.	Ability	Summed to form Sensory Abilities in the Survey
Sound Localization	The ability to identify the direction, origin and distance from which a sound comes.	Ability	Summed to form Sensory Abilities in the Survey
Personal Attributes	***Personal characteristics that are innate and developed through the social context and personal experiences to which the individual is exposed. These qualities influence the way one is and does things and are considered valuable assets for work performance.***	***Soft Skill***	
Social Traits	*The personal characteristics related to the positive attitudes one has toward other people, which most often lead to positive relationships.*	*Soft Skill*	
Collaboration	The quality of contributing and working cooperatively while being supportive and inclusive of others to achieve a common goal.	Soft Skill	Summed to form Teamwork Skills
Concern for Others	The quality of having empathy towards others' feelings and needs and being understanding and helpful.	Soft Skill	Summed to form Teamwork Skills
Leadership	The quality of leading others towards a common goal by guiding, influencing, and inspiring them.	Soft Skill	Leadership Skills in the Survey
Self-Improvement	*The personal characteristics related to the improvement of one's knowledge, status, or character by one's own efforts.*	*Soft Skill*	
Active Learning	Pro-actively looking to understand the implications of new information in the current and changing workplace.	Soft Skill	Called Lifelong Learning in the Survey
Adaptability	The quality of adapting oneself to expected or unexpected changes and different situations while continuing to achieve past or renewed goals.	Soft Skill	Called Adaptability Skills in the Survey
Stress Tolerance	The quality of being able to remain calm, without being carried away by stress situations and to deal effectively with such situations.	Soft Skill	Called Professional Composure in the Survey
Results-Based Attributes	*The personal characteristics related to the drivers around brining things to completion.*	*Soft Skill*	
Independence	The quality of developing one's own way of doing things, guiding oneself with little or no supervision, and depending on oneself to get things done.	Soft Skill	Called Independence Level in the Survey
Dynamic Thinking	*The personal characteristics related to bubbling ideas and critical thinking.*	*Soft Skill*	
Attention to Detail	The quality of being meticulous in the execution of tasks.	Soft Skill	Called Attention to Detail in the Survey
Creativity	The quality of coming up with unusual or clever ideas about a given topic or situation, or to develop original ways to solve a problem.	Soft Skill	Summed to form Creativity Skills
Innovativeness	The quality of alternative thinking to develop new products or services to make improvement or to develop a new approach.	Soft Skill	Summed to Form Creativity Skills
Knowledge	***Organized sets of principles and practices used for the execution of tasks and activities within a particular domain.***	***Knowledge***	
Administration and Management	*Organized set of principles and practices relating to administration and management domains.*	*Knowledge*	
Business Management	Knowledge of concepts, principles and practices of managing business operations such as strategic planning, resource allocation, production management, and coordination of people and activities.	Knowledge	Called Business Principles in the Survey
Logistics, Design and Evaluation	*Organized set of principles and practices relating to logistics, design and evaluation domains.*	*Knowledge*	*Major subconstructs used to form Knowledge of Logisitics in the Survey*
Manufacturing, Processing and Production	Knowledge of concepts, principles, methods and techniques of production and transformation, including manual and mechanical processes.	Knowledge	Summed to form Knowledge of Logisitcs in the Survey
Logistics	Knowledge of concepts, principles, infrastructures and processes for planning, organizing and coordinating the transportation of people and animals or for the acquisition, transportation, and storage of goods and resources.	Knowledge	Summed to form Knowledge of Logisitcs in the Survey
Performance Measurement	Knowledge of concepts, principles, methods, practices and strategies of monitoring the development, delivery and quality of products, programs or services.	Knowledge	Summed to form Knowledge of Logisitcs in the Survey

Definition of Key Skills	Definition	K, S, A, or O	Comments re Survey
Technical Design	Knowledge of technical design concepts, principles, methods, techniques, and tools involved in the creation and production of technical plans, blueprints, drawings or models.	Knowledge	Summed to form Knowledge of Logisitcs in the Survey
Work Activities	***General types of work-related activities.***	***Other***	
Information-Oriented Activities	*Information and data management and processing activities that are necessary to meet the requirements of the job.*		
Analyzing Data or Information	Identifying the underlying principles, reasons, or facts of information by breaking down information or data into separate parts.	Other	Summed to form Experimental Skills. Also summed to form Mental Processes
Clerical Activities	Entering, transcribing, recording, storing, or maintaining all types of information in written or electronic form.	Other	Summed to form Experimental Skills
Developing Technical Instructions	Providing documentation, detailed instructions, drawings, or specifications to tell others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used.	Other	Summed to form Experimental Skills
Estimating the Quantifiable Characteristics of Products, Events, or Information	Estimating cost, resources or materials needed to perform a work activity.	Other	Summed to form Experimental Skills
Getting Information	Observing, receiving, or obtaining information from all relevant sources.	Other	Summed to form Experimental Skills
Identifying Objects, Actions, and Events	Identifying information by categorizing, recognizing differences or similarities, measuring, investigating and detecting changes in circumstances or events.	Other	Summed to form Experimental Skills
Inspecting Equipment, Structures, or Material	Inspecting equipment, structures, or material to identify the cause of errors, problems or defects.	Other	Summed to form Experimental Skills
Monitoring Processes, Materials, or Surroundings	Tracking and reviewing information from materials, events, or the environment to detect or assess problems and progress.	Other	Summed to form Experimental Skills
Processing Information	Compiling, categorizing, tabulating, auditing, or verifying information or data.	Other	Summed to form Experimental Skills. Also summed to form Mental Processes
Mental Process-Oriented Activities	*The processing, planning, problem solving, and decision-making activities that are necessary for the overall completion of a job.*	*Other*	*Major subconstructs used to form Mental Processes in the Survey*
Developing Objectives and Strategies	Define and establish medium to long-term objectives, and determine strategies and actions to achieve them.	Other	Summed to form Mental Processes in the Survey
Evaluating Information to Determine Compliance	Using relevant information and individual judgment to determine whether events or processes comply with laws, regulations or standards.	Other	Summed to form Mental Processes in the Survey
Judging Quality	Assessing the value, importance or quality of materials, products, services or people.	Other	Summed to form Mental Processes in the Survey. Also used to form a single standalone Quality Skills
Making Decisions	Analyzing information and evaluating results to choose the best solution.	Other	Summed to form Mental Processes in the Survey
Planning and Organizing	Developing specific goals and plans to prioritize and organize tasks to accomplish the work.	Other	Summed to form Mental Processes in the Survey. Also used to form a single standalone Program Planning
Scheduling Work and Activities	Scheduling events, programs, and activities, as well as the work of others.	Other	Summed to form Mental Processes in the Survey
Thinking Creatively	Generating innovative or creative ideas to develop or design new application, products, including artistic contributions.	Other	Summed to form Mental Processes in the Survey. Also used to form a single standalone Alternate Solutions
Using New Relevant Knowledge	Keeping up-to-date technically and applying new knowledge at work.	Other	Summed to form Mental Processes in the Survey. Also used to form a single standalone New Knowledge
People-Oriented Activities	*The activities where social interaction with others is necessary to meet the requirements of the job.*	*Other*	

Definition of Key Skills	Definition	K, S, A, or O	Comments re Survey
Communicating with Persons Outside Organization	Sharing or exchanging information with people outside the organization, representing the organization to customers, the public, government or other external sources.	Other	Summed to form Support Skills
Providing Consultation and Advice	Providing guidance and expert advice to management or other groups on technical, systems, or process related topics.	Other	Summed to form Support Skills
Team Building	Encouraging and building mutual trust, respect, and cooperation among team members.	Other	Team Building in the Survey
Selling or Influencing Others	Convincing others to buy goods or services, or to change their minds or actions.	Other	Entrepeneurial Skills in the Survey

Appendix 8

Table of National Occupation Codes in the Survey Data and the Corresponding Occupation Types

Index	Occupation Description	NOC Code	# of Entries
Admin			
	Administrative assistants	13110	4
	Sales and account representatives - wholesale trade (non-technical)	64101	3
	Administrative officers	13100	2
	Accounting technicians and bookkeepers	12200	1
	Other customer and information services representatives	64409	1
Engineer			
	Chemical engineers	21320	20
	Biomedical engineers	21399.02	19
	Industrial and manufacturing engineers	21321	18
	Mechanical engineers	21301	14
	Electrical and electronics engineers	21310	6
	Aerospace Engineers	21390	4
	Industrial designers	22211	3
	Facility operation and maintenance managers	70012	2
	Agricultural and bio-resource engineers	21399.01	2
	Materials scientists	21109.02	2
	Computer and telecommunications hardware engineers	21311.01	2
	Engineering physicists and engineering scientists	21399.03	2
	Supervisors, electronics and electrical products manufacturing	92021	2
	Marine and naval engineers	21399.04	2
	Concrete products forming and finiching machine operators and workers	94103.01	2
	Material handlers	75101	1
	Statistical officers and related research support occupations	12113	1
Inspector			
	Non-destructive testers and inspectors	22230	3
	Product inspectors	94219.02	2
	Aircraft assembly inspectors	93200.02	2
	Airworthiness inspectors	22231.03	1
	Inspectors and testers in electrical apparatus manufacturing	94205.02	1
	Machining and tooling inspectors	72100.02	1
Manager			
	Manufacturing managers	90010	30
	Engineering managers	20010	21
	Supervisors, food and beverage processing	92012	13
	Supervisors, other products manufacturing and assembly	92024	13
	Contractors and supervisors, electrical trades and telecommunications occupations	72011	3
	Supervisors, supply chain, tracking and scheduling coordination occupations	12013	2
	Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	72010	2
	Senior Managers - public and private sector	18	1
	Supervisors, petroleum, gas and chemical processing and utilities	92011	1
	Supervisors, plastic and rubber products manufacturing	92013	1
	Supervisors, other mechanical and metal products manufacturing	92023	1
Production			
	Labourers in metal fabrication	95101	11
	Labourers in food and beverage processing	95106	10
	Mechanical assemblers	94204.01	8
	Machine operators, food and beverage processing	94140.02	7
	Process control operators, food and beverage processing	94140.01	6
	Construction trades helpers and labourers	75110	6
	Aircraft assemblers	93200.01	6
	Other labourers in processing, manufacturing and utilities	95109	5
	Industrial painters and coaters	94213.01	5
	Electronics assemblers and fabricators	94201.01	5
	Fish and seafood plant machine operators	94142.01	4
	Assemblers, electrical appliance, apparatus and equipment manufacturing	94202.01	4
	Aircraft instrument	22313	4

Index	Occupation Description	NOC Code	# of Entries
	Industrial meat cutters	94141.02	3
	Fish and seafood plant cutters and cleaners	94142.02	3
	Bakers	63202	3
	Chemical plant machine operators	94110	3
	Shippers and receivers	14400	2
	Testers and graders, food and beverage processing	94143	2
	Labourers in fish and seafood processing	95107	2
	Labourers in chemical products processing and utilities	95102	2
	Other trades helpers and labourers	75119	2
	Metalworking machine operators	94105.01	2
	Machine operators, mineral and metal processing	94100	2
	Other repairers and servicers	73209	2
	Poultry preparers	94141.03	1
	Production and transportation logistics coordinators	13201	1
	General building maintenance workers and building superintendents	73201	1
	Production logistics workers	14402	1
	Machine operators in electrical apparatus manufacturing	94205.01	1
	Geological and mineral technologists	22101.01	1
	Mine labourers	85110	1
	Welding, brazing and soldering machine operators	72106.02	1
	Machine operators of other metal products	94107	1
	Furniture and fixture assemblers	94210.01	1
	Product assemblers and finishers	94219.01	1
	Mining engineers	21330	1
Technician			
	Biological technicians	22110.02	15
	Mechanical engineering technicians	22301.02	6
	Industrial engineering and manufacturing technicians	22302.02	5
	Electrical and electronics engineering technicians	22310.02	5
	Chemical technicians	22100.02	4
	Purchasing managers	10012	2
	Dietary technicians	32129.01	1
	Drillers - surface mining, quarrying and construction	73402.01	1
	Civil engineering technicians	22300.02	1
	Prosthetic and orthotic technicians	32129.04	1
Technologist			
	Biological technologists	22110.01	19
	Chemical technologists	22100.01	6
	Industrial engineering and manufacturing technologists	22302.01	3
	Electrical and electronics engineering technologists	22310.01	2
	Mechanical engineering technologists	22301.01	2
	Chemists	21101	1
Trades			
	Welders	72106.01	25
	Machinists	72100.01	20
	Construction millwrights and industrial mechanics	72400	11
	Aircraft mechanics	72404.01	7
	Contractors and supervisors, mechanic trades	72020	6
	Industrial electricians	72201	5
	Electrical mechanics	72422	4
	Tool and die makers	72101.01	3
	Industrial instrument technicians and mechanics	22312	2
	Heavy-duty equipment mechanics	72401	2
	Electricians (except industrial and power system)	72200	2
	Human resources managers	10011	1
	Transport truck drivers	73300	1
	Cooks	63200	1
	Heating, refrigeration and air conditioning mechanics	72402	1
	Mechanical repairers, motor vehicle manufacturing	72410.02	1
	Motorcycle, all-terrain vehicle and other related mechanics	72423.01	1
	Electrical fitters and wirers, industrial electrical motors and transformers	94203.02	1
	Metallurgical and materials engineers	21322	1
	Underground production and development miners	83100	1
	Total		502

Appendix 9

Proficiency Data

Part A - Association Sector by Occupation Type

Pharma 3254 - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.42	1.00	2.58	1.02	2.85	1.29	3.13	1.52	0.27	0.54
Attention to Detail	2.75	1.36	2.63	1.18	2.73	1.28	2.79	1.46	0.10	0.17
Cognitive Abilities	1.88	0.44	2.15	0.88	2.42	0.98	2.61	1.14	0.27	0.46
Commitment to Lifelong Learning	2.00	0.74	2.08	1.01	2.35	1.02	2.56	1.19	0.27	0.48
Communication Skill	1.45	0.48	2.29	1.16	2.31	1.30	2.37	1.47	0.02	0.08
Creativity and Innovation	1.17	1.09	2.04	1.59	2.13	1.71	2.38	1.84	0.08	0.33
Critical Thinking Skills	1.75	0.62	2.19	1.15	2.27	1.39	2.71	1.70	0.08	0.52
Decision Making Skill	1.67	0.49	2.23	0.94	2.25	1.13	2.27	1.28	0.02	0.04
Digital Literacy	0.67	0.65	2.06	1.58	2.50	1.43	2.98	1.46	0.44	0.92
Entrepeneurial Skill	1.67	0.49	1.88	1.05	1.85	1.23	1.98	1.23	-0.02	0.10
Independence	2.42	1.08	2.15	1.10	2.48	1.17	2.83	1.17	0.33	0.69
Initiative	1.67	0.49	1.96	1.05	2.04	1.21	2.13	1.29	0.08	0.17
Interpersonal Skills	1.45	0.39	1.85	1.14	1.97	1.25	2.05	1.41	0.11	0.20
Knowledge of Emerging Trends and Technologies	0.50	0.52	1.00	1.32	1.10	1.40	1.25	1.60	0.10	0.25
Leadership Skills	2.17	0.94	1.96	1.11	2.06	1.37	2.25	1.52	0.10	0.29
New Relevant Knowledge	1.25	0.87	1.44	1.41	1.58	1.52	1.67	1.58	0.15	0.23
Numeracy	1.50	0.52	1.96	1.07	1.92	1.35	2.02	1.58	-0.04	0.06
Physical Abilities	2.58	0.74	3.13	0.79	3.11	0.89	3.09	1.00	-0.02	-0.04
Problem Solving	1.67	0.49	2.31	1.16	2.65	1.55	2.85	1.77	0.33	0.54
Professional Composure	2.25	1.29	2.21	1.23	2.52	1.32	2.58	1.44	0.31	0.38
Project Management Skill	1.30	0.49	1.65	1.16	1.71	1.31	1.75	1.46	0.06	0.10
Psychomotor Abilities	2.73	0.59	3.02	0.57	2.96	0.89	2.92	1.08	-0.06	-0.10
Reading Skill	1.67	0.49	2.67	1.25	2.73	1.56	2.79	1.79	0.06	0.13
Sensory Abilities	1.98	0.31	2.78	0.77	3.04	1.08	2.98	1.32	0.26	0.20
Skill Needed to Evaluate Alternatives	1.42	0.67	1.63	1.14	1.63	1.33	1.75	1.55	0.00	0.13
Skill Needed to Judge Quality	2.08	0.29	2.38	0.88	2.52	1.07	2.48	1.25	0.15	0.10
Skill Needed to Support Supplier Development	1.50	0.43	2.10	1.28	2.21	1.57	2.42	1.72	0.10	0.31
Skill Needed to Understand Business Principles	0.08	0.29	0.79	1.43	0.85	1.53	0.90	1.63	0.06	0.10
Skill to Conduct Work Design	1.25	1.14	1.52	1.42	1.92	1.80	2.13	1.99	0.40	0.60
Skill to Design a System	1.50	0.80	1.88	1.15	2.00	1.42	2.08	1.56	0.13	0.21
Skill to Design Experiments	1.87	0.44	2.03	0.98	2.09	1.20	2.15	1.35	0.05	0.12
Skill to Fomulate Alternative Solutions	1.08	1.00	1.40	1.40	1.60	1.60	1.71	1.70	0.21	0.31
Skill to Identify Problems	1.75	0.45	2.19	0.85	2.40	1.13	2.48	1.27	0.21	0.29
Skill to Identify, Formulate, and Solve Problems	1.65	0.63	1.85	1.14	2.10	1.40	2.20	1.57	0.25	0.35
Skill to Plan a Program	1.75	0.97	2.00	1.37	2.13	1.44	2.21	1.56	0.13	0.21
Skill to Use the Tools Necessary for the Job	2.31	0.91	3.00	0.95	3.11	1.12	3.24	1.35	0.11	0.24
Social Responsibility	1.42	0.51	1.90	1.18	1.98	1.42	2.08	1.61	0.08	0.19
Team Building Skills	1.75	0.62	2.13	1.04	2.19	1.26	2.25	1.37	0.06	0.13
Teamwork and Collaboration	2.67	0.81	3.23	0.91	3.19	1.16	3.10	1.43	-0.04	-0.13
Technical Skill	1.73	0.67	2.15	0.97	2.40	1.20	2.59	1.54	0.25	0.43
Writing Skill	1.42	0.51	2.04	1.21	2.00	1.34	2.10	1.64	-0.04	0.06

Aerospace - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.86	0.53	2.96	0.98	3.25	0.78	3.07	0.83	0.29	0.11
Attention to Detail	3.50	1.09	3.57	1.04	3.86	0.98	3.93	1.08	0.29	0.36
Cognitive Abilities	2.11	0.37	2.11	0.85	2.30	1.03	2.39	1.25	0.18	0.28
Commitment to Lifelong Learning	2.07	0.62	2.30	1.02	2.41	1.19	2.55	1.41	0.11	0.25
Communication Skill	1.29	0.34	1.95	0.90	2.28	1.05	2.32	1.10	0.33	0.36
Creativity and Innovation	1.43	0.65	1.75	0.69	2.21	0.98	2.38	1.13	0.46	0.63
Critical Thinking Skills	1.86	0.36	2.11	1.05	2.48	1.10	2.46	1.20	0.38	0.36
Decision Making Skill	1.86	0.36	1.98	1.38	2.30	1.45	2.20	1.40	0.32	0.21
Digital Literacy	0.86	0.36	1.59	0.68	2.70	0.86	2.98	1.01	1.11	1.39
Entrepeneurial Skill	1.21	0.43	0.95	0.69	1.02	0.64	1.02	0.64	0.07	0.07
Independence	2.86	0.86	2.89	1.10	3.23	0.77	3.29	0.91	0.34	0.39
Initiative	1.86	0.36	2.11	0.97	2.41	1.05	2.63	1.00	0.30	0.52
Interpersonal Skills	1.33	0.23	2.03	0.90	2.17	1.03	2.23	1.16	0.14	0.20
Knowledge of Emerging Trends and Technologies	0.55	0.20	1.21	1.04	1.54	1.46	1.63	1.48	0.32	0.41
Leadership Skills	2.14	0.66	1.77	0.95	2.14	1.20	2.18	1.18	0.38	0.41
New Relevant Knowledge	2.14	1.03	1.98	1.28	2.34	1.43	2.48	1.42	0.36	0.50
Numeracy	1.86	0.36	2.23	0.76	2.66	0.94	2.70	1.05	0.43	0.46
Physical Abilities	3.10	0.71	3.40	0.62	3.38	0.85	3.28	1.00	-0.02	-0.13
Problem Solving	1.86	0.36	2.32	0.65	2.52	0.77	2.59	1.09	0.20	0.27
Professional Composure	2.36	0.84	2.59	1.03	2.88	0.92	2.96	0.88	0.29	0.38
Project Management Skill	1.23	0.21	1.48	0.93	1.73	1.07	1.78	1.13	0.25	0.30
Psychomotor Abilities	3.03	0.24	3.50	0.68	3.76	0.70	3.71	0.76	0.26	0.21
Reading Skill	2.29	0.73	2.80	0.90	2.86	0.79	2.84	0.95	0.05	0.04
Sensory Abilities	2.37	0.43	2.77	0.66	2.76	0.67	2.65	0.84	-0.01	-0.11
Skill Needed to Evaluate Alternatives	2.07	0.92	2.00	1.24	2.32	1.35	2.32	1.36	0.32	0.32
Skill Needed to Judge Quality	2.79	1.12	2.86	1.13	3.14	1.08	3.16	1.31	0.29	0.30
Skill Needed to Support Supplier Development	1.54	0.31	1.23	0.70	1.43	0.82	1.41	0.81	0.20	0.18
Skill Needed to Understand Business Principles	0.00	0.00	0.34	0.77	0.50	0.90	0.63	1.06	0.16	0.29
Skill to Conduct Work Design	1.64	0.74	1.55	0.87	1.68	0.95	1.75	1.04	0.13	0.20
Skill to Design a System	2.07	0.92	1.93	1.45	2.20	1.46	2.23	1.49	0.27	0.30
Skill to Design Experiments	2.29	0.75	1.85	0.91	1.87	0.94	2.08	1.12	0.02	0.23
Skill to Fomulate Alternative Solutions	1.50	0.76	1.59	1.31	1.66	1.35	1.71	1.42	0.07	0.13
Skill to Identify Problems	1.86	0.36	2.38	0.90	2.80	1.03	2.93	1.18	0.43	0.55
Skill to Identify, Formulate, and Solve Problems	1.96	0.65	2.23	1.06	2.37	0.98	2.42	1.13	0.14	0.19
Skill to Plan a Program	1.57	0.65	1.63	0.89	1.86	0.93	1.75	0.96	0.23	0.13
Skill to Use the Tools Necessary for the Job	2.83	0.53	2.87	0.86	2.99	0.86	3.05	1.02	0.12	0.18
Social Responsibility	1.00	0.00	1.64	0.81	1.77	0.88	1.88	0.85	0.13	0.23
Team Building Skills	1.71	0.47	1.86	0.69	2.07	0.85	2.14	1.10	0.21	0.29
Teamwork and Collaboration	2.82	0.61	2.88	0.75	3.21	0.78	3.30	0.86	0.34	0.43
Technical Skill	2.02	0.45	2.99	1.08	3.06	0.91	2.85	0.83	0.08	-0.14
Writing Skill	1.43	0.51	2.05	1.09	1.96	0.74	1.86	0.71	-0.09	-0.20

Shipbuilding - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.08	0.49	2.90	0.78	2.98	0.79	3.06	0.71	0.08	0.15
Attention to Detail	3.00	1.41	3.15	1.13	3.15	1.17	3.17	1.17	0.00	0.02
Cognitive Abilities	1.87	0.37	1.89	0.43	1.88	0.47	1.86	0.51	-0.02	-0.04
Commitment to Lifelong Learning	2.15	0.80	2.27	0.73	2.52	0.70	2.62	0.84	0.25	0.35
Communication Skill	1.15	0.38	1.65	0.77	1.90	0.93	2.04	1.06	0.25	0.38
Creativity and Innovation	1.31	1.07	1.77	0.92	1.92	1.00	2.40	1.23	0.15	0.63
Critical Thinking Skills	1.54	0.52	1.60	0.67	1.73	0.66	1.77	0.70	0.13	0.17
Decision Making Skill	1.54	0.52	1.67	0.62	1.71	0.64	1.75	0.71	0.04	0.08
Digital Literacy	0.54	0.66	1.40	0.94	2.23	0.87	2.75	0.78	0.83	1.35
Entrepeneurial Skill	1.15	0.38	1.15	0.62	1.19	0.63	1.21	0.66	0.04	0.06
Independence	2.92	1.26	2.90	1.33	2.85	1.35	2.79	1.38	-0.06	-0.12
Initiative	1.54	0.52	1.96	0.79	2.00	0.90	2.00	0.94	0.04	0.04
Interpersonal Skills	1.22	0.32	1.67	0.58	2.40	1.03	2.40	1.00	0.72	0.72
Knowledge of Emerging Trends and Technologies	0.25	0.18	1.08	0.89	1.33	1.22	1.46	1.44	0.25	0.38
Leadership Skills	1.92	0.95	2.00	0.91	2.00	0.90	2.00	0.89	0.00	0.00
New Relevant Knowledge	1.23	1.09	1.50	1.14	1.69	1.19	1.79	1.23	0.19	0.29
Numeracy	1.38	0.51	1.48	0.78	1.85	0.97	1.87	1.00	0.37	0.38
Physical Abilities	3.06	0.65	3.15	0.72	3.12	0.70	3.10	0.74	-0.03	-0.05
Problem Solving	1.54	0.52	1.92	0.84	2.50	1.11	2.79	1.39	0.58	0.87
Professional Composure	2.46	1.33	2.62	1.14	2.56	1.13	2.52	1.16	-0.06	-0.10
Project Management Skill	1.15	0.39	1.19	0.68	1.25	0.71	1.28	0.70	0.05	0.09
Psychomotor Abilities	3.06	0.30	3.05	0.80	3.05	0.70	3.03	0.71	0.00	-0.02
Reading Skill	1.46	0.52	2.37	1.13	2.88	1.05	3.15	1.08	0.52	0.79
Sensory Abilities	2.24	0.38	2.35	0.48	2.39	0.45	2.45	0.46	0.04	0.10
Skill Needed to Evaluate Alternatives	1.62	0.77	1.77	0.75	1.79	0.80	1.81	0.85	0.02	0.04
Skill Needed to Judge Quality	2.15	0.80	2.38	0.77	2.71	0.93	2.75	0.97	0.33	0.37
Skill Needed to Support Supplier Development	1.38	0.42	1.31	0.70	1.35	0.75	1.40	0.79	0.04	0.10
Skill Needed to Understand Business Principles	0.08	0.28	0.44	0.78	0.48	0.86	0.52	0.94	0.04	0.08
Skill to Conduct Work Design	1.54	1.13	1.46	1.11	1.52	1.12	1.56	1.15	0.06	0.10
Skill to Design a System	1.62	0.77	1.56	0.96	1.65	0.99	1.67	1.04	0.10	0.12
Skill to Design Experiments	1.76	0.46	1.73	0.65	1.77	0.67	1.83	0.69	0.04	0.10
Skill to Fomulate Alternative Solutions	1.15	0.80	1.38	0.83	1.42	0.82	1.42	0.81	0.04	0.04
Skill to Identify Problems	1.85	0.55	1.90	0.80	2.17	1.02	2.21	1.05	0.27	0.31
Skill to Identify, Formulate, and Solve Problems	1.46	0.65	1.68	0.94	1.73	0.89	1.75	0.90	0.05	0.07
Skill to Plan a Program	1.15	0.90	1.40	0.88	1.46	0.89	1.52	0.93	0.06	0.12
Skill to Use the Tools Necessary for the Job	2.62	0.73	2.61	0.74	2.72	0.80	2.80	0.79	0.11	0.19
Social Responsibility	1.08	0.28	1.21	0.38	1.90	1.20	1.90	1.21	0.69	0.69
Team Building Skills	1.15	0.38	1.69	0.65	1.85	0.71	1.90	0.72	0.15	0.21
Teamwork and Collaboration	2.96	0.43	2.94	0.43	3.33	0.51	3.62	0.84	0.38	0.67
Technical Skill	1.88	0.76	1.93	0.89	2.17	1.03	2.22	1.26	0.24	0.28
Writing Skill	1.23	0.44	1.83	0.93	2.10	0.98	2.21	1.02	0.27	0.38

