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:
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In partnership with:
InnovaIT Professional Services

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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.

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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.

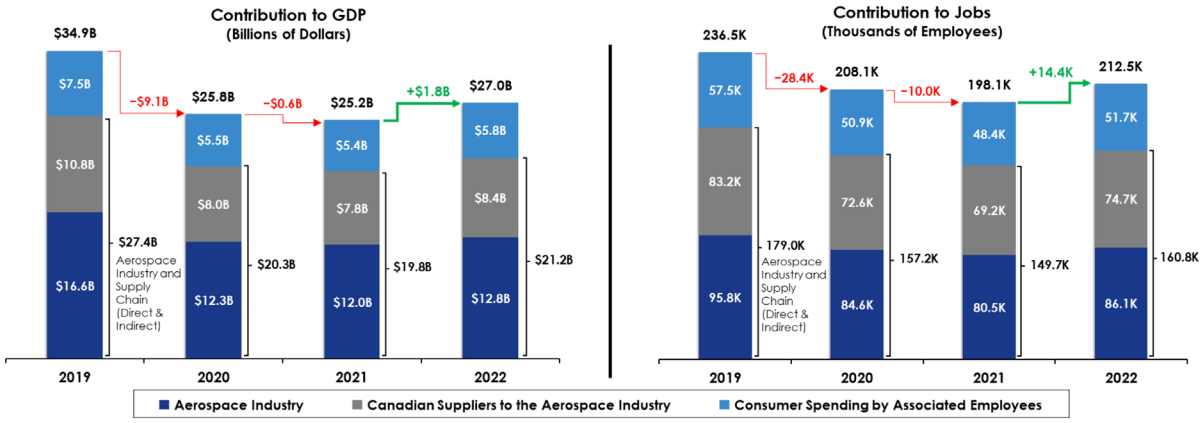


Figure 1 Aerospace Industry Contribution to the Canadian Economy (2019-2022), Source AIAC and ISED Canada 2023

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]

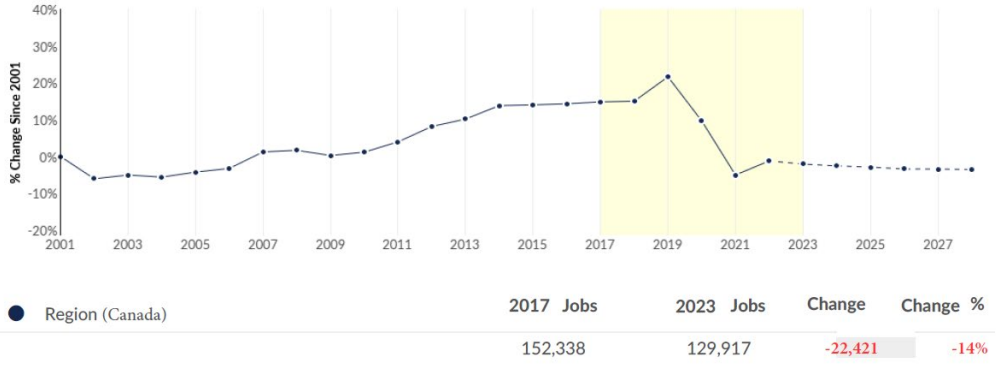


Figure 3 Aerospace Jobs 2001-2027+, highlight change 2017-2023, Source Lightcast

[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.

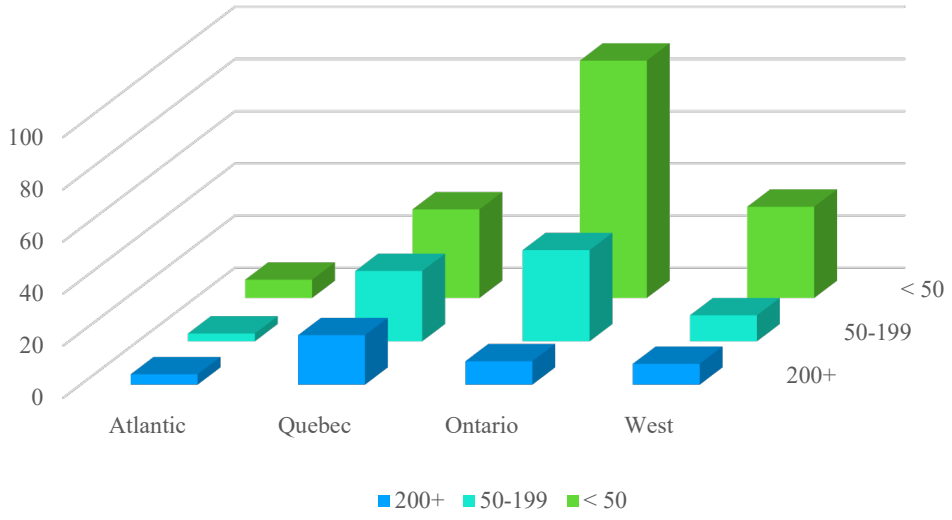


Figure 5 NAICS 3364 Establishments by Employment Size, Source Statistics Canada Table 22-10-0717-01, 2023, and provided by the Trillium Network for Advanced Manufacturing

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.

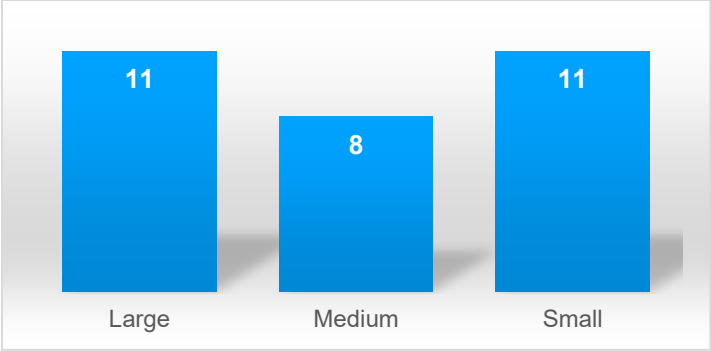


Figure 6 Final Sample, Company Size

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.

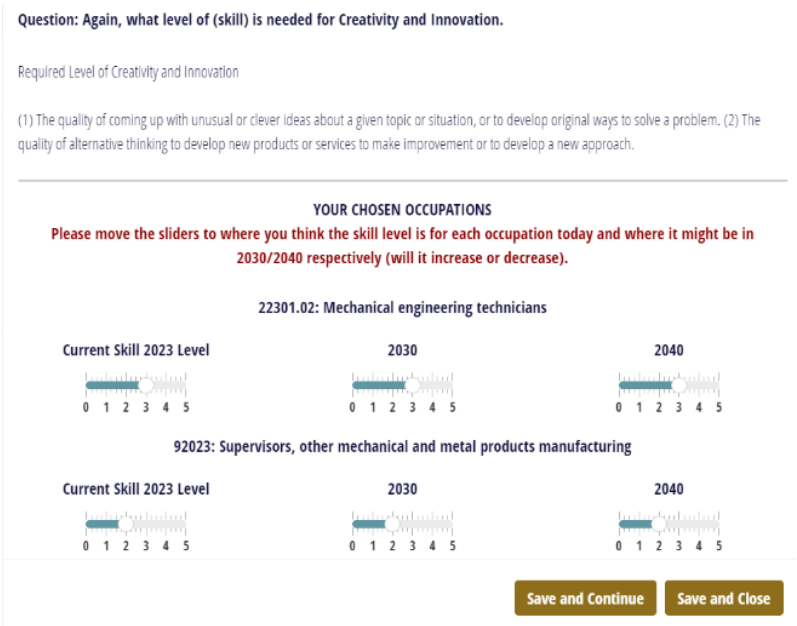


Figure 7 Vametric Survey Tool, Sample Question

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.

