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Ingredients for growth

How the emergence of plant-based protein opportunities in Saskatchewan and Manitoba will impact workers and future skills needs

PLACE Centre
Smart Prosperity Institute

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The Future Skills Centre (FSC) is a forward-thinking centre for research and collaboration dedicated to driving innovation in skills development so that everyone in Canada can be prepared for the future of work. We partner with policymakers, researchers, practitioners, employers and labour, and post-secondary institutions to solve pressing labour market challenges and ensure that everyone can benefit from relevant lifelong learning opportunities. We are founded by a consortium whose members are Toronto Metropolitan University, Blueprint, and The Conference Board of Canada, and are funded by the Government of Canada's Future Skills Program.

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Abbreviations

Agtech	Agricultural technology
CAHRC	Canadian Agricultural Human Resource Council
ESDC	Employment and Social Development Canada
ESG	Environment, social, and governance
GDP	Gross domestic product
HACCP	Hazard analysis and critical control point
LFS	Labour Force Survey
MB	Manitoba
MPAS	Manitoba's Protein Advantage Strategy
NAICS	North American Industry Classification System
NOC	National Occupational Classification
PBP	Plant-based protein
PIC	Protein Industries Canada
O*NET	Occupational Information Network
SK	Saskatchewan
SME	Small and medium-sized enterprises
TFW	Temporary foreign worker
WHMIS	Workplace Hazardous Materials Information System

Table of contents

List of tables

List of figures

Executive summary

Canada is a world leader in growing the crops needed for making plant-based protein (PBP) products, including pulses, peas, oilseeds, beans, and other grains. Major investments have been made in Saskatchewan (SK) and Manitoba (MB) for facilities to process and manufacture these crops. Provincial and federal governments have made optimistic projections about the future of PBP products in Canada, saying that, with the right supports, the sector could contribute $25 billion to the national gross domestic product (GDP) by 2035.[1] Manitoba alone wants to grow its protein sector by attracting $1.5 billion in investment and creating 1,550 jobs by 2025.[2]

What is not clear amidst the enthusiasm is if the industry and its workforce are prepared to embrace this kind of growth, and how these exciting new opportunities for growth might change the skills needs of workers. Food and beverage manufacturing is already the largest manufacturing sector in Canada by employment, with over 300,000 workers directly employed, and it is the second largest manufacturing sector in terms of production value at over $117.8 billion in 2019.[3] However, the sector currently struggles with persistent sector-wide labour shortages.[4]

Additionally, the advance of new opportunities is changing the nature of employment in the sector, requiring workers to learn new skills and pushing education and training organizations to adapt. Navigating these challenges by investing in both training and finding enough skilled workers for open positions will be key to supporting the growth of an industry that could prove a long-term economic engine for the Prairies.[5]

This report is the first of two examining the PBP industry supply chain in Saskatchewan and Manitoba—from primary agricultural production, through ingredient processing, to food research and manufacturing, into warehousing and distribution, and finally into end-stage retail—to better understand the impacts the PBP growth opportunity will have on the workforce. In this report, we detail the impacts the growth of PBP products will have on each stage of the supply chain, then identify the skills changes we expect as a result of these changes in industrial production.

Figure 1. A simplified supply chain diagram for plant-based protein (PBP) products, including selected North American Industry Classification System (NAICS) codes.

	Agriculture Raw materials	**Manufacturing** Ingredients	**Manufacturing** Final products	**Retail market**
Supply chain	Crops grown on farms: dry peas, lentils, chickpeas, beans, fava beans, etc.	Raw materials are cleaned and further processed into ingredients like flours, fibres, starches, and protein isolates.	Ingredients are used to manufacture final products like plant-based burgers, snacks, and protein-fortified staples.	Final products are sold to consumers.
Selected NAICS codes	Oilseed & grain farming (1111) Vegetable & melon farming (1112) Other crop farming (1119) Support activities for crop production (1151)	Grain & oilseed milling (3112)	Fruit and vegetable preserving and specialty food manufacturing (3114) Dairy product manufacturing (3115) Bakeries and tortilla manufacturing (3118) Other food manufacturing (3119)	Farm product merchant wholesalers (4111) Food merchant wholesalers (4131) Beverage merchant wholesalers (4132) Grocery and related product merchant wholesalers (4244) Grocery and convenience retailers (4451) Specialty food stores (4452) Warehousing and storage (4931)

Key findings

Labour shortages are currently holding back the growth of the agriculture and agri-food sector, and stakeholders warn this will persist unless addressed.

In 2018, a labour shortage of 2,000 positions, equal to 5.0% of total jobs needed, cost the "grain and oilseed" industry $594 million in lost sales.[6] The labour gap will likely increase to one in four "grain and oilseed" jobs being left open because of a shortage of available workers.[7] In 2022, labour shortages caused 48% of agri-businesses to turn down sales or contracts and 41% to reduce their service offerings.[8] Government stakeholders informed us that 60% of labour shortages are concentrated in roles that offer less than $20/hour in Manitoba.[9]

PBP products are a clean growth opportunity that can create jobs, attract investment, and increase GDP in Manitoba and Saskatchewan.

The global market for end-use products is rapidly growing, and Protein Industries Canada (PIC) projects it will be worth more than $250 billion CDN by 2035.[10] Local proximity of crop production and processing facilities increases operational resiliency and sustainability by reducing transportation distances and adds value locally through jobs and tax revenue for communities.

For Canada, plant protein crops are not new, but their branding as "plant-based proteins" and the emergence of a greater variety of final consumer products at retailers is novel for Canadian industry.

Canada is already a leading producer globally for dry peas, lentils, chickpeas, beans, fava beans, and canola. Outside of some bean production in Southern Ontario and Quebec, most pulses are grown in Manitoba, Saskatchewan, and Alberta.[11]

An aging workforce, the increased demand for sustainability practices, the consolidation of farms and farmland, and the adoption of new automation technologies are changing the skills needs of employers.

These four major trends are shaping skills needs throughout the supply chain alongside the emergence of new PBP opportunities in Manitoba and Saskatchewan.

A majority of respondents predict a future for the industry with persistent labour shortages.

The most likely future scenario was one in which the industry struggles with attracting, training, and retaining workers despite technology and capital availability. The reasons for this outcome included the inability to attract workers from other industries and the existing labour shortage in primary agriculture and agri-food manufacturing. Canada's agricultural sector was already short 63,000 workers in 2017, and this may grow to 123,000 by 2029.[12]

Stakeholders identified that the most optimistic economic scenarios were the least likely.

Only a small number of respondents surveyed for this report found it likely that the PBP industry would easily meet its labour needs and grow into a strong source of economic growth and employment without changes in labour market conditions and infrastructure investment. However, some individuals said that recent investments combined with increased national and international demand could bring in the skilled workers needed for the industry to expand.[13]

More immigration is needed to rural and remote communities to mitigate critical labour shortages in agricultural occupations.

Due to the high average age of the agricultural workforce, the expected number of upcoming retirements, and the relatively low population growth of rural communities, more immigration will be needed to fill critical occupations. A report from RBC Economics suggested that nationwide, Canada will need over 30,000 new permanent residents to start new farms or take over existing farm operations.[14]

Food manufacturing in Canada relies on immigrant workers, and this need is expected to increase as the PBP supply chain grows.

The number of immigrants participating in food manufacturing has almost tripled in the last 15 years, although the sector is less reliant on immigrant workers (by percentage) than agriculture. Recent immigration pilot programs like the federal Agri-Food Pilot have been created in response to the need for workers, but the industry is still short by thousands of positions.

Across several key occupations, employers found similar skills gaps for the most in-demand positions.

Specifically, respondents said that, compared to job expectations, workers were most deficient in job-specific technical knowledge, judgment and decision making, time management, and critical thinking. The most in-demand occupations included managers in agriculture, general farm workers, and sales and account representatives.

Key findings

As automation becomes more widespread in food manufacturing, some jobs will become more in demand, but it may not increase or decrease the net jobs required by small and medium-sized enterprises (SMEs).

As companies mitigate their employment shortage through more factory automation and digitization, they will need more repair technicians, mechanical engineers, and machine operators. SMEs already operate lean workforces because of a lack of entry-level workers. While this trend could change their operations, it will not change the number of workers needed to operate, oversee, repair, and improve on technology compared to large multinational companies.[15]

Digital literacy, machinery maintenance and repair, research, supply chain management, and regulatory and environment, social, and governance (ESG) knowledge were the skills that respondents thought would have the most significant shortages in the next three to five years.

Being able to repair and maintain equipment, combined with digital literacy, is increasingly a necessity with automation and digitization (i.e., "Industry 4.0"). This skill set however, is often less common in more remote and rural communities.[16] Importantly, these new skill sets may come from different individuals than those currently tasked with repairing and maintaining current equipment stock.

Some of the jobs projected to be most in demand in the sectors that will experience growth due to PBP production may look quite different than current expectations of agriculture or agri-food manufacturing.

These include sales and marketing specialists, general or agricultural technology specialists, policy managers, and researchers, particularly for more rural and remote workplaces. This projected labour need showcases the diversity of career paths available and the need for businesses to prepare to include these types of jobs and their associated skills into their workforce, especially with the implementation of greater digitization and data analysis (i.e., "Industry 4.0").[17]

Respondents overwhelmingly believed that their existing workers could adapt to the changing skills environment and learn new future skills.

However, their confidence did not extend to how well new additions to the workforce (i.e., students, graduates, and newcomers to Canada) would fare in learning new or existing skills.

The most significant difficulties employers face when recruiting for in-demand roles are a lack of on-the-job experience, difficulty relocating, and high competition for existing workers already in these sectors.

Respondents detailed how the agriculture and agri-food sectors are not viewed as good career prospects, and many potential workers are unaware of the opportunities available.[18] They also claimed that current educational programs for agriculture de-emphasize hands-on learning and that qualified urban workers do not want to relocate to rural and semi-rural communities for work.

One area that may need more specialized knowledge is workers who sell PBP products, like wholesalers and marketing specialists.

Conversations with stakeholders raised a potential challenge wherein customer-facing roles will need familiarity with PBP products to effectively market them, thereby requiring up-to-date knowledge and language in a rapidly innovating sector.[19]

More than half of respondents have recruited individuals directly from school despite recent graduates not having adequate direct agricultural or agri-food experience.

Due to the competition for labour, stakeholders have stressed that "pretty much anyone" could be hired and trained on-the-job and that companies are focused on immediate needs. This urgent scramble to address the labour gap now means companies are unable to plan for long-term labour needs or discuss specific skills and occupations.[20]

Recommendations

Recommendations for this report address three challenges identified by stakeholders: mitigating labour shortages through changes in immigration and education policies, increasing sectoral awareness to improve knowledge and understanding of opportunities in the PBP supply chain, and including greater consideration of the factors that matter most to workers in economic development.

Mitigating labour shortages through changes in immigration and education policies

1 **Temporary foreign worker (TFW) visas should be modified** to allow for greater flexibility by expanding to specific regions or industries involved in the PBP product supply chain.

2 **Training programs for existing workers in agriculture could be better scheduled** to fit around the planting season. This could help increase skill development and make it easier for workers to train during the off-season by completing existing courses for critical and emerging skills.

3 **The federal Agri-Food Pilot program should be made permanent and expanded** to include food manufacturing industries involved in making PBP products.

4 **Saskatchewan should consider removing the post-secondary education requirement** from the Occupations in Demand stream of their Provincial Nominee Program and add more positions around food manufacturing and ingredient processing.

5 **Saskatchewan and Manitoba should implement automatic spousal work visas** for high-need agricultural and manufacturing industries as well as create clearer pathways to permanent residency that will strengthen initiatives like the TFW and the Post Graduate Work Permit programs.

Increasing sectoral awareness to improve knowledge and understanding of opportunities in the PBP supply chain

6 **Educational programs should incorporate experiential learning components** and be designed to attract students to careers in agriculture. The recruitment focus should expand to high school and post-secondary students in non-agricultural-related fields.

7 **Existing and new educational programs need to tell a better story** about why students should enter agriculture and agri-food and include references to food security, opportunities for career advancement, and on-the-job training.

8 **Provincial governments could work with industry and educational institutions** to develop work-integrated learning opportunities that include equivalent wage subsidies for international students.

Greater consideration of factors that matter most to workers in economic development

9 **Municipal and provincial policymakers should increasingly incorporate a holistic worker approach** when planning how to support and attract businesses in their jurisdictions, going beyond zoning and taxes to include utility connection, transportation, housing, and access to immigration services.

10 **Businesses in agriculture and agri-food should explore providing flexible supports** to workers beyond wages and benefits that include on-site daycare, flexible work arrangements, and other quality-of-life improvements.

11 **Municipalities in communities with PBP opportunities should focus on projects that will enhance and build off this holistic worker approach,** such as more and denser housing, coordinated public transportation with businesses, and child and elder care.

Table 1. Select sub-sector summary of trends, future occupations, and skills.

Sub-sector (NAICS)	Trends impacting sub-sector	Future occupations in demand	Future skills in demand
Oilseed and grain farming (1111)	Farm consolidation, larger individual farms Labour shortage Aging workforce and retirements Increased use of agtech Increasing sustainability requirements	General farm workers Managers in agriculture	Judgment and decision making Critical thinking Time management Job-specific technical knowledge Communication Interpersonal relationships
Grain and oilseed milling (3112)	Increased automation and mechanization Labour shortage	Labourers Mechanical assemblers and inspectors	Judgment and decision making Critical thinking Time management Job-specific technical knowledge Communication
Other food manufacturing (3119)	Increased automation and mechanization Labour shortage	Labourers and machine operators in food and beverage processing Testers and graders in food and beverage processing Food science researchers Supervisors Food product developers Sales representatives Mechanical assemblers and inspectors	Computers and electronics Judgment and decision making Critical thinking Equipment maintenance Production and processing

Introduction

The world is growing. As the global population is set to increase to 9.7 billion in 2050, the demand for food and protein will follow.[21] Agricultural production will need to generate a sufficient supply to feed the world. In 2017, Canada was the world's fifth largest global exporter of agri-food products, worth over $55 billion.[22] Moreover, the demand for plant-based protein (PBP) is rising, and most consumers want diverse and affordable protein sources.[23] Canada's plant protein industry is well-positioned to meet this demand, as growing crops like pulses, soybeans, and canola are set to contribute over $4.5 billion to Canada's gross domestic product (GDP) growth throughout the next decade.[24] Protein Industries Canada (PIC), a joint government and industry body, has projected that the annual PBP market will be worth more than $250 billion worldwide by 2035.[25] To capture some of that value, PIC has set out a goal of growing the Canadian plant-based food, feed, and ingredient sector to be worth $25 billion and providing 10% of the world's plant-based food products by 2035.[26]

These growth projections align with provincial plans to increase both primary agriculture production and food processing and manufacturing capacity. The Saskatchewan Growth Plan has several goals for 2030, including increasing crop production to 45 million metric tonnes, increasing value-added revenue to $10 billion, crushing 75% of the canola produced in-province, and processing 50% of the pulse crops grown in-province.[27] Manitoba (MB) also wants to increase its provincial processing capacity for ingredient processing and food manufacturing with $1.5 billion in new investment and 1,550 jobs by 2025 through Manitoba's Protein Advantage Strategy (MPAS).[28]

These ambitious targets will require major growth in an already growing industry. In Manitoba and Saskatchewan (SK), two potential economic hubs for PBP production, these food manufacturing and ingredient processing industries have attracted new pea processing and canola crushing facilities. Interest in supporting this space has been reinvigorated by exciting investments from Roquette, Avena Foods, Burcon NutraScience, Cargill, Viterra, FCL, and AGT Foods. Roquette's largest pea processing plant opened in late 2021 in Portage la Prairie, MB.[29] Also in Portage la Prairie, Avena Foods received $6.3 million in funding from PIC for their tempered functional pulse and oat flours, which will be used to develop PBP consumer products.[30] Another announcement from May of 2023 included Burcon NutraScience's pilot plant, which will provide processing and scale-up validation services in Winnipeg, MB.[31] Burcon NutraScience's product line includes canola protein isolates made from canola meal, a co-product from canola crushing, that can be used in many food and beverage products.[32] In 2021, within the same week, Cargill and Viterra separately announced plans to build canola crushing facilities in Regina, SK, to be operational in 2024.[33] In early 2022, FCL and AGT Foods announced their joint investment of a $2 billion canola crushing and biodiesel plant in Regina, to be completed by 2027.[34] These investments will attract additional interest and activities as other businesses see the available opportunities and a PBP cluster emerges within the Prairies.