Automotive - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.86	0.38	3.07	0.59	3.21	0.70	3.29	0.57	0.14	0.21
Attention to Detail	3.86	0.38	3.57	0.53	3.79	0.49	4.14	0.24	0.21	0.57
Cognitive Abilities	2.06	0.14	2.06	0.14	2.56	0.50	2.49	0.44	0.50	0.43
Commitment to Lifelong Learning	2.14	0.38	2.32	0.55	2.43	0.61	2.46	0.62	0.11	0.14
Communication Skill	1.24	0.42	2.24	1.37	2.42	1.22	2.60	1.35	0.18	0.36
Creativity and Innovation	1.50	0.50	1.64	0.56	2.36	1.18	2.39	1.17	0.71	0.75
Critical Thinking Skills	2.00	0.00	2.57	0.98	2.89	0.93	3.04	0.76	0.32	0.46
Decision Making Skill	2.00	0.00	2.29	0.49	2.29	0.49	2.29	0.49	0.00	0.00
Digital Literacy	1.00	0.00	1.57	0.98	2.14	0.99	2.89	1.08	0.57	1.32
Entrepeneurial Skill	1.14	0.38	1.14	0.38	1.14	0.38	1.14	0.38	0.00	0.00
Independence	3.71	0.49	3.43	0.53	3.43	0.53	3.43	0.53	0.00	0.00
Initiative	2.00	0.00	2.29	0.49	2.29	0.49	2.29	0.49	0.00	0.00
Interpersonal Skills	1.20	0.26	1.91	1.11	2.11	1.02	2.11	1.00	0.19	0.19
Knowledge of Emerging Trends and Technologies	0.46	0.17	0.89	0.78	1.29	1.25	1.36	1.27	0.39	0.46
Leadership Skills	2.14	0.38	2.14	0.38	2.36	0.45	2.29	0.39	0.21	0.14
New Relevant Knowledge	1.86	0.38	2.14	0.69	2.54	0.77	2.61	1.02	0.39	0.46
Numeracy	1.86	0.38	2.14	0.69	2.43	0.79	2.43	0.79	0.29	0.29
Physical Abilities	2.63	0.40	2.77	0.42	2.77	0.42	2.77	0.42	0.00	0.00
Problem Solving	2.00	0.00	2.00	0.00	2.32	0.31	2.57	0.53	0.32	0.57
Professional Composure	3.14	0.38	3.14	0.38	3.36	0.45	3.39	0.50	0.21	0.25
Project Management Skill	1.26	0.10	1.49	0.36	1.68	0.34	1.68	0.34	0.19	0.19
Psychomotor Abilities	3.13	0.22	3.13	0.22	3.13	0.22	3.13	0.22	0.00	0.00
Reading Skill	2.00	0.00	2.29	0.76	2.29	0.76	2.29	0.76	0.00	0.00
Sensory Abilities	2.25	0.17	2.25	0.17	2.25	0.17	2.25	0.17	0.00	0.00
Skill Needed to Evaluate Alternatives	1.86	0.38	1.86	0.38	2.32	0.55	2.46	0.80	0.46	0.61
Skill Needed to Judge Quality	2.14	0.38	2.57	0.73	2.96	0.82	2.93	0.84	0.39	0.36
Skill Needed to Support Supplier Development	1.43	0.19	1.43	0.19	1.61	0.40	1.75	0.63	0.18	0.32
Skill Needed to Understand Business Principles	0.14	0.38	0.43	0.53	0.43	0.53	0.43	0.53	0.00	0.00
Skill to Conduct Work Design	1.86	0.38	2.43	1.13	2.46	1.12	2.75	1.15	0.04	0.32
Skill to Design a System	1.86	0.38	2.14	0.69	2.21	0.57	2.25	0.52	0.07	0.11
Skill to Design Experiments	1.96	0.20	1.96	0.20	1.96	0.20	1.96	0.20	0.00	0.00
Skill to Fomulate Alternative Solutions	1.86	0.38	1.86	0.38	2.18	0.47	2.07	0.45	0.32	0.21
Skill to Identify Problems	2.00	0.00	2.29	0.49	2.68	0.37	2.68	0.37	0.39	0.39
Skill to Identify, Formulate, and Solve Problems	1.79	0.19	2.44	1.08	2.60	0.99	2.67	0.96	0.16	0.23
Skill to Plan a Program	1.43	0.53	1.43	0.53	1.75	0.56	1.71	0.57	0.32	0.29
Skill to Use the Tools Necessary for the Job	2.86	0.38	3.17	0.53	3.56	0.64	3.63	0.72	0.39	0.46
Social Responsibility	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00
Team Building Skills	1.00	0.00	1.29	0.49	1.57	0.55	1.50	0.50	0.29	0.21
Teamwork and Collaboration	3.07	0.73	3.07	0.53	3.36	0.70	3.46	0.82	0.29	0.39
Technical Skill	1.99	0.16	2.30	0.50	3.01	0.53	3.05	0.52	0.71	0.75
Writing Skill	1.14	0.38	1.86	1.07	1.86	1.07	1.82	0.99	0.00	-0.04

Mining Supply Chain -Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.86	0.67	3.04	0.79	3.11	0.83	3.20	0.84	0.07	0.16
Attention to Detail	2.81	1.43	3.01	1.38	3.05	1.37	3.06	1.39	0.03	0.05
Cognitive Abilities	1.85	0.33	1.94	0.59	1.97	0.59	1.98	0.57	0.03	0.04
Commitment to Lifelong Learning	2.08	0.68	2.24	0.87	2.28	0.91	2.28	0.99	0.05	0.05
Communication Skill	1.30	0.48	2.21	1.15	2.41	1.20	2.49	1.37	0.20	0.28
Creativity and Innovation	1.03	1.01	1.69	1.08	1.84	1.17	1.93	1.24	0.15	0.24
Critical Thinking Skills	1.51	0.56	1.85	0.81	2.11	1.02	2.26	1.23	0.26	0.41
Decision Making Skill	1.54	0.56	1.89	0.93	1.99	1.07	2.05	1.15	0.10	0.16
Digital Literacy	0.68	0.67	1.49	1.06	1.89	1.35	2.12	1.51	0.40	0.64
Entrepeneurial Skill	1.35	0.54	1.32	0.69	1.28	0.63	1.29	0.65	-0.04	-0.03
Independence	2.57	1.01	2.75	1.08	2.80	1.04	2.86	0.99	0.05	0.11
Initiative	1.62	0.55	1.82	0.88	1.90	0.92	1.90	0.96	0.07	0.07
Interpersonal Skills	1.31	0.39	1.55	0.70	1.59	0.84	1.79	0.95	0.04	0.24
Knowledge of Emerging Trends and Technologies	0.33	0.28	0.54	0.79	0.66	0.90	0.74	1.01	0.11	0.20
Leadership Skills	1.86	0.86	1.99	0.95	2.03	1.01	2.07	1.04	0.04	0.08
New Relevant Knowledge	1.22	0.85	1.49	1.01	1.57	1.13	1.61	1.17	0.07	0.11
Numeracy	1.46	0.65	1.97	0.93	2.11	1.00	2.23	1.14	0.14	0.26
Physical Abilities	3.17	0.80	3.20	0.80	3.16	0.79	3.16	0.79	-0.04	-0.04
Problem Solving	1.59	0.55	2.18	0.97	2.51	1.09	2.61	1.19	0.32	0.43
Professional Composure	2.59	1.01	2.82	1.08	2.80	1.11	2.91	1.10	-0.02	0.09
Project Management Skill	1.17	0.40	1.34	0.75	1.42	0.86	1.46	0.91	0.08	0.12
Psychomotor Abilities	3.08	0.27	3.21	0.53	3.23	0.47	3.24	0.46	0.01	0.02
Reading Skill	1.49	0.56	2.43	1.15	2.68	1.19	2.79	1.28	0.24	0.36
Sensory Abilities	2.21	0.31	2.42	0.69	2.47	0.66	2.49	0.69	0.05	0.08
Skill Needed to Evaluate Alternatives	1.38	0.64	1.69	1.08	1.77	1.12	1.94	1.25	0.08	0.25
Skill Needed to Judge Quality	1.92	0.55	2.01	0.77	2.16	0.88	2.29	1.03	0.14	0.28
Skill Needed to Support Supplier Development	1.28	0.48	1.24	0.61	1.34	0.73	1.36	0.75	0.11	0.12
Skill Needed to Understand Business Principles	0.14	0.35	0.42	0.95	0.45	1.03	0.57	1.20	0.03	0.16
Skill to Conduct Work Design	1.11	1.05	1.48	1.04	1.71	1.08	1.94	1.24	0.23	0.46
Skill to Design a System	1.38	0.64	1.47	1.02	1.57	1.10	1.65	1.19	0.09	0.18
Skill to Design Experiments	1.77	0.52	1.72	0.69	1.85	0.80	1.91	0.89	0.13	0.19
Skill to Fomulate Alternative Solutions	1.05	0.85	1.28	1.05	1.35	1.09	1.44	1.17	0.07	0.16
Skill to Identify Problems	1.81	0.52	2.13	0.88	2.22	0.87	2.48	1.12	0.09	0.35
Skill to Identify, Formulate, and Solve Problems	1.39	0.62	1.74	0.94	2.02	0.98	2.19	1.20	0.28	0.45
Skill to Plan a Program	1.22	0.98	1.68	0.97	1.89	1.02	1.91	1.10	0.21	0.23
Skill to Use the Tools Necessary for the Job	2.48	0.75	2.65	0.78	2.89	0.74	3.09	0.86	0.25	0.44
Social Responsibility	1.11	0.39	1.44	0.98	1.49	1.05	1.54	1.13	0.05	0.10
Team Building Skills	1.27	0.51	1.63	0.95	1.72	1.10	1.80	1.30	0.09	0.18
Teamwork and Collaboration	2.93	0.54	3.09	0.80	3.21	0.87	3.32	0.91	0.12	0.24
Technical Skill	1.76	0.56	2.23	0.86	2.58	0.91	2.64	1.11	0.35	0.41
Writing Skill	1.14	0.42	2.10	1.21	2.14	1.36	2.16	1.38	0.04	0.05

Food Processing - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.93	0.76	2.84	0.92	3.25	0.84	3.44	0.96	0.41	0.60
Attention to Detail	2.53	1.19	2.92	1.05	3.06	1.18	3.23	1.27	0.15	0.32
Cognitive Abilities	1.73	0.46	2.09	0.89	2.28	0.90	2.48	1.10	0.20	0.39
Commitment to Lifelong Learning	1.86	0.48	2.07	0.80	2.40	0.92	2.59	1.10	0.33	0.53
Communication Skill	1.24	0.55	2.23	1.18	2.74	1.15	3.05	1.29	0.51	0.81
Creativity and Innovation	0.72	0.97	1.30	1.03	1.83	1.32	2.17	1.47	0.53	0.87
Critical Thinking Skills	1.43	0.60	1.93	1.00	2.33	0.99	2.60	1.13	0.41	0.67
Decision Making Skill	1.55	0.60	1.78	0.94	2.22	1.03	2.56	1.32	0.44	0.79
Digital Literacy	0.86	1.01	1.64	1.12	2.25	1.31	2.64	1.51	0.61	0.99
Entrepeneurial Skill	1.30	0.57	1.34	0.98	1.59	1.25	1.71	1.39	0.25	0.38
Independence	2.26	0.94	2.64	0.97	2.80	1.04	2.85	1.17	0.17	0.22
Initiative	1.55	0.60	1.95	0.97	2.22	0.98	2.47	1.18	0.27	0.52
Interpersonal Skills	1.29	0.55	1.87	0.86	2.35	1.00	2.52	1.15	0.48	0.66
Knowledge of Emerging Trends and Technologies	0.58	0.80	1.07	1.08	1.41	1.24	1.72	1.45	0.34	0.65
Leadership Skills	1.76	0.65	1.81	0.92	2.03	0.95	2.31	1.30	0.22	0.51
New Relevant Knowledge	0.97	0.85	1.54	1.06	2.03	1.17	2.41	1.42	0.49	0.87
Numeracy	1.68	0.58	2.20	0.82	2.54	0.87	2.85	1.10	0.33	0.65
Physical Abilities	2.81	0.58	3.18	0.98	3.08	1.01	3.13	1.14	-0.10	-0.05
Problem Solving	1.55	0.60	2.19	1.14	2.67	1.05	3.03	1.16	0.48	0.84
Professional Composure	1.78	1.18	2.10	1.07	2.39	1.11	2.63	1.20	0.29	0.53
Project Management Skill	1.29	0.52	1.53	0.85	1.84	1.06	2.16	1.31	0.31	0.62
Psychomotor Abilities	2.85	0.25	3.08	0.79	3.19	0.89	3.30	0.96	0.11	0.22
Reading Skill	1.36	0.59	2.13	1.04	2.63	1.07	3.11	1.15	0.49	0.98
Sensory Abilities	1.90	0.36	2.53	0.91	2.63	0.91	2.91	1.08	0.11	0.38
Skill Needed to Evaluate Alternatives	1.55	0.60	1.71	0.77	2.21	1.09	2.51	1.32	0.50	0.80
Skill Needed to Judge Quality	2.41	0.46	2.54	0.77	2.94	0.88	3.28	0.98	0.40	0.74
Skill Needed to Support Supplier Development	1.33	0.55	1.60	1.12	1.94	1.31	2.15	1.51	0.34	0.54
Skill Needed to Understand Business Principles	0.36	0.89	0.91	1.04	1.35	1.34	1.60	1.61	0.44	0.69
Skill to Conduct Work Design	0.74	0.89	1.02	0.98	1.45	1.21	1.74	1.46	0.43	0.72
Skill to Design a System	1.51	0.61	1.77	0.92	2.11	0.99	2.42	1.27	0.34	0.65
Skill to Design Experiments	1.82	0.51	1.83	0.83	2.19	0.97	2.42	1.15	0.36	0.59
Skill to Fomulate Alternative Solutions	1.11	0.92	1.64	1.11	2.05	1.31	2.31	1.58	0.41	0.67
Skill to Identify Problems	1.55	0.60	2.23	1.11	2.72	1.03	3.17	1.20	0.49	0.94
Skill to Identify, Formulate, and Solve Problems	1.53	0.56	1.68	0.82	2.14	1.09	2.42	1.33	0.46	0.74
Skill to Plan a Program	1.34	0.58	1.89	0.93	2.18	1.02	2.51	1.24	0.29	0.61
Skill to Use the Tools Necessary for the Job	2.23	0.51	2.28	0.89	2.68	1.05	2.94	1.19	0.40	0.66
Social Responsibility	1.43	0.60	1.81	1.04	2.14	1.09	2.47	1.30	0.33	0.66
Team Building Skills	1.32	0.58	1.88	0.82	2.18	0.93	2.54	1.31	0.30	0.66
Teamwork and Collaboration	2.41	0.64	2.56	0.98	3.09	0.88	3.30	1.11	0.53	0.74
Technical Skill	1.53	0.51	2.08	1.11	2.53	1.01	2.99	1.21	0.45	0.91
Writing Skill	1.28	0.56	2.02	1.16	2.31	1.12	2.54	1.30	0.30	0.52

Aerospace - Trades

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.52	0.54	3.27	0.73	3.55	0.78	3.56	0.92	0.28	0.29
Attention to Detail	4.02	0.43	4.10	0.70	4.29	0.51	4.29	0.57	0.19	0.19
Cognitive Abilities	2.80	0.45	2.81	0.46	2.86	0.65	2.87	0.83	0.05	0.06
Commitment to Lifelong Learning	2.94	0.22	3.17	0.64	3.43	0.72	3.52	0.80	0.26	0.35
Communication Skill	2.34	0.49	2.76	0.76	3.13	0.80	3.16	0.89	0.36	0.40
Creativity and Innovation	2.90	0.53	2.74	0.69	3.04	0.76	3.09	0.83	0.30	0.35
Critical Thinking Skills	2.52	0.58	2.66	0.73	2.97	0.81	2.93	0.94	0.31	0.27
Decision Making Skill	2.44	0.58	2.60	0.99	3.07	1.09	3.17	1.11	0.47	0.56
Digital Literacy	1.81	0.99	2.16	1.08	2.97	1.38	3.19	1.45	0.81	1.03
Entrepeneurial Skill	1.69	0.78	1.38	0.94	1.45	0.96	1.44	0.94	0.07	0.06
Independence	3.90	0.36	3.67	0.70	3.79	0.69	3.75	0.82	0.13	0.08
Initiative	2.27	0.74	2.33	0.72	2.68	0.93	2.70	1.00	0.34	0.36
Interpersonal Skills	2.06	0.58	2.33	0.78	2.69	0.96	2.72	0.97	0.36	0.39
Knowledge of Emerging Trends and Technologies	0.66	0.52	0.99	0.97	1.52	1.36	1.60	1.42	0.53	0.61
Leadership Skills	3.02	0.63	2.83	0.92	3.00	1.08	2.96	1.11	0.17	0.13
New Relevant Knowledge	2.48	0.71	2.60	0.98	2.90	1.14	2.95	1.15	0.29	0.34
Numeracy	2.85	0.45	3.10	0.47	3.33	0.62	3.38	0.82	0.23	0.27
Physical Abilities	2.82	0.44	3.01	0.54	3.04	0.63	3.03	0.62	0.03	0.02
Problem Solving	2.52	0.58	2.86	0.55	3.26	0.70	3.35	0.95	0.40	0.49
Professional Composure	3.56	0.74	3.55	0.74	3.67	0.71	3.64	0.73	0.11	0.08
Project Management Skill	2.09	0.91	1.82	0.99	2.00	1.01	2.06	1.11	0.18	0.25
Psychomotor Abilities	3.45	0.69	3.62	0.66	3.69	0.72	3.70	0.72	0.07	0.08
Reading Skill	2.90	0.42	2.94	0.64	3.25	0.68	3.21	0.72	0.31	0.27
Sensory Abilities	2.75	0.46	3.17	0.80	3.19	0.78	3.19	0.81	0.02	0.02
Skill Needed to Evaluate Alternatives	2.44	0.58	2.23	0.96	2.65	1.12	2.72	1.17	0.42	0.49
Skill Needed to Judge Quality	3.19	1.26	3.42	1.11	3.78	1.00	3.81	1.15	0.36	0.40
Skill Needed to Support Supplier Development	2.04	0.62	1.79	0.88	1.99	1.07	2.09	1.20	0.20	0.30
Skill Needed to Understand Business Principles	1.06	1.07	0.99	1.11	1.11	1.18	1.13	1.18	0.12	0.14
Skill to Conduct Work Design	2.90	0.51	2.55	0.84	2.76	0.97	2.78	1.02	0.21	0.23
Skill to Design a System	2.44	0.58	2.34	0.91	2.55	1.00	2.71	1.14	0.21	0.36
Skill to Design Experiments	2.73	0.43	2.36	0.98	2.50	1.02	2.53	1.05	0.13	0.17
Skill to Fomulate Alternative Solutions	2.48	0.58	2.26	1.33	2.47	1.39	2.51	1.40	0.21	0.25
Skill to Identify Problems	2.85	0.85	3.21	0.97	3.59	0.85	3.67	0.97	0.39	0.46
Skill to Identify, Formulate, and Solve Problems	2.43	0.58	2.69	0.68	3.04	0.72	3.07	0.86	0.35	0.38
Skill to Plan a Program	2.40	0.82	2.19	1.02	2.53	0.91	2.59	0.95	0.34	0.41
Skill to Use the Tools Necessary for the Job	3.73	0.71	3.93	0.65	4.04	0.78	4.03	0.91	0.10	0.10
Social Responsibility	2.02	0.60	2.19	0.56	2.54	0.88	2.65	0.96	0.35	0.46
Team Building Skills	1.77	0.75	2.07	0.85	2.31	1.11	2.32	1.24	0.24	0.25
Teamwork and Collaboration	3.15	0.38	3.20	0.45	3.38	0.43	3.39	0.49	0.18	0.19
Technical Skill	3.05	0.59	3.33	0.87	3.63	0.90	3.66	0.94	0.30	0.33
Writing Skill	2.10	0.51	2.39	0.58	2.66	0.74	2.75	0.84	0.27	0.36

Shipbuilding - Trades

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.07	0.56	3.13	0.61	3.32	0.67	3.43	0.84	0.18	0.30
Attention to Detail	3.87	0.72	3.75	0.61	3.87	0.52	3.87	0.49	0.12	0.12
Cognitive Abilities	2.26	0.36	2.31	0.41	2.40	0.50	2.40	0.50	0.09	0.09
Commitment to Lifelong Learning	2.87	0.30	2.88	0.45	2.98	0.43	3.07	0.45	0.10	0.18
Communication Skill	2.04	0.37	2.65	0.93	2.87	0.82	2.97	0.89	0.22	0.32
Creativity and Innovation	2.40	0.57	2.57	0.68	2.73	0.75	3.10	0.82	0.17	0.53
Critical Thinking Skills	2.07	0.42	2.25	0.57	2.57	0.53	2.65	0.71	0.32	0.40
Decision Making Skill	2.13	0.30	2.17	0.78	2.27	0.73	2.37	0.76	0.10	0.20
Digital Literacy	0.93	1.08	1.63	0.91	2.57	0.82	3.25	0.76	0.93	1.62
Entrepeneurial Skill	1.33	0.70	1.18	0.75	1.28	0.77	1.38	0.85	0.10	0.20
Independence	3.73	0.56	3.80	0.37	3.78	0.39	3.77	0.42	-0.02	-0.03
Initiative	2.07	0.42	2.42	0.70	2.30	0.77	2.32	0.80	-0.12	-0.10
Interpersonal Skills	1.77	0.39	2.12	0.75	2.63	0.87	2.76	0.93	0.50	0.64
Knowledge of Emerging Trends and Technologies	0.60	0.78	1.42	0.93	1.93	1.14	2.27	1.37	0.52	0.85
Leadership Skills	2.40	0.71	2.55	0.80	2.68	0.88	2.73	0.92	0.13	0.18
New Relevant Knowledge	2.07	0.42	2.20	0.52	2.57	0.78	2.82	1.00	0.37	0.62
Numeracy	2.33	0.59	2.30	0.76	2.85	0.72	3.18	0.95	0.55	0.88
Physical Abilities	2.85	0.30	3.44	0.69	3.31	0.53	3.28	0.56	-0.13	-0.17
Problem Solving	2.20	0.37	2.73	0.72	3.22	0.78	3.37	1.02	0.48	0.63
Professional Composure	3.00	0.50	2.78	0.92	2.85	0.89	2.95	0.95	0.07	0.17
Project Management Skill	1.63	0.46	1.65	0.42	1.88	0.71	2.06	0.95	0.24	0.41
Psychomotor Abilities	3.01	0.38	3.43	0.71	3.50	0.61	3.57	0.63	0.07	0.13
Reading Skill	2.73	0.42	3.02	0.68	3.43	0.49	3.62	0.76	0.42	0.60
Sensory Abilities	2.40	0.32	2.55	0.46	2.73	0.54	2.83	0.64	0.18	0.28
Skill Needed to Evaluate Alternatives	2.20	0.53	2.15	0.73	2.30	0.79	2.42	0.85	0.15	0.27
Skill Needed to Judge Quality	2.20	0.37	2.62	0.63	2.80	0.61	2.93	0.77	0.18	0.32
Skill Needed to Support Supplier Development	1.70	0.37	1.75	0.86	1.93	0.96	2.03	1.06	0.18	0.28
Skill Needed to Understand Business Principles	1.00	0.73	0.98	0.59	1.07	0.68	1.15	0.81	0.08	0.17
Skill to Conduct Work Design	1.80	0.84	2.17	0.90	2.37	0.99	2.48	1.11	0.20	0.32
Skill to Design a System	2.13	0.48	2.07	0.62	2.20	0.67	2.30	0.82	0.13	0.23
Skill to Design Experiments	2.18	0.29	2.03	0.58	2.15	0.62	2.27	0.66	0.12	0.24
Skill to Fomulate Alternative Solutions	2.00	0.33	2.07	0.76	2.25	0.81	2.37	0.95	0.18	0.30
Skill to Identify Problems	2.27	0.42	2.52	0.86	2.90	1.08	2.97	1.06	0.38	0.45
Skill to Identify, Formulate, and Solve Problems	1.95	0.29	2.25	0.71	2.67	0.71	2.83	0.84	0.42	0.57
Skill to Plan a Program	2.07	0.42	2.20	0.82	2.38	0.91	2.50	0.98	0.18	0.30
Skill to Use the Tools Necessary for the Job	2.91	0.44	3.02	0.40	3.31	0.50	3.46	0.64	0.28	0.43
Social Responsibility	1.47	0.61	1.30	0.53	1.75	0.99	1.77	1.07	0.45	0.47
Team Building Skills	1.33	0.70	2.15	1.00	2.30	0.94	2.45	0.93	0.15	0.30
Teamwork and Collaboration	2.90	0.47	3.05	0.71	3.45	0.52	3.72	0.63	0.40	0.67
Technical Skill	2.39	0.53	2.62	0.50	3.10	0.57	3.24	0.91	0.48	0.62
Writing Skill	1.47	0.61	2.07	0.95	2.30	0.92	2.37	0.95	0.23	0.30

Automotive - Trades

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.27	0.61	3.59	0.80	3.52	1.00	3.50	1.07	-0.07	-0.09
Attention to Detail	3.82	0.72	3.57	0.78	3.68	0.84	3.82	0.98	0.11	0.25
Cognitive Abilities	2.64	0.29	2.73	0.39	2.78	0.67	2.72	0.87	0.06	-0.01
Commitment to Lifelong Learning	2.91	0.20	2.50	0.54	2.82	0.61	2.77	0.75	0.32	0.27
Communication Skill	2.27	0.32	2.97	0.84	3.02	1.02	3.20	1.31	0.05	0.23
Creativity and Innovation	2.73	0.34	2.75	0.80	3.07	1.10	3.09	1.10	0.32	0.34
Critical Thinking Skills	2.45	0.47	3.36	0.81	3.41	1.02	3.50	0.94	0.05	0.14
Decision Making Skill	2.27	0.41	2.80	0.75	2.82	0.95	3.00	1.28	0.02	0.20
Digital Literacy	1.73	1.08	2.36	0.90	2.95	1.13	3.18	1.23	0.59	0.82
Entrepeneurial Skill	1.36	0.64	1.09	0.30	1.09	0.30	1.09	0.30	0.00	0.00
Independence	3.64	0.64	3.36	0.50	3.09	0.83	3.07	0.90	-0.27	-0.30
Initiative	2.36	0.45	2.70	0.46	2.66	0.69	2.66	0.78	-0.05	-0.05
Interpersonal Skills	2.00	0.33	2.68	0.86	2.73	0.85	2.78	0.88	0.05	0.10
Knowledge of Emerging Trends and Technologies	0.82	0.86	1.23	0.87	1.82	1.28	1.86	1.32	0.59	0.64
Leadership Skills	3.00	0.59	2.82	0.34	2.70	0.78	2.82	0.91	-0.11	0.00
New Relevant Knowledge	2.45	0.47	3.00	0.87	3.45	1.02	3.50	1.22	0.45	0.50
Numeracy	2.82	0.34	3.36	0.74	3.59	0.92	3.64	1.02	0.23	0.27
Physical Abilities	2.89	0.35	2.98	0.29	2.71	0.77	2.68	0.80	-0.27	-0.30
Problem Solving	2.45	0.47	2.50	0.62	2.64	0.94	2.64	1.13	0.14	0.14
Professional Composure	3.09	0.49	3.00	0.00	2.86	0.45	2.82	0.60	-0.14	-0.18
Project Management Skill	1.89	0.43	2.27	0.82	2.38	1.16	2.35	1.19	0.10	0.08
Psychomotor Abilities	3.25	0.50	3.25	0.50	2.90	0.77	2.81	0.87	-0.35	-0.44
Reading Skill	2.91	0.20	3.00	0.39	2.82	0.72	2.77	0.85	-0.18	-0.23
Sensory Abilities	2.54	0.31	2.54	0.31	2.38	0.62	2.36	0.69	-0.16	-0.18
Skill Needed to Evaluate Alternatives	2.36	0.45	2.50	0.55	2.45	0.84	2.43	0.90	-0.05	-0.07
Skill Needed to Judge Quality	2.36	0.45	3.14	0.78	3.20	1.13	3.18	1.19	0.07	0.05
Skill Needed to Support Supplier Development	1.86	0.45	1.77	0.34	1.73	0.71	1.77	0.93	-0.05	0.00
Skill Needed to Understand Business Principles	1.27	0.61	1.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00
Skill to Conduct Work Design	2.73	0.61	3.14	0.83	3.05	1.01	2.95	1.19	-0.09	-0.18
Skill to Design a System	2.36	0.45	2.82	0.75	2.77	1.00	2.75	1.05	-0.05	-0.07
Skill to Design Experiments	2.52	0.28	2.52	0.28	2.45	0.36	2.38	0.53	-0.07	-0.14
Skill to Fomulate Alternative Solutions	2.27	0.41	2.36	0.45	2.32	0.76	2.34	0.88	-0.05	-0.02
Skill to Identify Problems	2.45	0.47	3.00	0.63	2.98	0.87	3.00	0.89	-0.02	0.00
Skill to Identify, Formulate, and Solve Problems	2.24	0.34	3.22	0.85	3.24	0.94	3.24	1.01	0.02	0.02
Skill to Plan a Program	2.36	0.45	2.27	0.47	2.20	0.73	2.20	0.81	-0.07	-0.07
Skill to Use the Tools Necessary for the Job	3.27	0.53	3.86	0.54	3.67	0.86	3.70	0.91	-0.19	-0.17
Social Responsibility	1.91	0.49	1.91	0.49	1.70	0.51	1.68	0.56	-0.20	-0.23
Team Building Skills	1.91	0.92	2.09	0.80	2.09	0.80	2.09	0.80	0.00	0.00
Teamwork and Collaboration	2.91	0.38	2.80	0.53	3.02	0.83	2.98	0.96	0.23	0.18
Technical Skill	2.83	0.47	2.87	0.60	3.08	0.96	3.24	1.08	0.21	0.37
Writing Skill	2.00	0.39	2.20	0.77	2.25	0.94	2.23	1.05	0.05	0.02