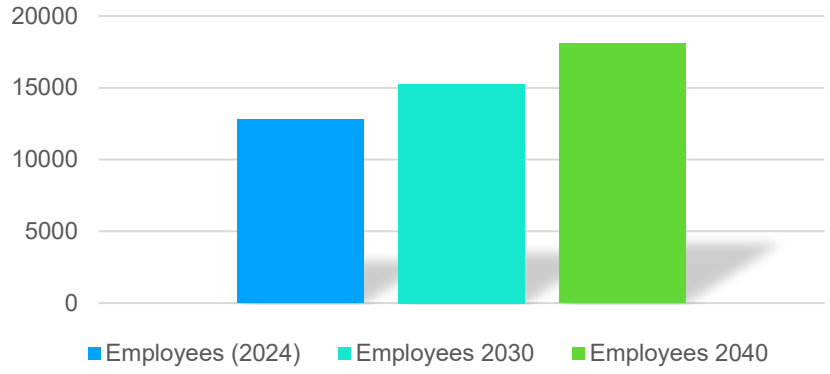


Figure 9 Anticipated Growth, Employees, 2024-2040

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.

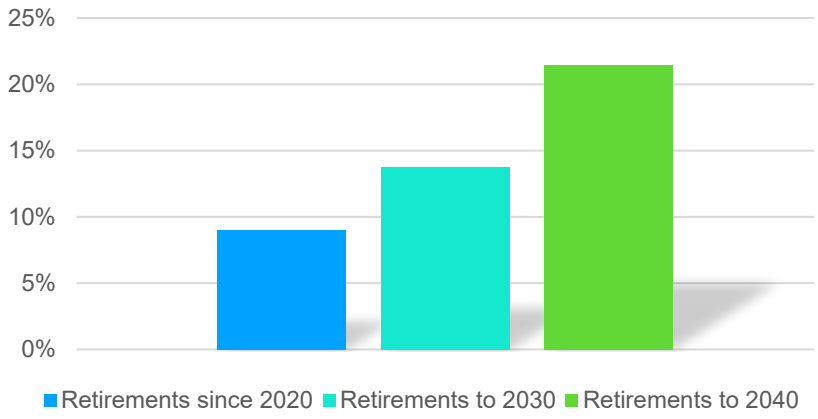


Figure 10 Retirements, 2020-2040

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.

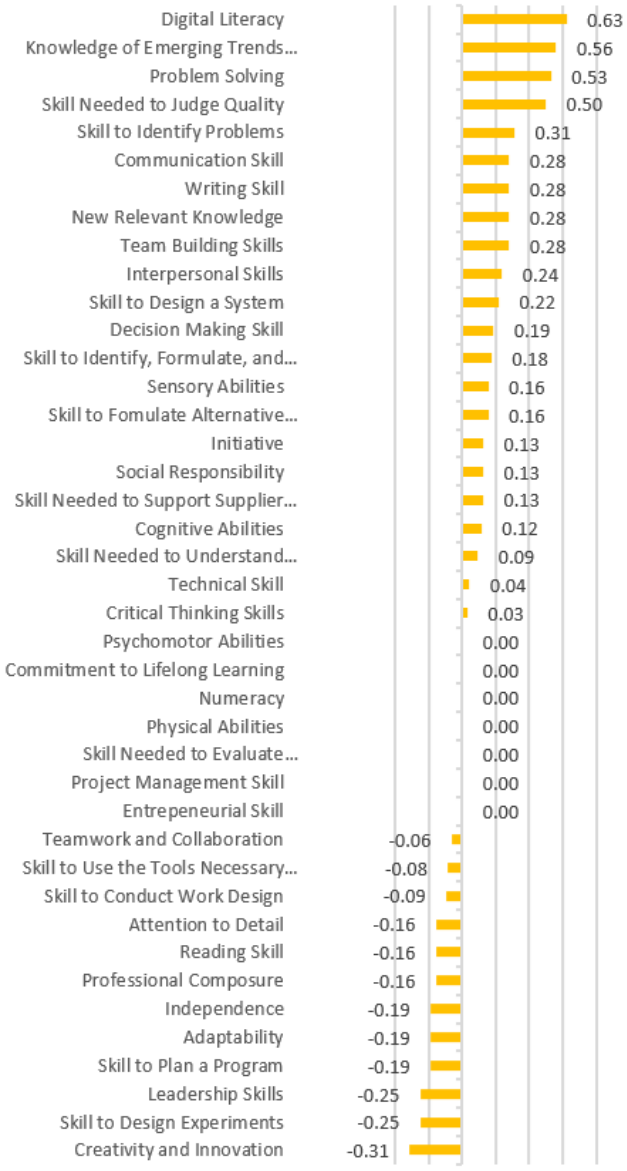


Figure 12 Change from Base Levels - Machinist

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.

[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.

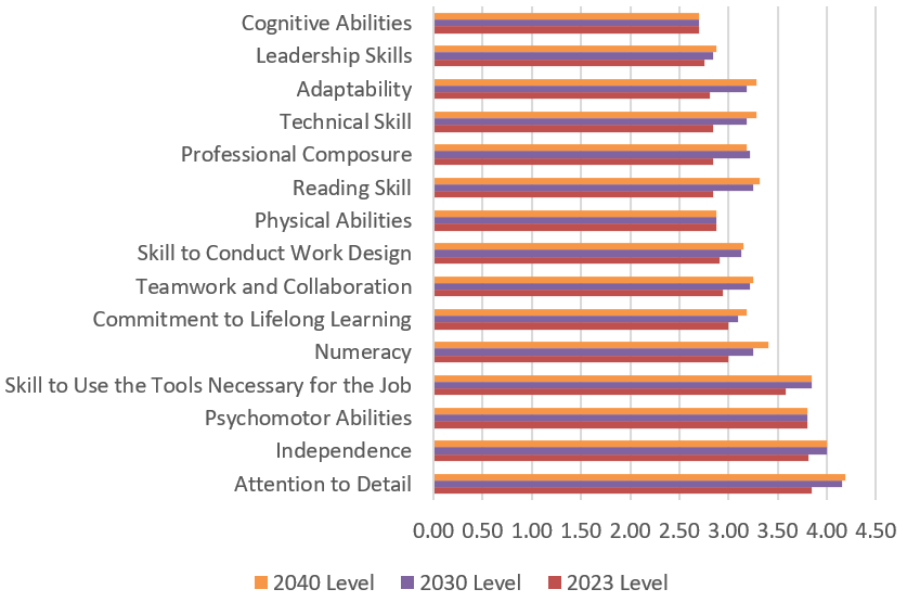


Figure 13 Top Proficiency Levels 2023-2040 – Machinist

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.