As this cluster grows, it will create jobs. While this benefits current and future workers in agriculture and agri-food, it is unclear how prepared the current workforce is to support the growth of this opportunity. Major trends are reshaping the employment landscape for industries involved in PBP within

Manitoba and Saskatchewan. An aging workforce, the increased demand for sustainability practices, the consolidation of farms and farmland, and the adoption of new automation technologies are changing the skills needs of employers. Additionally, labour shortages in the sector are creating challenges in finding skilled talent in every sector and are hindering growth. In 2018, a labour shortage of 2,000 positions, equal to 5.0% of total jobs needed but remained vacant, cost the "grain and oilseed" industry $594 million in lost sales.[35] The labour gap will likely increase to one in four "grain and oilseed" jobs being left open because of a shortage of available workers.[36] In 2022, labour shortages caused 48% of agri-businesses to turn down sales or contracts and 41% to reduce their service offerings.[37] Additionally, competition is high for qualified workers.

For Manitoba and Saskatchewan to contribute to the $25 billion goal set forward by PIC, they will need to ensure their workforces have the skills required to fill new roles as their sectors adapt to these trends. This report contributes to these objectives by identifying how the agriculture and agri-food sector will be affected by the growth of the PBP opportunity and what skills are needed for today's workers to fill the essential roles in these two Prairie provinces.

Report overview

This report begins by identifying the PBP supply chain, unpacking each aspect of the chain to detail how, and to what extent, changes to plant protein crops and products will impact production and workers. This report then offers an overview of the skills profile of the current workforce and a discussion of how skills needs will change as a result of the growth in PBP products. This quantitative profile was developed by applying the Occupational Information Network (O*NET) taxonomy for skills and knowledge to Labour Force Survey (LFS) data. This analysis is applied to every sector outlined in the initial supply chain analysis exercise while also building in inter-sectoral trade analysis to understand better how changes in one section of the supply chain might impact workers in others.

Once the current skills profile is understood, this report examines how skills needs will likely change in the future in each section of the supply chain. This information is identified through a literature review; stakeholder consultations; and surveys that engaged employers, training bodies, education providers, workforce groups (such as employment service providers), and other leading industry stakeholders. These findings offer a clear sense of the gaps in current skills needs relative to where the industry is headed based on current trends. This report concludes with a discussion of what these findings mean for workers and makes recommendations to better align training and education priorities with the changing needs of employers, workers, and communities.

What are plant proteins?

Canada produces and exports protein-rich crops like canola, dry peas, lentils, fava beans, chickpeas, soy, oats, and wheat.[38] These raw materials are cleaned on-farm and processed at a facility into ingredients like flours, fibres, starches, and protein isolates, which are further manufactured into the final consumer products found on retail shelves like plant-based burgers and plant protein-fortified staples. These additional steps beyond cleaning and bagging the raw materials add economic value to agricultural products or by-products by transforming them into an upgraded product in a process called "value-added agriculture."[39] Throughout the supply chain, there are also suppliers that sell the crops from primary producers to buyers, distributors that transport products, and research and development workers that improve processes and make new products.

For Canada, plant protein crops are not new, but their branding as "plant-based proteins" and the emergence of a greater variety of final consumer products at retailers is novel for Canadian industry. The five major pulses grown in Canada are dry peas, lentils, chickpeas, beans, and fava beans. Outside of some bean production in Southern Ontario and Quebec, most pulses are grown in Manitoba, Saskatchewan, and Alberta.[40] Over 80% of the pulses grown in Canada are exported, and Canada is the largest global producer-exporter.[41] Canada is also one of the largest pulse producers, particularly for lentils and dry peas.[42] For example, in 2021, Saskatchewan alone provided 51% of the world's lentil exports and 36% of the world's dry pea exports.[43] Canada has a strong reputation for growing plant proteins and exporting the raw materials as commodities for further processing. As such, there is a considerable economic opportunity to further expand into PBP value-added products by growing domestic value-added production capacity in ingredient processing and food manufacturing. The federally funded supercluster PIC, headquartered in Regina, SK, has the mandate to support research and investment into the growth of these opportunities.[44]

Box 1

Why are plant-based proteins a clean growth opportunity?

Plant-based protein products are a clean growth opportunity that can create jobs, attract investment, and increase the economic value generated from the agriculture and agri-food sectors in Manitoba and Saskatchewan because:

- The market for end-use products is growing rapidly, and companies are quickly entering the space to meet this growing demand. The number of new products entering the market increased by 74% over four years, from 2010 to 2014.[45] These new products will serve a global market that PIC estimates will be worth more than $250 billion by 2035.[46] Worldwide, PBP products sourced from peas are projected to have the greatest growth in demand given that wheat and soy (two other rapidly growing alternatives) are both allergens.[47] Given Canada's current production of peas and legumes, agricultural-producing regions have a strong PBP foundation in the early stages of the supply chain and are ready for more value-added agriculture activities.
- When fields where crops are grown and processing facilities are located close to each other, the supply chain is shorter, increasing operational resiliency and sustainability by reducing transportation distances and their associated emissions.
- Producing these products adds value locally, so communities and citizens experience subsequent economic benefits like local jobs and tax revenue. There are a number of communities and regions in Manitoba and Saskatchewan that are benefitting, or could benefit greatly, from the economic opportunity offered by producing PBP products:
    - Portage la Prairie, MB, is about an hour's drive from Winnipeg and has a population of just under 7,000 people.[48] In 2021, agriculture, forestry, fishing, and hunting had the greatest proportion of businesses by industry in Portage la Prairie by a significant margin.[49] Manufacturing had the third largest number of jobs by industry sector in the Portage la Prairie area between 2014 and 2019.[50]
    - In 2016, Moose Jaw, SK, had 87% more people employed in farming compared to the national economy.[51] Moose Jaw is about an hour's drive from Regina, Saskatchewan's capital, and has a population of just under 35,000 people.[52]
    - In Saskatchewan, the Yorkton–Melville region had the second largest share of employment in the food, beverage and tobacco manufacturing sub-sector at 21.3%.[53] This region has a population of just over 84,000.[54]
    - Planned for 2024, Cargill's new $350 million canola processing facility in Regina, SK, will likely need 1 million hours of employment for construction and will lead to about 50 full-time positions for daily operations.[55] Less than a week after Cargill's notice, Viterra announced that they would build the world's largest canola crushing plant in Regina.[56]
    - Also in Regina, FCL and AGT Foods are investing $2 billion for a combined canola crushing and biodiesel plant, with up to 300 permanent jobs for the canola crushing portion and 150 permanent operating jobs for the biodiesel plant, that will be completed by 2027.[57]

Plant proteins in Saskatchewan and Manitoba

Saskatchewan and Manitoba both have long traditions of growing and exporting protein-rich crops. Saskatchewan has the largest pulse crop area in Canada.[58] Its pulse crop production volume for 2022 was almost 2 million metric tonnes of lentils, almost 113,000 tonnes of metric chickpeas, and 1.57 million metric tonnes of peas.[59] Although crop production volume for both provinces declined from 2020 to 2021, production largely rebounded in 2022 (Figures 2 and 3). The value of top export products from Saskatchewan in 2022 was $4.7 billion for wheat, $2.0 billion for lentils, $1.1 billion for peas, $3.5 billion for canola oil, and $913 million for canola meal.[60] The province is already making strides in capturing greater value-added opportunities. Regina, SK, will soon have three value-added facilities centred around canola crushing, with Cargill and Viterra to have facilities operational in 2024[61] and FCL and AGT Foods together investing $2 billion for a combined canola crushing and biodiesel plant for 2027.[62]

While Manitoba's overall crop production is only about a third of Saskatchewan's, the province remains an important producer of soybeans and dry beans (Figure 3). In 2022, almost half of Manitoba's agri-food exports were as raw materials, so there is a significant opportunity to expand local processing for value-added activities to export.[63] The Portage la Prairie region in Manitoba is one of the highest pea-producing regions in the world by acreage and contributes significantly to Canada's pea production, which is 65-70% of global pea production.[64] This is a key reason why Roquette opened the world's largest pea protein processing plant in Portage la Prairie in late 2021, employing 114 full-time workers when it opened and having the potential for a full staff of 120 workers.[65] Also in Portage la Prairie, Avena Foods received $6.3 million from PIC for their tempered functional pulse and oat flours, ingredients used to develop PBP consumer products.[66]

Figure 2. Saskatchewan crop production volume (metric tonnes) for select plant-based proteins (PBP) crops from 2020 to 2022.[67]

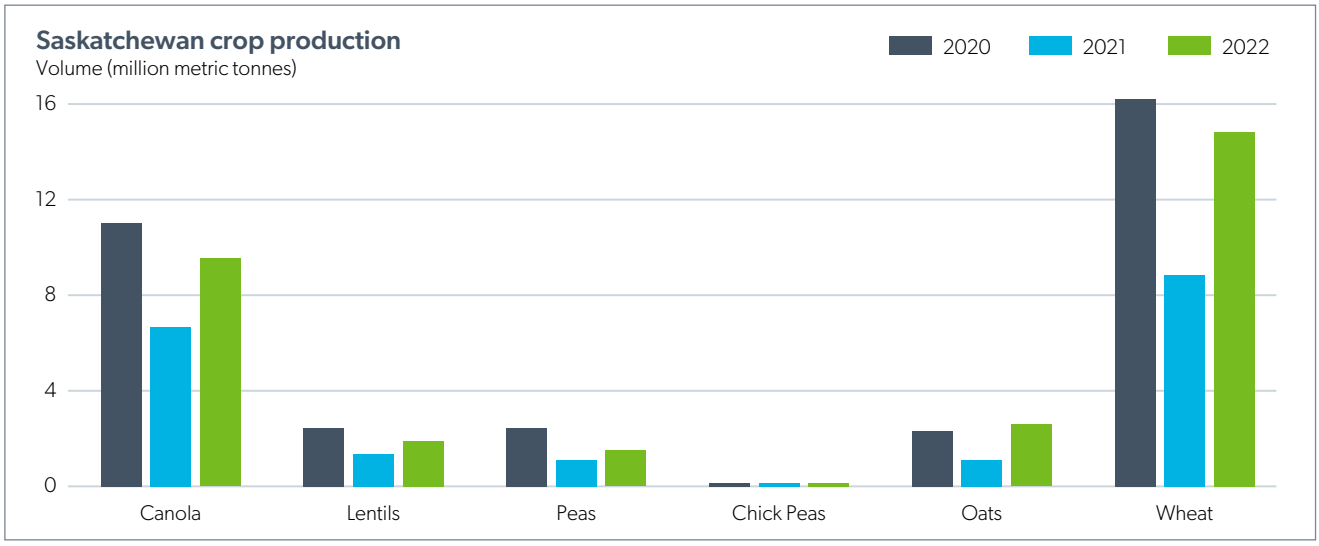
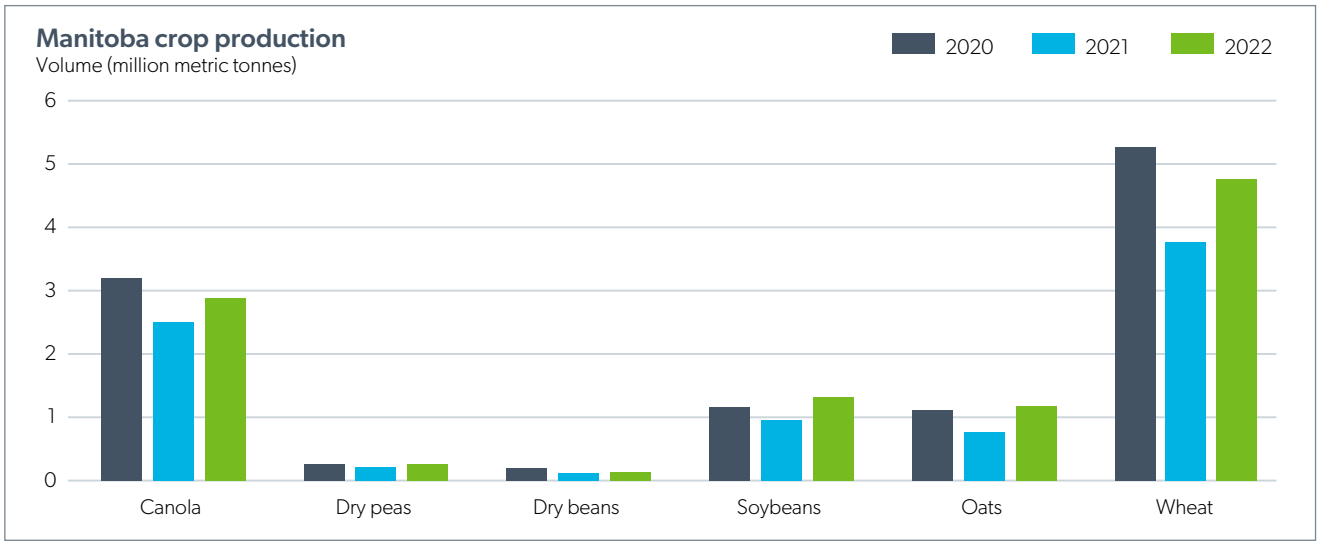


Figure 3. Manitoba crop production volume (metric tonnes) for select plant-based proteins (PBP) crops from 2020 to 2022.[68]

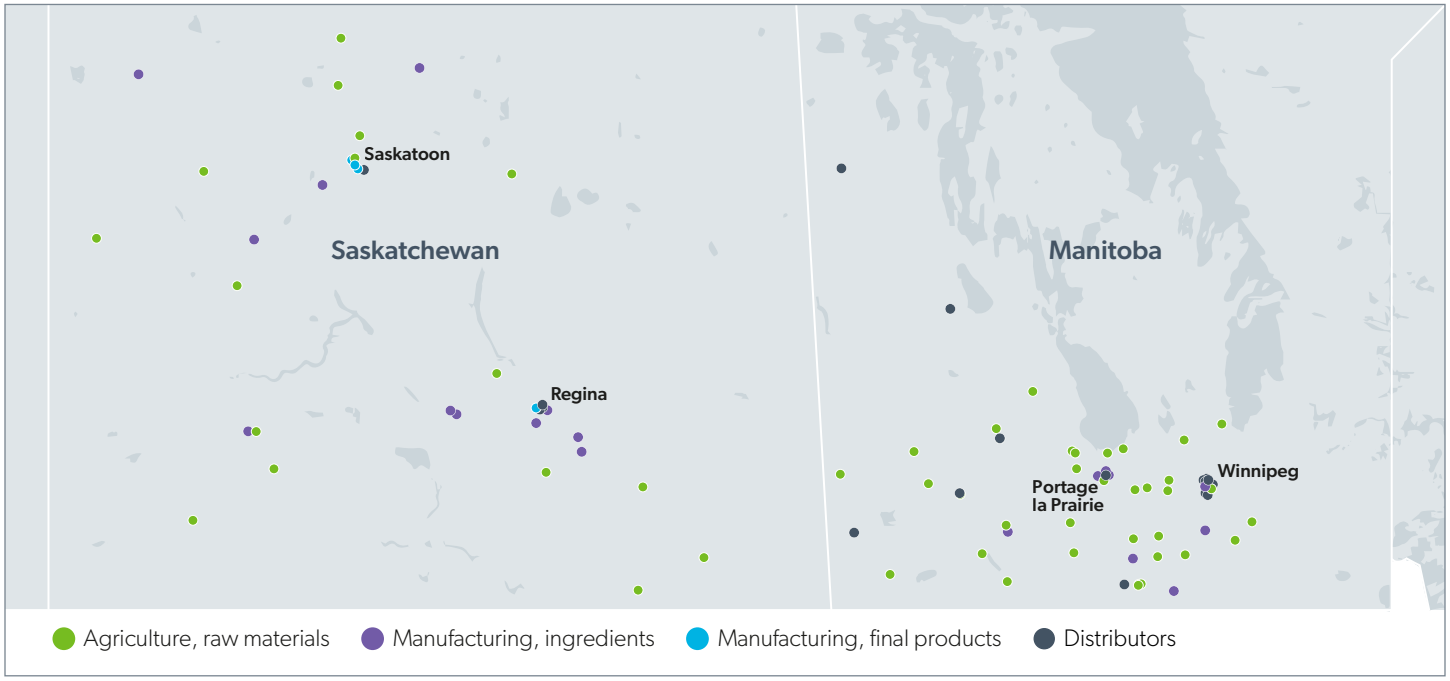


Provincial support

Many opportunities exist along the supply chain beyond just growing and cleaning raw materials. As of 2019, National Research Council Canada identified that greater innovation is still needed for this industry to succeed, as the majority of PBP products are at an early stage of development and continued investment into research and development is required to remain competitive within this rapidly growing space.[69] Major research areas to support greater innovation have been identified throughout the value chain, including: sourcing (crop location), isolation (removing unusable plant matter) and functionalization (separating crops into composite ingredients), formulation (designing new products), processing (combining ingredients into new products), and distribution.[70] The Prairies have been recognized as a promising centre for pulse fractionation, a processing technology that removes specific proteins for use as ingredients.[71]

Provincial governments in both Manitoba and Saskatchewan have been investing to support the growth of this opportunity. The Saskatchewan Government's Growth Plan outlines 30 goals for 2030, including growing Saskatchewan's agri-food exports to $20 billion, increasing the province's agriculture value-added revenue to $10 billion, crushing 75% of the canola Saskatchewan produces in-province, and processing 50% of the pulse crops Saskatchewan produces in-province.[72] The Value-Added Unit at the province's Ministry of Agriculture is working towards fostering growth, innovative processing, international trade, and a strong investment climate.[73] Provincial programs include the Agtech Growth Fund alongside tax incentive initiatives like the Saskatchewan Value-Added Agriculture Incentive, Saskatchewan Manufacturing and Processing Exporter Tax Incentive, Saskatchewan Manufacturing and Processing Investment Tax Credit, and Saskatchewan Manufacturing and Processing Profits Tax Reduction.[74]

Figure 4. A map of plant-based proteins (PBP) supply chain activities in Saskatchewan and Manitoba.