Mining Supply Chain - Trades

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.25	0.52	3.25	0.64	3.35	0.67	3.38	0.71	0.11	0.14
Attention to Detail	3.89	0.51	3.81	0.71	3.81	0.70	3.76	0.84	-0.01	-0.05
Cognitive Abilities	2.45	0.38	2.60	0.62	2.63	0.59	2.59	0.60	0.03	-0.01
Commitment to Lifelong Learning	2.95	0.15	3.04	0.57	3.03	0.68	2.98	0.81	-0.01	-0.06
Communication Skill	2.26	0.40	2.71	0.72	2.81	0.81	2.93	0.93	0.10	0.23
Creativity and Innovation	2.63	0.59	2.81	0.73	2.89	0.75	2.91	0.82	0.08	0.10
Critical Thinking Skills	2.27	0.42	2.60	0.74	2.69	0.85	2.80	0.97	0.10	0.21
Decision Making Skill	2.25	0.41	2.67	0.80	2.71	0.87	2.75	0.90	0.04	0.08
Digital Literacy	1.13	1.12	1.93	1.22	2.42	1.48	2.65	1.62	0.49	0.72
Entrepeneurial Skill	1.53	0.79	1.48	0.98	1.48	0.98	1.48	0.98	0.00	0.00
Independence	3.83	0.47	3.76	0.60	3.72	0.67	3.67	0.84	-0.04	-0.09
Initiative	2.33	0.57	2.59	0.84	2.61	0.83	2.67	0.85	0.02	0.08
Interpersonal Skills	2.00	0.56	2.24	0.81	2.23	0.88	2.33	0.94	-0.01	0.08
Knowledge of Emerging Trends and Technologies	0.68	0.70	1.35	1.28	1.41	1.38	1.46	1.43	0.07	0.12
Leadership Skills	2.75	0.76	2.96	0.89	2.92	0.94	2.92	0.94	-0.04	-0.04
New Relevant Knowledge	2.27	0.42	2.52	0.76	2.57	0.84	2.65	0.88	0.05	0.13
Numeracy	2.55	0.48	2.83	0.82	2.92	0.76	3.04	0.87	0.09	0.21
Physical Abilities	2.87	0.45	2.95	0.56	2.92	0.55	2.94	0.54	-0.03	-0.01
Problem Solving	2.31	0.44	2.73	0.78	2.75	0.98	2.82	1.05	0.02	0.09
Professional Composure	3.25	0.62	3.27	0.82	3.19	0.98	3.20	0.97	-0.08	-0.07
Project Management Skill	1.99	0.85	2.26	1.02	2.34	1.05	2.37	1.08	0.08	0.10
Psychomotor Abilities	3.06	0.54	3.23	0.72	3.22	0.67	3.22	0.67	-0.00	-0.00
Reading Skill	2.87	0.30	3.25	0.69	3.40	0.77	3.41	0.80	0.15	0.16
Sensory Abilities	2.51	0.29	2.76	0.70	2.80	0.65	2.82	0.67	0.04	0.06
Skill Needed to Evaluate Alternatives	2.35	0.45	2.73	0.81	2.78	0.93	2.89	1.00	0.05	0.16
Skill Needed to Judge Quality	2.33	0.53	2.72	0.86	2.75	0.88	2.84	0.99	0.03	0.12
Skill Needed to Support Supplier Development	1.84	0.50	1.83	0.88	1.88	0.90	1.88	0.91	0.05	0.05
Skill Needed to Understand Business Principles	1.35	0.87	1.58	1.04	1.64	1.10	1.66	1.16	0.06	0.09
Skill to Conduct Work Design	2.15	1.00	2.64	1.07	2.72	1.08	2.82	1.14	0.09	0.18
Skill to Design a System	2.35	0.45	2.48	0.90	2.54	0.97	2.57	1.01	0.07	0.09
Skill to Design Experiments	2.34	0.41	2.47	0.54	2.63	0.67	2.64	0.74	0.16	0.18
Skill to Fomulate Alternative Solutions	2.17	0.34	2.20	0.89	2.24	0.90	2.35	1.06	0.04	0.15
Skill to Identify Problems	2.31	0.44	2.65	0.81	2.67	0.81	2.85	0.98	0.02	0.20
Skill to Identify, Formulate, and Solve Problems	2.16	0.48	2.62	0.83	2.69	0.87	2.76	0.97	0.07	0.14
Skill to Plan a Program	2.23	0.66	2.55	0.90	2.63	0.97	2.74	1.09	0.08	0.19
Skill to Use the Tools Necessary for the Job	3.13	0.54	3.31	0.74	3.36	0.81	3.48	0.85	0.05	0.17
Social Responsibility	1.75	0.74	2.12	0.98	2.06	1.11	2.08	1.23	-0.06	-0.04
Team Building Skills	1.59	0.92	2.15	1.29	2.16	1.41	2.22	1.52	0.02	0.07
Teamwork and Collaboration	3.06	0.30	3.27	0.68	3.24	0.89	3.31	0.92	-0.03	0.04
Technical Skill	2.58	0.54	3.02	0.86	3.20	0.95	3.25	1.03	0.18	0.23
Writing Skill	1.79	0.73	2.43	0.95	2.51	0.99	2.52	1.01	0.09	0.09

Food Processing - Trades

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.14	0.80	3.54	0.92	3.64	0.84	3.61	0.89	0.11	0.07
Attention to Detail	3.29	1.04	3.68	1.11	3.57	0.93	3.54	0.96	-0.11	-0.14
Cognitive Abilities	2.59	0.23	2.81	0.57	3.17	0.98	3.17	0.98	0.36	0.36
Commitment to Lifelong Learning	2.71	0.27	3.11	0.57	3.43	0.93	3.11	0.86	0.32	0.00
Communication Skill	2.38	0.27	2.81	0.85	2.92	1.09	2.95	1.12	0.11	0.14
Creativity and Innovation	2.71	0.39	3.14	0.76	3.32	0.85	3.36	0.86	0.18	0.21
Critical Thinking Skills	2.43	0.35	2.86	0.63	3.11	0.96	3.04	1.02	0.25	0.18
Decision Making Skill	2.43	0.35	2.82	0.80	3.00	1.12	3.00	1.12	0.18	0.18
Digital Literacy	2.29	0.64	2.79	1.18	3.50	0.80	3.93	0.98	0.71	1.14
Entrepeneurial Skill	2.14	0.80	2.11	0.57	2.14	0.57	2.14	0.56	0.04	0.04
Independence	3.14	0.80	3.32	1.01	3.43	0.98	3.46	0.94	0.11	0.14
Initiative	2.43	0.35	2.64	0.69	3.00	1.12	2.96	1.05	0.36	0.32
Interpersonal Skills	2.26	0.35	2.47	0.75	2.83	1.22	2.83	1.22	0.36	0.36
Knowledge of Emerging Trends and Technologies	1.57	1.16	2.18	1.31	2.46	1.71	2.46	1.71	0.29	0.29
Leadership Skills	3.00	0.71	3.07	0.89	3.25	1.13	3.14	1.21	0.18	0.07
New Relevant Knowledge	2.57	0.35	2.86	0.56	3.32	0.92	3.32	0.92	0.46	0.46
Numeracy	2.71	0.27	3.21	0.86	3.39	0.81	3.43	0.84	0.18	0.21
Physical Abilities	2.75	0.47	3.25	0.66	3.32	0.96	3.32	0.96	0.07	0.07
Problem Solving	2.57	0.35	3.04	0.85	3.43	1.12	3.29	1.07	0.39	0.25
Professional Composure	3.00	0.71	3.21	0.76	3.57	0.93	3.57	0.93	0.36	0.36
Project Management Skill	2.23	0.38	2.86	0.85	2.86	1.04	2.75	1.04	0.00	-0.11
Psychomotor Abilities	2.79	0.36	3.21	0.61	2.94	0.55	2.86	0.61	-0.28	-0.35
Reading Skill	2.43	0.35	3.14	0.85	3.36	1.18	3.50	1.32	0.21	0.36
Sensory Abilities	2.66	0.22	3.20	0.72	3.10	1.08	3.13	1.03	-0.11	-0.07
Skill Needed to Evaluate Alternatives	2.71	0.27	2.96	0.51	3.04	1.14	3.04	1.14	0.07	0.07
Skill Needed to Judge Quality	2.57	0.35	3.00	0.76	3.14	1.03	3.14	1.03	0.14	0.14
Skill Needed to Support Supplier Development	2.29	0.39	2.79	0.76	2.89	1.17	2.86	1.19	0.11	0.07
Skill Needed to Understand Business Principles	1.71	1.04	2.43	1.11	2.86	1.49	2.89	1.57	0.43	0.46
Skill to Conduct Work Design	2.57	0.35	3.43	0.94	3.36	0.90	3.11	1.00	-0.07	-0.32
Skill to Design a System	2.71	0.27	3.07	0.89	3.25	0.85	3.32	0.87	0.18	0.25
Skill to Design Experiments	2.53	0.08	2.56	0.93	3.17	0.88	3.31	0.93	0.61	0.75
Skill to Fomulate Alternative Solutions	2.43	0.35	3.04	1.06	3.21	1.14	2.96	1.18	0.18	-0.07
Skill to Identify Problems	2.71	0.27	3.07	0.89	3.07	0.89	3.07	0.89	0.00	0.00
Skill to Identify, Formulate, and Solve Problems	2.44	0.30	3.04	0.56	3.40	0.92	3.40	0.92	0.36	0.36
Skill to Plan a Program	2.57	0.35	3.36	0.89	3.04	0.89	2.93	0.98	-0.32	-0.43
Skill to Use the Tools Necessary for the Job	3.00	0.65	3.43	0.69	3.82	0.86	3.86	0.85	0.39	0.43
Social Responsibility	2.14	0.56	2.21	0.95	2.54	1.46	2.50	1.39	0.32	0.29
Team Building Skills	2.29	0.64	2.50	0.91	2.79	1.04	2.79	1.04	0.29	0.29
Teamwork and Collaboration	2.93	0.53	2.93	0.98	3.36	0.89	3.46	0.85	0.43	0.54
Technical Skill	2.89	0.50	3.59	0.89	3.66	0.76	3.73	0.78	0.07	0.14
Writing Skill	2.29	0.27	2.61	1.34	2.57	1.30	2.64	1.38	-0.04	0.04

Part B - North American Industry Classification System (NAICS) Sector by Occupation Type

CHEMICAL - NAICS 325 - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.33	1.12	2.25	0.95	2.47	1.20	2.61	1.38	0.22	0.36
Attention to Detail	2.33	1.32	2.17	0.97	2.25	1.09	2.22	1.20	0.08	0.06
Cognitive Abilities	1.87	0.51	1.79	0.53	1.95	0.44	2.06	0.52	0.17	0.28
Commitment to Lifelong Learning	1.78	0.67	1.67	0.71	1.94	0.67	2.06	0.81	0.28	0.39
Communication Skill	1.41	0.49	1.74	0.66	1.66	0.62	1.63	0.70	-0.08	-0.11
Creativity and Innovation	0.94	1.01	1.56	1.53	1.47	1.41	1.69	1.56	-0.08	0.14
Critical Thinking Skills	1.67	0.71	1.69	0.84	1.69	1.02	2.11	1.52	0.00	0.42
Decision Making Skill	1.56	0.53	1.86	0.52	1.72	0.42	1.64	0.45	-0.14	-0.22
Digital Literacy	0.67	0.71	1.50	1.38	1.97	1.21	2.50	1.36	0.47	1.00
Entrepeneurial Skill	1.56	0.53	1.44	0.54	1.36	0.79	1.44	0.76	-0.08	0.00
Independence	2.11	1.05	1.72	0.67	2.03	0.79	2.42	0.94	0.31	0.69
Initiative	1.56	0.53	1.44	0.53	1.44	0.53	1.47	0.51	0.00	0.03
Interpersonal Skills	1.40	0.44	1.33	0.45	1.40	0.57	1.34	0.50	0.07	0.01
Knowledge of Emerging Trends and Technologies	0.50	0.60	0.36	0.22	0.39	0.31	0.44	0.45	0.03	0.08
Leadership Skills	2.00	1.00	1.58	0.85	1.56	0.97	1.64	1.07	-0.03	0.06
New Relevant Knowledge	1.11	0.93	0.81	0.79	0.89	0.78	0.92	0.79	0.08	0.11
Numeracy	1.44	0.53	1.44	0.58	1.25	0.66	1.25	0.79	-0.19	-0.19
Physical Abilities	2.70	0.83	2.98	0.85	2.89	0.93	2.84	1.03	-0.08	-0.14
Problem Solving	1.56	0.53	1.86	0.96	2.11	1.41	2.22	1.56	0.25	0.36
Professional Composure	1.89	1.27	1.64	0.73	1.97	0.99	2.00	1.12	0.33	0.36
Project Management Skill	1.24	0.51	1.14	0.56	1.12	0.57	1.06	0.66	-0.03	-0.09
Psychomotor Abilities	2.66	0.67	2.89	0.33	2.64	0.69	2.53	0.89	-0.24	-0.36
Reading Skill	1.56	0.53	2.28	1.20	2.22	1.48	2.14	1.57	-0.06	-0.14
Sensory Abilities	1.95	0.35	2.66	0.70	2.78	1.04	2.56	1.14	0.12	-0.10
Skill Needed to Evaluate Alternatives	1.33	0.50	1.08	0.40	0.97	0.44	0.97	0.49	-0.11	-0.11
Skill Needed to Judge Quality	2.11	0.33	2.14	0.42	2.11	0.61	1.97	0.74	-0.03	-0.17
Skill Needed to Support Supplier Development	1.39	0.42	1.75	1.20	1.72	1.34	1.86	1.53	-0.03	0.11
Skill Needed to Understand Business Principles	0.11	0.33	0.11	0.33	0.11	0.33	0.11	0.33	0.00	0.00
Skill to Conduct Work Design	0.89	1.05	1.00	1.11	1.25	1.48	1.42	1.70	0.25	0.42
Skill to Design a System	1.44	0.73	1.31	0.46	1.31	0.68	1.31	0.75	0.00	0.00
Skill to Design Experiments	1.84	0.50	1.63	0.54	1.56	0.70	1.56	0.75	-0.07	-0.07
Skill to Fomulate Alternative Solutions	1.00	1.12	0.75	0.83	0.86	0.91	0.92	0.97	0.11	0.17
Skill to Identify Problems	1.67	0.50	1.78	0.44	1.83	0.50	1.83	0.50	0.06	0.06
Skill to Identify, Formulate, and Solve Problems	1.60	0.73	1.41	0.74	1.56	0.95	1.46	0.88	0.14	0.05
Skill to Plan a Program	1.67	1.12	1.53	1.15	1.58	1.12	1.58	1.12	0.06	0.06
Skill to Use the Tools Necessary for the Job	2.11	0.97	2.78	0.99	2.79	1.09	2.76	1.19	0.01	-0.02
Social Responsibility	1.44	0.53	1.31	0.53	1.28	0.65	1.28	0.74	-0.03	-0.03
Team Building Skills	1.89	0.60	1.81	0.63	1.72	0.75	1.69	0.70	-0.08	-0.11
Teamwork and Collaboration	2.44	0.81	3.03	0.94	2.83	1.11	2.61	1.29	-0.19	-0.42
Technical Skill	1.51	0.53	1.73	0.64	1.89	0.87	1.98	1.19	0.16	0.24
Writing Skill	1.44	0.53	1.44	0.53	1.33	0.66	1.28	0.74	-0.11	-0.17

AEROSPACE - NAICS 3364 - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.76	0.50	2.91	0.89	3.15	0.74	2.96	0.83	0.24	0.04
Attention to Detail	3.41	0.91	3.84	1.01	4.03	0.97	4.12	1.04	0.19	0.28
Cognitive Abilities	2.17	0.39	2.24	0.95	2.40	1.06	2.47	1.22	0.16	0.23
Commitment to Lifelong Learning	2.24	0.50	2.63	1.22	2.74	1.35	2.85	1.49	0.10	0.22
Communication Skill	1.55	0.62	2.24	0.99	2.52	1.07	2.52	1.16	0.28	0.28
Creativity and Innovation	1.74	0.64	1.82	0.70	2.16	0.91	2.26	1.05	0.34	0.44
Critical Thinking Skills	2.00	0.43	2.40	1.02	2.63	1.04	2.54	1.18	0.24	0.15
Decision Making Skill	2.00	0.43	2.31	1.34	2.59	1.35	2.51	1.34	0.28	0.21
Digital Literacy	1.29	0.73	1.99	0.89	2.94	0.89	3.18	0.95	0.96	1.19
Entrepeneurial Skill	1.53	0.67	1.01	0.76	1.07	0.72	1.07	0.72	0.06	0.06
Independence	2.88	0.65	2.91	1.05	3.18	0.82	3.24	0.93	0.26	0.32
Initiative	2.00	0.43	2.04	0.90	2.38	1.08	2.53	1.06	0.34	0.49
Interpersonal Skills	1.60	0.55	2.07	0.87	2.19	1.00	2.19	1.08	0.12	0.12
Knowledge of Emerging Trends and Technologies	0.99	0.89	1.22	1.15	1.49	1.49	1.63	1.62	0.26	0.41
Leadership Skills	2.24	0.62	1.94	0.95	2.19	1.10	2.18	1.13	0.25	0.24
New Relevant Knowledge	2.18	0.92	2.22	1.30	2.54	1.40	2.69	1.38	0.32	0.47
Numeracy	2.00	0.43	2.53	0.84	2.87	0.91	2.84	1.03	0.34	0.31
Physical Abilities	2.90	0.65	3.22	0.62	3.22	0.82	3.15	0.94	0.00	-0.07
Problem Solving	2.00	0.43	2.38	0.61	2.54	0.71	2.57	0.98	0.16	0.19
Professional Composure	2.53	0.67	2.87	1.02	3.09	0.87	3.10	0.86	0.22	0.24
Project Management Skill	1.52	0.59	1.55	0.99	1.69	1.08	1.70	1.10	0.14	0.15
Psychomotor Abilities	2.88	0.32	3.63	0.76	3.81	0.76	3.79	0.80	0.19	0.17
Reading Skill	2.29	0.64	2.85	0.83	2.99	0.72	2.94	0.87	0.13	0.09
Sensory Abilities	2.40	0.36	2.97	0.71	2.99	0.73	2.90	0.89	0.02	-0.06
Skill Needed to Evaluate Alternatives	2.12	0.82	2.00	1.31	2.24	1.38	2.24	1.38	0.24	0.24
Skill Needed to Judge Quality	2.76	0.87	2.97	0.93	3.25	0.88	3.25	1.10	0.28	0.28
Skill Needed to Support Supplier Development	1.76	0.50	1.41	0.83	1.53	0.94	1.51	0.93	0.12	0.10
Skill Needed to Understand Business Principles	0.59	1.09	0.63	1.00	0.75	1.05	0.85	1.13	0.12	0.22
Skill to Conduct Work Design	1.94	0.61	1.85	0.91	1.88	0.96	1.93	1.05	0.03	0.07
Skill to Design a System	2.12	0.82	2.01	1.43	2.26	1.44	2.29	1.47	0.25	0.28
Skill to Design Experiments	2.30	0.64	1.86	0.98	1.91	1.04	2.04	1.16	0.04	0.18
Skill to Fomulate Alternative Solutions	1.76	0.71	1.75	1.34	1.82	1.38	1.85	1.42	0.07	0.10
Skill to Identify Problems	2.06	0.35	2.72	0.89	3.06	0.91	3.13	1.03	0.34	0.41
Skill to Identify, Formulate, and Solve Problems	2.08	0.56	2.51	0.95	2.55	0.91	2.58	1.13	0.04	0.07
Skill to Plan a Program	1.82	0.58	1.84	0.78	2.00	0.76	1.94	0.81	0.16	0.10
Skill to Use the Tools Necessary for the Job	2.77	0.44	3.02	0.82	3.23	0.77	3.25	0.91	0.21	0.23
Social Responsibility	1.35	0.66	1.76	0.85	1.94	1.00	1.97	0.97	0.18	0.21
Team Building Skills	1.88	0.55	2.03	0.72	2.19	0.80	2.24	1.02	0.16	0.21
Teamwork and Collaboration	2.74	0.56	2.82	0.70	3.07	0.76	3.10	0.81	0.25	0.28
Technical Skill	2.15	0.38	3.15	0.95	3.27	0.84	3.04	0.80	0.12	-0.11
Writing Skill	1.65	0.66	2.24	1.04	2.25	0.85	2.15	0.89	0.01	-0.09

Shipbuilding - NAICS 3366 - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.00	0.43	2.81	0.74	2.90	0.76	2.98	0.68	0.08	0.17
Attention to Detail	2.92	1.44	3.08	1.15	3.08	1.20	3.10	1.20	0.00	0.02
Cognitive Abilities	1.79	0.26	1.82	0.37	1.80	0.41	1.78	0.46	-0.02	-0.04
Commitment to Lifelong Learning	2.08	0.79	2.21	0.72	2.46	0.70	2.50	0.76	0.25	0.29
Communication Skill	1.08	0.29	1.63	0.80	1.83	0.93	1.92	1.01	0.21	0.29
Creativity and Innovation	1.21	1.05	1.71	0.93	1.88	1.03	2.40	1.29	0.17	0.69
Critical Thinking Skills	1.50	0.52	1.56	0.69	1.71	0.68	1.75	0.72	0.15	0.19
Decision Making Skill	1.50	0.52	1.65	0.64	1.69	0.67	1.73	0.73	0.04	0.08
Digital Literacy	0.42	0.51	1.35	0.96	2.19	0.90	2.71	0.80	0.83	1.35
Entrepeneurial Skill	1.17	0.39	1.17	0.64	1.21	0.66	1.23	0.69	0.04	0.06
Independence	2.83	1.27	2.81	1.34	2.75	1.36	2.69	1.39	-0.06	-0.13
Initiative	1.50	0.52	1.96	0.82	2.00	0.94	2.00	0.98	0.04	0.04
Interpersonal Skills	1.17	0.28	1.66	0.61	2.45	1.06	2.45	1.03	0.78	0.78
Knowledge of Emerging Trends and Technologies	0.25	0.18	1.00	0.88	1.17	1.12	1.33	1.42	0.17	0.33
Leadership Skills	1.83	0.94	1.92	0.90	1.92	0.88	1.92	0.87	0.00	0.00
New Relevant Knowledge	1.08	1.00	1.38	1.09	1.58	1.17	1.69	1.23	0.21	0.31
Numeracy	1.33	0.49	1.44	0.80	1.77	0.97	1.77	0.98	0.33	0.33
Physical Abilities	3.03	0.67	3.13	0.75	3.10	0.73	3.07	0.77	-0.03	-0.05
Problem Solving	1.50	0.52	1.92	0.88	2.46	1.15	2.73	1.43	0.54	0.81
Professional Composure	2.33	1.30	2.50	1.11	2.44	1.09	2.40	1.12	-0.06	-0.10
Project Management Skill	1.10	0.36	1.14	0.68	1.20	0.73	1.24	0.71	0.06	0.10
Psychomotor Abilities	3.01	0.25	3.00	0.81	3.00	0.70	2.97	0.72	0.00	-0.03
Reading Skill	1.42	0.51	2.40	1.17	2.81	1.07	3.06	1.07	0.42	0.67
Sensory Abilities	2.15	0.20	2.27	0.39	2.31	0.37	2.38	0.40	0.04	0.11
Skill Needed to Evaluate Alternatives	1.50	0.67	1.67	0.69	1.69	0.74	1.71	0.81	0.02	0.04
Skill Needed to Judge Quality	2.08	0.79	2.33	0.78	2.63	0.91	2.65	0.93	0.29	0.31
Skill Needed to Support Supplier Development	1.38	0.43	1.29	0.73	1.33	0.78	1.40	0.83	0.04	0.10
Skill Needed to Understand Business Principles	0.00	0.00	0.40	0.79	0.44	0.88	0.48	0.97	0.04	0.08
Skill to Conduct Work Design	1.42	1.08	1.33	1.05	1.40	1.07	1.44	1.11	0.06	0.10
Skill to Design a System	1.50	0.67	1.44	0.90	1.54	0.95	1.56	1.00	0.10	0.13
Skill to Design Experiments	1.69	0.40	1.65	0.62	1.70	0.65	1.76	0.68	0.04	0.11
Skill to Fomulate Alternative Solutions	1.08	0.79	1.33	0.84	1.38	0.84	1.38	0.83	0.04	0.04
Skill to Identify Problems	1.75	0.45	1.81	0.76	2.10	1.03	2.15	1.07	0.29	0.33
Skill to Identify, Formulate, and Solve Problems	1.38	0.61	1.62	0.96	1.68	0.91	1.70	0.91	0.06	0.08
Skill to Plan a Program	1.08	0.90	1.35	0.89	1.42	0.92	1.48	0.96	0.06	0.13
Skill to Use the Tools Necessary for the Job	2.50	0.63	2.49	0.64	2.62	0.73	2.70	0.73	0.12	0.20
Social Responsibility	1.08	0.29	1.23	0.39	1.98	1.22	1.98	1.23	0.75	0.75
Team Building Skills	1.17	0.39	1.67	0.68	1.79	0.71	1.85	0.73	0.13	0.19
Teamwork and Collaboration	2.96	0.45	2.94	0.45	3.29	0.52	3.60	0.88	0.35	0.67
Technical Skill	1.74	0.61	1.80	0.78	2.06	1.00	2.11	1.25	0.26	0.31
Writing Skill	1.17	0.39	1.81	0.97	2.02	0.98	2.08	0.95	0.21	0.27

Metal Products - NAICS 332;335;333 - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.95	0.40	3.26	0.67	3.36	0.81	3.51	0.75	0.09	0.25
Attention to Detail	2.47	1.47	2.83	1.32	2.99	1.31	3.20	1.32	0.16	0.37
Cognitive Abilities	1.82	0.25	2.04	0.73	2.16	0.77	2.20	0.75	0.12	0.16
Commitment to Lifelong Learning	1.63	0.60	2.05	1.03	2.14	1.12	2.22	1.18	0.09	0.17
Communication Skill	1.09	0.27	2.74	1.13	3.08	1.02	3.32	1.17	0.34	0.58
Creativity and Innovation	0.76	0.82	1.91	0.98	2.33	1.30	2.42	1.36	0.42	0.51
Critical Thinking Skills	1.42	0.51	2.03	1.08	2.57	1.22	2.86	1.42	0.54	0.83
Decision Making Skill	1.42	0.51	1.86	0.97	1.97	1.03	2.09	1.18	0.12	0.24
Digital Literacy	0.53	0.51	1.93	1.03	2.82	1.12	3.26	1.12	0.88	1.33
Entrepeneurial Skill	1.11	0.32	1.14	0.56	1.14	0.56	1.16	0.60	0.00	0.01
Independence	2.37	1.30	2.75	1.25	2.83	1.22	3.00	1.07	0.08	0.25
Initiative	1.42	0.51	1.97	1.18	2.12	1.21	2.14	1.28	0.14	0.17
Interpersonal Skills	1.09	0.19	1.82	1.06	1.97	1.15	2.36	1.17	0.15	0.54
Knowledge of Emerging Trends and Technologies	0.29	0.19	0.92	1.12	1.18	1.36	1.29	1.44	0.26	0.37
Leadership Skills	1.53	0.70	1.76	0.98	1.89	1.05	1.97	1.11	0.13	0.21
New Relevant Knowledge	0.84	0.96	1.49	1.42	1.68	1.64	1.82	1.76	0.20	0.33
Numeracy	1.37	0.50	2.30	1.03	2.63	1.04	2.78	1.18	0.33	0.47
Physical Abilities	3.11	0.48	3.22	0.44	3.26	0.36	3.26	0.36	0.05	0.05
Problem Solving	1.42	0.51	2.34	1.14	2.80	1.14	2.99	1.23	0.46	0.64
Professional Composure	2.16	1.17	2.51	1.29	2.45	1.34	2.61	1.29	-0.07	0.09
Project Management Skill	1.00	0.25	1.41	0.98	1.57	1.13	1.65	1.20	0.16	0.24
Psychomotor Abilities	3.03	0.19	3.28	0.65	3.32	0.57	3.34	0.55	0.04	0.06
Reading Skill	1.42	0.51	2.88	1.28	3.16	1.28	3.25	1.33	0.28	0.37
Sensory Abilities	2.18	0.24	2.59	0.87	2.64	0.79	2.65	0.81	0.05	0.07
Skill Needed to Evaluate Alternatives	1.37	0.50	1.67	1.07	1.86	1.13	2.14	1.22	0.18	0.47
Skill Needed to Judge Quality	1.74	0.73	2.20	1.11	2.51	1.28	2.72	1.43	0.32	0.53
Skill Needed to Support Supplier Development	1.18	0.25	1.12	0.50	1.28	0.70	1.28	0.70	0.16	0.16
Skill Needed to Understand Business Principles	0.05	0.23	0.71	1.24	0.76	1.34	0.93	1.56	0.05	0.22
Skill to Conduct Work Design	0.89	0.99	1.71	1.33	2.11	1.23	2.47	1.30	0.39	0.76
Skill to Design a System	1.37	0.50	1.66	1.30	1.84	1.39	1.95	1.52	0.18	0.29
Skill to Design Experiments	1.65	0.37	1.71	0.66	1.84	0.87	1.97	1.00	0.13	0.26
Skill to Fomulate Alternative Solutions	0.89	0.94	1.45	1.23	1.58	1.26	1.75	1.37	0.13	0.30
Skill to Identify Problems	1.58	0.51	2.13	1.01	2.34	1.04	2.84	1.33	0.21	0.71
Skill to Identify, Formulate, and Solve Problems	1.24	0.54	2.21	1.26	2.67	1.15	2.98	1.33	0.46	0.78
Skill to Plan a Program	0.74	0.81	1.49	1.21	1.75	1.33	1.63	1.39	0.26	0.14
Skill to Use the Tools Necessary for the Job	2.42	0.51	2.75	0.79	3.07	0.74	3.37	0.88	0.32	0.62
Social Responsibility	1.00	0.00	1.37	0.94	1.37	0.91	1.43	0.95	0.00	0.07
Team Building Skills	1.05	0.23	1.71	1.12	1.80	1.17	1.88	1.26	0.09	0.17
Teamwork and Collaboration	2.95	0.47	3.16	0.77	3.33	0.87	3.58	0.90	0.17	0.42
Technical Skill	1.55	0.43	2.52	1.00	3.10	0.88	3.20	1.19	0.58	0.68
Writing Skill	1.11	0.32	2.72	1.15	2.88	1.21	2.97	1.21	0.16	0.25