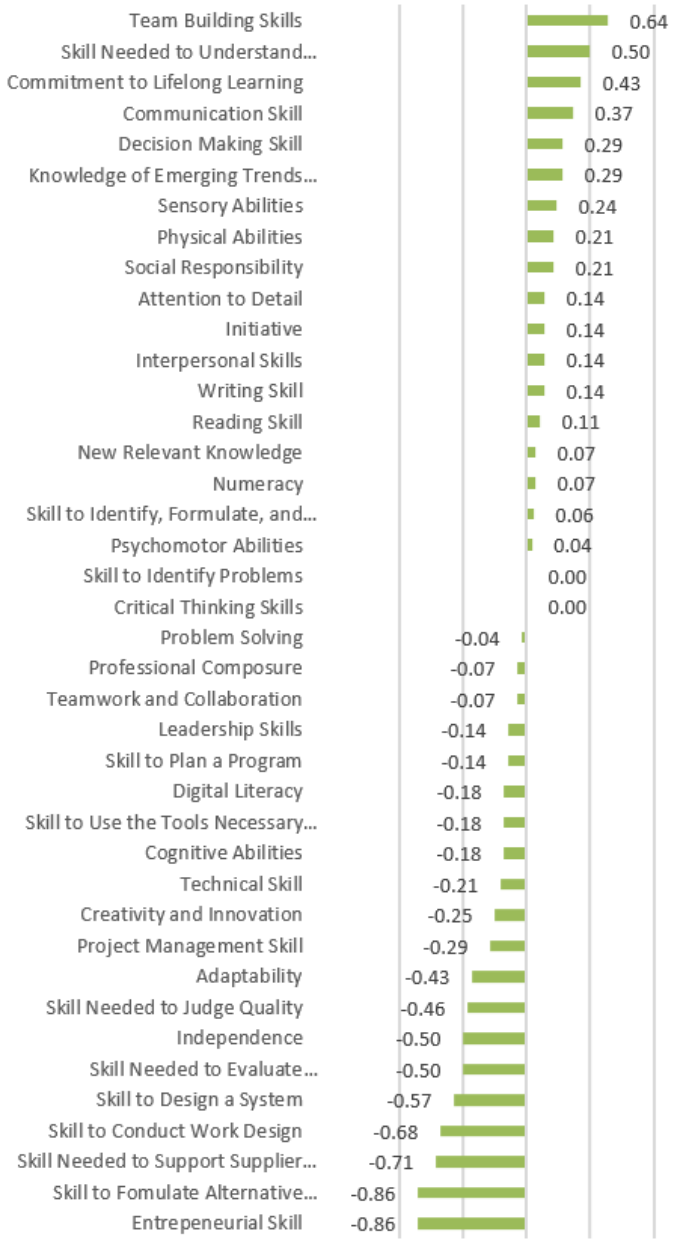


Figure 15 Change from Base Levels – Aircraft Mechanics

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.

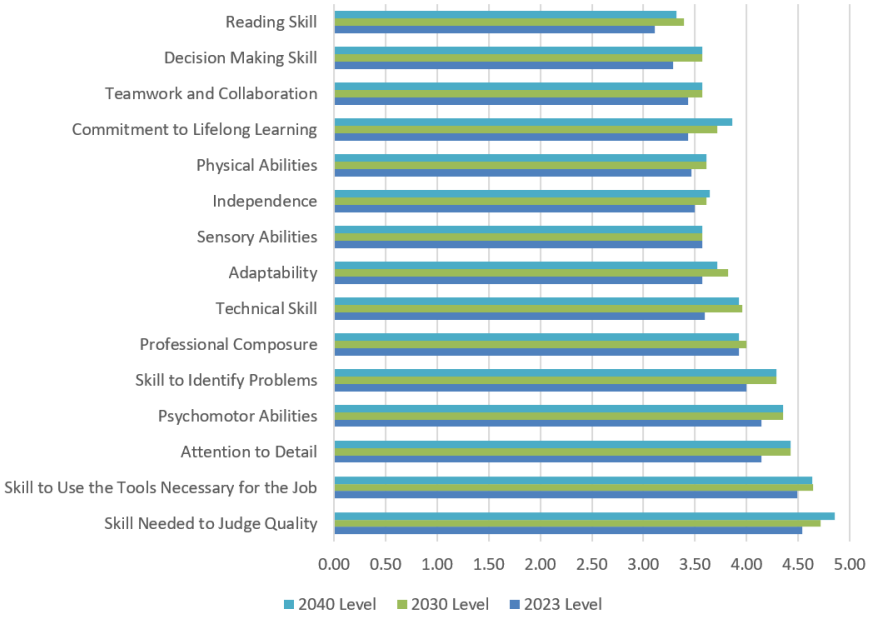


Figure 16 Top Proficiency Levels 2023-2040 – Aircraft Mechanic

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.

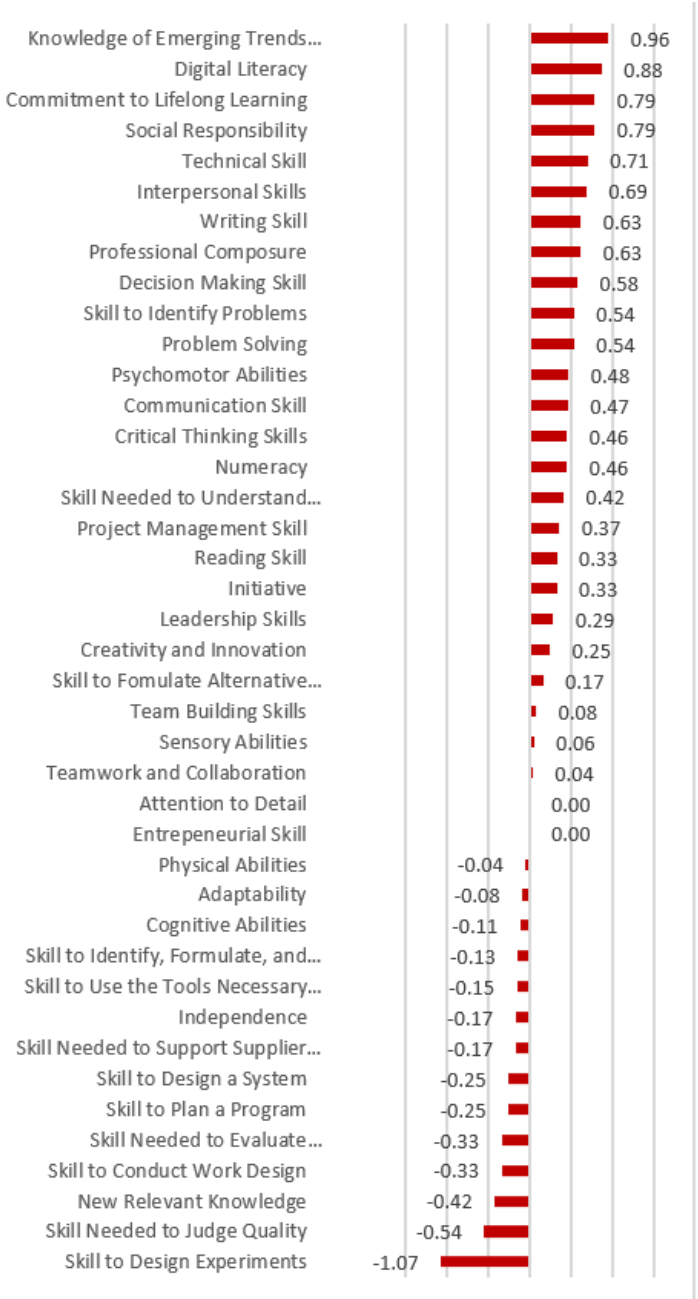


Figure 18 Change from Base Levels – Aircraft Assemblers

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.