This map may not be exhaustive of all businesses operating in the PBP space.

MPAS, created in 2019, identifies key actions needed to make Manitoba a sustainable animal and plant protein supplier.[75] Since MPAS was implemented there has been $753 million in new investments and 840 jobs created (MPAS' goal is to have $1.5 billion in investment and 1,550 jobs created by 2025), illustrating the promise the industry holds to support growth in the province.[76] This success has yielded further support. Manitoba has set 33% of its Research and Innovation funding for protein innovation.[77] Additionally, PIC has invested over $51 million into developing products and various projects with plant protein industry organizations in Manitoba.[78] Manitoba's Budget 2023 also prioritized several PBP opportunities, including the completion of Merit Functional Foods' $150 million canola and pea processing plant in the Rural Municipality of Rosser; completion of Roquette's $600 million pea protein production plant in Portage la Prairie; construction of a $94 million oat processing plant in Rosser; support of $3 million to Avena Foods over three years to increase their pulse processing capacity in Portage la Prairie; and equipment upgrades at Buffalo Creek Mills in Altona.[79] Both provincial governments are implementing policies and programs to support the plant protein industry, in part due to its potential as a job creation engine. The promise the PBP industry holds makes the discussion of the skilled workforce needs, challenges, and opportunities relevant for provincial policymakers keen to capture the benefits of this opportunity.

Overview of the supply chain for plant protein products

A PBP supply chain starts with farms and ends with final products sold to consumers. The supply chain has several components to get from raw materials on a farm (like peas, lentils, and soybeans) to products sold to consumers (like plant-protein-fortified staples and plant-based burgers). An overview of the simplified supply chain is shown in Figure 5. For the purposes of this work, the focus was on the PBP supply chain in Saskatchewan and Manitoba, and this supply chain is composed only of the parts most likely to be influenced by the growth of PBP products.

Figure 5. A simplified supply chain diagram for plant-based protein (PBP) products, including selected North American Industry Classification System (NAICS) codes.

	Agriculture Raw materials	**Manufacturing** Ingredients	**Manufacturing** Final products	**Retail market**
Supply chain	Crops grown on farms: dry peas, lentils, chickpeas, beans, fava beans, etc.	Raw materials are cleaned and further processed into ingredients like flours, fibres, starches, and protein isolates.	Ingredients are used to manufacture final products like plant-based burgers, snacks, and protein-fortified staples.	Final products are sold to consumers.
Selected NAICS codes	Oilseed & grain farming (1111) Vegetable & melon farming (1112) Other crop farming (1119) Support activities for crop production (1151)	Grain & oilseed milling (3112)	Fruit and vegetable preserving and specialty food manufacturing (3114) Dairy product manufacturing (3115) Bakeries and tortilla manufacturing (3118) Other food manufacturing (3119)	Farm product merchant wholesalers (4111) Food merchant wholesalers (4131) Beverage merchant wholesalers (4132) Grocery and related product merchant wholesalers (4244) Grocery and convenience retailers (4451) Specialty food stores (4452) Warehousing and storage (4931)

Agriculture

The supply chain begins with the primary production of raw materials by farmers, farm labourers, technicians, agronomists, and associated professions. The most relevant PBP-related agriculture activities fall under Oilseed and grain farming (NAICS 1111), which includes Soybean farming (NAICS 11111), Oilseed (except soybean) farming (NAICS 11112), Dry pea and bean farming (NAICS 11113), Wheat farming (NAICS 11114), Corn farming (NAICS 11115), Rice farming (NAICS 11116), and Other grain farming (NAICS 11116). There is also Vegetable and melon farming (1112), Other crop farming (NAICS 1119), and Support activities for crop production (NAICS 1151). Growing these crops happens on-farm, in the ground, from planting to harvesting.

Crops high in protein are best suited for conversion to PBP and are grown in both provinces. From planting to harvesting, a lot of work is required to accomplish these activities. In both Saskatchewan and Manitoba, oilseed and grain farms are overwhelmingly dominated by individual farm operators who control the farm's day-to-day operations and are the main or sole employee; Manitoba alone has a ratio of 1.3 farm operators to farms.[80] Out of the total number of oilseed and grain farms in Saskatchewan (20,496), over 81% were non-employers (total of 16,770), meaning there were no employees officially on the payroll but perhaps had some family working or contracted workers.[81] In Manitoba, a similar pattern emerges out of the total oilseed and grain farms (6,974), where 77% were non-employers (total of 5,383).[82] Of the remaining oilseed and grain farms in both provinces, those that employ workers remain on the smaller side, with 16% of farms in Saskatchewan (total of 3,240) and 24.6% of farms in Manitoba (total of 1,327) having between one and four employees.[83] Manitoba's average farm size of 1,177 acres per farm tends to be larger than the national average of 809 acres per farm.[84] Additionally, larger farms tend to have a disproportionate amount of revenue, with only 5.2% of total farms categorized as having over $2 million in revenue. Yet, that small percentage comprised more than 51.9% of Manitoba's total operating revenue.[85] Overall, from 1976 to 2016, the number of small-sized farms (under 240 acres) has slightly grown, the number of medium-sized farms (between 240 and 1,119 acres) has been cut nearly in half from 63.7% in 1976 to 37%, and the number of large-sized farms (above 1120 acres) has tripled from 11.2% to 33.3%.[86] This trend to larger consolidated farms has resulted in larger numbers of employees per farm, as owner-operators are substituted for several employees with more specialized skill sets.[87] Many of these workers are familiar with novel technologies and changing sustainability requirements, two other trends impacting workers' skills needs. Finally, the sector also faces the challenge of navigating an aging workforce. In 2021, the proportion of farm operators aged 55 years and older was 60.5% of total operators, and the percentage of young operators was only 8.6%.[88] This will create challenges as retirements increase and workers need to be replaced.

Manufacturing: ingredients and final products

Once crops are grown and harvested, raw materials can be sold as is or after basic processing (which would include being cleaned and dried in a grain dryer), or they can be further processed into PBP products. There are two steps in this further processing stage of the supply chain: the manufacturing of ingredients like flours, fibres, starches, and protein isolates that will be used to make other products ("ingredient manufacturing or processing") and the manufacturing of final products that can be purchased and consumed by individuals ("final product manufacturing"). Some manufacturers may process crops into both ingredients and final products, while others specialize in one or the other. Some examples of this value-added processing include canola crushing (to obtain canola meal and oil from canola seeds) or pea fractionation (to separate protein from starches). There are a number of different processing techniques that companies use, which are outlined in the text box below. Within this analysis, the NAICS codes represented in manufacturing include 3112 (Grain and oilseed milling), 3119 (Other food manufacturing), and occasionally 3115 (Dairy product manufacturing) for plant-based milk alternatives. Certain niche products can also be under 3114 (Fruit and vegetable preserving and specialty food manufacturing) for frozen and more specialty products, and 3118 (Bakeries and tortilla manufacturing) for certain protein-rich flours and prepared dry baked goods.

Both provinces have a strong foundation in this part of the supply chain. Food and beverage manufacturing is the largest manufacturing employer in Manitoba[89] and the second largest in Saskatchewan.[90] Both provinces want to increase value-added processing, as further refinement of ingredients means products can then be sold at a higher price.

Box 2

Processing techniques[91]

Part of the production process involves converting the raw materials from crops to ingredients that can be further used in manufacturing and food production processes.[92]

Dehulling: Dehulling is the process whereby the seed coat is removed using abrasive forces to disrupt the components of the seed. Dehulling processes include pitting with rollers, soaking in water, adding edible oils, hydrothermal treatments (like steam or microwave heating), and enzyme treatments. One theoretical procedure uses various sodium-based chemicals to break down the hull, but the process involves a loss of nutrients.

Milling: Milling is a category of procedures which create flours and grits from crop products. The quality of the end product is affected by many different factors, including the seed size, composition, cleanliness, grade, storage conditions, and growing environment. Different types of milling can also have major effects on the chemical composition and utility of the flour.

Dry separation: Once the milling process is complete, the flours can be further broken down into a spectrum of end products, with light fractions high in protein on one end of the spectrum and coarse fractions high in starch on the other. This process can be completed through streams of air that disperse the flour into its separate particles. With such an air classification process, the end-stage ingredient can double its protein concentration across crops like lentils, peas, and fava beans. Theoretically, this process could also be completed with electrostatic, which has been tested in laboratory conditions, wherein proteins are separated based on the presence of an external electric field. While there are positive results for this method as another classification process for flours or for further refinement, it does not appear to be widely used in Canadian production at the moment.

Wet separation: Separation of pulse flour into proteins, starches, and fibres is overwhelmingly done in Canada using alkaline extraction, also referred to as wet separation. The proteins are separated from other components by adjusting the pH balance of the plant slurry and using a combination of centrifugation, drying, and membrane technology to get the final protein products. This process also generates sediments high in starch from the alkaline solutions.

While these are the main production techniques used in the creation of protein flours and concentrates, other production and manufacturing processes can be used to modify the nutrition, flavour, and appearance of end products. These include soaking seeds, thermal treatments, extrusion through dies and pressure, micronizing cooking, germinating seeds, and fermentation, to name a few.

Research & development

One step in the process, which can fall outside the normal manufacturing process, is research, often in the form of product development or experimentation. At the earlier stages of the supply chain, agronomists, plant scientists, geneticists, food science technicians, and biotechnicians develop new crop lines and products, improve efficiencies, and match existing crops and their ingredients to new production processes. Later in the supply chain, research and product development can also involve finding new combinations of ingredients and materials to create products that taste better, have an improved texture, more closely replicate traditional proteins, and are healthier for consumers. Workers with specialized research and technical expertise are also invaluable during the production process in ensuring product quality and consistency through testing, grading ingredients, and reviewing the production for quality control. PBP-specific research and development is difficult to parse out through direct NAICS codes as many traditional scientific occupational categories often involve similar jobs and competencies. Mostly, this is covered by NAICS 5417, Research and development in the physical, engineering and life sciences. More entry-level testers and graders and Q/A technicians however, often fall into more specialized food and beverage manufacturing, such as 3112 (Grain and oilseed milling), 3119 (Other food manufacturing), and occasionally 3115 (Dairy product manufacturing) for plant-based milk alternatives.

Transport, warehousing, and sales

The final step in the PBP supply chain is delivering products to the consumer where they can be purchased. A product may be sold to a restaurant, a grocer, or even directly to consumers—this will vary by the type of food product a manufacturer makes. These activities take place among several different sectors and NAICS codes. Several of the most common are 4931 (Warehousing and storage), 4131 (Food merchant wholesalers), 4111 (Farm product merchant wholesalers), and 4244 (Grocery and Related Product Merchant Wholesalers).

There are a few types of professions found in this part of the supply chain—workers in marketing and sales roles responsible for selling products, transport workers who move products, warehouse workers who store products, and final sales workers in service (i.e., restaurants) and retail (i.e., grocery stores) sectors who interact with consumers. While these roles are critical in getting PBP products to market, the changes in their skills needs

will be less specific than those earlier in the supply chain. For example, a truck driver will not need to change their skills to drive their refrigerated truck if it is a load of vegetables or PBP burgers. The needs within warehousing and distribution may be slightly different across locations within each province, but the skills needed to work in these sectors are not expected to change significantly for PBP food products compared to other food products. One area that may need more specialized knowledge is workers who sell PBP products, like wholesalers and marketing specialists. Conversations with stakeholders have noted a potential challenge related to this area of work, namely a lack of customer-facing and sales workers. Individuals in these roles will require up-to-date knowledge and language familiarity with PBP products to effectively market them in a rapidly innovating sector.

Box 3

Where do stakeholders and experts feel the industry is going?

While there is a shared desire amongst governments, industry stakeholders, civil society groups, and communities to capture the PBP economic opportunity in the Prairies, the success of this endeavour is not guaranteed. Stakeholder perspectives differ on the trajectory of the industry. In our survey and conversations with stakeholders, we conducted a foresight exercise on the industry's likely future growth trajectory, which identified how stakeholders believe the sector will grow and what challenges it may need to overcome to support its growth.

Responses to the survey about the outlook of PBP were split, with a majority of responses saying the most likely future scenario was one in which the industry struggles with attracting, training, and retaining workers despite technology and capital availability. The second most common outlook for the sector identified that the industry was likely to face major sectoral challenges, including lower technology, capital, and worker availability than is needed to meet targets. Finally, the least favourable response was the most positive scenario, wherein the PBP industry can easily meet its needs and grow into a strong source of economic growth and employment for the provinces.

Some of this is at odds with many of the very optimistic early projections for the industry, most notably from PIC, which has set forward its "Roadmap to $25 Billion."[93] This roadmap presents a way forward for the PBP industry in Canada to grow from the at-time valuation of $2.5-$3 billion to $25 billion by 2035. Projections for the global market for PBP vary significantly, with PIC suggesting it could be worth $250 billion by 2035 and a more optimistic scenario from Natural Products Canada proposing it could be at least $290 billion.[94] Food and beverage processing in Manitoba employed 4,310 labourers, 1,765 process control and machine operators, 695 supervisors, and 395 testers and graders in 2021 (Table 3).[95] Provincially, Manitoba has set major growth targets with the MPAS, specifically aiming to generate new investments of $1.5 billion and to create 1,550 jobs by 2025.[96] Currently, they have reached $823.5 million and 912 jobs,[97] but the recent news of Merit Functional Foods, a large investor in the PBP industry in Manitoba, going into receivership has given some stakeholders cause for concern.

Two common challenges articulated by stakeholders were the inability to attract workers from other industries alongside the existing labour shortage in primary agriculture and agri-food manufacturing. Specifically in agriculture, the aging nature of the workforce and the high number of projected retirements were identified as major challenges by respondents. More specific responses about why stakeholders felt more bearish on the sector's future included a lack of awareness about career path opportunities, a belief that the regional industry may not be well positioned to capitalize on global demand, and a wider uncertainty about the future of the PBP global market. However, at least a few respondents said the optimistic growth scenarios were closest to their current experience in business and that the combination of recent investment and national and international demand will bring in the skilled workers needed for the industry to expand.

How will the growth of this opportunity impact workers?

To capture the extent of the PBP supply chain, this report uses NAICS industry groups at the 4-digit level (Table 2).

To understand the importance of skills and knowledge across the PBP supply chain, this analysis compiled a comprehensive dataset linking the Canadian industry and occupational codes with their associated skills and knowledge profiles. This dataset links labour market information specifically related to skills and knowledge, National Occupational Classification (NOC) codes, and inter-sectoral industry and trade data (for a list of NOC codes included in the analysis, please refer to Appendix B). The O*NET database was used as a foundation for the skills and knowledge component. Developed by the U.S. Bureau of Labor Statistics, the O*NET database is one of the most widely used and comprehensive databases for occupational information, including information related to skills, knowledge, abilities, and tasks.