FOOD PROCESSING - NAICS 311 - Production

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.93	0.76	2.84	0.92	3.25	0.84	3.44	0.96	0.41	0.60
Attention to Detail	2.53	1.19	2.92	1.05	3.06	1.18	3.23	1.27	0.15	0.32
Cognitive Abilities	1.73	0.46	2.09	0.89	2.28	0.90	2.48	1.10	0.20	0.39
Commitment to Lifelong Learning	1.86	0.48	2.07	0.80	2.40	0.92	2.59	1.10	0.33	0.53
Communication Skill	1.24	0.55	2.23	1.18	2.74	1.15	3.05	1.29	0.51	0.81
Creativity and Innovation	0.72	0.97	1.30	1.03	1.83	1.32	2.17	1.47	0.53	0.87
Critical Thinking Skills	1.43	0.60	1.93	1.00	2.33	0.99	2.60	1.13	0.41	0.67
Decision Making Skill	1.55	0.60	1.78	0.94	2.22	1.03	2.56	1.32	0.44	0.79
Digital Literacy	0.86	1.01	1.64	1.12	2.25	1.31	2.64	1.51	0.61	0.99
Entrepeneurial Skill	1.30	0.57	1.34	0.98	1.59	1.25	1.71	1.39	0.25	0.38
Independence	2.26	0.94	2.64	0.97	2.80	1.04	2.85	1.17	0.17	0.22
Initiative	1.55	0.60	1.95	0.97	2.22	0.98	2.47	1.18	0.27	0.52
Interpersonal Skills	1.29	0.55	1.87	0.86	2.35	1.00	2.52	1.15	0.48	0.66
Knowledge of Emerging Trends and Technologies	0.58	0.80	1.07	1.08	1.41	1.24	1.72	1.45	0.34	0.65
Leadership Skills	1.76	0.65	1.81	0.92	2.03	0.95	2.31	1.30	0.22	0.51
New Relevant Knowledge	0.97	0.85	1.54	1.06	2.03	1.17	2.41	1.42	0.49	0.87
Numeracy	1.68	0.58	2.20	0.82	2.54	0.87	2.85	1.10	0.33	0.65
Physical Abilities	2.81	0.58	3.18	0.98	3.08	1.01	3.13	1.14	-0.10	-0.05
Problem Solving	1.55	0.60	2.19	1.14	2.67	1.05	3.03	1.16	0.48	0.84
Professional Composure	1.78	1.18	2.10	1.07	2.39	1.11	2.63	1.20	0.29	0.53
Project Management Skill	1.29	0.52	1.53	0.85	1.84	1.06	2.16	1.31	0.31	0.62
Psychomotor Abilities	2.85	0.25	3.08	0.79	3.19	0.89	3.30	0.96	0.11	0.22
Reading Skill	1.36	0.59	2.13	1.04	2.63	1.07	3.11	1.15	0.49	0.98
Sensory Abilities	1.90	0.36	2.53	0.91	2.63	0.91	2.91	1.08	0.11	0.38
Skill Needed to Evaluate Alternatives	1.55	0.60	1.71	0.77	2.21	1.09	2.51	1.32	0.50	0.80
Skill Needed to Judge Quality	2.41	0.46	2.54	0.77	2.94	0.88	3.28	0.98	0.40	0.74
Skill Needed to Support Supplier Development	1.33	0.55	1.60	1.12	1.94	1.31	2.15	1.51	0.34	0.54
Skill Needed to Understand Business Principles	0.36	0.89	0.91	1.04	1.35	1.34	1.60	1.61	0.44	0.69
Skill to Conduct Work Design	0.74	0.89	1.02	0.98	1.45	1.21	1.74	1.46	0.43	0.72
Skill to Design a System	1.51	0.61	1.77	0.92	2.11	0.99	2.42	1.27	0.34	0.65
Skill to Design Experiments	1.82	0.51	1.83	0.83	2.19	0.97	2.42	1.15	0.36	0.59
Skill to Fomulate Alternative Solutions	1.11	0.92	1.64	1.11	2.05	1.31	2.31	1.58	0.41	0.67
Skill to Identify Problems	1.55	0.60	2.23	1.11	2.72	1.03	3.17	1.20	0.49	0.94
Skill to Identify, Formulate, and Solve Problems	1.53	0.56	1.68	0.82	2.14	1.09	2.42	1.33	0.46	0.74
Skill to Plan a Program	1.34	0.58	1.89	0.93	2.18	1.02	2.51	1.24	0.29	0.61
Skill to Use the Tools Necessary for the Job	2.23	0.51	2.28	0.89	2.68	1.05	2.94	1.19	0.40	0.66
Social Responsibility	1.43	0.60	1.81	1.04	2.14	1.09	2.47	1.30	0.33	0.66
Team Building Skills	1.32	0.58	1.88	0.82	2.18	0.93	2.54	1.31	0.30	0.66
Teamwork and Collaboration	2.41	0.64	2.56	0.98	3.09	0.88	3.30	1.11	0.53	0.74
Technical Skill	1.53	0.51	2.08	1.11	2.53	1.01	2.99	1.21	0.45	0.91
Writing Skill	1.28	0.56	2.02	1.16	2.31	1.12	2.54	1.30	0.30	0.52

Aerospace NAICS 3364 - Trades

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.53	0.55	3.20	0.75	3.54	0.84	3.50	0.96	0.34	0.30
Attention to Detail	3.98	0.41	4.05	0.73	4.31	0.48	4.30	0.54	0.26	0.25
Cognitive Abilities	2.87	0.37	2.80	0.35	2.85	0.60	2.86	0.83	0.05	0.06
Commitment to Lifelong Learning	2.98	0.11	3.25	0.64	3.51	0.69	3.63	0.78	0.26	0.38
Communication Skill	2.41	0.40	2.70	0.77	3.09	0.87	3.06	0.92	0.39	0.36
Creativity and Innovation	2.98	0.34	2.76	0.59	3.10	0.68	3.13	0.75	0.34	0.36
Critical Thinking Skills	2.58	0.49	2.51	0.67	2.81	0.79	2.74	0.92	0.30	0.23
Decision Making Skill	2.53	0.50	2.55	1.05	3.05	1.18	3.11	1.21	0.50	0.56
Digital Literacy	1.88	1.00	1.96	1.08	2.84	1.48	3.04	1.52	0.88	1.08
Entrepeneurial Skill	1.73	0.75	1.35	0.95	1.44	0.98	1.43	0.95	0.09	0.08
Independence	3.93	0.34	3.60	0.75	3.78	0.74	3.73	0.88	0.18	0.13
Initiative	2.33	0.73	2.33	0.69	2.74	0.94	2.75	1.02	0.41	0.43
Interpersonal Skills	2.10	0.51	2.35	0.77	2.69	0.93	2.67	0.91	0.34	0.31
Knowledge of Emerging Trends and Technologies	0.69	0.52	0.84	0.83	1.43	1.36	1.49	1.39	0.59	0.65
Leadership Skills	3.08	0.47	2.85	0.88	3.05	1.07	3.00	1.11	0.20	0.15
New Relevant Knowledge	2.58	0.49	2.73	0.87	3.08	1.02	3.14	1.03	0.35	0.41
Numeracy	2.93	0.24	3.01	0.43	3.21	0.61	3.21	0.80	0.20	0.20
Physical Abilities	2.83	0.47	3.05	0.57	3.09	0.67	3.08	0.67	0.04	0.03
Problem Solving	2.58	0.49	2.81	0.58	3.20	0.75	3.24	0.99	0.39	0.43
Professional Composure	3.63	0.78	3.61	0.77	3.75	0.72	3.71	0.75	0.14	0.10
Project Management Skill	2.13	0.85	1.77	0.96	1.93	0.99	1.97	1.09	0.16	0.20
Psychomotor Abilities	3.54	0.69	3.67	0.65	3.74	0.70	3.75	0.69	0.07	0.08
Reading Skill	2.98	0.11	2.98	0.64	3.18	0.70	3.13	0.74	0.20	0.15
Sensory Abilities	2.81	0.45	3.17	0.81	3.12	0.80	3.09	0.82	-0.05	-0.08
Skill Needed to Evaluate Alternatives	2.53	0.50	2.28	0.99	2.63	1.14	2.65	1.14	0.35	0.38
Skill Needed to Judge Quality	3.28	1.35	3.41	1.21	3.80	1.08	3.78	1.25	0.39	0.36
Skill Needed to Support Supplier Development	2.13	0.60	1.80	0.94	1.95	1.10	2.00	1.20	0.15	0.20
Skill Needed to Understand Business Principles	1.03	1.06	1.03	1.07	1.19	1.14	1.20	1.14	0.16	0.18
Skill to Conduct Work Design	2.88	0.46	2.55	0.90	2.75	1.03	2.76	1.08	0.20	0.21
Skill to Design a System	2.53	0.50	2.25	0.97	2.43	1.04	2.56	1.20	0.18	0.31
Skill to Design Experiments	2.78	0.36	2.35	1.04	2.46	1.07	2.46	1.08	0.11	0.11
Skill to Fomulate Alternative Solutions	2.58	0.49	2.29	1.42	2.45	1.46	2.46	1.46	0.16	0.18
Skill to Identify Problems	2.93	0.89	3.23	1.01	3.61	0.90	3.64	1.05	0.39	0.41
Skill to Identify, Formulate, and Solve Problems	2.49	0.54	2.65	0.72	3.01	0.76	2.96	0.89	0.36	0.31
Skill to Plan a Program	2.38	0.74	2.13	0.99	2.55	0.87	2.55	0.90	0.43	0.43
Skill to Use the Tools Necessary for the Job	3.83	0.71	4.00	0.67	4.06	0.84	4.01	1.00	0.05	0.01
Social Responsibility	2.08	0.52	2.24	0.51	2.56	0.81	2.65	0.91	0.33	0.41
Team Building Skills	1.78	0.73	2.14	0.83	2.40	1.10	2.39	1.23	0.26	0.25
Teamwork and Collaboration	3.20	0.34	3.19	0.45	3.35	0.38	3.35	0.43	0.16	0.16
Technical Skill	3.14	0.56	3.29	0.91	3.56	0.94	3.57	0.96	0.28	0.29
Writing Skill	2.13	0.46	2.33	0.59	2.63	0.81	2.73	0.92	0.30	0.40

Shipbuilding NAICS 3366 - Trades

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.13	0.59	3.19	0.63	3.36	0.67	3.47	0.83	0.17	0.28
Attention to Detail	3.88	0.70	3.77	0.59	3.88	0.50	3.88	0.47	0.11	0.11
Cognitive Abilities	2.29	0.37	2.34	0.41	2.42	0.49	2.42	0.49	0.08	0.08
Commitment to Lifelong Learning	2.88	0.29	2.89	0.44	3.00	0.42	3.13	0.49	0.11	0.23
Communication Skill	2.04	0.36	2.61	0.92	2.86	0.79	3.00	0.87	0.25	0.39
Creativity and Innovation	2.41	0.55	2.56	0.66	2.72	0.73	3.06	0.81	0.16	0.50
Critical Thinking Skills	2.06	0.40	2.23	0.55	2.53	0.53	2.61	0.70	0.30	0.38
Decision Making Skill	2.13	0.29	2.16	0.75	2.25	0.71	2.34	0.74	0.09	0.19
Digital Literacy	1.00	1.08	1.66	0.88	2.58	0.79	3.25	0.73	0.92	1.59
Entrepeneurial Skill	1.31	0.68	1.17	0.72	1.27	0.75	1.36	0.83	0.09	0.19
Independence	3.75	0.55	3.81	0.36	3.80	0.38	3.78	0.41	-0.02	-0.03
Initiative	2.06	0.40	2.39	0.69	2.28	0.75	2.30	0.78	-0.11	-0.09
Interpersonal Skills	1.78	0.38	2.10	0.73	2.58	0.86	2.70	0.93	0.47	0.60
Knowledge of Emerging Trends and Technologies	0.58	0.76	1.45	0.91	2.02	1.15	2.31	1.34	0.56	0.86
Leadership Skills	2.44	0.70	2.58	0.78	2.70	0.85	2.75	0.89	0.13	0.17
New Relevant Knowledge	2.13	0.47	2.25	0.54	2.59	0.76	2.83	0.96	0.34	0.58
Numeracy	2.31	0.57	2.28	0.74	2.84	0.70	3.17	0.92	0.56	0.89
Physical Abilities	2.88	0.31	3.44	0.67	3.31	0.51	3.28	0.54	-0.13	-0.16
Problem Solving	2.19	0.36	2.69	0.72	3.20	0.76	3.38	0.98	0.52	0.69
Professional Composure	3.06	0.54	2.86	0.94	2.92	0.90	3.02	0.95	0.06	0.16
Project Management Skill	1.64	0.44	1.66	0.40	1.88	0.68	2.04	0.92	0.22	0.38
Psychomotor Abilities	3.06	0.41	3.45	0.69	3.51	0.59	3.58	0.61	0.06	0.13
Reading Skill	2.69	0.44	2.95	0.71	3.45	0.48	3.66	0.75	0.50	0.70
Sensory Abilities	2.46	0.39	2.60	0.49	2.77	0.54	2.87	0.63	0.17	0.27
Skill Needed to Evaluate Alternatives	2.25	0.55	2.20	0.74	2.34	0.78	2.45	0.84	0.14	0.25
Skill Needed to Judge Quality	2.25	0.41	2.64	0.62	2.86	0.64	3.00	0.79	0.22	0.36
Skill Needed to Support Supplier Development	1.69	0.36	1.73	0.83	1.91	0.93	2.00	1.03	0.17	0.27
Skill Needed to Understand Business Principles	1.00	0.71	0.98	0.57	1.06	0.66	1.14	0.79	0.08	0.16
Skill to Conduct Work Design	1.88	0.87	2.22	0.90	2.41	0.97	2.52	1.08	0.19	0.30
Skill to Design a System	2.19	0.51	2.13	0.64	2.25	0.68	2.34	0.81	0.13	0.22
Skill to Design Experiments	2.21	0.30	2.06	0.58	2.18	0.61	2.29	0.65	0.12	0.23
Skill to Fomulate Alternative Solutions	2.00	0.32	2.06	0.73	2.23	0.79	2.34	0.92	0.17	0.28
Skill to Identify Problems	2.31	0.44	2.55	0.84	2.91	1.04	2.97	1.03	0.36	0.42
Skill to Identify, Formulate, and Solve Problems	1.98	0.31	2.26	0.68	2.66	0.69	2.80	0.82	0.39	0.54
Skill to Plan a Program	2.06	0.40	2.19	0.79	2.36	0.88	2.47	0.96	0.17	0.28
Skill to Use the Tools Necessary for the Job	2.98	0.50	3.09	0.46	3.35	0.51	3.49	0.63	0.27	0.41
Social Responsibility	1.44	0.60	1.28	0.52	1.70	0.98	1.72	1.05	0.42	0.44
Team Building Skills	1.31	0.68	2.14	0.97	2.31	0.91	2.45	0.90	0.17	0.31
Teamwork and Collaboration	2.91	0.46	3.05	0.68	3.47	0.51	3.72	0.60	0.42	0.67
Technical Skill	2.46	0.58	2.68	0.53	3.13	0.56	3.26	0.88	0.45	0.58
Writing Skill	1.50	0.61	2.06	0.92	2.34	0.90	2.45	0.98	0.28	0.39

NAICS 331 332 333 335 METAL TRADES

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.22	0.51	3.26	0.75	3.34	0.83	3.36	0.89	0.09	0.11
Attention to Detail	3.95	0.60	3.76	0.86	3.82	0.85	3.80	1.04	0.05	0.04
Cognitive Abilities	2.44	0.33	2.61	0.62	2.67	0.66	2.61	0.73	0.06	-0.01
Commitment to Lifelong Learning	2.95	0.16	2.99	0.69	3.07	0.78	3.02	0.89	0.08	0.03
Communication Skill	2.14	0.26	2.75	0.78	2.91	0.93	3.08	1.10	0.15	0.33
Creativity and Innovation	2.57	0.49	2.74	0.80	2.87	0.92	2.93	0.98	0.14	0.19
Critical Thinking Skills	2.24	0.40	2.81	0.91	2.99	0.97	3.17	1.02	0.18	0.36
Decision Making Skill	2.14	0.30	2.64	0.81	2.70	0.91	2.82	1.07	0.07	0.19
Digital Literacy	1.11	1.09	2.07	1.11	2.74	1.34	3.03	1.44	0.67	0.95
Entrepeneurial Skill	1.24	0.52	1.29	0.69	1.29	0.69	1.29	0.68	0.00	0.00
Independence	3.78	0.51	3.60	0.64	3.52	0.80	3.48	0.93	-0.08	-0.12
Initiative	2.19	0.36	2.57	0.77	2.58	0.81	2.67	0.86	0.01	0.09
Interpersonal Skills	1.84	0.31	2.39	0.92	2.44	0.93	2.60	0.99	0.06	0.21
Knowledge of Emerging Trends and Technologies	0.60	0.70	1.55	1.14	1.82	1.33	1.93	1.42	0.27	0.37
Leadership Skills	2.68	0.60	2.76	0.62	2.68	0.78	2.72	0.83	-0.08	-0.05
New Relevant Knowledge	2.27	0.42	2.74	0.93	2.94	1.09	3.07	1.15	0.20	0.32
Numeracy	2.59	0.47	2.91	0.91	3.13	0.92	3.27	1.02	0.22	0.36
Physical Abilities	2.91	0.34	3.03	0.47	2.93	0.59	2.92	0.60	-0.09	-0.10
Problem Solving	2.30	0.43	2.71	0.82	2.76	1.12	2.79	1.22	0.05	0.08
Professional Composure	3.05	0.37	3.09	0.64	2.91	0.89	2.92	0.91	-0.18	-0.17
Project Management Skill	1.70	0.38	2.12	0.90	2.23	1.07	2.28	1.12	0.11	0.16
Psychomotor Abilities	3.21	0.47	3.37	0.66	3.27	0.70	3.24	0.75	-0.10	-0.13
Reading Skill	2.86	0.30	3.26	0.81	3.41	0.96	3.33	0.99	0.14	0.07
Sensory Abilities	2.46	0.29	2.74	0.73	2.75	0.76	2.75	0.79	0.01	0.01
Skill Needed to Evaluate Alternatives	2.27	0.42	2.60	0.81	2.70	0.98	2.84	1.08	0.09	0.24
Skill Needed to Judge Quality	2.22	0.38	2.81	0.86	2.88	0.99	2.95	1.07	0.07	0.14
Skill Needed to Support Supplier Development	1.72	0.38	1.78	0.73	1.82	0.83	1.87	0.92	0.04	0.09
Skill Needed to Understand Business Principles	1.08	0.57	1.27	0.88	1.34	1.00	1.38	1.10	0.07	0.11
Skill to Conduct Work Design	2.19	0.92	2.68	1.06	2.75	1.08	2.80	1.16	0.07	0.13
Skill to Design a System	2.27	0.42	2.51	0.96	2.57	1.09	2.60	1.14	0.05	0.09
Skill to Design Experiments	2.33	0.35	2.38	0.41	2.52	0.59	2.56	0.72	0.14	0.18
Skill to Fomulate Alternative Solutions	2.19	0.36	2.36	0.69	2.42	0.79	2.60	1.03	0.05	0.24
Skill to Identify Problems	2.30	0.43	2.72	0.87	2.76	0.92	3.02	1.06	0.05	0.30
Skill to Identify, Formulate, and Solve Problems	2.07	0.34	2.81	0.95	2.98	0.98	3.09	1.10	0.18	0.29
Skill to Plan a Program	2.19	0.36	2.46	0.78	2.51	0.93	2.61	1.05	0.05	0.15
Skill to Use the Tools Necessary for the Job	3.16	0.55	3.44	0.74	3.46	0.86	3.60	0.92	0.02	0.17
Social Responsibility	1.59	0.58	1.97	0.87	1.78	0.92	1.78	1.01	-0.18	-0.19
Team Building Skills	1.49	0.79	2.01	1.24	1.95	1.28	1.94	1.27	-0.05	-0.07
Teamwork and Collaboration	2.96	0.30	3.13	0.74	3.13	1.00	3.18	1.08	0.00	0.05
Technical Skill	2.60	0.54	3.08	0.95	3.33	1.05	3.48	1.16	0.25	0.39
Writing Skill	1.70	0.55	2.43	0.98	2.51	1.02	2.52	1.05	0.07	0.09

Chemical NAICS 325 - Engineer

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	4.00	0.00	3.76	0.93	4.24	0.52	4.39	0.56	0.48	0.63
Attention to Detail	5.00	0.00	4.74	0.48	4.87	0.29	4.89	0.27	0.13	0.15
Cognitive Abilities	4.19	0.07	4.16	0.11	4.17	0.36	4.17	0.59	0.01	0.01
Commitment to Lifelong Learning	3.97	0.17	4.02	0.56	4.27	0.51	4.23	0.74	0.25	0.21
Communication Skill	4.24	0.17	4.07	0.70	4.34	0.62	4.45	0.53	0.28	0.39
Creativity and Innovation	4.36	0.26	3.83	1.10	4.01	0.92	4.24	0.64	0.18	0.40
Critical Thinking Skills	4.78	0.42	4.24	1.19	4.57	0.69	4.69	0.64	0.33	0.45
Decision Making Skill	4.97	0.17	4.54	0.68	4.64	0.71	4.66	0.80	0.10	0.12
Digital Literacy	4.36	0.49	3.99	0.73	4.33	0.53	4.47	0.51	0.35	0.49
Entrepeneurial Skill	3.36	0.49	3.01	1.15	3.26	1.22	3.30	1.26	0.24	0.28
Independence	4.03	0.17	4.01	0.56	4.13	0.45	4.33	0.45	0.12	0.33
Initiative	4.19	0.40	3.94	0.55	4.06	0.62	4.15	0.61	0.13	0.21
Interpersonal Skills	3.37	0.15	3.23	0.49	3.35	0.59	3.28	0.94	0.11	0.04
Knowledge of Emerging Trends and Technologies	1.64	0.58	2.34	1.08	2.76	1.17	3.15	1.45	0.42	0.81
Leadership Skills	3.97	0.17	3.67	0.76	3.83	0.54	3.85	0.66	0.17	0.19
New Relevant Knowledge	4.33	0.48	4.08	0.68	4.34	0.54	4.35	0.61	0.26	0.27
Numeracy	4.67	0.48	4.25	1.04	4.49	0.63	4.52	0.83	0.24	0.27
Physical Abilities	0.42	0.14	1.20	1.15	1.16	1.10	1.08	1.14	-0.05	-0.12
Problem Solving	4.97	0.17	4.28	1.08	4.70	0.54	4.72	0.83	0.42	0.44
Professional Composure	3.97	0.17	3.75	0.45	3.87	0.46	3.81	0.70	0.12	0.06
Project Management Skill	3.87	0.20	3.63	0.94	3.85	0.70	3.99	0.56	0.22	0.36
Psychomotor Abilities	1.46	0.12	2.25	1.04	2.28	1.05	2.19	1.08	0.03	-0.06
Reading Skill	4.97	0.17	4.58	0.80	4.73	0.56	4.69	0.72	0.15	0.12
Sensory Abilities	1.91	0.19	2.21	0.69	2.64	1.09	2.59	1.20	0.43	0.38
Skill Needed to Evaluate Alternatives	4.97	0.17	4.33	0.94	4.40	1.01	4.41	1.07	0.07	0.08
Skill Needed to Judge Quality	4.00	0.00	3.96	0.40	4.07	0.41	4.03	0.84	0.11	0.07
Skill Needed to Support Supplier Development	4.07	0.36	3.66	0.78	3.88	0.57	3.99	0.55	0.22	0.33
Skill Needed to Understand Business Principles	1.94	0.33	2.65	1.09	2.96	1.15	3.11	1.28	0.31	0.47
Skill to Conduct Work Design	4.97	0.17	4.25	1.16	4.34	0.93	4.38	0.86	0.09	0.13
Skill to Design a System	4.97	0.17	4.53	0.82	4.69	0.50	4.51	0.87	0.16	-0.02
Skill to Design Experiments	4.56	0.39	4.21	0.91	4.53	0.42	4.44	0.72	0.32	0.23
Skill to Fomulate Alternative Solutions	4.78	0.42	4.28	0.98	4.69	0.47	4.63	0.61	0.42	0.35
Skill to Identify Problems	4.75	0.44	4.25	0.91	4.38	0.93	4.38	1.18	0.13	0.13
Skill to Identify, Formulate, and Solve Problems	4.28	0.28	4.04	0.79	4.26	0.58	4.39	0.49	0.22	0.35
Skill to Plan a Program	3.92	0.28	3.78	0.88	4.06	0.61	4.08	0.74	0.28	0.30
Skill to Use the Tools Necessary for the Job	3.70	0.32	3.83	0.69	3.94	0.71	3.88	0.95	0.10	0.05
Social Responsibility	3.00	0.00	2.83	0.95	3.06	0.94	3.27	0.95	0.23	0.44
Team Building Skills	4.25	0.65	3.97	0.87	3.99	0.88	4.08	0.86	0.02	0.11
Teamwork and Collaboration	2.83	0.29	3.33	0.63	3.45	0.86	3.46	1.09	0.13	0.13
Technical Skill	3.95	0.32	3.76	0.65	4.19	0.47	4.29	0.55	0.43	0.53
Writing Skill	4.08	0.28	4.13	0.69	4.29	0.60	4.24	0.76	0.17	0.11

Aerospace NAICS 3364 - Engineer

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.40	0.77	3.75	0.59	4.05	0.66	4.18	0.61	0.30	0.43
Attention to Detail	4.00	1.29	4.55	0.79	4.80	0.55	4.83	0.47	0.25	0.28
Cognitive Abilities	3.47	0.84	3.80	0.55	3.95	0.45	4.03	0.38	0.15	0.23
Commitment to Lifelong Learning	3.30	0.75	3.58	0.55	3.88	0.32	4.00	0.35	0.30	0.43
Communication Skill	3.47	0.84	3.53	0.84	3.95	0.79	3.96	0.79	0.43	0.43
Creativity and Innovation	3.40	0.81	3.70	0.79	4.03	0.86	4.10	0.91	0.33	0.40
Critical Thinking Skills	3.70	1.11	3.85	0.84	4.05	0.72	4.20	0.76	0.20	0.35
Decision Making Skill	4.00	1.29	4.10	1.02	4.40	0.67	4.58	0.62	0.30	0.48
Digital Literacy	3.40	0.77	4.05	0.64	4.43	0.51	4.43	0.47	0.38	0.38
Entrepeneurial Skill	2.80	0.54	2.40	0.99	2.50	1.11	2.58	1.26	0.10	0.18
Independence	3.50	0.91	3.83	0.66	4.03	0.59	4.13	0.57	0.20	0.30
Initiative	3.70	1.11	3.30	0.92	3.70	0.86	3.80	0.81	0.40	0.50
Interpersonal Skills	3.04	0.47	3.29	0.35	3.42	0.51	3.54	0.67	0.13	0.25
Knowledge of Emerging Trends and Technologies	2.30	0.54	2.88	0.50	3.25	0.59	3.55	0.72	0.38	0.68
Leadership Skills	3.40	0.77	3.33	0.67	3.58	0.71	3.60	1.02	0.25	0.28
New Relevant Knowledge	3.40	0.77	3.73	0.66	3.95	0.70	3.98	0.69	0.23	0.25
Numeracy	4.00	1.29	4.18	0.91	4.45	0.60	4.60	0.57	0.28	0.43
Physical Abilities	1.24	1.10	1.73	1.03	1.75	1.06	1.73	1.03	0.03	0.00
Problem Solving	3.90	1.24	4.00	0.93	4.30	0.86	4.38	0.86	0.30	0.38
Professional Composure	3.40	0.77	3.85	0.39	4.08	0.49	4.15	0.43	0.23	0.30
Project Management Skill	3.42	0.81	3.40	1.02	3.90	0.64	3.95	0.64	0.50	0.55
Psychomotor Abilities	1.87	0.57	2.22	0.65	2.30	0.78	2.30	0.78	0.08	0.08
Reading Skill	4.00	1.29	4.03	0.95	4.25	0.82	4.33	0.73	0.23	0.30
Sensory Abilities	2.19	0.27	2.58	0.73	2.73	0.78	2.86	0.93	0.15	0.28
Skill Needed to Evaluate Alternatives	3.90	1.24	3.98	0.83	4.20	0.80	4.30	0.74	0.23	0.33
Skill Needed to Judge Quality	3.40	0.77	3.73	0.46	3.98	0.38	4.15	0.49	0.25	0.43
Skill Needed to Support Supplier Development	3.25	0.68	3.00	1.26	3.35	1.21	3.58	1.35	0.35	0.58
Skill Needed to Understand Business Principles	2.20	0.26	2.68	0.83	2.93	0.91	3.18	1.13	0.25	0.50
Skill to Conduct Work Design	4.00	1.29	4.10	1.02	4.33	1.01	4.35	1.13	0.23	0.25
Skill to Design a System	3.90	1.24	3.95	0.89	4.13	0.78	4.30	0.80	0.18	0.35
Skill to Design Experiments	3.44	0.84	3.86	0.70	4.06	0.70	4.14	0.64	0.20	0.28
Skill to Fomulate Alternative Solutions	3.50	0.91	3.40	0.87	3.73	0.65	3.80	0.67	0.33	0.40
Skill to Identify Problems	3.50	0.91	3.73	0.84	4.10	0.39	4.30	0.42	0.38	0.58
Skill to Identify, Formulate, and Solve Problems	3.34	0.74	3.54	0.48	3.86	0.54	3.99	0.47	0.33	0.45
Skill to Plan a Program	3.20	0.71	3.23	0.89	3.80	0.28	4.05	0.51	0.58	0.83
Skill to Use the Tools Necessary for the Job	3.17	0.64	3.52	0.50	3.88	0.59	3.96	0.66	0.37	0.44
Social Responsibility	2.80	0.26	2.93	0.44	3.08	0.58	3.20	0.65	0.15	0.28
Team Building Skills	3.30	0.89	3.43	0.72	3.85	0.54	3.88	0.54	0.43	0.45
Teamwork and Collaboration	2.75	0.26	3.28	0.42	3.78	0.52	3.88	0.58	0.50	0.60
Technical Skill	3.35	0.76	3.88	0.50	3.95	0.47	4.05	0.45	0.08	0.18
Writing Skill	3.40	0.77	3.58	0.85	3.78	0.73	3.88	0.79	0.20	0.30