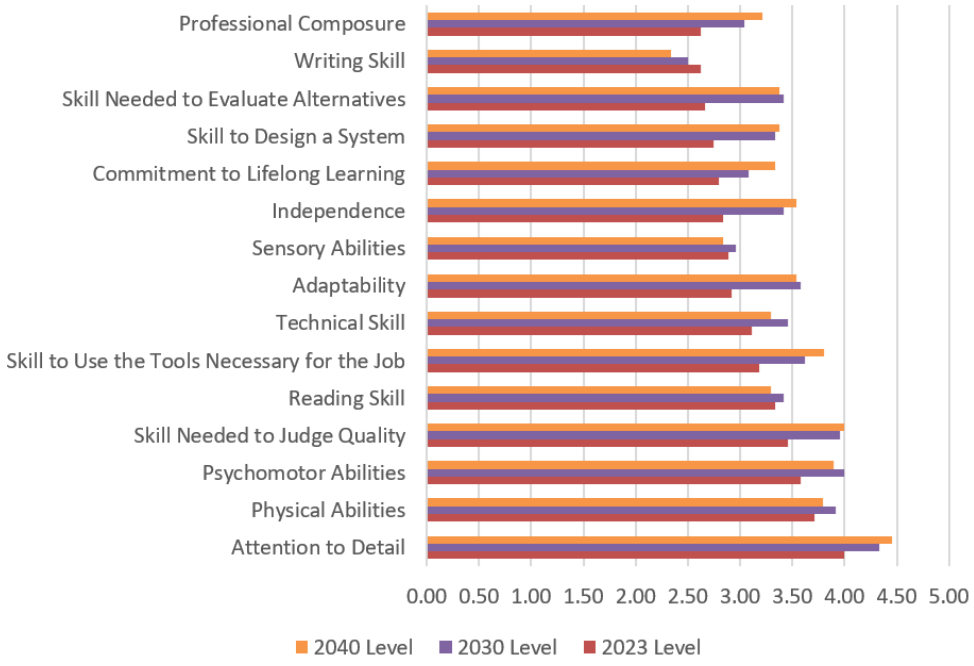


Figure 19 Top Proficiency Levels 2023-2040 – Aircraft Assemblers

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

Benchmark & Current Levels

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.

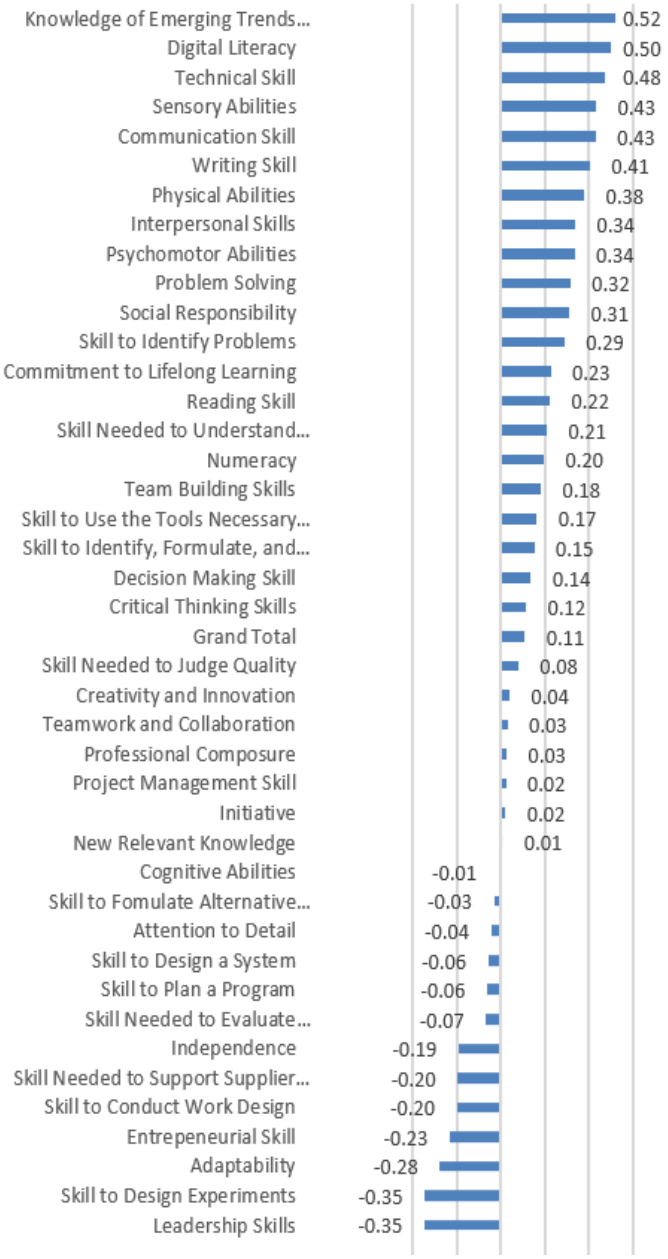


Figure 21 Change from Base Levels – All Occupations

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

Future Expectations

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]

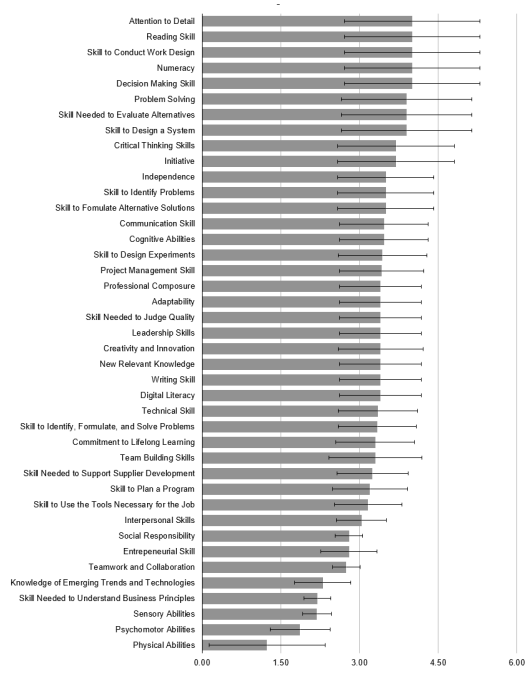
The following is a proficiency analysis based on a grouping of the Occupations into three categories - Engineer, Production, and Trades[14]. This additional perspective is useful in that it provides a more fulsome view of the skill ratings for each broad employment type within the sector than the more 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.