This analysis focused on the 35 skills identified within the database that were classified broadly as basic and cross-functional skills, as well as the 33 knowledge attributes identified within the database. Basic skills, which include both content and process skills, enable workers to develop capacities that further allow for learning and acquiring knowledge. These include active listening, reading, critical thinking, and monitoring. Cross-functional skills enable workers to undertake activities across tasks, including coordination, problem solving, operations monitoring, decision making, and management.[98] (For a detailed classification of the top skills and knowledge attributes identified in our analysis, see following page). Due to their fundamental nature, basic content skills[99] have the highest importance scores across jobs and sectors. While these are included as part of the analysis, they do not differ across positions but serve as a baseline competency. More importantly, this analysis includes basic process skills, such as critical thinking and monitoring. The O*NET assigns "importance" scores to skills and knowledge attributes, which quantify how proficient an individual must be at a particular skill to perform in each occupation. This analysis emphasizes the importance of understanding the relative skills and knowledge profiles within specific occupations.

Finally, the quantitative analysis in this report was substantiated through direct input from stakeholders collected from a survey and informal discussions about the future of the sector. Respondents were asked questions related to their professional disciplines and expertise, and their answers were used to contextualize our findings around future skills needs.

When interpreting insights about skills needs from employers, the relative importance of these changes is linked to the overall employment figures within a given occupation. Table 3 details the employment figures in several relevant NOC codes discussed in this report, broken down by total employment in both Prairie provinces discussed in this analysis.

Examples of O*NET Skills:[100]	
Top Skills	**Description**
Active listening	understanding what is being said, asking questions, not interrupting
Critical thinking	evaluating solutions using logic
Complex problem solving	identifying complex problems, evaluating options to make informed decisions, and implementing solutions
Speaking	verbal communication
Monitoring	evaluating yourself and others to improve performance
Judgment and decision making	evaluating the best course of action and making informed choices
Reading comprehension	understanding written text

Examples of O*NET Knowledge Attributes:[101]	
Top Knowledge Attributes	**Description**
Production and processing	knowledge related to manufacturing and distributing goods
Food production	agricultural knowledge
Mechanical	knowledge of machinery, including repair and maintenance
Administration and management	includes strategic planning, budgeting, human resources, leadership, coordinating people and resources

Table 2: North American Industry Classification System (NAICS) codes and industry groups used for analysis.

NAICS 2022 code	Industry group	Analysis
1111	Oilseed and grain farming	Agriculture
1112	Vegetable and melon farming	
1119	Other crop farming	
1151	Support activities for crop production	
3112	Grain and oilseed milling	Manufacturing
3114	Fruit and vegetable preserving and specialty food manufacturing	
3115	Dairy product manufacturing	
3118	Bakeries and tortilla manufacturing	
3119	Other food manufacturing	
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing	
3331	Agricultural, construction and mining machinery manufacturing	
4111	Farm product merchant wholesalers	Wholesale trade
4131	Food merchant wholesalers	
4132	Beverage merchant wholesalers	
4171	Farm, lawn and garden machinery and equipment merchant wholesalers	
4183	Agricultural supplies merchant wholesalers	
4191	Business-to-business electronic markets, and agents and brokers	Wholesale trade
4244	Grocery and related product merchant wholesalers	
4451	Grocery and convenience retailers	Retail trade
4452	Specialty Food Stores	
4529	Other general merchandise stores	
4821	Rail Transportation	Transportation and warehousing
4841	General Freight Trucking	
4842	Specialized Freight Trucking	
4882	Support activities for rail transportation	
4884	Support activities for road transportation	
4889	Other support activities for transportation	
4931	Warehousing and storage	
2213	Water, sewage and other systems	Utilities

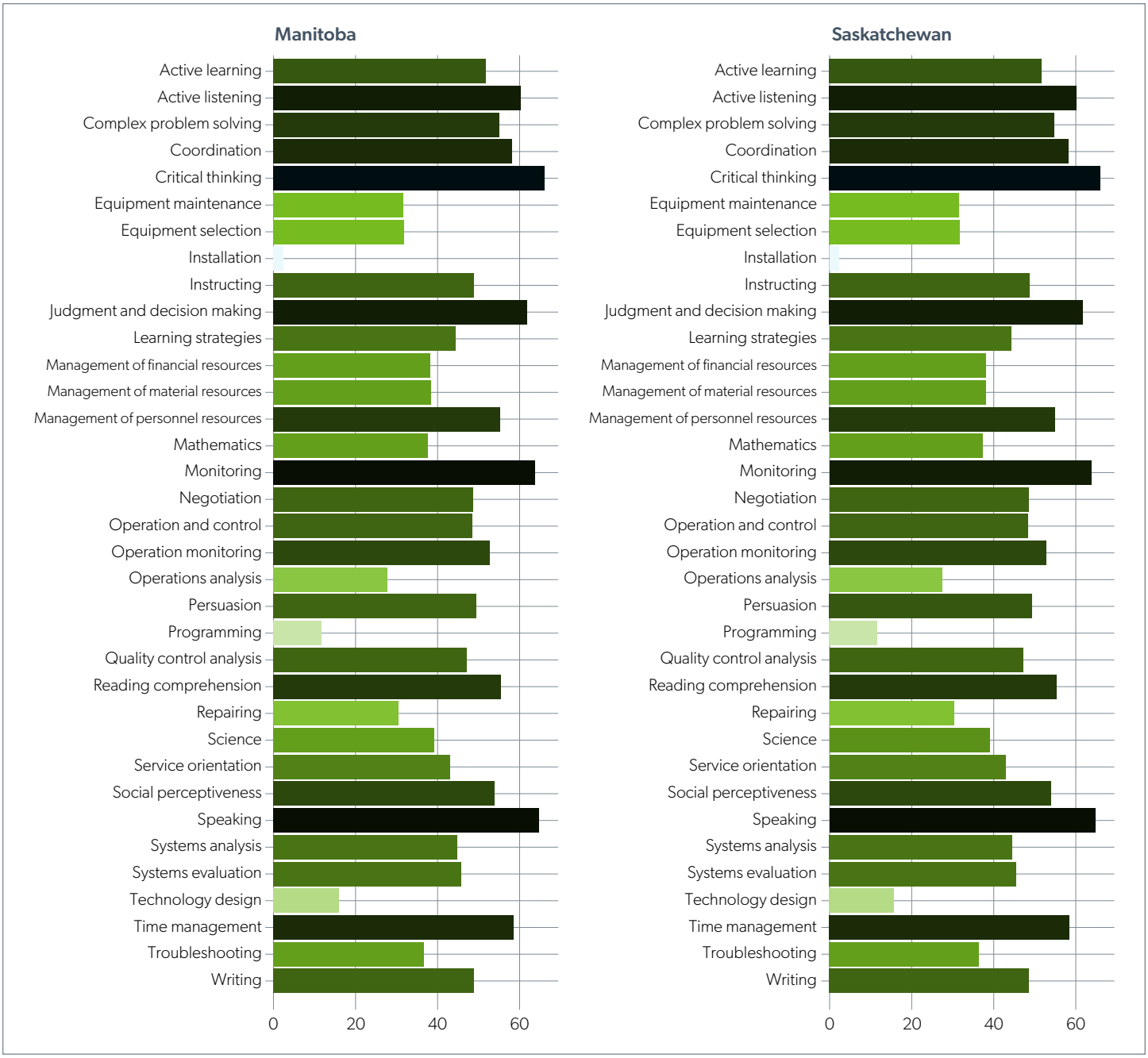
Table 3. Employment numbers in Manitoba and Saskatchewan in 2021 for select relevant National Occupational Classification (NOC) occupation groups from Statistics Canada's 2021 Census.[102]

Previous NOC code	Occupation - Unit group - NOC 2021	Manitoba	Saskatchewan
1215	12013 Supervisors, supply chain, tracking and scheduling coordination occupations	980	590
152	1440 Supply chain logistics, tracking and scheduling coordination occupations	8,460	6,520
2121	21110 Biologists and related scientists	1,185	1,040
621	60020 Retail and wholesale trade managers	13,145	11,705
6221	621 Specialized sales occupations	2,820	2,310
6411	641 Retail salespersons and non-technical wholesale trade sales and account representatives	22,730	18,710
821	80020 Managers in agriculture	12,265	24,610
8252	82030 Agricultural service contractors and farm supervisors	170	280
8252	84120 Specialized livestock workers and farm machinery operators	3,895	6,720
8611	85101 Harvesting labourers	480	305
911	90010 Manufacturing managers	2,450	1,310
9201	92012 Supervisors, food and beverage processing	695	320
9461	94140 Process control and machine operators, food and beverage processing	1,765	1,255
9465	94143 Testers and graders, food and beverage processing	395	130
9526	94204 Mechanical assemblers and inspectors	1,445	740
9617	95106 Labourers in food and beverage processing	4,310	1,540

Agriculture

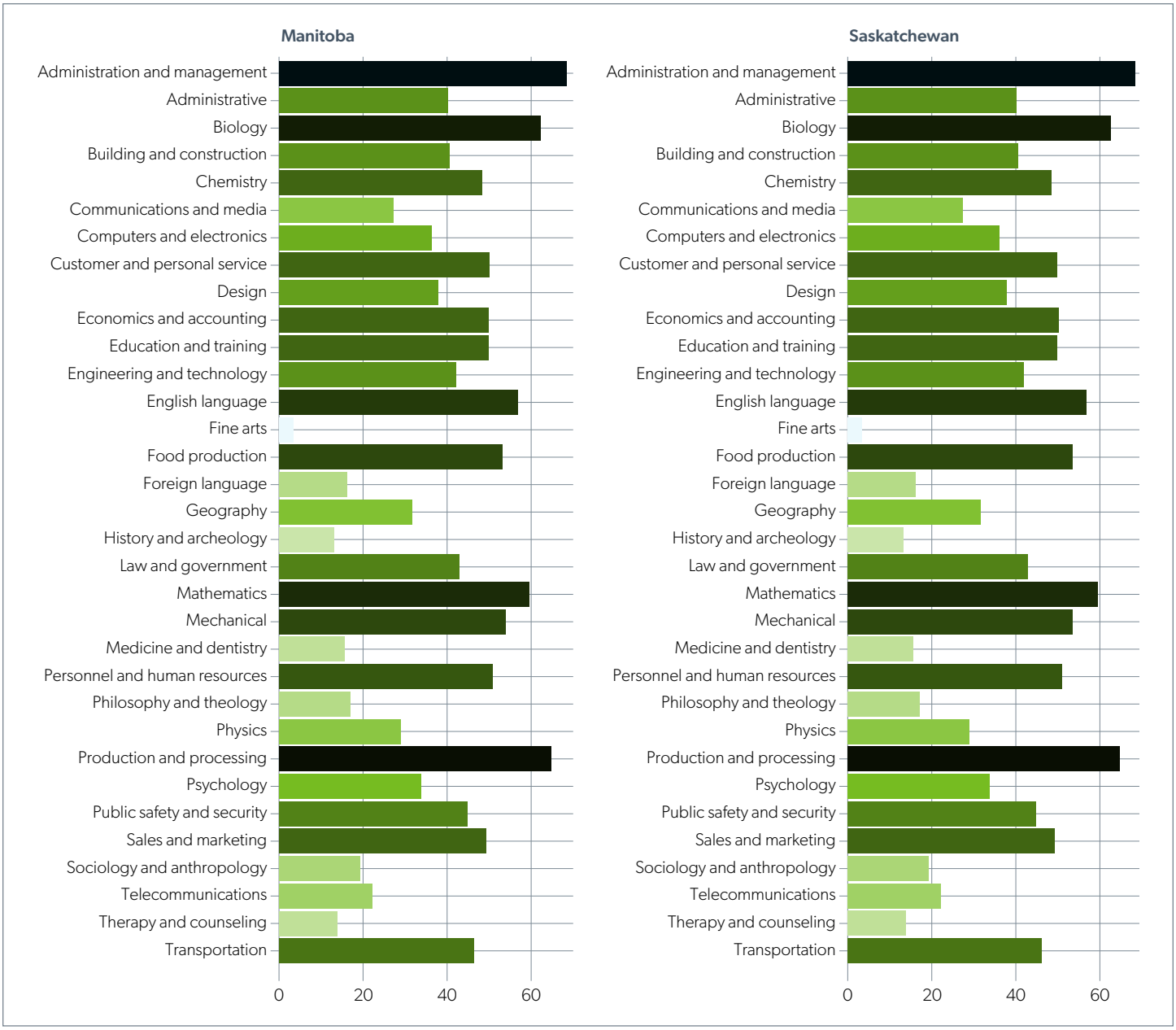
As noted, agriculture consists of the primary production of raw materials by farmers/owner-operators, farm labourers, technicians, agronomists, and associated professions. Currently, the four most important skills for workers in this sector are critical thinking, speaking, monitoring, and judgment and decision making (Figure 6). Other valuable skills for agricultural workers include time management and coordination (Figure 6). Skills related to being able to assess a situation and make reasoned decisions were important across the sector, but critical thinking, judgment and decision making, and monitoring were more important for workers in management positions such as farm supervisors and managers in agriculture (Figure 8)—jobs that are continuing to be needed more in the sector. Agricultural workers also have specific knowledge requirements, often around the understanding of managing a farm on both the business and agriculture sides. Alongside understanding the basics of biology and mathematics, top knowledge attributes include administration and management, production and processing, and food production (Figure 7).

Figure 6. The relative importance of skills within the agricultural sector in Manitoba and Saskatchewan (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. North American Industry Classification System (NAICS) codes include 1111 (Oilseed and grain farming), 1112 (Vegetable and melon farming), 1119 (Other crop farming), and 1151 (Support activities for crop production). The NOC codes with the highest employment in the LFS data include 821 (Managers in agriculture), 8252 (Agricultural service contractors and farm supervisors), and 8431 (General farm workers).*

Figure 7. The relative importance of knowledge attributes within the agricultural sector in Manitoba and Saskatchewan (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. North American Industry Classification System (NAICS) codes include 1111 (Oilseed and grain farming), 1112 (Vegetable and melon farming), 1119 (Other crop farming), and 1151 (Support activities for crop production). The NOC codes with the highest employment in the LFS data include 821 (Managers in agriculture), 8252 (Agricultural service contractors and farm supervisors), and 8431 (General farm workers).*

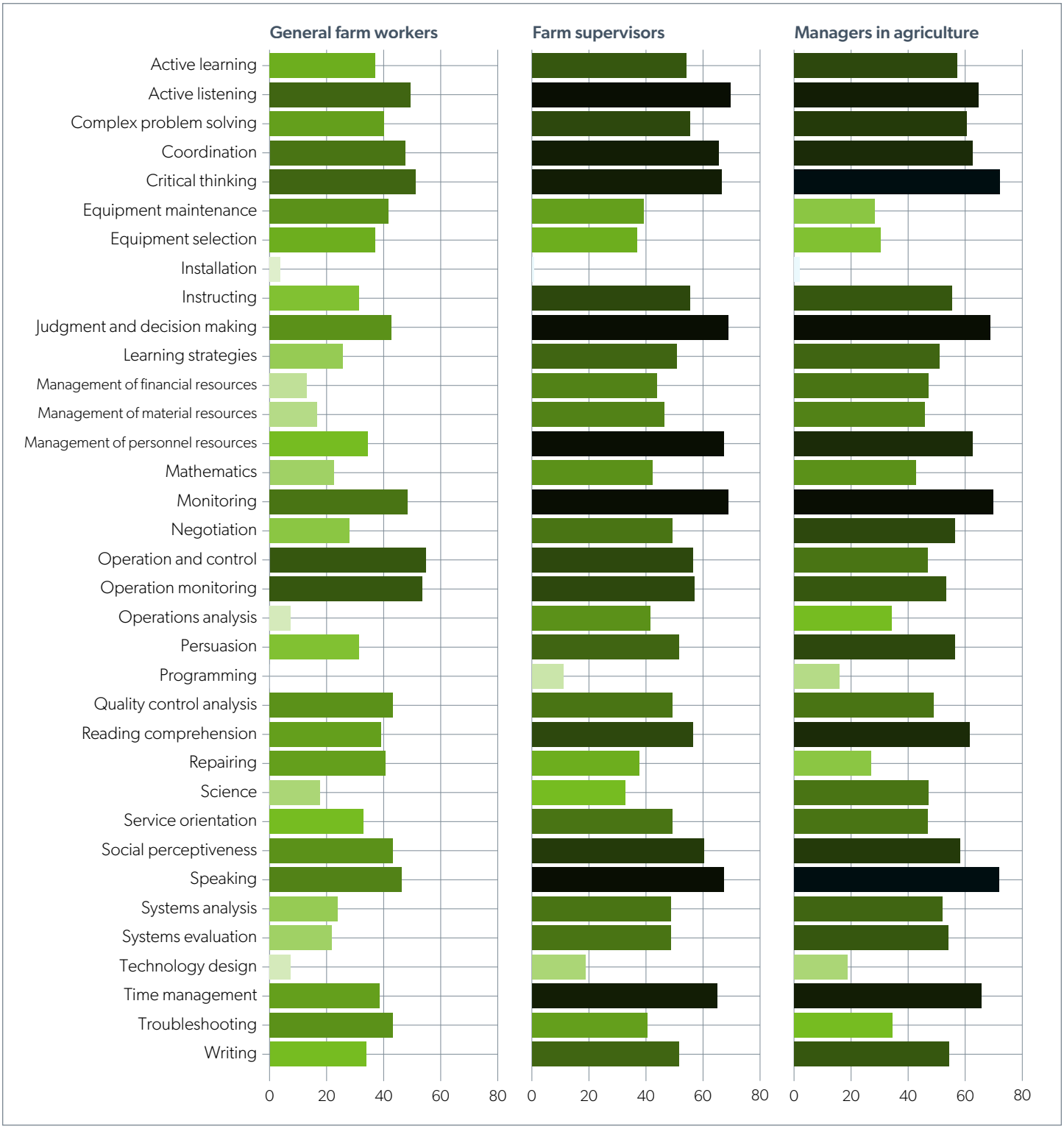
Current skills profile for agriculture workers

Occupations used in our analysis include General farm workers (NOC 84321); Agricultural service contractors, farm supervisors and specialized livestock workers (NOC 8252); and Managers in agriculture (NOC 0821). General farm labour is often the most common entry-level position for many farms in oilseed and grain farming. These positions often do not require any specific educational requirements (outside of an awareness of farm operations), but there are college certificates and specialized courses like farm equipment mechanics, agricultural welding, or pesticide application that are available to help workers gain skills. General farm workers not in a management position have different key skills, which relate more to being able to carry out manual jobs and looking for potential issues. These skills include operation and control, operations monitoring, and critical thinking (Figure 8).