Medical Equipment 3391 - Engineer

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	4.00	0.00	3.77	0.64	4.16	0.68	4.25	0.78	0.39	0.48
Attention to Detail	5.00	0.00	4.16	1.10	4.32	0.87	4.45	0.70	0.17	0.30
Cognitive Abilities	4.06	0.38	4.20	0.61	4.30	0.49	4.34	0.43	0.11	0.14
Commitment to Lifelong Learning	3.70	0.47	3.96	0.80	4.30	0.64	4.34	0.62	0.33	0.38
Communication Skill	4.12	0.31	3.80	0.93	4.42	0.44	4.59	0.44	0.61	0.79
Creativity and Innovation	4.19	0.44	3.82	1.04	4.19	0.70	4.44	0.70	0.36	0.62
Critical Thinking Skills	4.52	0.70	4.07	0.88	4.39	0.69	4.33	0.78	0.31	0.26
Decision Making Skill	4.74	0.76	3.90	0.99	4.21	0.93	4.27	0.84	0.31	0.37
Digital Literacy	4.30	0.47	3.97	0.90	4.43	0.63	4.55	0.55	0.45	0.57
Entrepeneurial Skill	3.00	0.48	3.13	1.20	3.29	1.13	3.34	1.11	0.16	0.21
Independence	4.19	0.40	4.31	0.64	4.19	0.56	3.81	1.01	-0.12	-0.50
Initiative	4.04	0.71	3.51	0.77	3.86	0.61	3.90	0.59	0.35	0.39
Interpersonal Skills	3.31	0.36	3.73	0.72	3.86	0.71	3.96	0.74	0.13	0.23
Knowledge of Emerging Trends and Technologies	1.81	0.63	2.91	1.03	3.21	0.88	3.44	1.06	0.31	0.53
Leadership Skills	3.81	0.48	3.69	0.62	3.84	0.58	4.05	0.58	0.15	0.35
New Relevant Knowledge	4.22	0.64	4.33	0.68	4.48	0.62	4.49	0.62	0.15	0.16
Numeracy	4.59	0.50	3.87	1.05	4.10	0.89	4.21	0.77	0.23	0.34
Physical Abilities	0.30	0.23	0.75	1.05	0.74	1.01	0.70	1.00	-0.01	-0.05
Problem Solving	4.70	0.67	4.24	0.75	4.36	0.78	4.32	0.93	0.12	0.08
Professional Composure	3.85	0.46	3.85	0.48	3.85	0.47	4.15	0.45	0.00	0.30
Project Management Skill	3.73	0.59	3.33	0.98	3.62	0.96	3.68	0.95	0.29	0.35
Psychomotor Abilities	1.31	0.31	2.12	1.45	1.89	1.07	1.65	1.12	-0.23	-0.47
Reading Skill	4.81	0.56	4.23	0.70	4.34	0.74	4.35	0.83	0.11	0.12
Sensory Abilities	1.83	0.26	2.47	1.31	2.19	1.21	2.09	1.31	-0.28	-0.38
Skill Needed to Evaluate Alternatives	4.70	0.67	4.19	0.82	4.24	0.93	4.22	1.10	0.06	0.04
Skill Needed to Judge Quality	3.81	0.48	3.82	0.84	4.20	0.75	4.24	0.79	0.38	0.42
Skill Needed to Support Supplier Development	3.89	0.49	3.55	1.15	3.91	1.07	3.94	1.08	0.36	0.39
Skill Needed to Understand Business Principles	1.89	0.32	2.64	1.10	2.77	1.17	2.81	1.30	0.13	0.17
Skill to Conduct Work Design	4.63	1.33	3.63	1.39	3.76	1.46	3.79	1.53	0.13	0.16
Skill to Design a System	4.74	0.53	3.99	1.23	4.27	0.89	4.38	0.74	0.28	0.39
Skill to Design Experiments	4.16	0.64	3.73	1.18	3.87	1.01	3.96	0.99	0.15	0.23
Skill to Fomulate Alternative Solutions	4.41	0.69	4.14	0.76	4.33	0.64	4.43	0.60	0.19	0.29
Skill to Identify Problems	4.22	0.75	3.94	0.77	4.19	0.57	4.30	0.62	0.24	0.35
Skill to Identify, Formulate, and Solve Problems	3.96	0.55	3.72	0.80	3.84	0.83	3.83	1.15	0.12	0.10
Skill to Plan a Program	3.56	0.58	3.44	0.76	3.65	0.81	3.66	0.92	0.21	0.22
Skill to Use the Tools Necessary for the Job	3.53	1.05	3.18	1.40	3.37	1.48	3.40	1.64	0.19	0.22
Social Responsibility	2.93	0.27	2.82	1.18	3.19	1.36	3.24	1.42	0.36	0.42
Team Building Skills	3.52	1.01	3.81	0.99	3.84	0.96	3.95	0.99	0.04	0.15
Teamwork and Collaboration	2.94	0.25	3.69	0.77	4.07	0.77	4.12	0.87	0.38	0.43
Technical Skill	3.71	0.92	3.66	1.03	3.81	1.01	3.80	1.17	0.15	0.14
Writing Skill	3.89	0.32	3.86	0.66	4.17	0.67	4.31	0.68	0.31	0.44

Part C - Occupation Types Within a Sector

CHEMICAL NAICS 325 MANAGER

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	4.00	0.00	3.81	0.70	4.06	0.54	4.15	0.60	0.25	0.35
Attention to Detail	4.05	0.75	4.10	0.64	4.15	0.72	4.06	0.96	0.06	-0.03
Cognitive Abilities	3.27	0.47	3.35	0.66	3.60	0.62	3.70	0.68	0.26	0.35
Commitment to Lifelong Learning	3.30	0.46	3.40	0.57	3.59	0.79	3.61	0.96	0.19	0.21
Communication Skill	3.54	0.54	3.83	0.72	4.09	0.72	4.20	0.93	0.26	0.37
Creativity and Innovation	3.25	0.78	3.26	0.88	3.66	0.85	3.78	0.75	0.41	0.53
Critical Thinking Skills	3.59	0.92	3.76	0.89	4.12	0.88	4.15	0.94	0.36	0.39
Decision Making Skill	4.02	0.76	4.03	0.81	4.16	0.82	4.19	0.84	0.13	0.16
Digital Literacy	3.05	0.75	3.19	0.92	3.83	0.84	4.09	0.88	0.64	0.90
Entrepeneurial Skill	3.18	0.81	3.05	0.86	3.15	0.87	3.27	0.97	0.11	0.22
Independence	4.00	0.00	3.94	0.48	4.04	0.61	3.97	0.91	0.10	0.03
Initiative	4.30	0.46	4.03	0.97	4.26	0.73	4.36	0.58	0.23	0.34
Interpersonal Skills	3.83	0.60	3.94	0.58	4.17	0.61	4.21	0.61	0.23	0.27
Knowledge of Emerging Trends and Technologies	1.89	0.13	2.21	0.71	2.63	0.99	2.77	1.12	0.42	0.56
Leadership Skills	4.73	0.45	4.60	0.67	4.64	0.71	4.57	0.95	0.03	-0.03
New Relevant Knowledge	3.05	0.75	3.26	0.88	3.55	0.97	3.60	1.02	0.29	0.34
Numeracy	4.02	0.76	3.90	0.92	3.98	0.92	4.08	0.85	0.09	0.18
Physical Abilities	0.50	0.60	1.18	1.22	1.16	1.21	1.16	1.27	-0.02	-0.03
Problem Solving	4.05	0.75	3.99	0.87	4.31	0.65	4.43	0.64	0.32	0.44
Professional Composure	3.75	0.44	3.83	0.58	3.95	0.61	3.97	0.65	0.13	0.14
Project Management Skill	4.50	0.46	4.17	0.83	4.31	0.70	4.35	0.74	0.14	0.18
Psychomotor Abilities	1.25	0.61	1.85	1.17	1.89	1.15	1.83	1.07	0.04	-0.01
Reading Skill	3.59	0.92	3.95	0.86	4.19	0.82	4.20	0.92	0.23	0.24
Sensory Abilities	1.89	0.31	2.36	0.81	2.53	1.02	2.48	1.03	0.17	0.11
Skill Needed to Evaluate Alternatives	3.75	0.44	3.57	0.81	3.80	0.78	3.88	0.78	0.23	0.31
Skill Needed to Judge Quality	3.70	0.51	3.68	0.65	4.00	0.59	4.07	0.57	0.32	0.39
Skill Needed to Support Supplier Development	3.74	0.80	3.59	0.93	3.75	0.94	3.86	0.92	0.16	0.27
Skill Needed to Understand Business Principles	2.73	0.45	3.14	0.73	3.51	0.86	3.61	0.96	0.37	0.47
Skill to Conduct Work Design	3.27	1.26	3.24	1.21	3.51	1.17	3.59	1.18	0.27	0.34
Skill to Design a System	4.05	0.75	3.70	1.03	3.91	0.97	3.97	0.93	0.21	0.26
Skill to Design Experiments	3.48	0.61	3.32	0.87	3.72	0.97	3.79	0.96	0.40	0.47
Skill to Fomulate Alternative Solutions	3.27	0.50	3.27	0.75	3.67	0.78	3.76	0.86	0.40	0.48
Skill to Identify Problems	3.75	0.44	3.68	0.62	4.06	0.53	4.07	0.68	0.39	0.39
Skill to Identify, Formulate, and Solve Problems	3.72	0.57	3.75	0.62	4.02	0.58	4.17	0.52	0.27	0.42
Skill to Plan a Program	4.16	0.83	4.02	0.86	4.13	0.85	4.11	0.94	0.10	0.09
Skill to Use the Tools Necessary for the Job	2.33	0.45	2.72	0.66	3.12	0.84	3.01	0.99	0.40	0.29
Social Responsibility	3.30	0.46	3.43	0.67	3.71	0.77	3.72	0.84	0.28	0.30
Team Building Skills	4.73	0.45	4.40	0.93	4.53	0.84	4.51	0.89	0.13	0.10
Teamwork and Collaboration	3.65	0.23	3.76	0.50	3.90	0.76	3.88	0.96	0.14	0.12
Technical Skill	1.86	0.35	2.68	0.83	3.16	1.01	3.27	1.24	0.49	0.59
Writing Skill	3.59	0.92	3.81	0.92	3.93	0.96	3.91	1.18	0.13	0.11

CHEMICAL NAICS 325 ENGINEER

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	4.00	0.00	3.76	0.93	4.24	0.52	4.39	0.56	0.48	0.63
Attention to Detail	5.00	0.00	4.74	0.48	4.87	0.29	4.89	0.27	0.13	0.15
Cognitive Abilities	4.19	0.07	4.16	0.11	4.17	0.36	4.17	0.59	0.01	0.01
Commitment to Lifelong Learning	3.97	0.17	4.02	0.56	4.27	0.51	4.23	0.74	0.25	0.21
Communication Skill	4.24	0.17	4.07	0.70	4.34	0.62	4.45	0.53	0.28	0.39
Creativity and Innovation	4.36	0.26	3.83	1.10	4.01	0.92	4.24	0.64	0.18	0.40
Critical Thinking Skills	4.78	0.42	4.24	1.19	4.57	0.69	4.69	0.64	0.33	0.45
Decision Making Skill	4.97	0.17	4.54	0.68	4.64	0.71	4.66	0.80	0.10	0.12
Digital Literacy	4.36	0.49	3.99	0.73	4.33	0.53	4.47	0.51	0.35	0.49
Entrepeneurial Skill	3.36	0.49	3.01	1.15	3.26	1.22	3.30	1.26	0.24	0.28
Independence	4.03	0.17	4.01	0.56	4.13	0.45	4.33	0.45	0.12	0.33
Initiative	4.19	0.40	3.94	0.55	4.06	0.62	4.15	0.61	0.13	0.21
Interpersonal Skills	3.37	0.15	3.23	0.49	3.35	0.59	3.28	0.94	0.11	0.04
Knowledge of Emerging Trends and Technologies	1.64	0.58	2.34	1.08	2.76	1.17	3.15	1.45	0.42	0.81
Leadership Skills	3.97	0.17	3.67	0.76	3.83	0.54	3.85	0.66	0.17	0.19
New Relevant Knowledge	4.33	0.48	4.08	0.68	4.34	0.54	4.35	0.61	0.26	0.27
Numeracy	4.67	0.48	4.25	1.04	4.49	0.63	4.52	0.83	0.24	0.27
Physical Abilities	0.42	0.14	1.20	1.15	1.16	1.10	1.08	1.14	-0.05	-0.12
Problem Solving	4.97	0.17	4.28	1.08	4.70	0.54	4.72	0.83	0.42	0.44
Professional Composure	3.97	0.17	3.75	0.45	3.87	0.46	3.81	0.70	0.12	0.06
Project Management Skill	3.87	0.20	3.63	0.94	3.85	0.70	3.99	0.56	0.22	0.36
Psychomotor Abilities	1.46	0.12	2.25	1.04	2.28	1.05	2.19	1.08	0.03	-0.06
Reading Skill	4.97	0.17	4.58	0.80	4.73	0.56	4.69	0.72	0.15	0.12
Sensory Abilities	1.91	0.19	2.21	0.69	2.64	1.09	2.59	1.20	0.43	0.38
Skill Needed to Evaluate Alternatives	4.97	0.17	4.33	0.94	4.40	1.01	4.41	1.07	0.07	0.08
Skill Needed to Judge Quality	4.00	0.00	3.96	0.40	4.07	0.41	4.03	0.84	0.11	0.07
Skill Needed to Support Supplier Development	4.07	0.36	3.66	0.78	3.88	0.57	3.99	0.55	0.22	0.33
Skill Needed to Understand Business Principles	1.94	0.33	2.65	1.09	2.96	1.15	3.11	1.28	0.31	0.47
Skill to Conduct Work Design	4.97	0.17	4.25	1.16	4.34	0.93	4.38	0.86	0.09	0.13
Skill to Design a System	4.97	0.17	4.53	0.82	4.69	0.50	4.51	0.87	0.16	-0.02
Skill to Design Experiments	4.56	0.39	4.21	0.91	4.53	0.42	4.44	0.72	0.32	0.23
Skill to Fomulate Alternative Solutions	4.78	0.42	4.28	0.98	4.69	0.47	4.63	0.61	0.42	0.35
Skill to Identify Problems	4.75	0.44	4.25	0.91	4.38	0.93	4.38	1.18	0.13	0.13
Skill to Identify, Formulate, and Solve Problems	4.28	0.28	4.04	0.79	4.26	0.58	4.39	0.49	0.22	0.35
Skill to Plan a Program	3.92	0.28	3.78	0.88	4.06	0.61	4.08	0.74	0.28	0.30
Skill to Use the Tools Necessary for the Job	3.70	0.32	3.83	0.69	3.94	0.71	3.88	0.95	0.10	0.05
Social Responsibility	3.00	0.00	2.83	0.95	3.06	0.94	3.27	0.95	0.23	0.44
Team Building Skills	4.25	0.65	3.97	0.87	3.99	0.88	4.08	0.86	0.02	0.11
Teamwork and Collaboration	2.83	0.29	3.33	0.63	3.45	0.86	3.46	1.09	0.13	0.13
Technical Skill	3.95	0.32	3.76	0.65	4.19	0.47	4.29	0.55	0.43	0.53
Writing Skill	4.08	0.28	4.13	0.69	4.29	0.60	4.24	0.76	0.17	0.11

CHEMICAL NAICS 325 PRODUCTION

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.33	1.12	2.25	0.95	2.47	1.20	2.61	1.38	0.22	0.36
Attention to Detail	2.33	1.32	2.17	0.97	2.25	1.09	2.22	1.20	0.08	0.06
Cognitive Abilities	1.87	0.51	1.79	0.53	1.95	0.44	2.06	0.52	0.17	0.28
Commitment to Lifelong Learning	1.78	0.67	1.67	0.71	1.94	0.67	2.06	0.81	0.28	0.39
Communication Skill	1.41	0.49	1.74	0.66	1.66	0.62	1.63	0.70	-0.08	-0.11
Creativity and Innovation	0.94	1.01	1.56	1.53	1.47	1.41	1.69	1.56	-0.08	0.14
Critical Thinking Skills	1.67	0.71	1.69	0.84	1.69	1.02	2.11	1.52	0.00	0.42
Decision Making Skill	1.56	0.53	1.86	0.52	1.72	0.42	1.64	0.45	-0.14	-0.22
Digital Literacy	0.67	0.71	1.50	1.38	1.97	1.21	2.50	1.36	0.47	1.00
Entrepeneurial Skill	1.56	0.53	1.44	0.54	1.36	0.79	1.44	0.76	-0.08	0.00
Independence	2.11	1.05	1.72	0.67	2.03	0.79	2.42	0.94	0.31	0.69
Initiative	1.56	0.53	1.44	0.53	1.44	0.53	1.47	0.51	0.00	0.03
Interpersonal Skills	1.40	0.44	1.33	0.45	1.40	0.57	1.34	0.50	0.07	0.01
Knowledge of Emerging Trends and Technologies	0.50	0.60	0.36	0.22	0.39	0.31	0.44	0.45	0.03	0.08
Leadership Skills	2.00	1.00	1.58	0.85	1.56	0.97	1.64	1.07	-0.03	0.06
New Relevant Knowledge	1.11	0.93	0.81	0.79	0.89	0.78	0.92	0.79	0.08	0.11
Numeracy	1.44	0.53	1.44	0.58	1.25	0.66	1.25	0.79	-0.19	-0.19
Physical Abilities	2.70	0.83	2.98	0.85	2.89	0.93	2.84	1.03	-0.08	-0.14
Problem Solving	1.56	0.53	1.86	0.96	2.11	1.41	2.22	1.56	0.25	0.36
Professional Composure	1.89	1.27	1.64	0.73	1.97	0.99	2.00	1.12	0.33	0.36
Project Management Skill	1.24	0.51	1.14	0.56	1.12	0.57	1.06	0.66	-0.03	-0.09
Psychomotor Abilities	2.66	0.67	2.89	0.33	2.64	0.69	2.53	0.89	-0.24	-0.36
Reading Skill	1.56	0.53	2.28	1.20	2.22	1.48	2.14	1.57	-0.06	-0.14
Sensory Abilities	1.95	0.35	2.66	0.70	2.78	1.04	2.56	1.14	0.12	-0.10
Skill Needed to Evaluate Alternatives	1.33	0.50	1.08	0.40	0.97	0.44	0.97	0.49	-0.11	-0.11
Skill Needed to Judge Quality	2.11	0.33	2.14	0.42	2.11	0.61	1.97	0.74	-0.03	-0.17
Skill Needed to Support Supplier Development	1.39	0.42	1.75	1.20	1.72	1.34	1.86	1.53	-0.03	0.11
Skill Needed to Understand Business Principles	0.11	0.33	0.11	0.33	0.11	0.33	0.11	0.33	0.00	0.00
Skill to Conduct Work Design	0.89	1.05	1.00	1.11	1.25	1.48	1.42	1.70	0.25	0.42
Skill to Design a System	1.44	0.73	1.31	0.46	1.31	0.68	1.31	0.75	0.00	0.00
Skill to Design Experiments	1.84	0.50	1.63	0.54	1.56	0.70	1.56	0.75	-0.07	-0.07
Skill to Fomulate Alternative Solutions	1.00	1.12	0.75	0.83	0.86	0.91	0.92	0.97	0.11	0.17
Skill to Identify Problems	1.67	0.50	1.78	0.44	1.83	0.50	1.83	0.50	0.06	0.06
Skill to Identify, Formulate, and Solve Problems	1.60	0.73	1.41	0.74	1.56	0.95	1.46	0.88	0.14	0.05
Skill to Plan a Program	1.67	1.12	1.53	1.15	1.58	1.12	1.58	1.12	0.06	0.06
Skill to Use the Tools Necessary for the Job	2.11	0.97	2.78	0.99	2.79	1.09	2.76	1.19	0.01	-0.02
Social Responsibility	1.44	0.53	1.31	0.53	1.28	0.65	1.28	0.74	-0.03	-0.03
Team Building Skills	1.89	0.60	1.81	0.63	1.72	0.75	1.69	0.70	-0.08	-0.11
Teamwork and Collaboration	2.44	0.81	3.03	0.94	2.83	1.11	2.61	1.29	-0.19	-0.42
Technical Skill	1.51	0.53	1.73	0.64	1.89	0.87	1.98	1.19	0.16	0.24
Writing Skill	1.44	0.53	1.44	0.53	1.33	0.66	1.28	0.74	-0.11	-0.17

CHEMICAL NAICS 325 TECHNICIAN

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.94	0.24	3.69	0.79	3.82	0.49	4.07	0.65	0.13	0.38
Attention to Detail	4.00	0.00	3.85	0.42	4.16	0.34	4.18	0.36	0.31	0.32
Cognitive Abilities	2.90	0.25	2.96	0.37	3.17	0.56	3.26	0.93	0.21	0.30
Commitment to Lifelong Learning	3.00	0.00	2.81	0.56	2.99	0.56	3.01	0.68	0.18	0.21
Communication Skill	3.00	0.00	3.09	0.66	3.60	0.85	3.79	1.05	0.51	0.71
Creativity and Innovation	2.56	0.17	2.37	0.57	2.87	1.11	2.99	1.16	0.50	0.62
Critical Thinking Skills	3.00	0.00	2.85	0.66	3.07	0.58	3.37	0.79	0.22	0.51
Decision Making Skill	2.94	0.24	2.97	0.62	3.38	0.71	3.51	0.79	0.41	0.54
Digital Literacy	2.00	0.00	2.13	0.59	3.03	0.97	3.28	1.06	0.90	1.15
Entrepeneurial Skill	2.00	0.00	1.85	0.60	1.96	0.59	2.00	0.62	0.10	0.15
Independence	2.94	0.24	3.01	0.34	3.35	0.57	3.38	0.60	0.34	0.37
Initiative	2.29	0.47	2.44	0.61	2.88	0.87	3.01	0.94	0.44	0.57
Interpersonal Skills	2.21	0.27	2.39	0.52	2.98	0.90	3.06	0.98	0.59	0.68
Knowledge of Emerging Trends and Technologies	0.47	0.50	1.25	0.97	1.81	1.37	2.00	1.52	0.56	0.75
Leadership Skills	2.12	0.33	2.16	0.51	2.47	0.80	2.51	0.83	0.31	0.35
New Relevant Knowledge	2.94	0.24	3.00	0.50	3.38	0.48	3.40	0.56	0.38	0.40
Numeracy	3.12	0.33	3.22	0.54	3.56	0.70	3.63	0.70	0.34	0.41
Physical Abilities	1.32	0.26	1.87	1.06	2.01	1.09	2.10	1.18	0.15	0.24
Problem Solving	3.00	0.00	2.84	0.85	3.53	0.83	3.74	0.83	0.69	0.90
Professional Composure	3.00	0.00	2.93	0.65	3.40	0.70	3.43	0.72	0.47	0.50
Project Management Skill	1.79	0.24	1.83	0.50	2.27	0.87	2.33	0.92	0.44	0.50
Psychomotor Abilities	2.56	0.28	3.03	0.93	3.23	0.88	3.38	0.97	0.21	0.35
Reading Skill	3.53	0.62	3.38	0.88	3.82	0.69	3.94	0.85	0.44	0.56
Sensory Abilities	1.76	0.12	2.08	0.79	2.52	1.02	2.66	1.25	0.44	0.58
Skill Needed to Evaluate Alternatives	2.94	0.24	2.90	0.69	3.19	0.47	3.34	0.69	0.29	0.44
Skill Needed to Judge Quality	1.82	1.01	2.34	1.03	3.09	1.09	3.22	1.12	0.75	0.88
Skill Needed to Support Supplier Development	2.03	0.45	2.32	0.86	2.59	0.80	2.72	0.90	0.26	0.40
Skill Needed to Understand Business Principles	0.18	0.39	0.74	0.91	1.46	1.46	1.66	1.68	0.72	0.93
Skill to Conduct Work Design	2.94	0.83	2.88	0.81	3.07	0.85	3.21	0.85	0.19	0.32
Skill to Design a System	2.94	0.24	2.81	0.57	2.84	0.55	2.87	0.57	0.03	0.06
Skill to Design Experiments	3.06	0.17	2.73	1.06	3.39	0.78	3.45	0.81	0.66	0.72
Skill to Fomulate Alternative Solutions	2.94	0.24	2.85	0.70	3.22	0.75	3.26	0.82	0.37	0.41
Skill to Identify Problems	2.94	0.24	2.88	0.78	3.50	0.83	3.60	0.87	0.62	0.72
Skill to Identify, Formulate, and Solve Problems	2.74	0.27	2.77	0.55	3.07	0.73	3.22	0.88	0.30	0.45
Skill to Plan a Program	2.41	0.51	2.50	0.75	3.21	1.00	3.22	1.02	0.71	0.72
Skill to Use the Tools Necessary for the Job	3.25	0.78	3.18	1.08	3.90	0.60	3.97	0.60	0.72	0.79
Social Responsibility	2.29	0.47	2.46	0.64	2.79	0.77	2.88	0.90	0.34	0.43
Team Building Skills	2.12	0.33	2.29	0.59	2.81	0.93	2.93	1.03	0.51	0.63
Teamwork and Collaboration	2.91	0.26	3.19	0.51	3.47	0.82	3.51	0.79	0.28	0.32
Technical Skill	2.36	0.64	2.98	0.84	3.64	0.72	3.89	0.87	0.66	0.91
Writing Skill	2.94	0.24	3.04	0.71	3.47	0.70	3.69	1.14	0.43	0.65

AEROSPACE NAICS 3364 ENGINEER

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.40	0.77	3.75	0.59	4.05	0.66	4.18	0.61	0.30	0.43
Attention to Detail	4.00	1.29	4.55	0.79	4.80	0.55	4.83	0.47	0.25	0.28
Cognitive Abilities	3.47	0.84	3.80	0.55	3.95	0.45	4.03	0.38	0.15	0.23
Commitment to Lifelong Learning	3.30	0.75	3.58	0.55	3.88	0.32	4.00	0.35	0.30	0.43
Communication Skill	3.47	0.84	3.53	0.84	3.95	0.79	3.96	0.79	0.43	0.43
Creativity and Innovation	3.40	0.81	3.70	0.79	4.03	0.86	4.10	0.91	0.33	0.40
Critical Thinking Skills	3.70	1.11	3.85	0.84	4.05	0.72	4.20	0.76	0.20	0.35
Decision Making Skill	4.00	1.29	4.10	1.02	4.40	0.67	4.58	0.62	0.30	0.48
Digital Literacy	3.40	0.77	4.05	0.64	4.43	0.51	4.43	0.47	0.38	0.38
Entrepeneurial Skill	2.80	0.54	2.40	0.99	2.50	1.11	2.58	1.26	0.10	0.18
Independence	3.50	0.91	3.83	0.66	4.03	0.59	4.13	0.57	0.20	0.30
Initiative	3.70	1.11	3.30	0.92	3.70	0.86	3.80	0.81	0.40	0.50
Interpersonal Skills	3.04	0.47	3.29	0.35	3.42	0.51	3.54	0.67	0.13	0.25
Knowledge of Emerging Trends and Technologies	2.30	0.54	2.88	0.50	3.25	0.59	3.55	0.72	0.38	0.68
Leadership Skills	3.40	0.77	3.33	0.67	3.58	0.71	3.60	1.02	0.25	0.28
New Relevant Knowledge	3.40	0.77	3.73	0.66	3.95	0.70	3.98	0.69	0.23	0.25
Numeracy	4.00	1.29	4.18	0.91	4.45	0.60	4.60	0.57	0.28	0.43
Physical Abilities	1.24	1.10	1.73	1.03	1.75	1.06	1.73	1.03	0.03	0.00
Problem Solving	3.90	1.24	4.00	0.93	4.30	0.86	4.38	0.86	0.30	0.38
Professional Composure	3.40	0.77	3.85	0.39	4.08	0.49	4.15	0.43	0.23	0.30
Project Management Skill	3.42	0.81	3.40	1.02	3.90	0.64	3.95	0.64	0.50	0.55
Psychomotor Abilities	1.87	0.57	2.22	0.65	2.30	0.78	2.30	0.78	0.08	0.08
Reading Skill	4.00	1.29	4.03	0.95	4.25	0.82	4.33	0.73	0.23	0.30
Sensory Abilities	2.19	0.27	2.58	0.73	2.73	0.78	2.86	0.93	0.15	0.28
Skill Needed to Evaluate Alternatives	3.90	1.24	3.98	0.83	4.20	0.80	4.30	0.74	0.23	0.33
Skill Needed to Judge Quality	3.40	0.77	3.73	0.46	3.98	0.38	4.15	0.49	0.25	0.43
Skill Needed to Support Supplier Development	3.25	0.68	3.00	1.26	3.35	1.21	3.58	1.35	0.35	0.58
Skill Needed to Understand Business Principles	2.20	0.26	2.68	0.83	2.93	0.91	3.18	1.13	0.25	0.50
Skill to Conduct Work Design	4.00	1.29	4.10	1.02	4.33	1.01	4.35	1.13	0.23	0.25
Skill to Design a System	3.90	1.24	3.95	0.89	4.13	0.78	4.30	0.80	0.18	0.35
Skill to Design Experiments	3.44	0.84	3.86	0.70	4.06	0.70	4.14	0.64	0.20	0.28
Skill to Fomulate Alternative Solutions	3.50	0.91	3.40	0.87	3.73	0.65	3.80	0.67	0.33	0.40
Skill to Identify Problems	3.50	0.91	3.73	0.84	4.10	0.39	4.30	0.42	0.38	0.58
Skill to Identify, Formulate, and Solve Problems	3.34	0.74	3.54	0.48	3.86	0.54	3.99	0.47	0.33	0.45
Skill to Plan a Program	3.20	0.71	3.23	0.89	3.80	0.28	4.05	0.51	0.58	0.83
Skill to Use the Tools Necessary for the Job	3.17	0.64	3.52	0.50	3.88	0.59	3.96	0.66	0.37	0.44
Social Responsibility	2.80	0.26	2.93	0.44	3.08	0.58	3.20	0.65	0.15	0.28
Team Building Skills	3.30	0.89	3.43	0.72	3.85	0.54	3.88	0.54	0.43	0.45
Teamwork and Collaboration	2.75	0.26	3.28	0.42	3.78	0.52	3.88	0.58	0.50	0.60
Technical Skill	3.35	0.76	3.88	0.50	3.95	0.47	4.05	0.45	0.08	0.18
Writing Skill	3.40	0.77	3.58	0.85	3.78	0.73	3.88	0.79	0.20	0.30