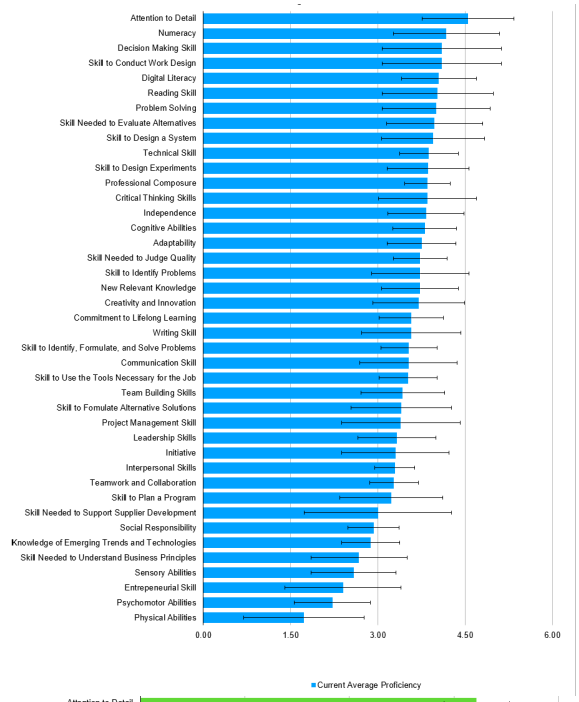
For all occupations in aerospace manufacturing, attention to detail is a skill requiring a high level of mastery. Little or no adjustment to the base level is suggested by many respondents. The potential human impact of errors due to poor documentation, observation, and attention is of great significance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

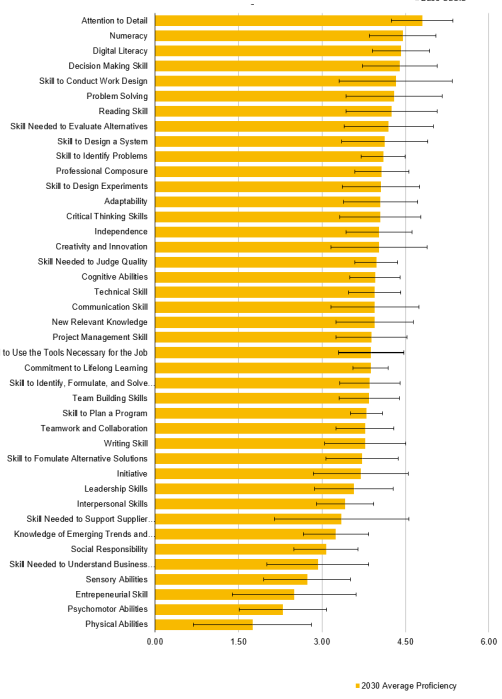
[13] Groupings of occupations based on NGen full manufacturing report. *Production* category includes the presented Aircraft Assemblers NOC, *Trades* includes the presented Machinists and Aircraft Mechanics NOCs.
An area for future research would be a full type of occupation categorization which includes 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.

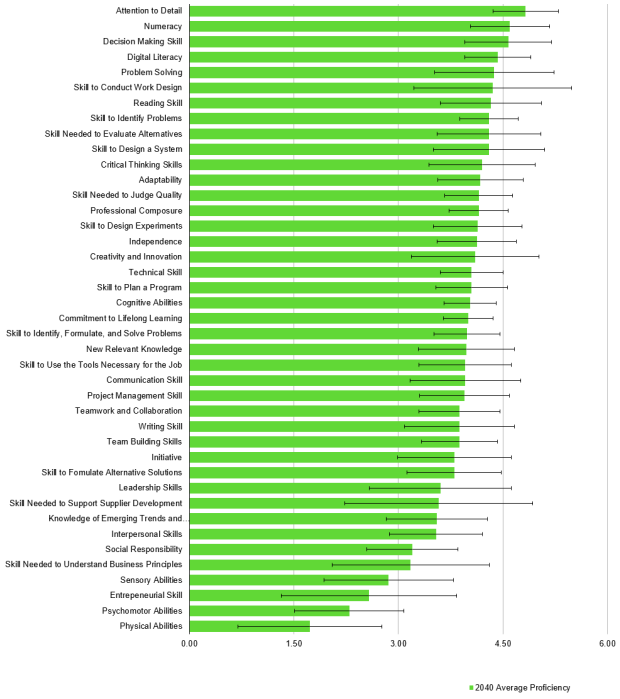
Engineer

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.