Farm supervisors are not often the owners of the farm but may have their own separate business related to crop planting, soil preparation, or harvesting. Farm supervisors permanently employed on a larger farm are often in a supervisory role with several general farm workers or harvesting labourers. Farm supervisors on small or medium-sized farms however, may have no employees or just one employee. Common skills and competencies for this occupation are coordinating other workers, supervising growing and crop-related operations, organizing work schedules, hiring and training workers, and facilitating quality control processes, among other general farm tasks. This occupation often requires a college certificate like Agribusiness or Farm Management, or at least specific industry courses in agricultural studies combined with several years of relevant experience.[103]

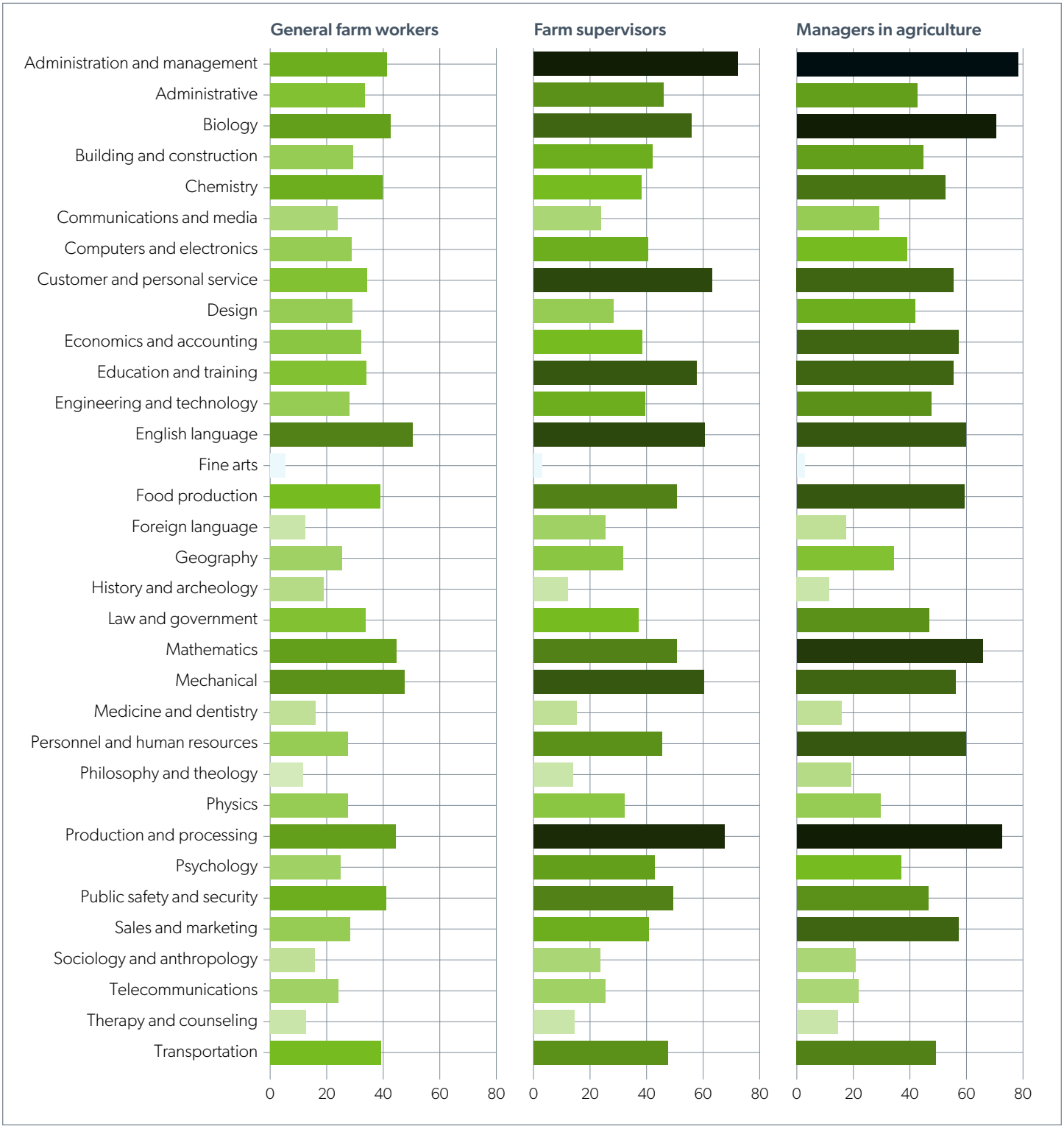
Managers in agriculture are often the owner-operators of their farms, and this job is one of the largest occupation categories in oilseed and grain agriculture. In 2021, there were 24,610 managers in agriculture in Saskatchewan and 12,265 in Manitoba (Table 3).[104] A considerable number of individual farms without employees would fall into this category. This role involves planning, organizing, and evaluating the operation of the farm. Managers in agriculture oversee growing crops, market their products, manage financial records, hire and train employees, purchase and maintain equipment, and determine the type and quantity of production. They often require extensive farming experience, generally working as a supervisor or other specialized crop worker, as well as a university degree or college diploma in agriculture or farm management.

Figure 8. The relative importance of skills for top occupations within the agricultural sector (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. The NOC codes with the highest employment in the LFS data include 821 (Managers in agriculture), 8252 (Agricultural service contractors and farm supervisors), and 8431 (General farm workers).*

Figure 9. The relative importance of knowledge attributes for top occupations within the agricultural sector (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. The NOC codes with the highest employment in the LFS data include 821 (Managers in agriculture), 8252 (Agricultural service contractors and farm supervisors), and 8431 (General farm workers).*

Future skills needs for agriculture workers

In terms of the changes and opportunities presented by PBP in Manitoba and Saskatchewan, primary agriculture skills will change slightly for the crops that become a greater part of the supply chain, specifically soybeans, dry peas, dry beans, and oilseeds like canola or sunflower. Some of these changes are because of wider trends in the industry, but others are more specific to PBP. Early conversations with stakeholders identified the trend towards farm consolidation and larger individual farms as affecting both the composition of the workforce and the skills workers require. Over the last twenty years, the total amount of farms in Canada has fallen significantly from 246,923 in 2001 to only 189,874 in 2021.[105] This almost 23% decrease in the number of farms has changed what skills are needed as roles on farms become more specialized and individual owner-operators are less common.[106] Larger farms will need more workers as well as more specialized workers, especially around farm mechanization. It has also increased the need for managers in agriculture to manage additional employees and larger acreages. A farmer who was previously able to run their farm alone now has a much larger farm with employees and will need additional skills, such as specific technical knowledge for large farm machinery, supply chain logistics, human resource management, and business skills.[107]

For farms producing crops for PBP products, grocery stores and other end-stage retail are beginning to include the analysis of Scope 3 emissions (emissions resulting not just from businesses' production and assets, but from impacts up and down the value chain like transportation, employee travel, and products' end-of-life waste) for their entire supply chain. Accompanying this shift includes sustainability requirements for fertilizer, farm products, and land use, which can be favourable for pulse crops due to their lower nitrogen and water needs.[108] As more production chain activities become domestic, businesses will need workers who can ensure compliance with these requirements and plan for logistics changes.

Through the survey, we examined future projections and perspectives on what jobs and skills would be needed to grow the PBP industry. From our respondents, the most in-demand positions for the next three to five years, in order, were labourers and machine operators in food and beverage processing, general farm workers, testers and graders in food and beverage processing tied with managers in agriculture, and then food science researchers. Future occupations of importance include supervisors in food and beverage processing, food product developers, sales representatives, and mechanical assemblers and inspectors. Within those identified occupations, we asked what would be the most in-demand skills and knowledge for these roles in the next three to five years, and several common results emerged. Across all occupations, judgment and decision making, as well as critical thinking, were often the two highest-ranked skills for workers.

Among entry-level positions, like general farm workers and labourers and machine operators, respondents thought that of the identified skills, time management, job-specific technical knowledge, and communications (both written and verbal) would be most in demand in the future. Job-specific technical skills in this context refer to things like farm operations or the use of agricultural machines (such as tractors or harvesters) for farm labourers. For labourers and machine operators in food and beverage manufacturing, it covers aspects of food production, ingredient fractionization, and the operation of machinery inside factories (like conveyor belts, extruders, ovens, and other equipment). This combination of soft and hard skills shows that even workers in entry-level positions will need to be more competent in a wider range of skills as more will be asked of them.

Managers in agriculture are projected to be one of the most needed positions and will require a wider range of skills and capacity in the future. Judgment and decision making, critical thinking, and job-specific technical knowledge for farm work were identified as the most important future skills. Keenly important for respondents was the need for skills regarding interpersonal relationships and communications. This is in line with increasing farm consolidation, where managers in agriculture will need to have a greater focus on communicating and managing their employees rather than an owner-operator running their farm business alone.

Manufacturing: ingredients and final products

Current skills profile for manufacturing workers

In terms of specific occupations crucial to the PBP supply chain, one of the most relevant at the entry-level is labourers in food and beverage manufacturing. In 2021, 4,310 labourers in food and beverage were employed in Manitoba and 1,540 in Saskatchewan (Table 3).[109] These workers fulfil entry-level production and processing tasks and generally only require a full (or even partial) high school education. Individuals with more experience or higher education levels may work as process control and machine operators, which often involve controlling machinery (single or multi-function) within factory operations.[110] These positions include control room operators, fermenter operators, grain processing, and pasteurizing operators. Occupations like mechanical assemblers and inspectors who are more involved in the factory design, construction, maintenance, and repair process than in the day-to-day operations of food manufacturing are also important components of this sector.[111]

Another major group of occupations for food manufacturing is quality control (QC) and quality assurance (QA) jobs, which are split between those inside of the production process (QA) and those outside of the process reviewing standards (QC). These include testers and graders in food and beverage processing, QC technicians, and QA technicians. In terms of management, workers can progress in their careers to become supervisors in food and beverage manufacturing with titles like foreperson, Hazard Analysis and Critical Control Point (HACCP) coordinator, floor supervisor, or team supervisor, and then into levels of higher management like manufacturing managers or general managers.[112]

Our research found that within manufacturing for PBP products, there are core competencies that are essential for many workers, from entry-level to managerial. Some of these include communications (both written and verbal), active listening, critical thinking, and operational awareness (Figure 10). For occupations involving machinery and factory operations, monitoring, digital literacy, and mechanical-specific knowledge are important. More specialized positions lead to more specialized skill requirements, with QC workers needing more scientific and safety skills, mechanical assemblers and inspectors requiring more problem solving and engineering knowledge, and managers needing to branch out into administration, management, speaking, communications, and production scheduling (Figures 12-15).

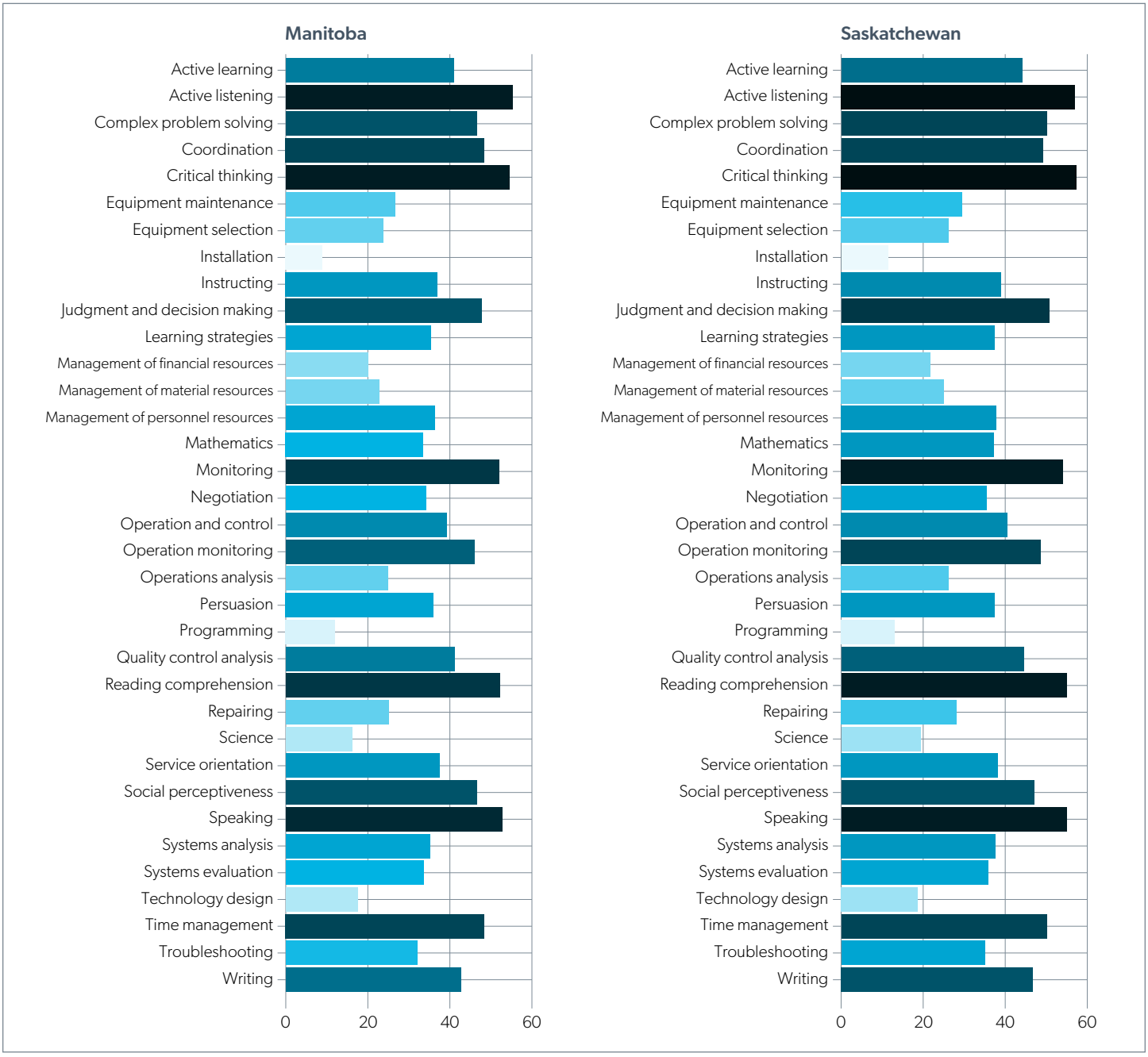
For formal education requirements, entry-level labourers often only require a high school education and may require some form of driver's license but not a commercial license. Process control, testers and graders, and machine operators also require high school education but may need supplemental college credits and relevant manufacturing experience.[113] QC workers often require some form of scientific background, either a diploma in food safety or an equivalent program, a degree in food science, or a specific certification, like the Workplace Hazardous Materials Information System (WHMIS) certification or HACCP certification for food safety.[114]

When discussing food manufacturing in Saskatchewan and Manitoba within the PBP industry, it is important to remember that these businesses are often small and medium-sized enterprises (SMEs). In 2021, of the over 7,800 food and beverage processing establishments in Canada with employees, the vast majority (91%) had 100 or fewer employees.[115] Our discussions with industry experts in Manitoba and Saskatchewan also suggested that a large number of food manufacturing businesses have far fewer than 100 employees. Of those remaining, only 8% have between 100-500 employees, and barely more than 1% have more than 500 employees, like Cargill, McCain, or Roquette.[116]

Similar to agricultural businesses, the size of the manufacturing company affects not just the type of workers needed but their required skill sets. For a small operation with only 4-6 workers outside of the owner, the workers may be cross-trained or expected to cover several tasks, like the machine operator also having repair skills and some quality control functions or the manager needing to also understand accounting, legal and human resources protocols, and other more specialized tasks.[117] At a larger company with dozens or hundreds of employees and where margins are higher, dedicated workers with specialized skill sets typically perform these tasks. Additionally, a larger company may have more resources to dedicate to formal on-the-job training and accreditation rather than more ad hoc arrangements. As such, the company could be willing to take in workers without as much experience, knowing that they have the capital and time to train them to their requirements.