AEROSPACE NAICS 3364 PRODUCTION

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	2.76	0.50	2.91	0.89	3.15	0.74	2.96	0.83	0.24	0.04
Attention to Detail	3.41	0.91	3.84	1.01	4.03	0.97	4.12	1.04	0.19	0.28
Cognitive Abilities	2.17	0.39	2.24	0.95	2.40	1.06	2.47	1.22	0.16	0.23
Commitment to Lifelong Learning	2.24	0.50	2.63	1.22	2.74	1.35	2.85	1.49	0.10	0.22
Communication Skill	1.55	0.62	2.24	0.99	2.52	1.07	2.52	1.16	0.28	0.28
Creativity and Innovation	1.74	0.64	1.82	0.70	2.16	0.91	2.26	1.05	0.34	0.44
Critical Thinking Skills	2.00	0.43	2.40	1.02	2.63	1.04	2.54	1.18	0.24	0.15
Decision Making Skill	2.00	0.43	2.31	1.34	2.59	1.35	2.51	1.34	0.28	0.21
Digital Literacy	1.29	0.73	1.99	0.89	2.94	0.89	3.18	0.95	0.96	1.19
Entrepeneurial Skill	1.53	0.67	1.01	0.76	1.07	0.72	1.07	0.72	0.06	0.06
Independence	2.88	0.65	2.91	1.05	3.18	0.82	3.24	0.93	0.26	0.32
Initiative	2.00	0.43	2.04	0.90	2.38	1.08	2.53	1.06	0.34	0.49
Interpersonal Skills	1.60	0.55	2.07	0.87	2.19	1.00	2.19	1.08	0.12	0.12
Knowledge of Emerging Trends and Technologies	0.99	0.89	1.22	1.15	1.49	1.49	1.63	1.62	0.26	0.41
Leadership Skills	2.24	0.62	1.94	0.95	2.19	1.10	2.18	1.13	0.25	0.24
New Relevant Knowledge	2.18	0.92	2.22	1.30	2.54	1.40	2.69	1.38	0.32	0.47
Numeracy	2.00	0.43	2.53	0.84	2.87	0.91	2.84	1.03	0.34	0.31
Physical Abilities	2.90	0.65	3.22	0.62	3.22	0.82	3.15	0.94	0.00	-0.07
Problem Solving	2.00	0.43	2.38	0.61	2.54	0.71	2.57	0.98	0.16	0.19
Professional Composure	2.53	0.67	2.87	1.02	3.09	0.87	3.10	0.86	0.22	0.24
Project Management Skill	1.52	0.59	1.55	0.99	1.69	1.08	1.70	1.10	0.14	0.15
Psychomotor Abilities	2.88	0.32	3.63	0.76	3.81	0.76	3.79	0.80	0.19	0.17
Reading Skill	2.29	0.64	2.85	0.83	2.99	0.72	2.94	0.87	0.13	0.09
Sensory Abilities	2.40	0.36	2.97	0.71	2.99	0.73	2.90	0.89	0.02	-0.06
Skill Needed to Evaluate Alternatives	2.12	0.82	2.00	1.31	2.24	1.38	2.24	1.38	0.24	0.24
Skill Needed to Judge Quality	2.76	0.87	2.97	0.93	3.25	0.88	3.25	1.10	0.28	0.28
Skill Needed to Support Supplier Development	1.76	0.50	1.41	0.83	1.53	0.94	1.51	0.93	0.12	0.10
Skill Needed to Understand Business Principles	0.59	1.09	0.63	1.00	0.75	1.05	0.85	1.13	0.12	0.22
Skill to Conduct Work Design	1.94	0.61	1.85	0.91	1.88	0.96	1.93	1.05	0.03	0.07
Skill to Design a System	2.12	0.82	2.01	1.43	2.26	1.44	2.29	1.47	0.25	0.28
Skill to Design Experiments	2.30	0.64	1.86	0.98	1.91	1.04	2.04	1.16	0.04	0.18
Skill to Fomulate Alternative Solutions	1.76	0.71	1.75	1.34	1.82	1.38	1.85	1.42	0.07	0.10
Skill to Identify Problems	2.06	0.35	2.72	0.89	3.06	0.91	3.13	1.03	0.34	0.41
Skill to Identify, Formulate, and Solve Problems	2.08	0.56	2.51	0.95	2.55	0.91	2.58	1.13	0.04	0.07
Skill to Plan a Program	1.82	0.58	1.84	0.78	2.00	0.76	1.94	0.81	0.16	0.10
Skill to Use the Tools Necessary for the Job	2.77	0.44	3.02	0.82	3.23	0.77	3.25	0.91	0.21	0.23
Social Responsibility	1.35	0.66	1.76	0.85	1.94	1.00	1.97	0.97	0.18	0.21
Team Building Skills	1.88	0.55	2.03	0.72	2.19	0.80	2.24	1.02	0.16	0.21
Teamwork and Collaboration	2.74	0.56	2.82	0.70	3.07	0.76	3.10	0.81	0.25	0.28
Technical Skill	2.15	0.38	3.15	0.95	3.27	0.84	3.04	0.80	0.12	-0.11
Writing Skill	1.65	0.66	2.24	1.04	2.25	0.85	2.15	0.89	0.01	-0.09

AEROSPACE NAICS 3364 TRADES

	Base OaSIS	Base STDev	Current Average Proficiency	Current Proficiency STDev	2030 Average Proficiency	2030 Proficiency STDev	2040 Average Proficiency	2040 Proficiency STDev	Change Current to 2030	Change Current to 2040
Adaptability	3.53	0.55	3.20	0.75	3.54	0.84	3.50	0.96	0.34	0.30
Attention to Detail	3.98	0.41	4.05	0.73	4.31	0.48	4.30	0.54	0.26	0.25
Cognitive Abilities	2.87	0.37	2.80	0.35	2.85	0.60	2.86	0.83	0.05	0.06
Commitment to Lifelong Learning	2.98	0.11	3.25	0.64	3.51	0.69	3.63	0.78	0.26	0.38
Communication Skill	2.41	0.40	2.70	0.77	3.09	0.87	3.06	0.92	0.39	0.36
Creativity and Innovation	2.98	0.34	2.76	0.59	3.10	0.68	3.13	0.75	0.34	0.36
Critical Thinking Skills	2.58	0.49	2.51	0.67	2.81	0.79	2.74	0.92	0.30	0.23
Decision Making Skill	2.53	0.50	2.55	1.05	3.05	1.18	3.11	1.21	0.50	0.56
Digital Literacy	1.88	1.00	1.96	1.08	2.84	1.48	3.04	1.52	0.88	1.08
Entrepeneurial Skill	1.73	0.75	1.35	0.95	1.44	0.98	1.43	0.95	0.09	0.08
Independence	3.93	0.34	3.60	0.75	3.78	0.74	3.73	0.88	0.18	0.13
Initiative	2.33	0.73	2.33	0.69	2.74	0.94	2.75	1.02	0.41	0.43
Interpersonal Skills	2.10	0.51	2.35	0.77	2.69	0.93	2.67	0.91	0.34	0.31
Knowledge of Emerging Trends and Technologies	0.69	0.52	0.84	0.83	1.43	1.36	1.49	1.39	0.59	0.65
Leadership Skills	3.08	0.47	2.85	0.88	3.05	1.07	3.00	1.11	0.20	0.15
New Relevant Knowledge	2.58	0.49	2.73	0.87	3.08	1.02	3.14	1.03	0.35	0.41
Numeracy	2.93	0.24	3.01	0.43	3.21	0.61	3.21	0.80	0.20	0.20
Physical Abilities	2.83	0.47	3.05	0.57	3.09	0.67	3.08	0.67	0.04	0.03
Problem Solving	2.58	0.49	2.81	0.58	3.20	0.75	3.24	0.99	0.39	0.43
Professional Composure	3.63	0.78	3.61	0.77	3.75	0.72	3.71	0.75	0.14	0.10
Project Management Skill	2.13	0.85	1.77	0.96	1.93	0.99	1.97	1.09	0.16	0.20
Psychomotor Abilities	3.54	0.69	3.67	0.65	3.74	0.70	3.75	0.69	0.07	0.08
Reading Skill	2.98	0.11	2.98	0.64	3.18	0.70	3.13	0.74	0.20	0.15
Sensory Abilities	2.81	0.45	3.17	0.81	3.12	0.80	3.09	0.82	-0.05	-0.08
Skill Needed to Evaluate Alternatives	2.53	0.50	2.28	0.99	2.63	1.14	2.65	1.14	0.35	0.38
Skill Needed to Judge Quality	3.28	1.35	3.41	1.21	3.80	1.08	3.78	1.25	0.39	0.36
Skill Needed to Support Supplier Development	2.13	0.60	1.80	0.94	1.95	1.10	2.00	1.20	0.15	0.20
Skill Needed to Understand Business Principles	1.03	1.06	1.03	1.07	1.19	1.14	1.20	1.14	0.16	0.18
Skill to Conduct Work Design	2.88	0.46	2.55	0.90	2.75	1.03	2.76	1.08	0.20	0.21
Skill to Design a System	2.53	0.50	2.25	0.97	2.43	1.04	2.56	1.20	0.18	0.31
Skill to Design Experiments	2.78	0.36	2.35	1.04	2.46	1.07	2.46	1.08	0.11	0.11
Skill to Fomulate Alternative Solutions	2.58	0.49	2.29	1.42	2.45	1.46	2.46	1.46	0.16	0.18
Skill to Identify Problems	2.93	0.89	3.23	1.01	3.61	0.90	3.64	1.05	0.39	0.41
Skill to Identify, Formulate, and Solve Problems	2.49	0.54	2.65	0.72	3.01	0.76	2.96	0.89	0.36	0.31
Skill to Plan a Program	2.38	0.74	2.13	0.99	2.55	0.87	2.55	0.90	0.43	0.43
Skill to Use the Tools Necessary for the Job	3.83	0.71	4.00	0.67	4.06	0.84	4.01	1.00	0.05	0.01
Social Responsibility	2.08	0.52	2.24	0.51	2.56	0.81	2.65	0.91	0.33	0.41
Team Building Skills	1.78	0.73	2.14	0.83	2.40	1.10	2.39	1.23	0.26	0.25
Teamwork and Collaboration	3.20	0.34	3.19	0.45	3.35	0.38	3.35	0.43	0.16	0.16
Technical Skill	3.14	0.56	3.29	0.91	3.56	0.94	3.57	0.96	0.28	0.29
Writing Skill	2.13	0.46	2.33	0.59	2.63	0.81	2.73	0.92	0.30	0.40

PART D: AGGREGATE DATA ANALYSIS FOR KSAO FRAMEWORK

Descriptive Statistics - ALL DATA In terms of KSAO Framework

	N	Minimum	Maximum	Mean	Std. Deviation
Know_2024	502	.00	5.00	2.2717	1.07329
Know_2030	502	.00	5.00	2.5730	1.17696
Know_2040	502	.00	5.00	2.7124	1.24767
CogSk_2024	502	.77	4.86	3.0321	.96675
CogSk_2030	502	.79	5.00	3.3178	.95320
CogSk_2040	502	.65	5.00	3.4447	.96965
CogAb_2024	502	.50	5.00	2.9618	.93303
CogAb_2030	502	.50	5.00	3.1069	.95859
CogAb_2040	502	.50	5.00	3.1660	1.01102
Sense_2024	502	.00	5.00	2.5206	.82259
Sense_2030	502	.00	5.00	2.6334	.91052
Sense_2040	502	.00	5.00	2.6742	1.00490
Physic_2024	502	.00	5.00	2.2053	1.32005
Physic_2030	502	.00	5.00	2.1888	1.33161
Physic_2040	502	.00	5.00	2.1858	1.37678
Motor_2024	502	.00	5.00	2.7218	1.08612
Motor_2030	502	.00	5.00	2.7458	1.10668
Motor_2040	502	.00	5.00	2.7390	1.15787
SoftSk_2024	502	.96	4.68	3.0013	.79740
SoftSk_2030	502	1.04	4.79	3.1835	.83250
SoftSk_2040	502	.84	4.88	3.2507	.86134
WorkSk_2024	502	.47	4.91	2.7388	.99369
WorkSk_2030	502	.47	5.00	2.9549	1.02248
WorkSk_2040	502	.20	5.00	3.0456	1.05317
Valid N (listwise)	502				

Source: RAD SCIENCE SOLUTION

Descriptive Statistics - ALL DATA - ENGINEER

	N	Minimum	Maximum	Mean	Std. Deviation
Know_2024	102	.88	5.00	3.2512	.76703
Know_2030	102	1.13	5.00	3.5172	.79175
Know_2040	102	1.13	5.00	3.6446	.88681
CogSk_2024	102	1.38	4.86	4.0029	.73847
CogSk_2030	102	1.41	4.98	4.2289	.63383
CogSk_2040	102	1.41	5.00	4.2906	.62800
CogAb_2024	102	1.00	5.00	3.9950	.61892
CogAb_2030	102	1.50	5.00	4.0727	.59117
CogAb_2040	102	1.95	5.00	4.0832	.63174
Sense_2024	102	.00	5.00	2.3356	.90705
Sense_2030	102	.00	5.00	2.4614	1.04613
Sense_2040	102	.00	5.00	2.4385	1.14964
Physic_2024	102	.00	4.25	1.1651	1.17686
Physic_2030	102	.00	5.00	1.1725	1.19640
Physic_2040	102	.00	5.00	1.1235	1.20231
Motor_2024	102	.20	5.00	2.1784	1.16372
Motor_2030	102	.20	5.00	2.1510	1.09851
Motor_2040	102	.20	5.00	2.0495	1.12357
SoftSk_2024	102	1.79	4.65	3.6180	.45835
SoftSk_2030	102	2.08	4.79	3.7920	.45403
SoftSk_2040	102	2.28	4.85	3.8442	.46087
WorkSk_2024	102	1.02	4.91	3.6879	.67495
WorkSk_2030	102	1.27	5.00	3.8757	.65102
WorkSk_2040	102	1.52	5.00	3.9237	.68411
Valid N (listwise)	102				

Source: RAD SCIENCE SOLUTION

Descriptive Statistics - ALL DATA Manager

	N	Minimum	Maximum	Mean	Std. Deviation
Know_2024	88	1.38	4.38	2.6463	.71524
Know_2030	88	1.38	5.00	2.9517	.85127
Know_2040	88	1.38	5.00	3.0852	.93225
CogSk_2024	88	1.50	4.76	3.5154	.66795
CogSk_2030	88	1.48	5.00	3.7793	.67619
CogSk_2040	88	1.48	5.00	3.8927	.70590
CogAb_2024	88	1.00	5.00	3.2433	.69837
CogAb_2030	88	1.00	5.00	3.5127	.72526
CogAb_2040	88	1.00	5.00	3.6015	.78115
Sense_2024	88	1.00	5.00	2.3717	.80060
Sense_2030	88	.75	5.00	2.4861	.96353
Sense_2040	88	1.00	5.00	2.5156	1.04811
Physic_2024	88	.00	4.25	1.2930	1.20430
Physic_2030	88	.00	5.00	1.2632	1.20535
Physic_2040	88	.00	5.00	1.2973	1.31238
Motor_2024	88	.00	4.75	1.8432	1.08390
Motor_2030	88	.00	5.00	1.8892	1.14509
Motor_2040	88	.00	5.00	1.8920	1.16187
SoftSk_2024	88	1.33	4.68	3.7221	.61318
SoftSk_2030	88	1.33	4.75	3.8902	.62205
SoftSk_2040	88	1.31	4.88	3.9406	.66369
WorkSk_2024	88	1.61	4.48	3.4276	.63211
WorkSk_2030	88	1.64	4.91	3.6496	.64365
WorkSk_2040	88	1.66	4.91	3.7345	.65418
Valid N (listwise)	88				

Source: RAD SCIENCE SOLUTION

Descriptive Statistics - ALL DATA Production

	N	Minimum	Maximum	Mean	Std. Deviation
Know_2024	121	.00	3.88	1.3037	1.04443
Know_2030	121	.00	5.00	1.5950	1.21503
Know_2040	121	.00	5.00	1.8006	1.36679
CogSk_2024	121	.77	4.54	2.0820	.75739
CogSk_2030	121	.79	4.65	2.4227	.82501
CogSk_2040	121	.67	4.85	2.6397	.94413
CogAb_2024	121	.50	4.53	2.0939	.82906
CogAb_2030	121	.50	4.53	2.2545	.88064
CogAb_2040	121	.50	5.00	2.3695	1.01702
Sense_2024	121	.75	5.00	2.5856	.79077
Sense_2030	121	.75	5.00	2.6802	.81984
Sense_2040	121	.75	5.00	2.7904	.94679
Physic_2024	121	.31	5.00	3.1846	.86821
Physic_2030	121	.31	5.00	3.1338	.89923
Physic_2040	121	.31	5.00	3.1379	.98405
Motor_2024	121	.65	5.00	3.1612	.75654
Motor_2030	121	.65	5.00	3.2380	.82404
Motor_2040	121	.65	5.00	3.2748	.87615
SoftSk_2024	121	.96	4.08	2.2087	.67299
SoftSk_2030	121	1.04	4.40	2.4179	.75833
SoftSk_2040	121	.92	4.77	2.5506	.87241
WorkSk_2024	121	.47	4.05	1.7173	.78151
WorkSk_2030	121	.47	4.41	1.9769	.90445
WorkSk_2040	121	.20	4.73	2.1436	1.04990
Valid N (listwise)	121				

Source: RAD SCIENCE SOLUTION

Descriptive StatisticS - ALL DATA Trades

	N	Minimum	Maximum	Mean	Std. Deviation
Know_2024	96	.13	4.00	2.0339	.81181
Know_2030	96	.13	5.00	2.3242	1.03405
Know_2040	96	.13	5.00	2.4258	1.09403
CogSk_2024	96	1.21	4.54	2.7256	.62412
CogSk_2030	96	.92	4.98	2.9644	.70537
CogSk_2040	96	.65	5.00	3.0646	.78404
CogAb_2024	96	1.00	4.00	2.6550	.56651
CogAb_2030	96	1.25	5.00	2.7271	.66750
CogAb_2040	96	.50	5.00	2.7043	.74575
Sense_2024	96	1.00	5.00	2.8500	.71021
Sense_2030	96	.75	5.00	2.8708	.73789
Sense_2040	96	.50	5.00	2.8943	.76135
Physic_2024	96	.38	5.00	3.0800	.66644
Physic_2030	96	.38	5.00	3.0252	.72434
Physic_2040	96	.38	5.00	3.0252	.72161
Motor_2024	96	1.30	5.00	3.3729	.70881
Motor_2030	96	1.00	5.00	3.3359	.73473
Motor_2040	96	.75	5.00	3.3333	.76443
SoftSk_2024	96	1.63	4.17	2.7901	.50972
SoftSk_2030	96	1.09	4.79	2.8836	.62634
SoftSk_2040	96	.84	4.75	2.9065	.66577
WorkSk_2024	96	1.09	4.36	2.4525	.64440
WorkSk_2030	96	.64	5.00	2.5778	.72507
WorkSk_2040	96	.34	5.00	2.6416	.77073
Valid N (listwise)	96				

Source: RAD SCIENCE SOLUTION

Descriptive Statistics - ALL DATA Technician

	N	Minimum	Maximum	Mean	Std. Deviation
Know_2024	41	1.13	4.00	2.2591	.67972
Know_2030	41	1.50	5.00	2.6646	.82084
Know_2040	41	1.63	5.00	2.7713	.87808
CogSk_2024	41	1.45	4.42	3.0328	.54880
CogSk_2030	41	2.25	4.83	3.4447	.54710
CogSk_2040	41	2.27	4.92	3.6066	.62529
CogAb_2024	41	1.95	4.00	2.8780	.38128
CogAb_2030	41	2.00	5.00	3.0900	.60847
CogAb_2040	41	1.00	5.00	3.2146	.73724
Sense_2024	41	1.58	5.00	2.3317	.80137
Sense_2030	41	1.58	5.00	2.6024	.98669
Sense_2040	41	1.25	5.00	2.7000	1.14272
Physic_2024	41	.75	4.25	1.9120	.96783
Physic_2030	41	.50	5.00	2.0583	1.12246
Physic_2040	41	.75	5.00	2.0949	1.14882
Motor_2024	41	1.00	4.75	2.8012	.80828
Motor_2030	41	1.50	5.00	2.9390	.84362
Motor_2040	41	1.00	5.00	3.0427	.95010
SoftSk_2024	41	2.10	4.10	2.8085	.44260
SoftSk_2030	41	2.15	4.79	3.1184	.51426
SoftSk_2040	41	2.17	4.77	3.1946	.56499
WorkSk_2024	41	1.30	4.00	2.5432	.57673
WorkSk_2030	41	1.59	4.73	2.9110	.65217
WorkSk_2040	41	1.57	4.91	3.0190	.75438
Valid N (listwise)	41				

Source: RAD SCIENCE SOLUTION

Descriptive Statistics - ALL DATA Technologist

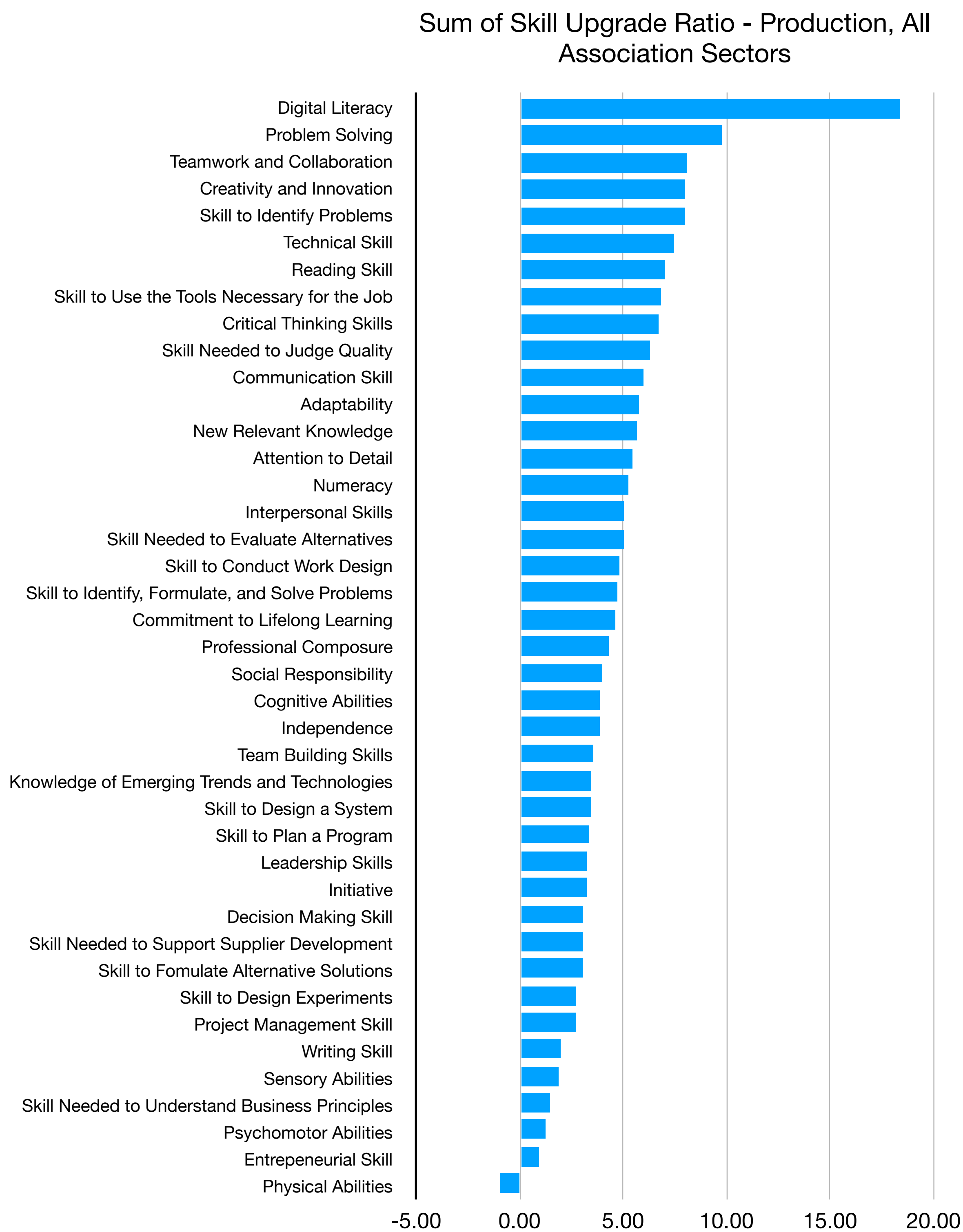
	N	Minimum	Maximum	Mean	Std. Deviation
Know_2024	33	1.00	4.38	2.4318	.76998
Know_2030	33	1.25	4.38	2.8068	.80713
Know_2040	33	1.25	5.00	2.9811	.96730
CogSk_2024	33	1.88	4.29	3.3135	.52546
CogSk_2030	33	2.13	4.63	3.6707	.45999
CogSk_2040	33	2.33	4.79	3.7703	.48342
CogAb_2024	33	1.00	4.50	3.3079	.56774
CogAb_2030	33	2.00	4.50	3.3988	.46164
CogAb_2040	33	2.75	5.00	3.4885	.48112
Sense_2024	33	1.92	3.75	2.3230	.59866
Sense_2030	33	1.25	4.00	2.5370	.74167
Sense_2040	33	1.00	4.75	2.5118	.80364
Physic_2024	33	.50	4.00	2.0385	.98316
Physic_2030	33	.50	4.00	1.9855	.94432
Physic_2040	33	.50	4.25	1.9400	1.03530
Motor_2024	33	2.00	4.75	3.0561	.81401
Motor_2030	33	1.50	4.75	3.0076	.87456
Motor_2040	33	.75	4.75	2.9545	1.00610
SoftSk_2024	33	2.29	4.10	2.9864	.45455
SoftSk_2030	33	2.30	4.17	3.2508	.49402
SoftSk_2040	33	2.30	4.40	3.2980	.53324
WorkSk_2024	33	1.59	4.18	2.8796	.61959
WorkSk_2030	33	1.07	4.36	3.1336	.65661
WorkSk_2040	33	.86	4.41	3.1747	.71552
Valid N (listwise)	33				