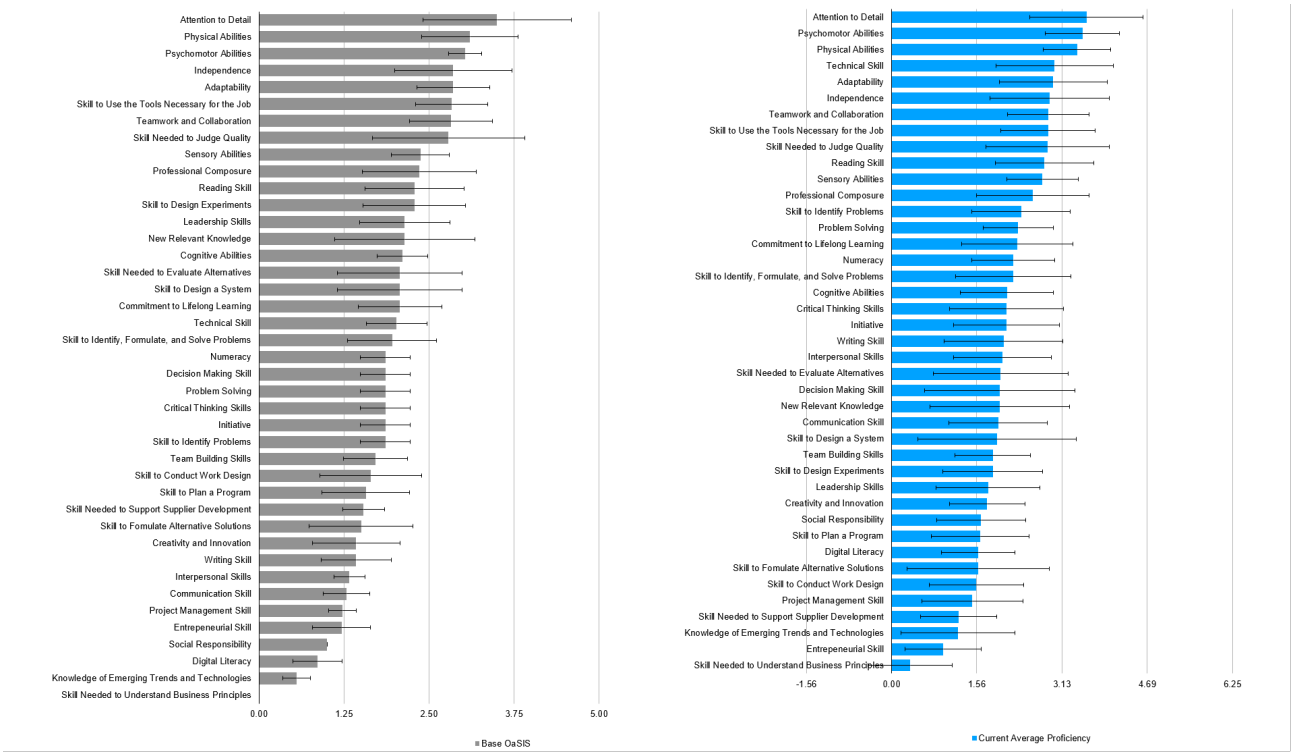


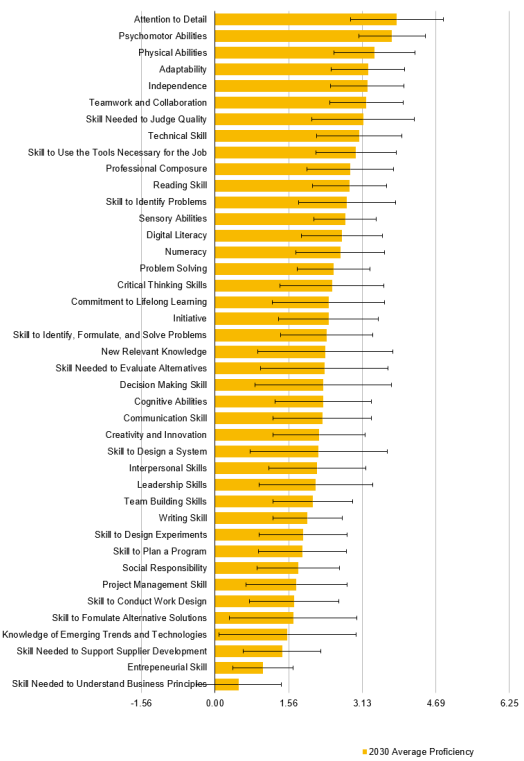


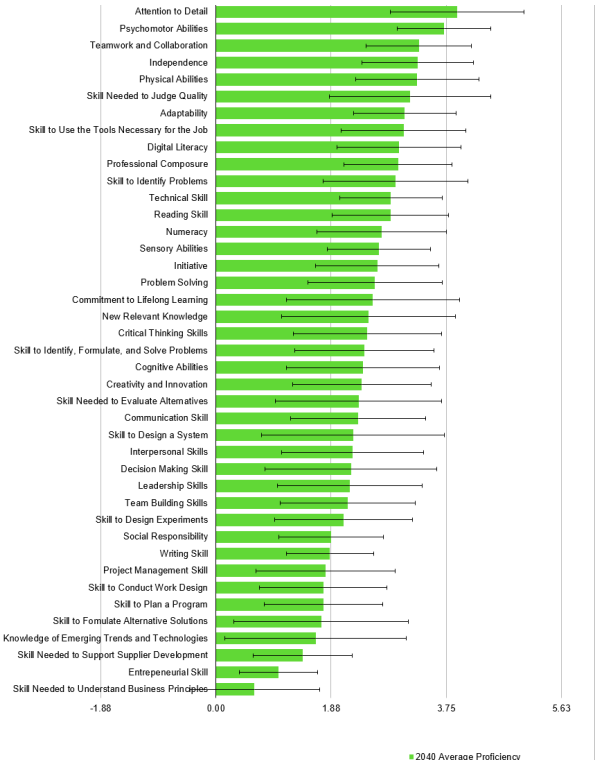
Production

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.

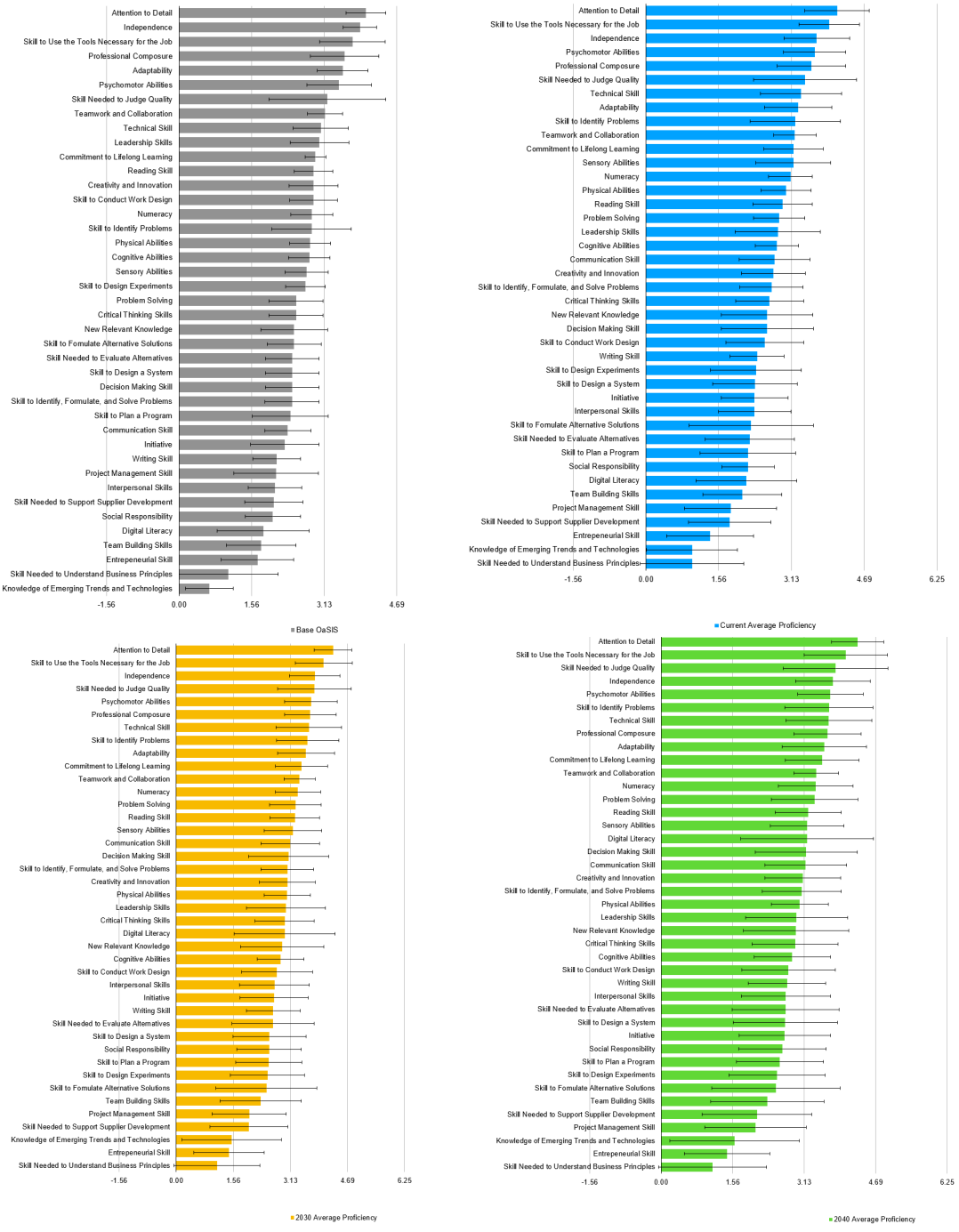



Attention to Detail
Psychomotor Abilities
Physical Abilities
Adaptability
Independence
Teamwork and Collaboration
Skill Needed to Judge Quality
Technical Skill
Skill to Use the Tools Necessary for the Job
Professional Composure
Reading Skill
Skill to Identify Problems
Sensory Abilities
Digital Literacy
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 Formulate 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 Formulate 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, but none of these resulted in a sustained national aerospace strategy. 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