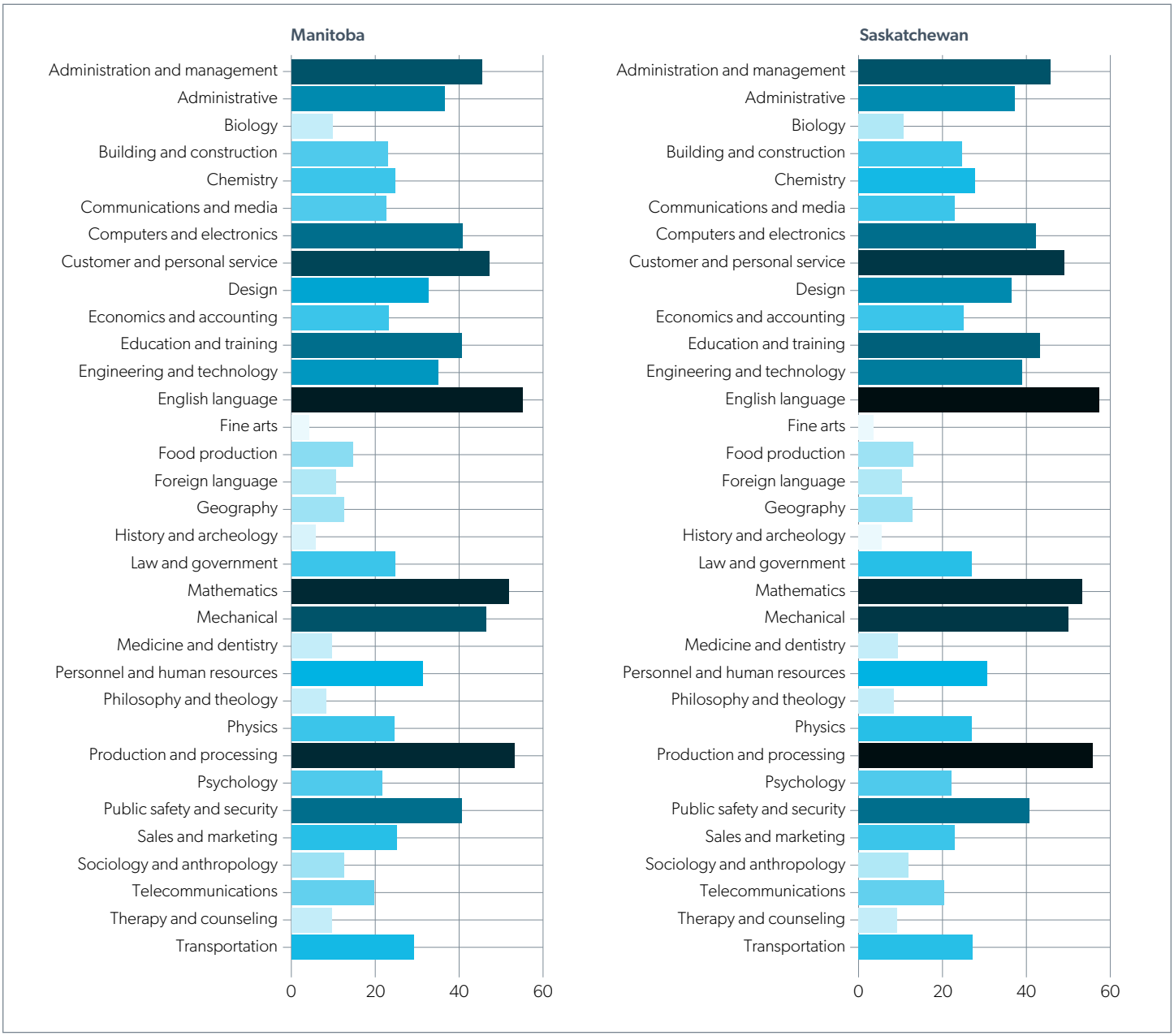
In Manitoba, food and beverage manufacturing is the largest manufacturing sector in the province, with almost 30% of all provincial manufacturing sales and directly employing 14,440 Manitobans in 2021.[118] In Saskatchewan, one of the largest components of their food and beverage manufacturing is ingredient processing and value-added manufacturing, which employs over 5,000 individuals and has around 300 provincial businesses.[119] Specifically, this sector is dominated by oilseed and grain milling, canola crushing, and pea fractionization, all of which are major components of the PBP supply chain. Provincial demographic breakdowns of the industry are unavailable, but from national estimates, the types of workers employed in food manufacturing are known to a degree. Almost a quarter of the workforce is aged between 55 and 64, immigrants comprise 31% of the national workforce, and more than half the workforce is employed as labourers, process control operators, machine operators, or factory plant workers.[120]

Figure 10. The relative importance of skills within the manufacturing sector in Manitoba and Saskatchewan (absolute scores, 0-100).



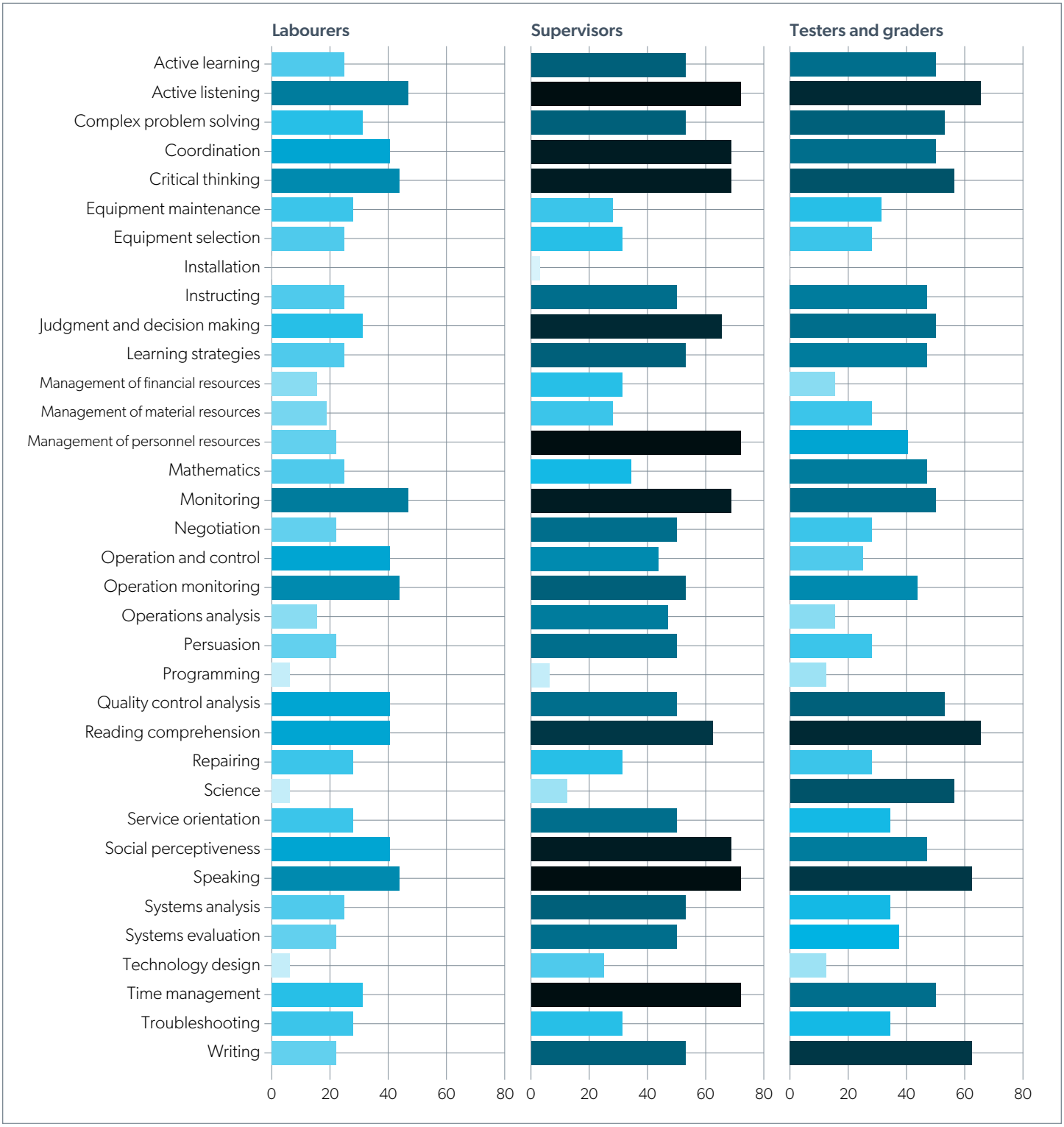
*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. North American Industry Classification System (NAICS) codes include 3112 (Grain and oilseed milling), 3114 (Fruit and vegetable preserving and specialty food manufacturing), 3115 (Dairy product manufacturing), 3118 (Bakeries and tortilla manufacturing), 3119 (Other food manufacturing), 3253 (Pesticide, fertilizer, and other agricultural chemical manufacturing), and 3331 (Agricultural, construction and mining machinery manufacturing). The NOC codes with the highest employment in the LFS data include 9461 (Machine operators, food and beverage processing), 9526 (Mechanical assemblers and inspectors), 7237 (Welders, brazing and soldering machine operators), 7452 (Material handlers), 7311 (Construction millwrights and industrial mechanics), and 9617 (Labourers in food and beverage processing).*

Figure 11. The relative importance of knowledge attributes within the manufacturing sector in Manitoba and Saskatchewan (absolute scores, 0-100).



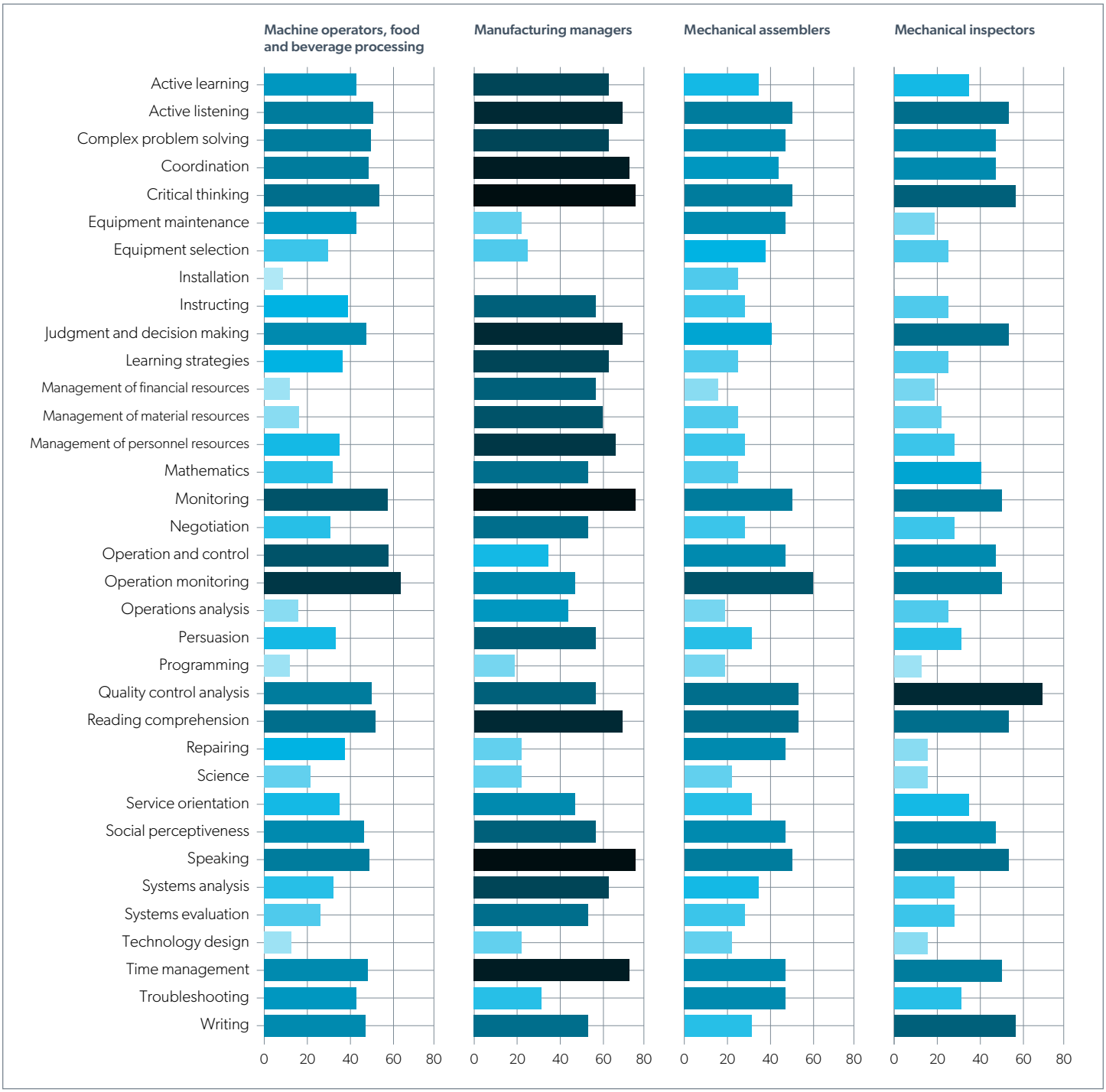
*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. North American Industry Classification System (NAICS) codes include 3112 (Grain and oilseed milling), 3114 (Fruit and vegetable preserving and specialty food manufacturing), 3115 (Dairy product manufacturing), 3118 (Bakeries and tortilla manufacturing), 3119 (Other food manufacturing), 3253 (Pesticide, fertilizer, and other agricultural chemical manufacturing), and 3331 (Agricultural, construction and mining machinery manufacturing). The NOC codes with the highest employment in the LFS data include 9461 (Machine operators, food and beverage processing), 9526 (Mechanical assemblers and inspectors), 7237 (Welders, brazing and soldering machine operators), 7452 (Material handlers), 7311 (Construction millwrights and industrial mechanics), and 9617 (Labourers in food and beverage processing).*

Figure 12. The relative importance of skills for top occupations within the manufacturing sector relevant to food and beverage processing (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. The NOC codes included in Figure 12 are 9617 (Labourers in food and beverage processing), 9213 (Supervisors, food and beverage processing), and 9465 (Testers and graders, food and beverage processing). Listed NOC codes were derived from supply chain analysis and prominence of occupations in data from the Labour Force Survey.*

Figure 13. The relative importance of skills for top occupations within the manufacturing sector relevant to food and beverage processing (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. The NOC codes included in Figure 13 include 9461 (Machine operators, food and beverage processing), 9526 (Mechanical assemblers and inspectors), and 911 (Manufacturing managers).*

Future skills needs for manufacturing workers

Several trends have been identified as affecting the future skills needed for PBP manufacturing. One of the most important trends is the increased automation and mechanization of food processing and agri-food manufacturing plants. These changes will require workers who are able to maintain, repair, oversee, and improve the new machines as those machines and technologies become more involved in the production process. Through our conversations and research, employers and industry experts have indicated that for smaller-scale operations, they think the number of workers will not change with automation. Rather, the skills workers need will shift. We expect that the types of skills will be highly transferable from other sections of food manufacturing or even other non-consumable manufacturing. What will also change from these trends is the addition and combination of techniques and practices from other industries, such as the grading requirements for pea milling or canola crushing, in addition to food safety, quality standards, and refrigeration of processed foods or meat manufacturing.