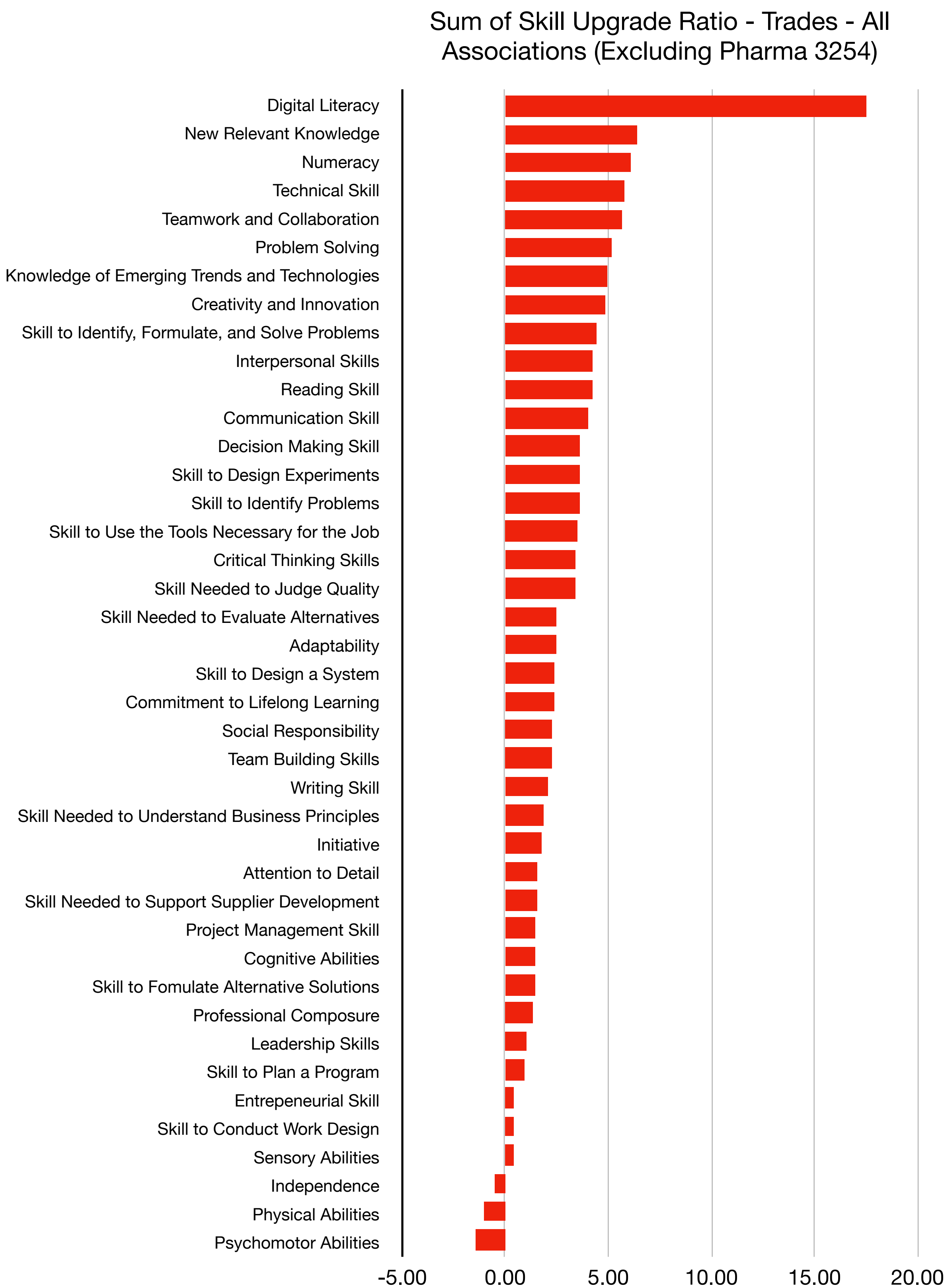
Source: RAD SCIENCE SOLUTION

Appendix 10

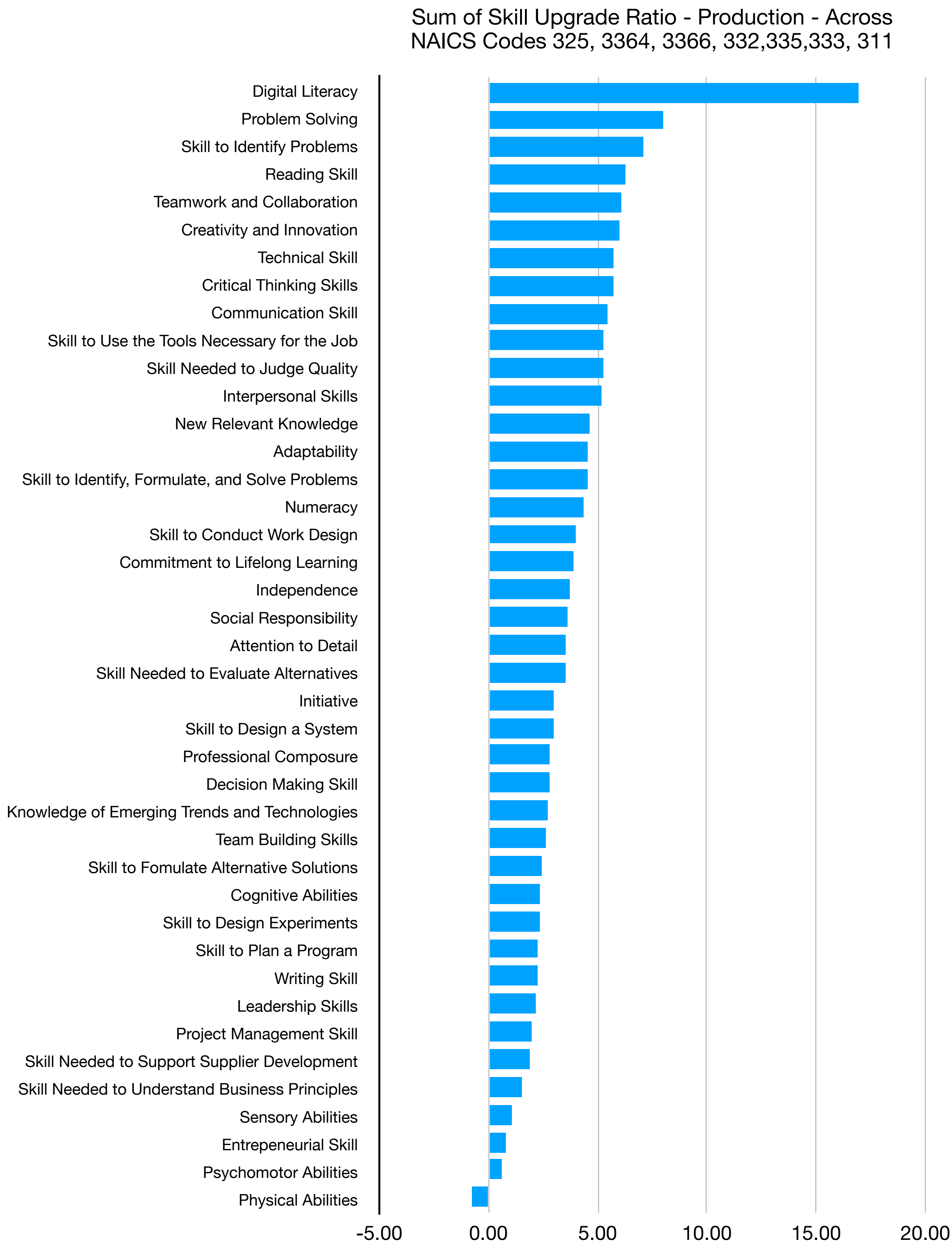
Skill Upgrade Ratio Plots

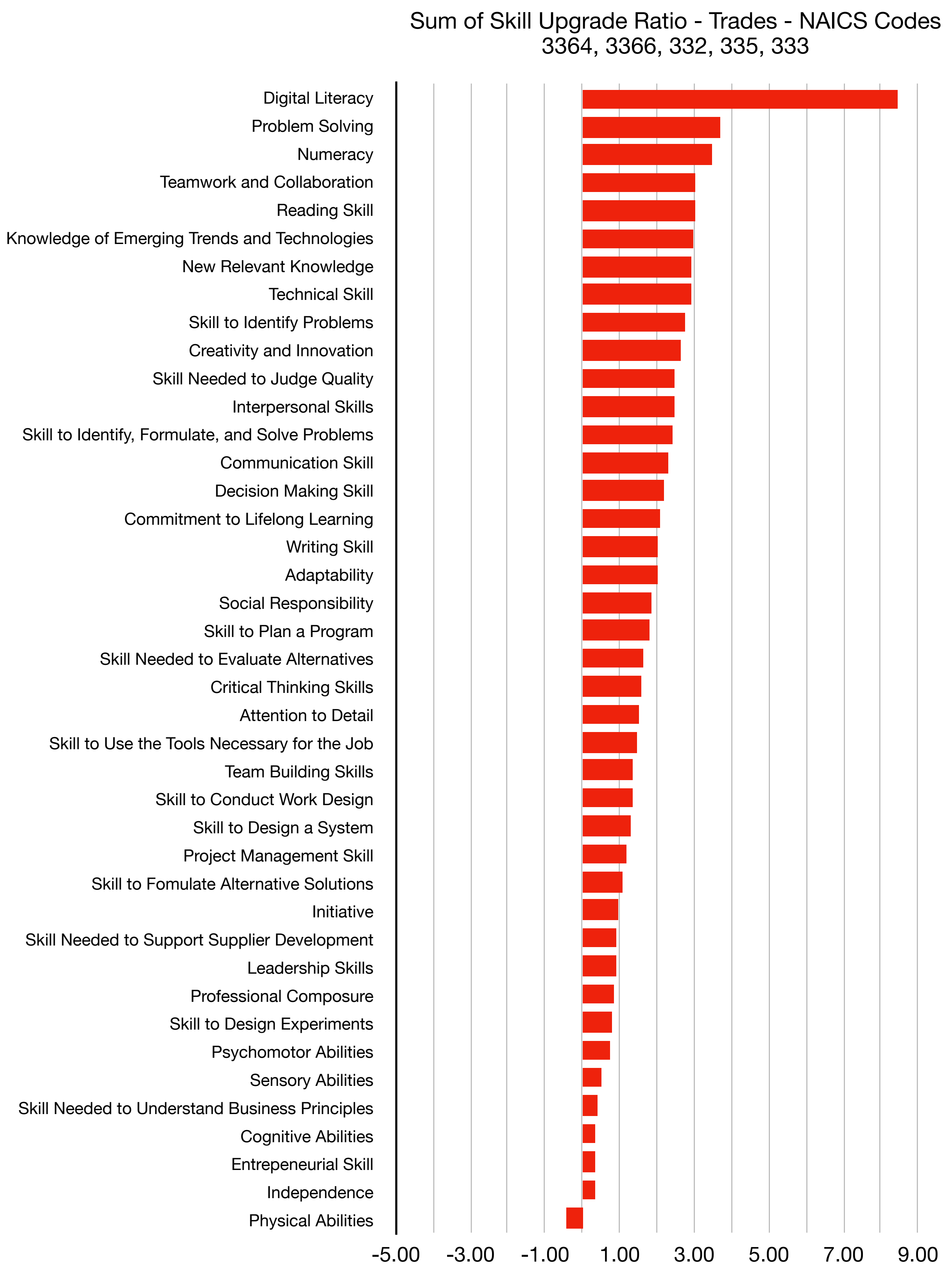
Part A: Occupation Type across Association Sector

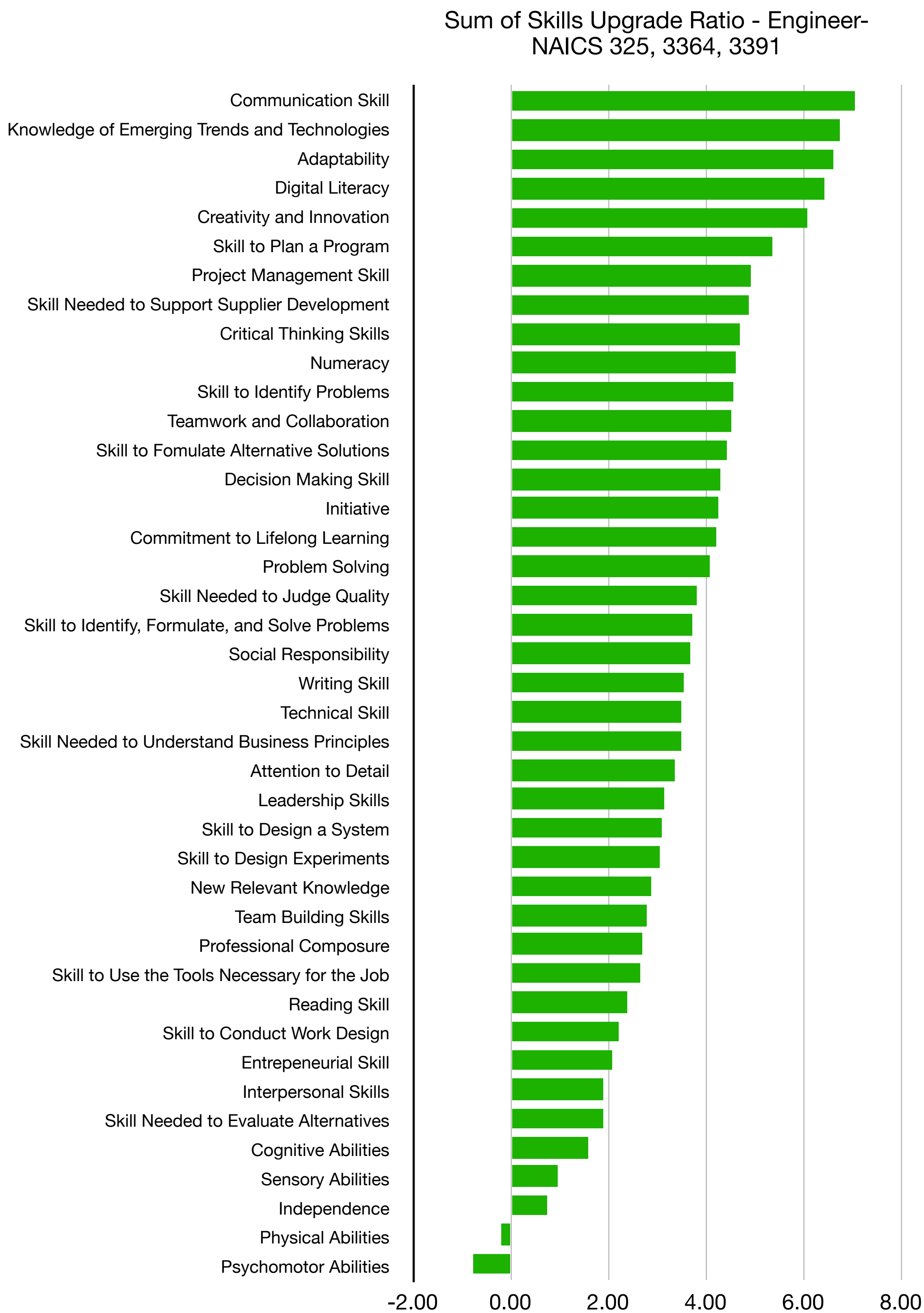

Sum of Skill Upgrade Ratio - Production, All Association Sectors
Digital Literacy
Problem Solving
Teamwork and Collaboration
Creativity and Innovation
Skill to Identify Problems
Technical Skill
Reading Skill
Skill to Use the Tools Necessary for the Job
Critical Thinking Skills
Skill Needed to Judge Quality
Communication Skill
Adaptability
New Relevant Knowledge
Attention to Detail
Numeracy
Interpersonal Skills
Skill Needed to Evaluate Alternatives
Skill to Conduct Work Design
Skill to Identify, Formulate, and Solve Problems
Commitment to Lifelong Learning
Professional Composure
Social Responsibility
Cognitive Abilities
Independence
Team Building Skills
Knowledge of Emerging Trends and Technologies
Skill to Design a System
Skill to Plan a Program
Leadership Skills
Initiative
Decision Making Skill
Skill Needed to Support Supplier Development
Skill to Fomulate Alternative Solutions
Skill to Design Experiments
Project Management Skill
Writing Skill
Sensory Abilities
Skill Needed to Understand Business Principles
Psychomotor Abilities
Entrepeneurial Skill
Physical Abilities
-5.00
0.00
5.00
10.00
15.00
20.00


Sum of Skill Upgrade Ratio - Trades - All Associations (Excluding Pharma 3254)
Digital Literacy
New Relevant Knowledge
Numeracy
Technical Skill
Teamwork and Collaboration
Problem Solving
Knowledge of Emerging Trends and Technologies
Creativity and Innovation
Skill to Identify, Formulate, and Solve Problems
Interpersonal Skills
Reading Skill
Communication Skill
Decision Making Skill
Skill to Design Experiments
Skill to Identify Problems
Skill to Use the Tools Necessary for the Job
Critical Thinking Skills
Skill Needed to Judge Quality
Skill Needed to Evaluate Alternatives
Adaptability
Skill to Design a System
Commitment to Lifelong Learning
Social Responsibility
Team Building Skills
Writing Skill
Skill Needed to Understand Business Principles
Initiative
Attention to Detail
Skill Needed to Support Supplier Development
Project Management Skill
Cognitive Abilities
Skill to Fomulate Alternative Solutions
Professional Composure
Leadership Skills
Skill to Plan a Program
Entrepeneurial Skill
Skill to Conduct Work Design
Sensory Abilities
Independence
Physical Abilities
Psychomotor Abilities
-5.00
0.00
5.00
10.00
15.00
20.00

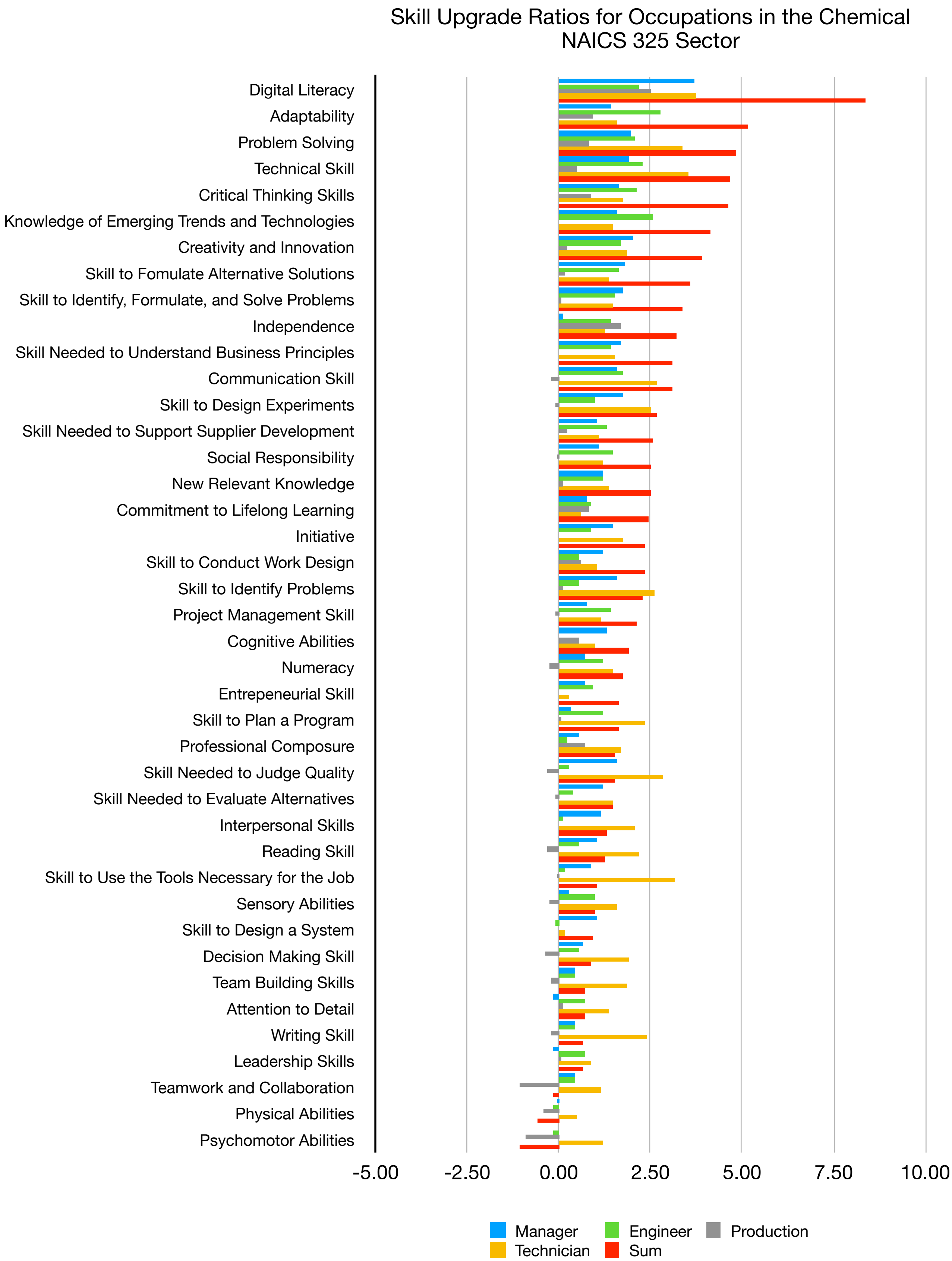
Part B: Occupation Types Across NAICS Code Sectors

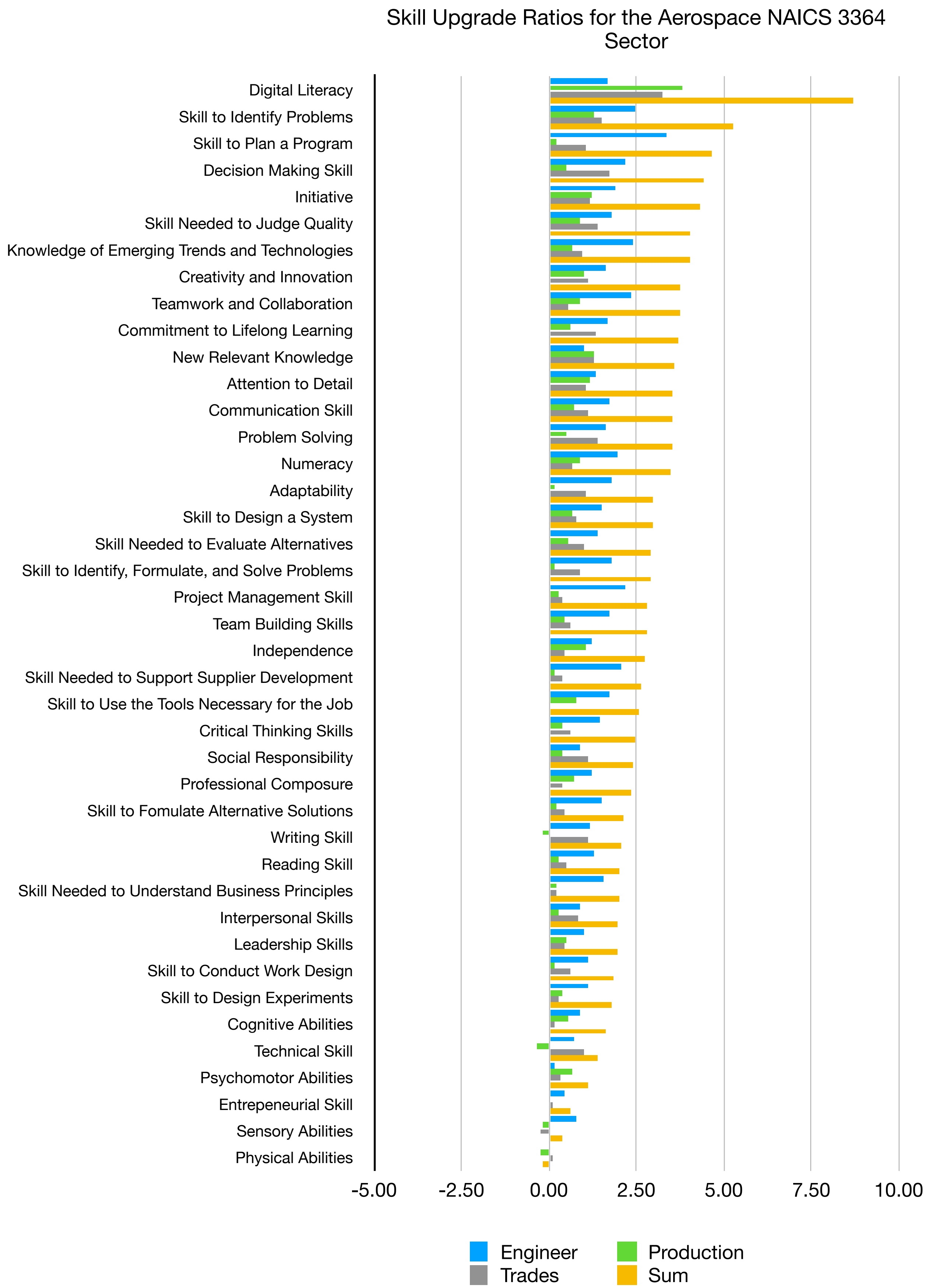

Sum of Skill Upgrade Ratio - Production - Across NAICS Codes 325, 3364, 3366, 332,335,333, 311
Digital Literacy
Problem Solving
Skill to Identify Problems
Reading Skill
Teamwork and Collaboration
Creativity and Innovation
Technical Skill
Critical Thinking Skills
Communication Skill
Skill to Use the Tools Necessary for the Job
Skill Needed to Judge Quality
Interpersonal Skills
New Relevant Knowledge
Adaptability
Skill to Identify, Formulate, and Solve Problems
Numeracy
Skill to Conduct Work Design
Commitment to Lifelong Learning
Independence
Social Responsibility
Attention to Detail
Skill Needed to Evaluate Alternatives
Initiative
Skill to Design a System
Professional Composure
Decision Making Skill
Knowledge of Emerging Trends and Technologies
Team Building Skills
Skill to Fomulate Alternative Solutions
Cognitive Abilities
Skill to Design Experiments
Skill to Plan a Program
Writing Skill
Leadership Skills
Project Management Skill
Skill Needed to Support Supplier Development
Skill Needed to Understand Business Principles
Sensory Abilities
Entrepeneurial Skill
Psychomotor Abilities
Physical Abilities
-5.00
0.00
5.00
10.00
15.00
20.00


Sum of Skill Upgrade Ratio - Trades - NAICS Codes 3364, 3366, 332, 335, 333
Digital Literacy
Problem Solving
Numeracy
Teamwork and Collaboration
Reading Skill
Knowledge of Emerging Trends and Technologies
New Relevant Knowledge
Technical Skill
Skill to Identify Problems
Creativity and Innovation
Skill Needed to Judge Quality
Interpersonal Skills
Skill to Identify, Formulate, and Solve Problems
Communication Skill
Decision Making Skill
Commitment to Lifelong Learning
Writing Skill
Adaptability
Social Responsibility
Skill to Plan a Program
Skill Needed to Evaluate Alternatives
Critical Thinking Skills
Attention to Detail
Skill to Use the Tools Necessary for the Job
Team Building Skills
Skill to Conduct Work Design
Skill to Design a System
Project Management Skill
Skill to Fomulate Alternative Solutions
Initiative
Skill Needed to Support Supplier Development
Leadership Skills
Professional Composure
Skill to Design Experiments
Psychomotor Abilities
Sensory Abilities
Skill Needed to Understand Business Principles
Cognitive Abilities
Entrepeneurial Skill
Independence
Physical Abilities
-5.00
-3.00
-1.00
1.00
3.00
5.00
7.00
9.00


Sum of Skills Upgrade Ratio - Engineer-
NAICS 325, 3364, 3391
Communication Skill
Knowledge of Emerging Trends and Technologies
Adaptability
Digital Literacy
Creativity and Innovation
Skill to Plan a Program
Project Management Skill
Skill Needed to Support Supplier Development
Critical Thinking Skills
Numeracy
Skill to Identify Problems
Teamwork and Collaboration
Skill to Fomulate Alternative Solutions
Decision Making Skill
Initiative
Commitment to Lifelong Learning
Problem Solving
Skill Needed to Judge Quality
Skill to Identify, Formulate, and Solve Problems
Social Responsibility
Writing Skill
Technical Skill
Skill Needed to Understand Business Principles
Attention to Detail
Leadership Skills
Skill to Design a System
Skill to Design Experiments
New Relevant Knowledge
Team Building Skills
Professional Composure
Skill to Use the Tools Necessary for the Job
Reading Skill
Skill to Conduct Work Design
Entrepeneurial Skill
Interpersonal Skills
Skill Needed to Evaluate Alternatives
Cognitive Abilities
Sensory Abilities
Independence
Physical Abilities
Psychomotor Abilities
-2.00
0.00
2.00
4.00
6.00
8.00

Part C: Occupation Types Within a Sector


Skill Upgrade Ratios for Occupations in the Chemical NAICS 325 Sector
Digital Literacy
Adaptability
Problem Solving
Technical Skill
Critical Thinking Skills
Knowledge of Emerging Trends and Technologies
Creativity and Innovation
Skill to Fomulate Alternative Solutions
Skill to Identify, Formulate, and Solve Problems
Independence
Skill Needed to Understand Business Principles
Communication Skill
Skill to Design Experiments
Skill Needed to Support Supplier Development
Social Responsibility
New Relevant Knowledge
Commitment to Lifelong Learning
Initiative
Skill to Conduct Work Design
Skill to Identify Problems
Project Management Skill
Cognitive Abilities
Numeracy
Entrepeneurial Skill
Skill to Plan a Program
Professional Composure
Skill Needed to Judge Quality
Skill Needed to Evaluate Alternatives
Interpersonal Skills
Reading Skill
Skill to Use the Tools Necessary for the Job
Sensory Abilities
Skill to Design a System
Decision Making Skill
Team Building Skills
Attention to Detail
Writing Skill
Leadership Skills
Teamwork and Collaboration
Physical Abilities
Psychomotor Abilities
-5.00
-2.50
0.00
2.50
5.00
7.50
10.00
Manager
Engineer
Production
Technician
Sum


Skill Upgrade Ratios for the Aerospace NAICS 3364 Sector
Digital Literacy
Skill to Identify Problems
Skill to Plan a Program
Decision Making Skill
Initiative
Skill Needed to Judge Quality
Knowledge of Emerging Trends and Technologies
Creativity and Innovation
Teamwork and Collaboration
Commitment to Lifelong Learning
New Relevant Knowledge
Attention to Detail
Communication Skill
Problem Solving
Numeracy
Adaptability
Skill to Design a System
Skill Needed to Evaluate Alternatives
Skill to Identify, Formulate, and Solve Problems
Project Management Skill
Team Building Skills
Independence
Skill Needed to Support Supplier Development
Skill to Use the Tools Necessary for the Job
Critical Thinking Skills
Social Responsibility
Professional Composure
Skill to Fomulate Alternative Solutions
Writing Skill
Reading Skill
Skill Needed to Understand Business Principles
Interpersonal Skills
Leadership Skills
Skill to Conduct Work Design
Skill to Design Experiments
Cognitive Abilities
Technical Skill
Psychomotor Abilities
Entrepeneurial Skill
Sensory Abilities
Physical Abilities
-5.00
-2.50
0.00
2.50
5.00
7.50
10.00
Engineer
Production
Trades
Sum

Appendix 11

OaSIS Searches for Occupations Having the Top 5 Production Upskilling Competencies

Government of Canada Gouvernement du Canada

OaSIS - Search results

Keyword Code Competency

Version

OaSIS 2023 Version 1.0

Search by keyword

Example: Designer Search

View all occupations A-Z

Advanced search

Search parameters:

▼ Competency search description:

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Digital Literacy:**
  The capability to understand and use digital devices and tools to obtain, exchange, create or process digital information in a secure manner.