Aggregated Competency Data by Selected Occupational Codes

Occupation: **Aircraft assemblers**

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

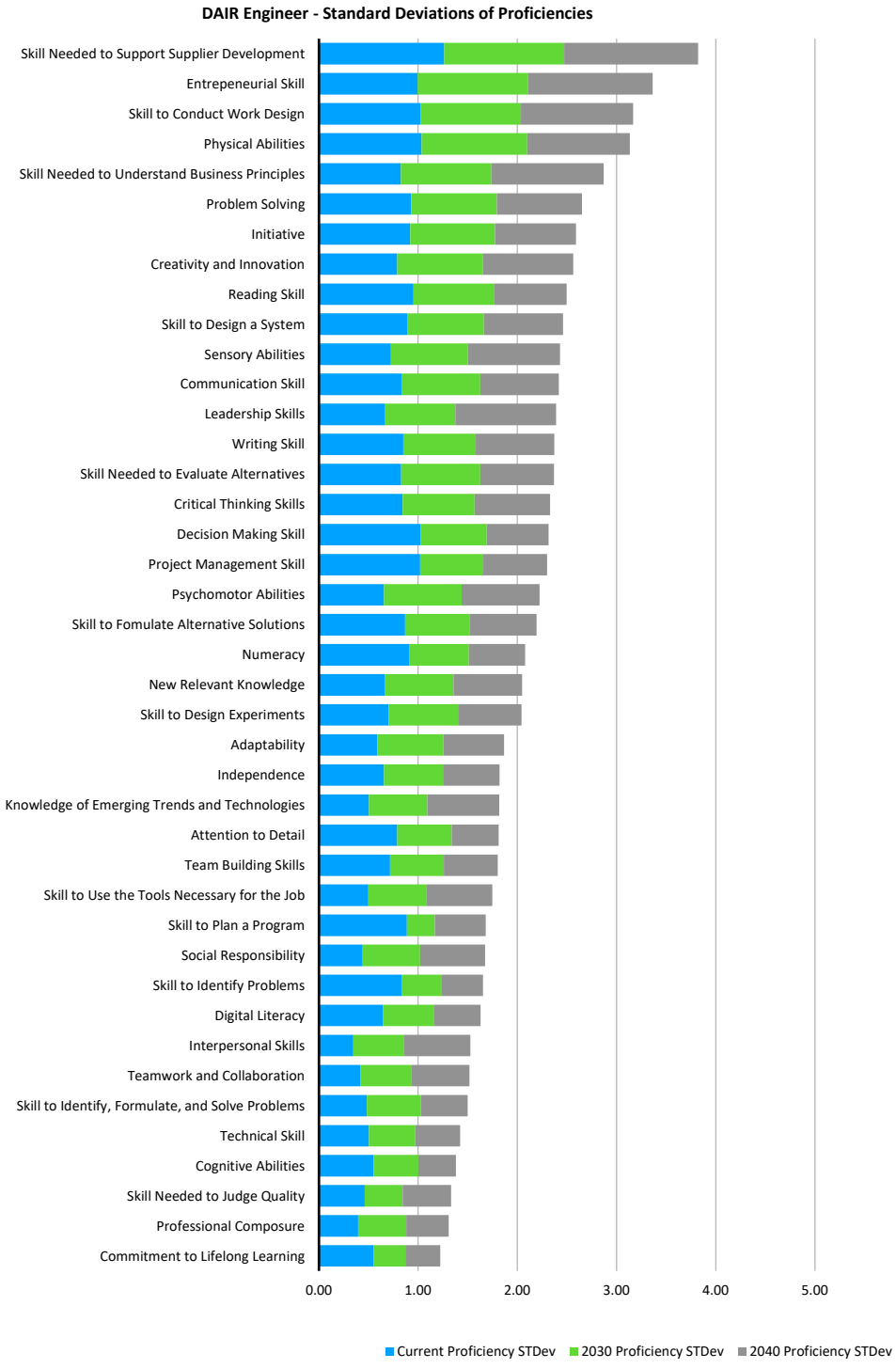
Occupation (All)

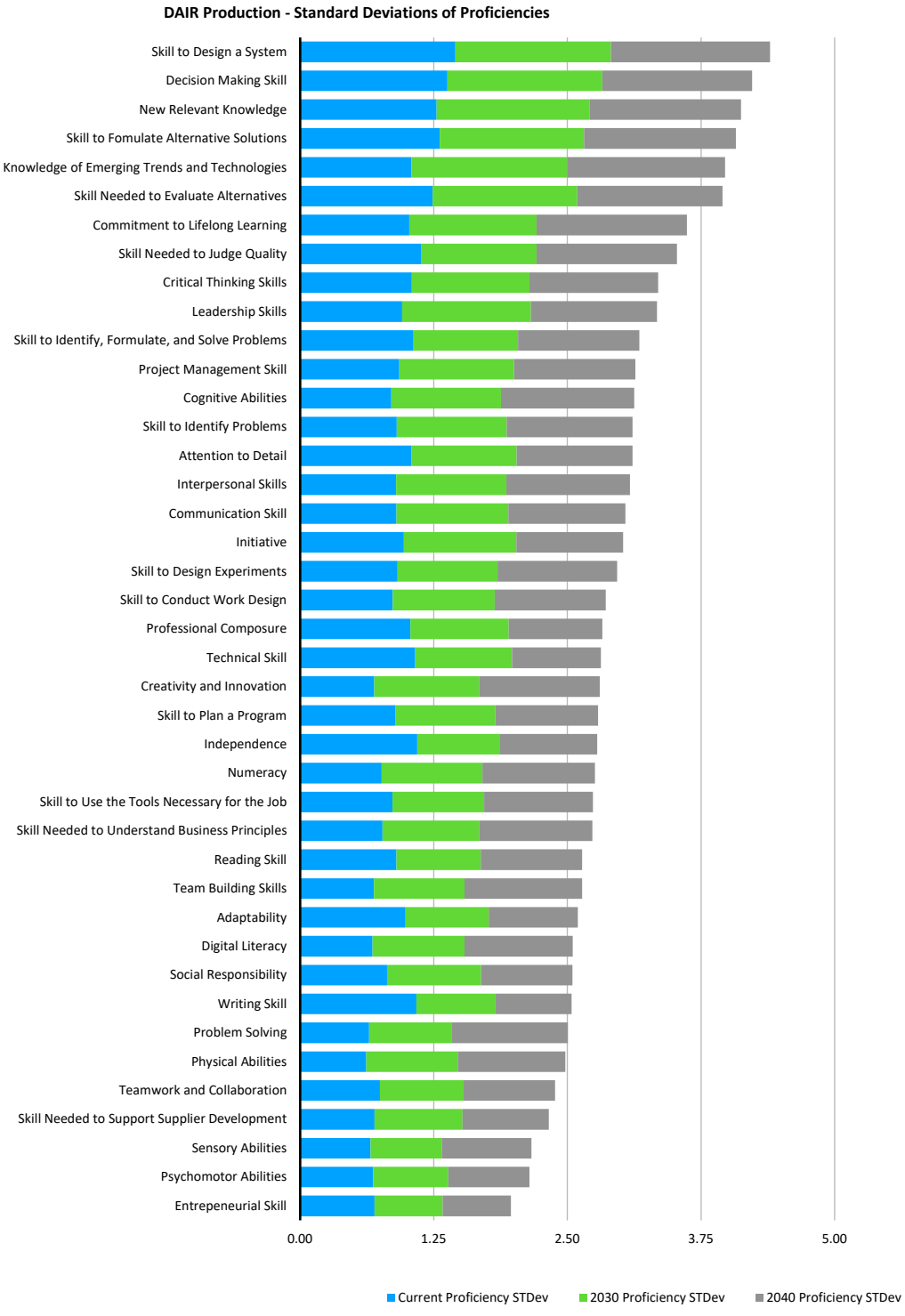
Skill/ Proficiency	Base	Base Change	2023 Level	2030 Change	2030 Level	2040 Change	2040 Level
Attention to Detail	4.21	-0.04	3.59	0.19	3.79	0.21	3.81
Independence	3.59	-0.19	2.93	0.05	3.14	0.07	3.15
Adaptability	3.52	-0.28	2.79	0.05	3.07	0.03	3.06
Skill to Use the Tools Necessary for the Job	3.41	0.17	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