For the PBP industry to grow, technology that increases efficiency will be necessary to meet projected global demand and for businesses to scale up to a more sustainable size. In our survey responses and conversations, employers also highlighted that workers with the skills, confidence, and autonomy to make in-line mechanical improvements to the production process would be highly in demand for their combination of mechanical and food production knowledge.

Another trend observed is the need for more workers with scientific experience in both product research and quality control. Given the rapid pace of innovation and experimentation in this sector, from fermentation to die extrusion to dry fractionation with electricity, companies will need more workers who are able to navigate new technologies as well as specialists who can work to develop new products and methods. On the production line, occupations like testers and graders and QA/QC specialists will need greater technical and scientific literacy to support these new products and to manage the production process. As regulations change around adding more PBP products to the market, regulators may shift and adjust relevant regulation and safety protocols, such as WHMIS or HACCP, or those protocols may apply to businesses where it was not as relevant before.

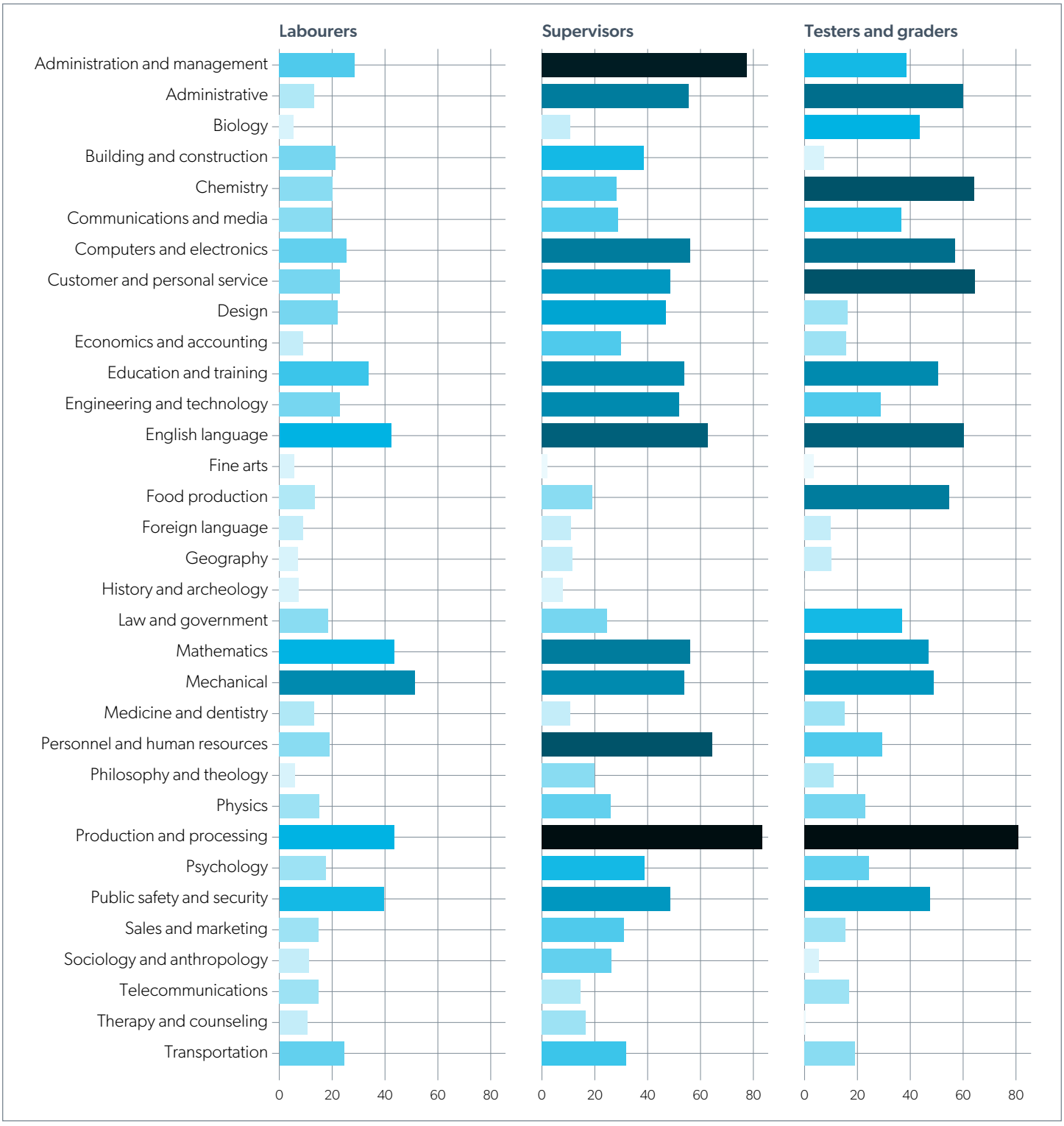
Additionally, PBP businesses will need to find market niches, understand consumer demand, and market their products effectively. Because of the relative newness and constantly developing nature of PBP products, many consumers are still not fully aware of PBP products as a food option or the health or environmental benefits of consuming them. In our survey, several respondents highlighted that finding specialized sales, marketing, or supply chain workers with PBP knowledge was already difficult, and it would only become more acute as companies grow larger and encounter greater market competition.

For food manufacturing, we expect that outside of the general increase in employment that the PBP industry promises for Manitoba and Saskatchewan, there will also be shifts and changes in the required occupations. One expected trend driving occupational changes is how companies will work around the entry-level labour shortage through specialization or automation. These entry-level labourer positions are some of the ones most at risk of automation given their lower relative wage and technical skill requirements. Stakeholders have stressed though, that as companies mitigate their employment shortage through more factory automation and machinery, they will need more technicians, mechanical engineers, and machine operators to handle the automation. Some industry groups have even speculated that this automation will not increase or decrease the net jobs required by SMEs but instead shift which occupations businesses need.[121] Smaller companies have less capacity to hire new workers, which means that they may struggle to find workers who can repair, operate, and improve such technology compared to large multinational companies.

Another common response was the need for more technically skilled and educated workers, specifically in occupations like biologists and food safety inspectors and managers. These positions would help businesses ensure the quality of their products as well as help tailor future products to the demands of customers and any changing requirements or regulations for PBP products. Recent graduates with scientific or biology research backgrounds have an abundance of options available to them in other industries, so if food manufacturing remains less competitive in salary, benefits, and value of work, this cross-sectoral discrepancy may act as a bottleneck for the industry.

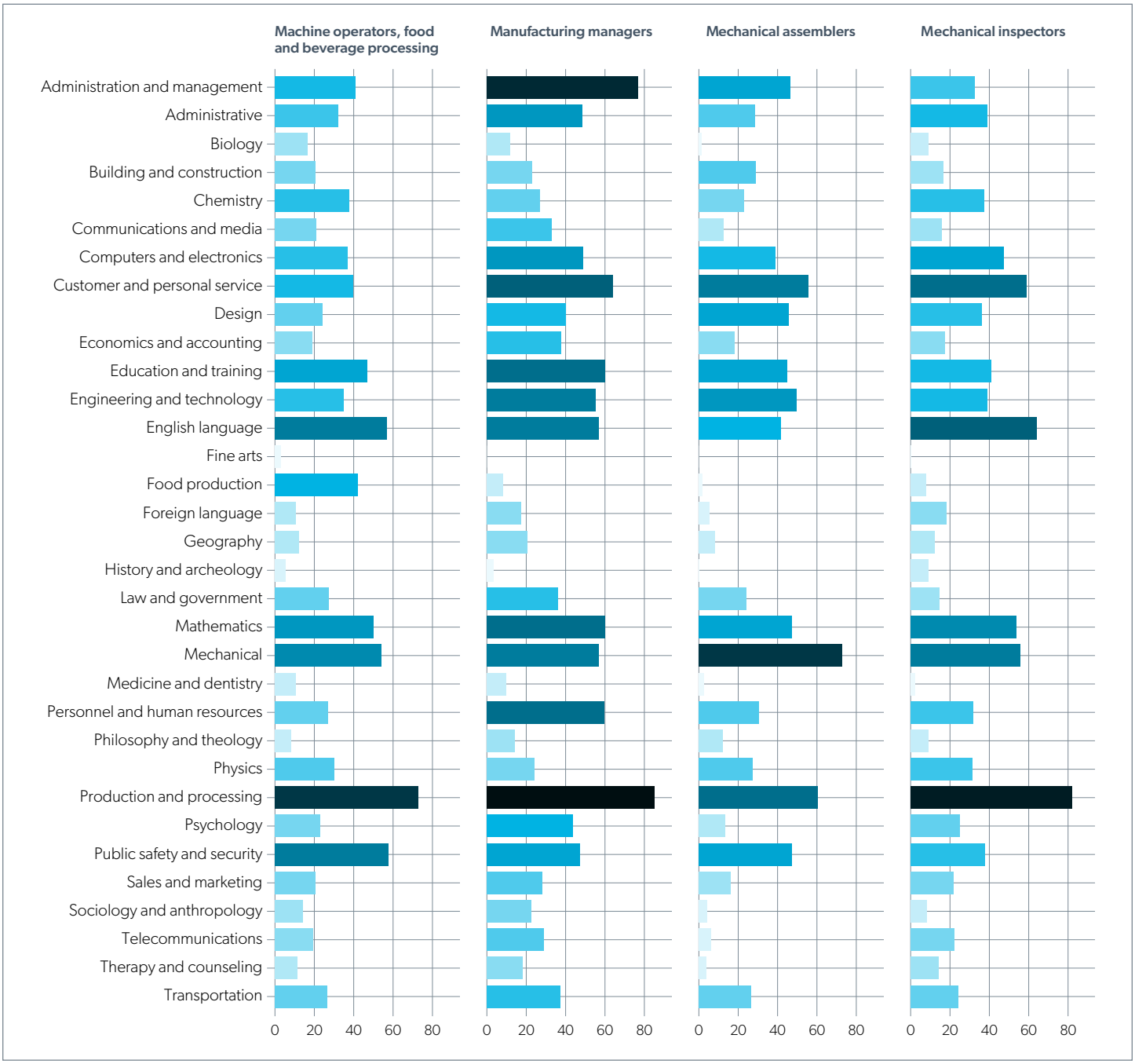
The size and composition of the PBP industry in the next decade will also drive the types of occupations needed. Much focus and investment have been put towards large single-company factories like Roquette, AGT Foods, or McCain, but according to Food and Beverage Manitoba, 80% of such businesses in the province have fewer than ten employees, and 70% are SMEs.[122] As noted, smaller companies will require workers to have a greater range of skills, and the workers they employ will reflect this need. The machine operator at a small factory may also need to be the QC specialist, or the general manager may also need to act as the sales and accounts representative. The largest companies however, will have the capacity to hire more specialized workers and even recruit workers from other smaller businesses within the community. This competition for workers could reduce the industry's overall growth prospects if no new workers join the labour pool. Additionally, as the technology required for research and production increases, there will be less variety in the types of PBP businesses that can get off the ground. Capital-intensive start-ups may be able to acquire the funding needed to competitively recruit experienced workers, but the lack of a broader occupational ecosystem may prevent the PBP manufacturing sector from developing internal capacity and may reduce worker choice.

Figure 14. The relative importance of knowledge attributes for top occupations within the manufacturing sector relevant to food and beverage processing (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. The NOC codes included in Figure 14 are 9617 (Labourers in food and beverage processing), 9213 (Supervisors, food and beverage processing), and 9465 (Testers and graders, food and beverage processing).*

Figure 15. The relative importance of knowledge attributes for top occupations within the manufacturing sector relevant to food and beverage processing (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. The NOC codes included in Figure 15 include 9461 (Machine operators, food and beverage processing), 9526 (Mechanical assemblers and inspectors), and 911 (Manufacturing managers).*

Research & development

Research and development, especially conducted by plant geneticists, food scientists, and product researchers, is a major component of the PBP supply chain and critical to the PBP industry's success and growth. Crop scientists work to breed plants that are suited to Canada's unique climate, produce more per acre, and are more resistant to common diseases. They also breed plants to create varieties with traits preferable for PBP manufacturing, such as a more neutral flavour or more protein content. Food scientists are also important as they work on how processed plant proteins can be made into various food products—from precision fermentation techniques to refining texture qualities to removing unwanted flavours. Other research may include improving the nutritional value of these processed products.

Current skills needs

Conversations with key stakeholders and experts have expressed a significant need for workers at all levels of research and development. Product development encompasses several categories of work—from optimizing equipment and processing techniques to planning for market trends and entering new markets—and can be involved in many steps along the supply chain. This process of creating new products and formulas is key for scaling up as it generates new intellectual property, patents, and products that can be then sold, expanded, or exported.

Within this area of the supply chain, there are several essential occupations for the PBP industry. At the earlier stages of the supply chain, agronomists work on developing new crops and new agricultural methods. Occupations important to the design and research process are food science technicians, biologists, and related scientists who work to develop new products and production methods as well as test existing formulas and recipes to improve product quality and appeal.[123] Within the production process, one major occupation is testers and graders who review the quality of incoming materials and ingredients to ensure the consistency of products. On the production line, there are QA and QC workers who monitor the entire production process to ensure regulatory and safety standards are being followed, as well as work to improve the efficiency and safety of the overall process.[124]

Occupations within research and development often involve more formal education when compared to non-management occupations within the PBP industry. Generally, at least a bachelor-level education in some form of scientific discipline, such as biology, chemistry, biochemistry, or food science, is required for product researchers.[125] Still, sometimes this requirement can be substituted for a specific food technology diploma or college program. Positions at larger companies, companies with more technologically advanced production processes, or companies with on-site laboratory testing facilities may require graduate-level education. QC or QA workers also generally require a bachelor-level of scientific expertise or a college diploma, but often do not need to be as specialized as food researchers.[126] More entry-level workers, like testers and graders, often do not have the same educational requirements as other positions outside of a high school education. However, they may find it difficult to progress within research and development without more specialized education.[127]

Future skills needs

In terms of skills, these research occupations tend to require the ability to work independently, utilize critical thinking and problem solving, and have strong communication skills (specifically listening alongside written and verbal). These occupations will often be given broader objectives and will have the autonomy to pursue company objectives and research goals. Across all types of QA/QC occupations, a strong awareness of systems analysis, technical knowledge of the production process, and monitoring control are beneficial competencies, as are formal workplace safety certifications like WHMIS and HACCP.

It is challenging to get empirical estimates for the number of biologists, food technicians, and product researchers working in Saskatchewan and Manitoba solely on PBP. Often, these positions are not listed separately from total employment, and the 2021 LFS data identified only a few hundred workers in each province as biologists, food technicians, or product researchers for the identified industry codes.[128] However, there is some sign that demand for these services and occupations has increased in recent years. The Saskatchewan Food Industry Development Centre, an organization providing expertise and laboratory space to food production companies, stated in their 2021 annual report that in 2021, they had 116 clients in product development, processing, extrusion, and ingredients as compared to 93 in 2020 and that those clients were often utilizing multiple technologies and services.[129]

The manufacturing of PBP products is still an emerging field, with many products in North America entering the market within the last ten years.[130] Up to this point, there has been immense amounts of research and product development to develop consumables that are healthy, reach a wide audience, and fit existing consumer desires. As newer companies in the Canadian ecosystem emerge and as the industry expands, businesses will need to find their market niche and their consumers amid wider competition. The need to create new intellectual property in their recipes and to adapt to match market demand will only push more investment into research. However, this will make entry into the market for newer companies more capital-intensive as they need more up-front costs for laboratory equipment, skilled researchers, and time to develop their products before scaling up to commercial production.