Filter items:

▶ Broad occupational category

▶ Training, Education, Experience and Responsibilities

▶ Alphabetical listing

▶ Filter by descriptor rating:

Sort by:

Code - Ascending

Card view

Filter items Showing 1 to 188 of 188 entries (filtered from 900 total entries)**Show** All **entries**

OaSIS profile	Broad occupational category	Training, Education, Experience and Responsibilities	Measured dimensions
10012.00 – Purchasing managers	Business, finance and administration occupations	Management occupations	▼ Search parameters: Digital Literacy Proficiency or complexity level: 3
10019.00 – Other administrative services managers	Business, finance and administration occupations	Management occupations	▶ Search

			parameters:
10020.02 – Real estate service managers	Business, finance and administration occupations	Management occupations	▶ Search parameters:
10029.00 – Other business services managers	Business, finance and administration occupations	Management occupations	▶ Search parameters:
10030.00 – Telecommunication carriers managers	Business, finance and administration occupations	Management occupations	▶ Search parameters:
11200.00 – Human resources professionals	Business, finance and administration occupations	Occupations usually require a university degree	▶ Search parameters:
11201.00 – Professional occupations in business management consulting	Business, finance and administration occupations	Occupations usually require a university degree	▶ Search parameters:
11202.00 – Professional occupations in marketing, advertising and public relations	Business, finance and administration occupations	Occupations usually require a university degree	▶ Search parameters:
12010.00 – Supervisors, general office and administrative support workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12011.00 – Supervisors, finance and insurance office workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12012.00 – Supervisors, library, correspondence and related information workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12013.00 – Supervisors, supply chain, tracking and scheduling coordination occupations	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12100.00 – Executive assistants	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12101.00 – Human resources and recruitment officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12102.00 – Procurement and purchasing agents and officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12103.00 – Conference and event planners	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12104.01 – Excise tax revenue officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12104.02 – Government benefits services officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

12110.01 – Court reporters	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12110.02 – Medical transcriptionists	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12111.00 – Health information management occupations	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12112.00 – Records management technicians	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12200.00 – Accounting technicians and bookkeepers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12201.01 – Insurance adjusters	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12201.02 – Insurance claims examiners	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12202.00 – Insurance underwriters	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12203.01 – Assessors	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12203.02 – Business valuators	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12203.03 – Appraisers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
13201.01 – Production logistics coordinators	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of less than two years; or more than six months of on-the-job training	▶ Search parameters:
13201.02 – Transportation logistics coordinators	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of less than two years; or more than six months of on-the-job training	▶ Search parameters:
21111.00 – Forestry professionals	Natural and applied sciences and related occupations	Occupations usually require a university degree	▶ Search parameters:
21112.00 – Agricultural representatives, consultants and specialists	Natural and applied sciences and related occupations	Occupations usually require a university degree	▶ Search parameters:
21120.00 – Public and environmental health and safety professionals	Natural and applied sciences and related occupations	Occupations usually require a university degree	▶ Search parameters:

21223.02 – Data administrators	Natural and applied sciences and related occupations	Occupations usually require a university degree	▶ Search parameters:
22100.01 – Chemical technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22101.01 – Geological and mineral technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22110.01 – Biological technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22112.00 – Forestry technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22114.04 – Landscape designers and landscape architectural technicians and technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22210.00 – Architectural technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22212.01 – Drafting technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22213.01 – Land survey technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.01 – Cartographic technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.02 – Photogrammetric technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.03 – Aerial survey and remote sensing technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.04 – Geographic information system (GIS) technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.05 – Meteorological technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22220.02 – Web technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22221.00 – User support technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

22231.03 – Airworthiness inspectors	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.01 – Civil engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.02 – Civil engineering technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22301.01 – Mechanical engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22302.01 – Industrial engineering and manufacturing technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22310.01 – Electrical and electronics engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22311.00 – Electronic service technicians (household and business equipment)	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22312.00 – Industrial instrument technicians and mechanics	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.01 – Aircraft instrument mechanics and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.02 – Aircraft electrical mechanics and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.03 – Avionics mechanics and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.04 – Avionics inspectors	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
30010.00 – Managers in health care	Health occupations	Management occupations	▶ Search parameters:
31100.02 – Internists, general	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31100.03 – Pediatricians, general	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31100.05 – Allergists and immunologists	Health occupations	Occupations usually require a university degree	▶ Search parameters:

31100.06 – Hospitalists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31100.09 – Dermatologists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31100.10 – Physical medicine and rehabilitation physicians	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31100.11 – Preventive medicine physicians	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31100.13 – Other specialists in clinical medicine	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31100.14 – Specialists in laboratory medicine, including pathologists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31101.01 – General surgery	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31101.02 – Obstetricians and gynecologists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31101.03 – Ophthalmologists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31101.04 – Urologists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31101.05 – Other specialists in surgery	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31102.00 – General practitioners and family physicians	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31103.00 – Veterinarians	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31110.01 – Dentists, General	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31110.03 – Orthodontists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31110.04 – Prosthodontists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31111.00 – Optometrists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31112.01 – Audiologists	Health occupations	Occupations usually require a university degree	▶ Search

			parameters:
31112.02 – Speech language pathologists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31120.01 – Community pharmacists and hospital pharmacists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31120.02 – Industrial pharmacists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31202.00 – Physiotherapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31203.00 – Occupational therapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31204.01 – Recreational therapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31204.02 – Kinesiologists and exercise therapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31209.01 – Doctors of Podiatric Medicine	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31300.00 – Nursing coordinators and supervisors	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31301.01 – General duty registered nurses	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31301.02 – Occupational health nurses	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31301.05 – Nursing researchers and consultants	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31301.06 – Clinical nurses	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31302.00 – Nurse practitioners	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31303.03 – Genetic counsellors	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31303.04 – Orthoptists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
32100.00 – Opticians	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

32101.02 – Operating room technicians	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32102.00 – Paramedical occupations	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.01 – Respiratory therapists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.02 – Clinical perfusionists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.03 – Cardiopulmonary technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32112.00 – Dental technologists and technicians	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32120.00 – Medical laboratory technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32121.01 – Radiological technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32121.02 – Nuclear medicine technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32121.03 – Radiation therapists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32121.04 – Magnetic Resonance Technologist	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32122.00 – Medical sonographers	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32123.01 – Cardiology technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32129.02 – Ocularists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
40019.00 – Other managers in public administration	Occupations in education, law and social, community and government services	Management occupations	▶ Search parameters:
40020.01 – Faculty administrators	Occupations in education, law and social, community and government services	Management occupations	▶ Search parameters:

40020.02 – Registrars	Occupations in education, law and social, community and government services	Management occupations	▶ Search parameters:
40020.03 – Administrator of vocational training schools	Occupations in education, law and social, community and government services	Management occupations	▶ Search parameters:
40021.01 – School principals	Occupations in education, law and social, community and government services	Management occupations	▶ Search parameters:
40021.02 – Administrators of elementary and secondary education	Occupations in education, law and social, community and government services	Management occupations	▶ Search parameters:
40030.00 – Managers in social, community and correctional services	Occupations in education, law and social, community and government services	Management occupations	▶ Search parameters:
41101.00 – Lawyers and Quebec notaries	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41201.02 – Post-secondary research assistants	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41210.00 – College and other vocational instructors	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41310.01 – Police investigators	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41310.02 – Coroners and medical examiners	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41403.04 – Immigration and citizenship consultants	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41403.05 – International aid and development project officers	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41403.06 – Social survey researchers	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41403.07 – Social service planners	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41407.00 – Program officers unique to government	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.01 – Anthropologists	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:

41409.02 – Archaeologists	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.03 – Geographers	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.04 – Historians	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.05 – Linguists	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.06 – Political scientists	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.07 – Psychometricians	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.08 – Sociologists	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.09 – Other social science professionals	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
42102.00 – Specialized members of the Canadian Armed Forces	Occupations in education, law and social, community and government services	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
51100.00 – Librarians	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51101.01 – Conservators	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51101.02 – Curators	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51102.00 – Archivists	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51112.00 – Technical writers	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51120.01 – Film, radio, television and video game producers	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51120.02 – Directors	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51121.03 – Arrangers	Occupations in art, culture,	Occupations usually require a university degree	▶ Search

	recreation and sport		parameters:
52120.01 – Graphic designers	Occupations in art, culture, recreation and sport	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
52120.02 – Illustrators	Occupations in art, culture, recreation and sport	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
60010.00 – Corporate sales managers	Sales and service occupations	Management occupations	▶ Search parameters:
60020.00 – Retail and wholesale trade managers	Sales and service occupations	Management occupations	▶ Search parameters:
60030.00 – Restaurant and food service managers	Sales and service occupations	Management occupations	▶ Search parameters:
60031.00 – Accommodation service managers	Sales and service occupations	Management occupations	▶ Search parameters:
60040.00 – Managers in customer and personal services	Sales and service occupations	Management occupations	▶ Search parameters:
62023.01 – Customer service representatives supervisors - financial services	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
62100.00 – Technical sales specialists - wholesale trade	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
63102.00 – Financial sales representatives	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of less than two years; or more than six months of on-the-job training	▶ Search parameters:
64400.00 – Customer services representatives - financial institutions	Sales and service occupations	Occupations usually require a secondary school diploma; or several weeks of on-the-job training	▶ Search parameters:
70010.00 – Construction managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
70011.00 – Home building and renovation managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
70012.01 – Facility operation managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
70020.01 – Transportation managers, operations	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
70020.02 – Transportation managers, freight traffic	Trades, transport and equipment operators and	Management occupations	▶ Search parameters:

	related occupations		
70021.00 – Postal and courier services managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
72011.00 – Contractors and supervisors, electrical trades and telecommunications occupations	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72022.00 – Supervisors, printing and related occupations	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72200.00 – Electricians (except industrial and power system)	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72201.00 – Industrial electricians	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72202.00 – Power system electricians	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72404.01 – Aircraft mechanics	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72404.02 – Aircraft inspectors	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72410.01 – Automotive service technicians	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72601.03 – Flight service specialists	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72602.00 – Deck officers, water transport	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72603.00 – Engineer officers, water transport	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72604.01 – Railway traffic controllers	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72604.02 – Marine traffic regulators	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
90010.00 – Manufacturing managers	Occupations in manufacturing and utilities	Management occupations	▶ Search parameters:
90011.01 – Water supply managers	Occupations in manufacturing and utilities	Management occupations	▶ Search parameters:

OaSIS - Search results

Keyword | Code | Competency

Version

OaSIS 2023 Version 1.0

Search by keyword

Example: Designer Search

View all occupations A-Z

Advanced search

Search parameters:

▼ Competency search description:

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Problem Solving:**
  The capability to identify problems and review related information to develop solutions or feasible options to achieve the desired end state.

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Digital Literacy:**
  The capability to understand and use digital devices and tools to obtain, exchange, create or process digital information in a secure manner.

Filter items:

▶ Broad occupational category

▶ Training, Education, Experience and Responsibilities

▶ Alphabetical listing

▶ Filter by descriptor rating:

Sort by:

Code - Ascending

Card view

Filter items Showing 1 to 78 of 78 entries (filtered from 900 total entries)**Show** All **entries**

OaSIS profile	Broad occupational category	Training, Education, Experience and Responsibilities	Measured dimensions
11202.00 – Professional occupations in marketing, advertising and public relations	Business, finance and administration occupations	Occupations usually require a university degree	▼ Search parameters: Digital Literacy Proficiency or complexity

			level: 3 Problem Solving Proficiency or complexity level: 3
12010.00 – Supervisors, general office and administrative support workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12011.00 – Supervisors, finance and insurance office workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12012.00 – Supervisors, library, correspondence and related information workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12101.00 – Human resources and recruitment officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12102.00 – Procurement and purchasing agents and officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12103.00 – Conference and event planners	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12200.00 – Accounting technicians and bookkeepers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12201.01 – Insurance adjusters	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12202.00 – Insurance underwriters	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12203.02 – Business valuators	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22100.01 – Chemical technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22101.01 – Geological and mineral technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22110.01 – Biological technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22112.00 – Forestry technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or	▶ Search

		supervisory occupations	parameters:
22114.04 – Landscape designers and landscape architectural technicians and technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22210.00 – Architectural technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22212.01 – Drafting technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22213.01 – Land survey technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.01 – Cartographic technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.02 – Photogrammetric technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.03 – Aerial survey and remote sensing technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.04 – Geographic information system (GIS) technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22220.02 – Web technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22221.00 – User support technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22231.03 – Airworthiness inspectors	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.01 – Civil engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.02 – Civil engineering technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22301.01 – Mechanical engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22302.01 – Industrial engineering and manufacturing technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22310.01 – Electrical and electronics	Natural and applied sciences	Occupations usually require a college diploma or	▶ Search

engineering technologists	and related occupations	apprenticeship training of two or more years; or supervisory occupations	parameters:
22311.00 – Electronic service technicians (household and business equipment)	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22312.00 – Industrial instrument technicians and mechanics	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.01 – Aircraft instrument mechanics and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.02 – Aircraft electrical mechanics and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.03 – Avionics mechanics and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22313.04 – Avionics inspectors	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
31204.01 – Recreational therapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31204.02 – Kinesiologists and exercise therapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
32100.00 – Opticians	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.01 – Respiratory therapists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.02 – Clinical perfusionists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.03 – Cardiopulmonary technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32120.00 – Medical laboratory technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32121.04 – Magnetic Resonance Technologist	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32123.01 – Cardiology technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
41210.00 – College and other vocational instructors	Occupations in education, law and social, community and	Occupations usually require a university degree	▶ Search

	government services		parameters:
41310.02 – Coroners and medical examiners	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41403.04 – Immigration and citizenship consultants	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.04 – Historians	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
51100.00 – Librarians	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51102.00 – Archivists	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51120.02 – Directors	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51121.03 – Arrangers	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
52120.01 – Graphic designers	Occupations in art, culture, recreation and sport	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
52120.02 – Illustrators	Occupations in art, culture, recreation and sport	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
60020.00 – Retail and wholesale trade managers	Sales and service occupations	Management occupations	▶ Search parameters:
60030.00 – Restaurant and food service managers	Sales and service occupations	Management occupations	▶ Search parameters:
60031.00 – Accommodation service managers	Sales and service occupations	Management occupations	▶ Search parameters:
60040.00 – Managers in customer and personal services	Sales and service occupations	Management occupations	▶ Search parameters:
62023.01 – Customer service representatives supervisors - financial services	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
62100.00 – Technical sales specialists - wholesale trade	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
63102.00 – Financial sales representatives	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of less than two years; or more than six months of on-the-job training	▶ Search parameters:

70012.01 – Facility operation managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
70021.00 – Postal and courier services managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
72011.00 – Contractors and supervisors, electrical trades and telecommunications occupations	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72022.00 – Supervisors, printing and related occupations	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72200.00 – Electricians (except industrial and power system)	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72201.00 – Industrial electricians	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72202.00 – Power system electricians	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72404.01 – Aircraft mechanics	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72404.02 – Aircraft inspectors	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72601.03 – Flight service specialists	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72602.00 – Deck officers, water transport	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72603.00 – Engineer officers, water transport	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72604.01 – Railway traffic controllers	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
92100.01 – Power engineers	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
92100.02 – Power systems operators	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

Date modified: 2023-06-02

90011.02 – Electrical power distribution managers	Occupations in manufacturing and utilities	Management occupations	▶ Search parameters:
90011.03 – Natural gas and petroleum supply managers	Occupations in manufacturing and utilities	Management occupations	▶ Search parameters:
90011.04 – Water pollution control managers	Occupations in manufacturing and utilities	Management occupations	▶ Search parameters:
90011.05 – Waste systems managers	Occupations in manufacturing and utilities	Management occupations	▶ Search parameters:
92100.01 – Power engineers	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
92100.02 – Power systems operators	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

Date modified: 2023-06-02

Government of Canada Gouvernement du Canada

OaSIS - Search results

Keyword | Code | Competency

Version

OaSIS 2023 Version 1.0

Search by keyword

Example: Designer Search

View all occupations A-Z

Advanced search

Search parameters:

▼ Competency search description:

Category – Abilities:

Innate and developed aptitudes that facilitate the acquisition of knowledge and skills to carry out expected work.

- **Descriptor – Problem Identification:**
  The ability to identify an existing or potential problem. It is not about solving the problem, but only about recognizing its presence.

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Problem Solving:**
  The capability to identify problems and review related information to develop solutions or feasible options to achieve the desired end state.

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Digital Literacy:**
  The capability to understand and use digital devices and tools to obtain, exchange, create or process digital information in a secure manner.

Filter items:

▶ Broad occupational category

▶ Training, Education, Experience and Responsibilities

▶ Alphabetical listing

▶ Filter by descriptor rating:

Sort by:

Code - Ascending

Card view

Filter items Showing 1 to 55 of 55 entries (filtered from 900 total entries)**Show** All **entries**

OaSIS profile	Broad occupational category	Training, Education, Experience and Responsibilities	Measured dimensions
11202.00 – Professional occupations in marketing, advertising and public relations	Business, finance and administration occupations	Occupations usually require a university degree	▼ Search parameters:

			Problem Identification Proficiency or complexity level: 3 Digital Literacy Proficiency or complexity level: 3 Problem Solving Proficiency or complexity level: 3
12010.00 – Supervisors, general office and administrative support workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12011.00 – Supervisors, finance and insurance office workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12012.00 – Supervisors, library, correspondence and related information workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12101.00 – Human resources and recruitment officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12102.00 – Procurement and purchasing agents and officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12103.00 – Conference and event planners	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12200.00 – Accounting technicians and bookkeepers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12202.00 – Insurance underwriters	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22101.01 – Geological and mineral technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22112.00 – Forestry technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22114.04 – Landscape designers and	Natural and applied sciences	Occupations usually require a college diploma or	▶ Search

landscape architectural technicians and technologists	and related occupations	apprenticeship training of two or more years; or supervisory occupations	parameters:
22210.00 – Architectural technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22212.01 – Drafting technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.04 – Geographic information system (GIS) technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22220.02 – Web technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22221.00 – User support technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.01 – Civil engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.02 – Civil engineering technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22301.01 – Mechanical engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22302.01 – Industrial engineering and manufacturing technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22310.01 – Electrical and electronics engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22311.00 – Electronic service technicians (household and business equipment)	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22312.00 – Industrial instrument technicians and mechanics	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
31204.01 – Recreational therapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
31204.02 – Kinesiologists and exercise therapists	Health occupations	Occupations usually require a university degree	▶ Search parameters:
32100.00 – Opticians	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.01 – Respiratory therapists	Health occupations	Occupations usually require a college diploma or	▶ Search

		apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.02 – Clinical perfusionists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.03 – Cardiopulmonary technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32120.00 – Medical laboratory technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32123.01 – Cardiology technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
41210.00 – College and other vocational instructors	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41403.04 – Immigration and citizenship consultants	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
41409.04 – Historians	Occupations in education, law and social, community and government services	Occupations usually require a university degree	▶ Search parameters:
51100.00 – Librarians	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
51120.02 – Directors	Occupations in art, culture, recreation and sport	Occupations usually require a university degree	▶ Search parameters:
60020.00 – Retail and wholesale trade managers	Sales and service occupations	Management occupations	▶ Search parameters:
60030.00 – Restaurant and food service managers	Sales and service occupations	Management occupations	▶ Search parameters:
60031.00 – Accommodation service managers	Sales and service occupations	Management occupations	▶ Search parameters:
60040.00 – Managers in customer and personal services	Sales and service occupations	Management occupations	▶ Search parameters:
62023.01 – Customer service representatives supervisors - financial services	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
62100.00 – Technical sales specialists - wholesale trade	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
63102.00 – Financial sales representatives	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of less than two years; or more	▶ Search parameters:

		than six months of on-the-job training	
70012.01 – Facility operation managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
70021.00 – Postal and courier services managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
72011.00 – Contractors and supervisors, electrical trades and telecommunications occupations	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72022.00 – Supervisors, printing and related occupations	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72200.00 – Electricians (except industrial and power system)	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72201.00 – Industrial electricians	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72601.03 – Flight service specialists	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72602.00 – Deck officers, water transport	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72603.00 – Engineer officers, water transport	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
92100.01 – Power engineers	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
92100.02 – Power systems operators	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

Date modified: 2023-06-02

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OaSIS - Search results

Keyword Code Competency

Version

OaSIS 2023 Version 1.0

Search by keyword

Example: Designer Search

View all occupations A-Z

Advanced search

Search parameters:

▼ Competency search description:

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Reading Comprehension:**
  The capability to understand written information presented through words, sentences, paragraphs, symbols, and images in work-related documents.

Category – Abilities:

Innate and developed aptitudes that facilitate the acquisition of knowledge and skills to carry out expected work.

- **Descriptor – Problem Identification:**
  The ability to identify an existing or potential problem. It is not about solving the problem, but only about recognizing its presence.

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Problem Solving:**
  The capability to identify problems and review related information to develop solutions or feasible options to achieve the desired end state.

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Digital Literacy:**
  The capability to understand and use digital devices and tools to obtain, exchange, create or process digital information in a secure manner.

Filter items:

▶ Broad occupational category

▶ Training, Education, Experience and Responsibilities

▶ Alphabetical listing

▶ Filter by descriptor rating:

Sort by:

Code - Ascending

Card view

Filter items Showing 1 to 48 of 48 entries (filtered from 900 total entries)**Show** All **entries**

OaSIS profile	Broad occupational category	Training, Education, Experience and Responsibilities	Measured dimensions
12010.00 – Supervisors, general office and administrative support workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▼ Search parameters: Problem Identification Proficiency or complexity level: 3; Reading Comprehension Proficiency or complexity level: 3; Digital Literacy Proficiency or complexity level: 3; Problem Solving Proficiency or complexity level: 3
12011.00 – Supervisors, finance and insurance office workers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12101.00 – Human resources and recruitment officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12102.00 – Procurement and purchasing agents and officers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12103.00 – Conference and event planners	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12200.00 – Accounting technicians and bookkeepers	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
12202.00 – Insurance underwriters	Business, finance and administration occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22101.01 – Geological and mineral technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

22112.00 – Forestry technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22210.00 – Architectural technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22212.01 – Drafting technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22214.04 – Geographic information system (GIS) technologists and technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22220.02 – Web technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22221.00 – User support technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.01 – Civil engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22300.02 – Civil engineering technicians	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22301.01 – Mechanical engineering technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
22302.01 – Industrial engineering and manufacturing technologists	Natural and applied sciences and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
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32100.00 – Opticians	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.01 – Respiratory therapists	Health occupations	Occupations usually require a college diploma or	

		apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.02 – Clinical perfusionists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32103.03 – Cardiopulmonary technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32120.00 – Medical laboratory technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
32123.01 – Cardiology technologists	Health occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
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60030.00 – Restaurant and food service managers	Sales and service occupations	Management occupations	▶ Search parameters:
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60040.00 – Managers in customer and personal services	Sales and service occupations	Management occupations	▶ Search parameters:
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62100.00 – Technical sales specialists - wholesale trade	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
63102.00 – Financial sales representatives	Sales and service occupations	Occupations usually require a college diploma or apprenticeship training of less than two years; or more than six months of on-the-job training	▶ Search parameters:
70012.01 – Facility operation managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
70021.00 – Postal and courier services managers	Trades, transport and equipment operators and related occupations	Management occupations	▶ Search parameters:
72011.00 – Contractors and supervisors, electrical trades and	Trades, transport and equipment operators and	Occupations usually require a college diploma or apprenticeship training of two or more years; or	▶ Search

telecommunications occupations	related occupations	supervisory occupations	parameters:
72022.00 – Supervisors, printing and related occupations	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
72200.00 – Electricians (except industrial and power system)	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
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72602.00 – Deck officers, water transport	Trades, transport and equipment operators and related occupations	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
92100.01 – Power engineers	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:
92100.02 – Power systems operators	Occupations in manufacturing and utilities	Occupations usually require a college diploma or apprenticeship training of two or more years; or supervisory occupations	▶ Search parameters:

Date modified: 2023-06-02

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Canada.ca > National Occupational Classification > Welcome to the OaSIS > OaSIS - Advanced search > OaSIS - Search results

OaSIS - Search results

Keyword | Code | Competency

Version

OaSIS 2023 Version 1.0

Search by keyword

Example: Designer

Search

View all occupations A-Z

Advanced search

Search parameters:

▼ Competency search description:

Category – Personal Attributes:

Personal characteristics that are innate and developed through the social context and personal experiences to which the individual is exposed. These qualities influence the way one is and does things and are considered valuable assets for work performance.

- **Descriptor – Collaboration:**
  The quality of contributing and working cooperatively while being supportive and inclusive of others to achieve a common goal.

Category – Personal Attributes:

Personal characteristics that are innate and developed through the social context and personal experiences to which the individual is exposed. These qualities influence the way one is and does things and are considered valuable assets for work performance.

- **Descriptor – Concern for Others:**
  The quality of having empathy towards others' feelings and needs and being understanding and helpful.

Category – Skills:

Developed capabilities that an individual must have to be effective in a job, role, function, task or duty.

- **Descriptor – Reading Comprehension:**
  The capability to understand written information presented through words, sentences, paragraphs, symbols, and images in work-related documents.

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  The ability to identify an existing or potential problem. It is not about solving the problem, but only about recognizing its presence.

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  The capability to identify problems and review related information to develop solutions or feasible options to achieve the desired end state.

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- **Descriptor – Digital Literacy:**
  The capability to understand and use digital devices and tools to obtain, exchange, create or process digital information in a secure manner.

Filter items:

▶ Broad occupational category

▶ Training, Education, Experience and Responsibilities

▶ Alphabetical listing

▶ Filter by descriptor rating:

Sort by:

Code - Ascending

Grid view

Filter items Showing 0 to 0 of 0 entries (filtered from 900 total entries)**Show** All **entries**

Showing 0 to 0 of 0 entries

Date modified: 2023-06-02

Appendix 12

Association Recommendations

Appendix 12: Association Recommendations

Recruitment Recommendations

Associations					
APMA	**BioTalent Canada**	**CMISA**	**DAIR**	**FPSC**	**SIMSA**
Importance of strategic recruitment efforts and collaboration with educational institutions.	Recruit skilled immigrants	Increase level of diversity, equity and inclusion: Focus on women, new Canadians, Indigenous Peoples	Establish academic-industry collaborations so industry partner has 'first shot' at graduates	Access to a highly skilled workforce will be key for all food and beverage manufacturers	Require a highly trained, agile, and flexible workforce
Companies that invest in robust training programs will be better positioned to attract skilled talent and enhance their competitiveness	Hire promising candidates with most of the qualifications they need and provide their own training to produce the exact, highly tailored skill sets for specific positions		Reduce application, duplication, and administrative requirements for the Temporary Foreign Worker Program and Labour Market Impact Assessments; fast-track applications	Prediction: If all food and beverage manufacturers were fully integrated in Industry 4.0, there would be a 20% reduction in the amount of workforce needed to operate	Utilize opportunities in sectoral shifts – e.g. change in automotive to EV will streamline processes – encourage workforce migration to areas with more affordable costs
	Look beyond traditional pools		Offer more incentives - Rapid advancement, job enrichment, varied work and training, and more social engagement within company ranks	Need to recruit a more skilled workforce – even though have lack of applicants with proper experience or proper training – larger issue for rural	Promote diversity and inclusion – increase underrepresented groups such as Indigenous peoples and women
			Structural labour shortages can only be relieved by either discouraging retirement of skilled and experienced workers or replacing them	Closer proximity to training institutions gives better exposure to recruiting recent graduates that have latest technical training	Adopt a skill-based approach
			Attract and retain a diverse population, including skilled immigrants, women and Canada's Indigenous Peoples	Need for a large workforce, regardless of the level of tech integration in any facility	Promote diversity and inclusion for growth
			Actively target competitor and unrelated industries	Explore every option to find people	Encouraging more young Canadians to join the sector
			Target skilled talent from other jurisdictions and countries – strong with STEM		
			Dramatically expand pool of candidates; 80% of the workforce requirements from new jurisdictions;		
			Move operations from urban core where competition is high to suburban or rural settings where they can dominate the job market		

Training and Certification Recommendations

Associations					
APMA	**BioTalent Canada**	**CMISA**	**DAIR**	**FPSC**	**SIMSA**
Future skills required for employees in this evolving landscape will necessitate additional training, particularly in the realm of technological proficiency for operating advanced machinery	Knowledge of emerging trends and technologies, digital literacy and skills needed to understand business principles.	Establish train-the-trainer programs in post-secondary institutions using former, retired and/or physically disabled employees, shipyards, Canadian Forces, CCG, RCN, Transport Canada, trade unions	Engage retired senior employees to act as consultants, specialists, advisors, trainers and mentors due to the lack of mastery-level skills among the existing candidate pool	Build learning and recognition framework to help all industry stakeholders understand the skills, competencies, and career progression opportunities within the sector	Tailor training and development programs to meet anticipated needs – urgent because of retirement challenge
Training programs focusing on software integration, robotics, and control systems will be essential	Work-integrated learning (WIL) programs like BioTalent Canada's Student Work Placement Program (SWPP) are an essential piece	Ensure programs like welding offer access to variations for different ship-oriented materials	Create coordinated targeting for skillsets that will support aerospace	Train new hires to have the required skill set for each operation determines each business competitiveness	Embrace innovative solutions to skill development
Ongoing training programs and upskilling initiatives will be crucial to enable continuous adaptation	Soft skills - problem-solving, collaboration, business development skills	Explore private / public sector partnerships for training infrastructure	Increase support to research and innovation focused on training efficacy	Communicate with stakeholders, especially training providers to ensure skills for today and future are being taught	Adopt a skills-based approach to workforce development
Invest in tailored training initiatives, collaborating with educational partners and promoting ongoing professional development.	Sector emphasizing the need for tailored training and professional development initiatives to ensure workforce readiness and innovation for engineers	Revisit training requirements and accreditation models: Focus on outcomes and competencies specific to marine and shipbuilding	Re-assess existing training and assessment regimes to support mobility and advancement, especially for skilled immigrants and foreign workers		Alter traditional perceptions of manufacturing and mining sectors
Invest in technological training to meet the evolving demands of ZEV production.	Look beyond the classroom to develop the skills employers seek when recruiting.		Remove barriers to more dynamically presented and modern deliveries based on competencies, not seat time		
	Need for tailored training and professional development opportunities		Offer micro-credentials, shorter training to re-skill, upskill and cross-skill		
			Support centralized training hubs devoted to hands-on-training common to industry requirements		
			Collaboration between industry, academic and training organizations		
			Re-design traditional credential and certification preparation		

National Strategy Recommendations

Associations					
APMA	**BioTalent Canada**	**CMISA**	**DAIR**	**FPSC**	**SIMSA**
Necessity of a sector-wide approach to effectively address workforce challenges		Develop a coordinated, national strategy for relevant post-secondary training	Fragility in the sector – calls for national strategy for aerospace similar in scope to Canada's Oceans Strategy	Sector wide approach to addressing challenges and highlighting opportunities is the best strategy to changing perceptions of the industry	
		Validate curricula through provincial and national tables	Failing the OEMs (and Tier-1 suppliers), could signal a devastating impact for the industry	More collaborative efforts to talk about the skills needed, training, and career opportunities	
			Find ways to recognize prior learning and achieved competencies with portfolio or national qualification records	Work with academic institutions, training institutions, and non-profits like FPSC	
			Recognize that manufacturing workforce is a key national asset	Work with people currently outside the workforce to train and recruit	
			Implement focused, sustained national strategy to develop and enhance the skills of this workforce.		
			Enable increased flexibility for working from home		
			Critical focus - the basics of safe workspaces and work practices, increasing vigilance for fatigue, cyclical downtime, and provision of at-work personal services (e.g. daycare, cafeterias, etc.)		
			Re-assess bureaucracy and regulations to enable faster availability to work		
			Re-visit and update National Occupational Classification (NOC) codes		

Marketing Recommendations

Associations					
APMA	**BioTalent Canada**	**CMISA**	**DAIR**	**FPSC**	**SIMSA**
Employ stronger marketing and communications to raise awareness about the state-of-the-art facilities, advanced technologies, clean environments, and career paths to increase talent attraction.	Raise awareness of bio-manufacturing careers within the bio-economy, among these groups	Promote and facilitate second career opportunities	Promote opportunities to engage in well-paid and stable roles across a variety of job classifications	Highlight the skills needed in the future and indicate, to job seekers, how roles in the sector currently operate and how they will change as more technology gets integrated.	Better understanding of the roles in advanced manufacturing
	Promote greater mobility			Increasing awareness of the sector will help improve perceptions of working in this sector	
				Highlight the connections between information and communications technology and the manufacturing sector	
				Communicate with stakeholders, especially training providers	
				Speak about the opportunities within the sector to have a meaningful career	