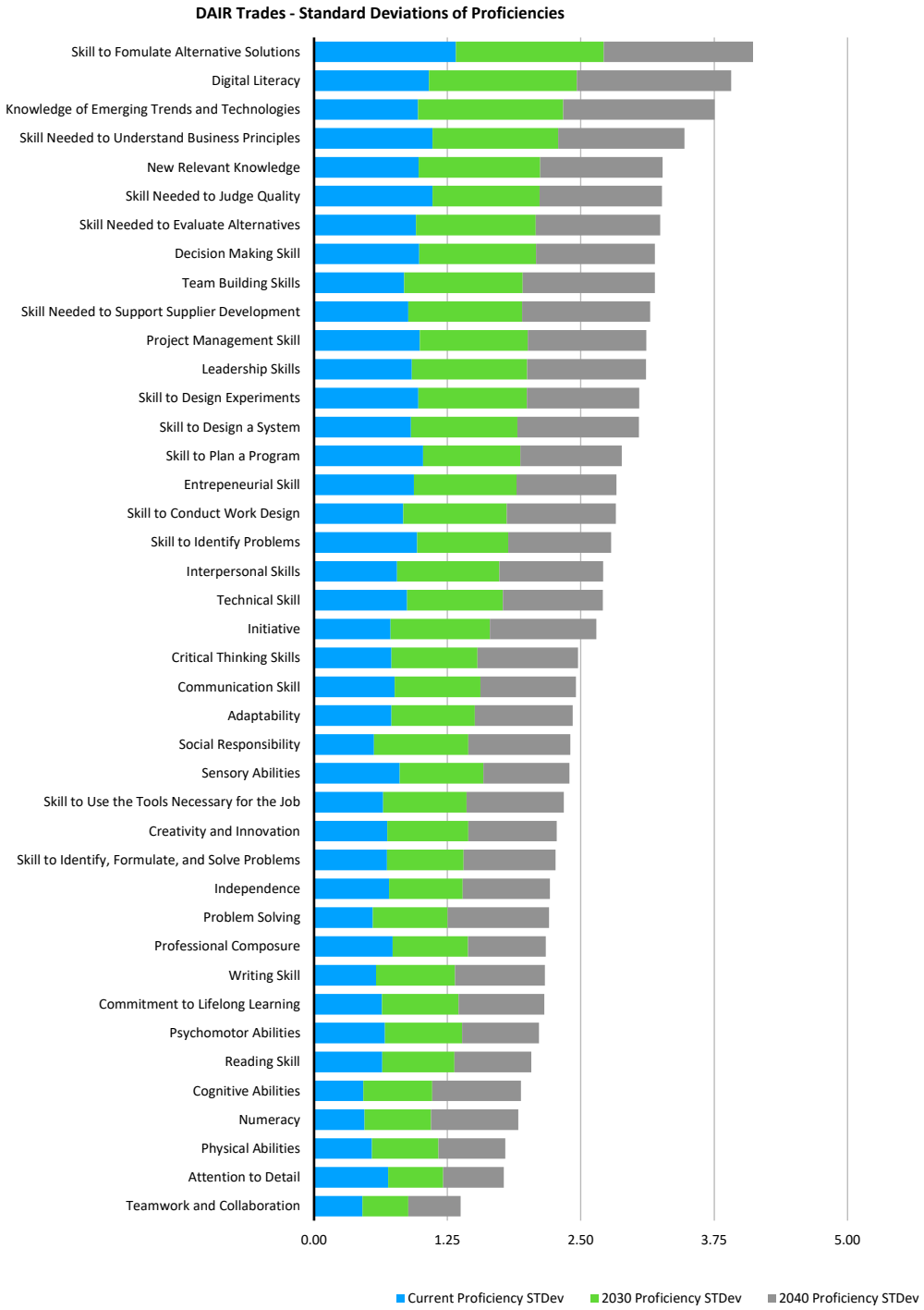
Skill Needed to Support Supplier Development	2.26	-0.20	1.78	-0.02	1.93	0.03	1.97
Writing Skill	2.25	0.41	2.29	0.51	2.38	0.52	2.39
Team Building Skills	2.21	0.18	2.07	0.38	2.23	0.40	2.25
Project Management Skill	2.15	0.02	1.88	0.16	1.99	0.19	2.02
Interpersonal Skills	2.15	0.34	2.14	0.58	2.35	0.61	2.37
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
Skill to Fomulate Alternative Solutions
Digital Literacy
Knowledge of Emerging Trends and Technologies
Skill Needed to Understand Business Principles
New Relevant Knowledge
Skill Needed to Judge Quality
Skill Needed to Evaluate Alternatives
Decision Making Skill
Team Building Skills
Skill Needed to Support Supplier Development
Project Management Skill
Leadership Skills
Skill to Design Experiments
Skill to Design a System
Skill to Plan a Program
Entrepeneurial Skill
Skill to Conduct Work Design
Skill to Identify Problems
Interpersonal Skills
Technical Skill
Initiative
Critical Thinking Skills
Communication Skill
Adaptability
Social Responsibility
Sensory Abilities
Skill to Use the Tools Necessary for the Job
Creativity and Innovation
Skill to Identify, Formulate, and Solve Problems
Independence
Problem Solving
Professional Composure
Writing Skill
Commitment to Lifelong Learning
Psychomotor Abilities
Reading Skill
Cognitive Abilities
Numeracy
Physical Abilities
Attention to Detail
Teamwork and Collaboration
0.00
1.25
2.50
3.75
5.00
Current Proficiency STDev
2030 Proficiency STDev
2040 Proficiency STDev