As the industry develops going forward, the need for these new and more specific products will require a greater amount of research and development and, thus, more specialized and skilled workers. This may lead to intra-industry competition as smaller companies may find themselves competing over the food scientists and biologists already working in food development. Unless the industry can expand to have greater investment potential outside of the massive companies like Roquette or

AGT Foods, these SMEs may find it difficult to have the capital needed for attracting these workers into the industry or the higher research and development costs. Companies may need to find cross-training or upskilling opportunities for existing workers if they are unable to attract workers with these scientific backgrounds into food manufacturing. One final concern for businesses is around the changing nature of regulatory requirements for new products. Though Canadian Food Inspection Agency licences are relatively easy to obtain for most businesses, some newer products can take more time to get approval for wholesale consumption, which can strain smaller companies operating close to margins. Additionally, some companies worry that as environment, social, and governance (ESG) requirements and consumer dietary restrictions like vegan or gluten-free diets become more common, additional workers who are aware of such regulations and can ensure product compliance will be required.

Distributors & suppliers

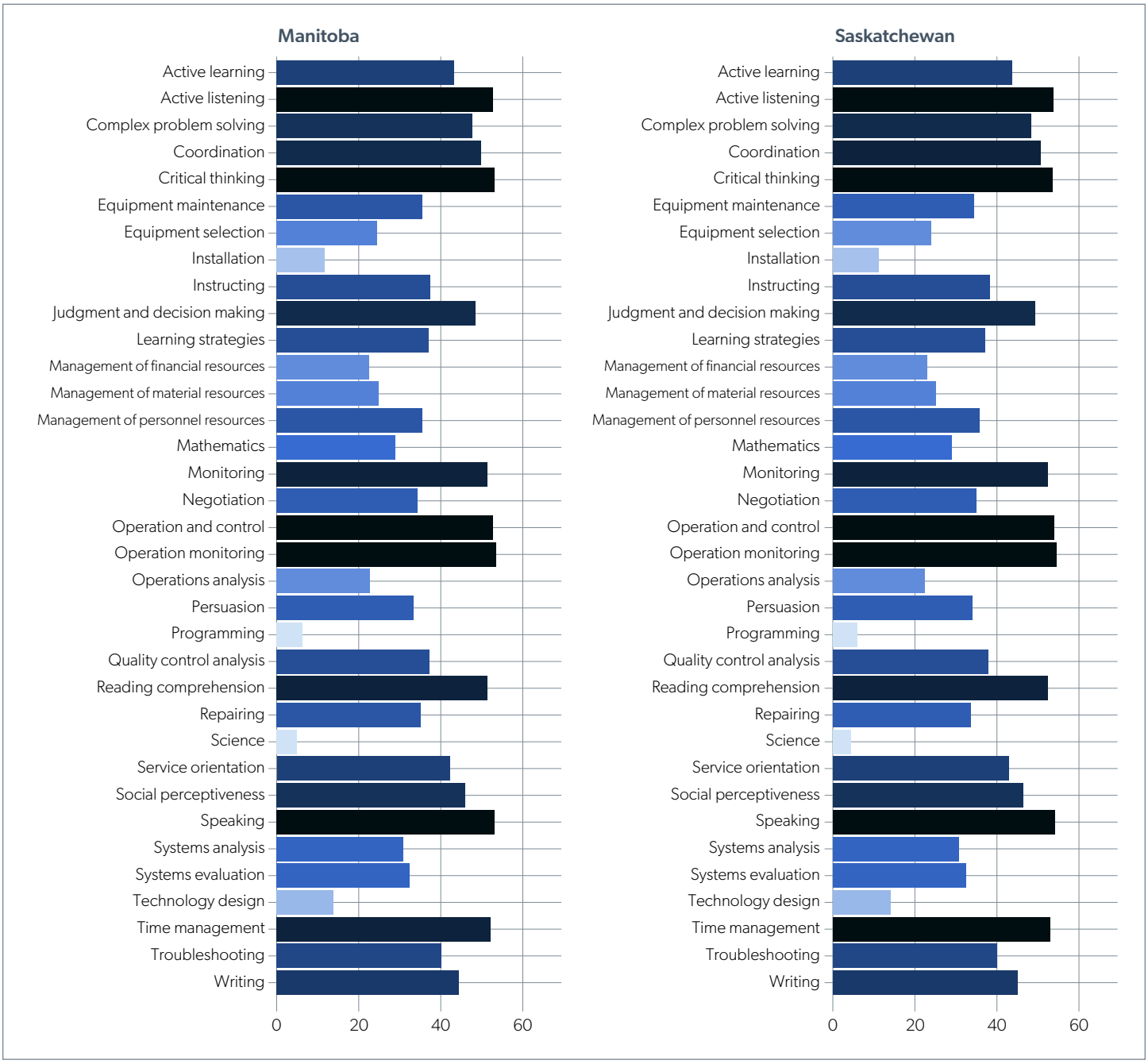
Distributors and suppliers form an essential component of the PBP supply chain. From farm to mill to factory to retail, workers will need to distribute and organize the components of what is eventually eaten by consumers or exported to other countries. A robust sector of businesses ranging from warehouses to grocery suppliers to rail and truck transportation already exists in both Manitoba and Saskatchewan, and many businesses have their own in-house staff specializing in these parts of the supply chain.

Current skillsets for distributors and suppliers

Specific occupations involved in entry-level distribution and supply chain management are material handlers and store shelf stockers, which are often referred to as package handlers, loaders, pallet lift operators, storage persons, or warehouse workers.[131] Further up the distribution career progression, similar to manufacturing, more experienced workers are in positions such as testers and graders, food and beverage processing, logistics workers, shippers and receivers, and purchasing and inventory control workers.[132] For supervisory and management occupations, there are supply chain and scheduling supervisors, head shippers, logistics supervisors, warehouse supervisors, warehouse managers, inventory managers, and facility operation managers.[133]

Our research found that distributors and suppliers have very similar skill sets to manufacturing, with active listening, speaking, and critical thinking being very important to core occupational duties (Figure 16). Also important for both sectors are the more process-focused skills of coordination, operations monitoring, and reading comprehension (Figure 16). Entry-level positions often only require high school diplomas and do not include specific training like WHMIS or HACCP. Positions like logistics workers, shippers and receivers, and supply chain coordinators often require slightly higher levels of monitoring, communications, and operations management skills and knowledge, alongside higher levels of work experience and training certificates, like WHMIS or HACCP.

Figure 16. The relative importance of skills for transportation and warehousing in Manitoba and Saskatchewan (absolute scores, 0-100).



*Source: Analyzed using the United States Occupational Information Network (O*NET) and Employment and Social Development Canada (ESDC) correspondence concordance table between the Canadian National Occupational Classification (NOC) and US O*NET. North American Industry Classification System (NAICS) codes include 4821 (Rail transportation), 4841 (General freight trucking), 4842 (Specialized freight trucking), 4882 (Support activities for rail transportation), 4884 (Support activities for road transportation), 4889 (Other support activities for transportation), and 4931 (Warehousing and storage). The NOC codes with the highest employment in the LFS data include 7511 (Transport truck drivers), 7305 (Supervisors, motor transport and other ground transit operators), and 7452 (Material handlers).*

Future skills needs

Regarding our skills and occupation findings in distribution, supply chain management, and research and development, we found that these areas are relevant for new and existing businesses in PBP manufacturing and processing companies. As the sector expands, some larger businesses like Roquette or AGT Foods will have a greater in-house capacity for their own dedicated distribution and supply chain workers. In contrast, smaller companies might have to rely on cross-training or retraining existing workers into these skills as well as relying on specialized businesses in these areas.

While we do not expect the fundamental skills required of such businesses and their workers to change because of the PBP industry, in scenarios with more aggressive growth, the PBP industry will need to expand to add workers with these skills. However, there are major future workforce challenges for businesses seeking to expand or even just maintain the same level of production. Research from Canadian Agricultural Human Resource Council (CAHRC) on their National Workforce Strategy found that food and beverage manufacturing is short approximately 20% of its workforce even after recovering from losses due to COVID-19, and this does not include any future growth from the PBP industry.[134] One skills change that we predict will deeply affect distributors and suppliers is the impact of automation and digitization on supply chain and storage management. As automated facilities become more common, entry-level positions like material handlers are more at risk of being replaced through automation.

Box 4

Other impacted sectors

Plant-based protein will also have an impact on sectors not directly in the simplified supply chain diagram, including transportation, utilities, and retailers. We do not expect these three sectors to face a similar degree of occupation and skills changes, but they will be impacted nonetheless. Transportation is important for all stages of the PBP supply chain. Operations monitoring, time management, and critical thinking were at the top of our analysis as essential skills for this sector (Figure 16). One key occupation is supervisors in supply chain tracking and scheduling, who will serve a key role in connecting the production process with the sales component of any business. The skills needed for PBP are projected to be very similar to other food transportation services, but there will be some differences around the handling of products and the management of health and safety requirements.

One sector which may not require additional changes to its skills profile but may require more workers is the utilities sector. As new factories and facilities are built in more rural or remote locations, more workers will be needed to expand the road and rail systems as well as the crucial power, water, natural gas, and internet infrastructure. Much of pea fractionation and other ingredient processing requires a large amount of water and wastewater processing, which smaller municipal water systems and their connected sewage networks may not be prepared to accommodate. For workers in utilities, we found that operations monitoring, active listening, and critical thinking would be some of the most crucial occupational skills outside of specific technical expertise (Appendix D).

End-stage retail, either in the form of grocery stores or restaurants, is another component of the PBP supply chain where we do not expect that the expansion of PBP products will require changes to skills or the labour force. There is a wide range of skills, occupations, and competencies across the sector, and while PBP will hopefully become an increasingly large component of their offerings, it will not change these underlying job requirements or the amount or types of positions. One potential trend we found from the survey was the projected increase in demand for dedicated sales and account representatives with knowledge of PBP products, as well as experts in supply chain tracking and scheduling, sales fulfilment agents, and business support specialists. Time management and a strong understanding of the operations process were two of the most important future skills for these occupations (Appendix D). Also identified were communications skills, interpersonal relationships, and job-specific technical knowledge, which may cover several logistics, design, communications, and procurement processes.

Outlook for workers around PBP opportunities

The growth of the PBP opportunity will have impacts on the entire supply chain, as well as on specific sectors. While this report has so far identified changes through each sub-sector of the supply chain, trends such as labour shortages will also impact every sub-sector throughout the supply chain. This section offers insights into the major challenges that will face every aspect of the supply chain, as well as the barriers holding back workforce planning.

One of the greatest limiting factors for this industry is the labour shortage. There is a current labour gap that keeps widening—Canada's agriculture sector was short 63,000 workers in 2017 and this may grow to 123,000 by 2029, equivalent to one in three jobs being unfilled.[135] The primary agriculture sector loses approximately $2.9 billion in revenue annually because of labour and skills shortages.[136] In 2017, 1,100 jobs in Manitoba's agriculture sector were unfilled, and by 2029, 33% of the workforce will likely retire and there may be 5,300 jobs unfilled from existing vacancies or retirements,[137] equivalent to one in five agriculture jobs going unfilled.[138] Shortages span from general on-farm labour to specialized roles like agriculture engineers, large animal veterinarians, agronomists, and supply chain developers who deal with supply chain logistics.[139] Some typical aspects of this sector that are contributing to the labour shortage include its rural and seasonal nature, older-than-average workforce, and just-in-time supply chains.[140]

There are also major upcoming demographic changes that will amplify the labour shortage issue. In 2021, compared to the Canadian median worker age of 41.6 years old, the median age of farm operators was 58.0.[141] The proportion of farm operators aged 55 years and older has risen to 60.5% of total operators from its 2016 level of 54.6%, and the percentage of young operators (under 30) has fallen from 9.1% in 2016 to 8.6% in 2021.[142] This gap between the number of older workers and new entrants has significant implications for the labour needs of this sector. Manitoba and Saskatchewan both project major labour shortages in the near future. Manitoba's 2020 labour market outlook projects that by 2025, there will be 26,500 unfilled job openings within agriculture, the majority of which arise due to a lack of replacements for retiring workers.[143] A similar situation is found in Saskatchewan, with their provincial forecast predicting that by 2023, agriculture will have 8,300 new job openings from replacement needs and there will actually be a net reduction in total employment.[144] For context, in 2021, there were 24,610 managers in agriculture in Saskatchewan and 12,265 in Manitoba; 6,720 specialized livestock workers and farm machinery operators in SK and 3,895 in MB; 305 harvesting labourers in SK and 480 in MB; and 280 agricultural service contractors and farm supervisors in SK and 170 in MB (Table 3).[145]

There is also a labour shortage in manufacturing. CAHRC's National Workforce Strategy found that the food and beverage manufacturing workforce is short by about 20%, even after

recovering from COVID-19 losses and not considering any future growth from the PBP industry.[146] These issues in agriculture and agri-food manufacturing will likely need a combination of many short- and long-term solutions to address.

The findings from our survey provide a present view of the landscape of current and future skills and jobs needed to grow the PBP industry. It also provides insights into other factors impacting worker recruitment and retention in Manitoba and Saskatchewan. Just over half of the respondents said that their organization is currently trying to hire managers in agriculture. This aligns with the Government of Saskatchewan's 2022 Detailed Occupational Outlook, wherein "managers in agriculture" was the occupation with the most job openings available.[147] About a third of the survey respondents said that their organization is trying to hire sales and account representatives. Managers in agriculture was the most difficult position to fill, while general farm workers and sales and account representatives were tied for the next most difficult position to fill.

As part of our survey, data was collected on the top skills stakeholders felt were most deficient for different occupations. For managers in agriculture, the gap between what companies needed and what workers had was largest for job-specific technical knowledge. The next biggest gap identified was a tie between judgment and decision making, administration and management, job-specific technical knowledge, and manufacturing operations and production. Critical thinking, communications (written and verbal), and interpersonal relationships followed as the third biggest gap. For general farm workers, judgment and decision making, alongside time management, were most lacking, followed by critical thinking and communications (written and verbal). For sales and account representatives, the biggest gaps were job-specific technical knowledge, followed by interpersonal relationships, then critical thinking alongside judgment and decision making, followed by time management.

When recruiting for hard-to-fill jobs, the key issues organizations encounter are, in order: a lack of applicants tied with candidates that lack "on-the-job" experience; difficulty relocating; and high competition for employees. Respondents commented that the "agriculture sector not being viewed as an attractive sector for career growth," unawareness of the opportunities available in agriculture, the current education system prioritizing soft skills over hands-on learning, and jobs being located in rural areas contribute to the lack of candidates. Finding qualified people with unique skills in rural areas can be difficult, as is recruiting them because urbanites often do not want to relocate. The most common strategies applied to overcome the lack of suitable candidates, in order, are financial incentives (for example, competitive pay, benefits, and so forth), hiring for attitude and training candidates on the job, accommodations for work/life balance, initiatives to recruit more diverse and traditionally underrepresented groups, and actively recruiting candidates from other companies in the same sector.

Over the past three years, about two-thirds of the respondents noted that the skills gap in the sector has increased. More than half of respondents have recruited individuals directly from school. Recent graduates often did not have adequate direct agriculture sector experience and associated farm knowledge, especially with specific technology tools. Changes to education curriculums and utilizing retraining/reskilling programs were voted to be the most effective strategies to close the skills gap in this sector, followed by international recruitment programs. Comments on measures to help close the skills gap include promoting agriculture as a career and emphasizing "the wide range of career opportunities available with technical diplomas and community college." Stakeholders flagged that some of the most crucial occupations to grow the current work related to PBP in rural workplaces are policy managers, sales people (either general or for agricultural technology (agtech)), and researchers in agtech or product development, showcasing the diversity of career paths.

All respondents agreed to some extent that employers have a responsibility to provide upskilling and/or reskilling programs for their employees. Half of the organizations surveyed provide upskilling or reskilling programs. Conversations with stakeholders identified that educational institutions provide training programs on an ad-hoc basis for businesses, but there remains a great deal of internal training due to the use of proprietary machinery and processes. The greatest incentive for providing these programs seems to be for employee retention. However, one respondent commented that companies want to be confident that individuals will stay at the company before investing in their reskilling. An additional respondent noted that reskilling is worthwhile, as losing an employee with accrued skills and knowledge is a loss of resources for them. The biggest barriers for over half of the respondents were cost and time. Another respondent commented that companies may not have the internal capacity to dedicate to retraining staff. A further respondent noted that it is currently unclear what skills will be most needed in the future. Another remarked that Canada is lagging in food and beverage manufacturing innovation and adoption, which is creating future labour and skills gaps. Of the respondents who provide training, a majority said they were delivering these training programs in-house (71% of responses), with fewer working with local educational institutions (43% of responses) or online resources (57% of responses). One positive note is that the respondents with training programs were generally optimistic about their workforces being prepared for the future.

There are some major limitations preventing workforce planning in this space, with the most pressing matter being the severe and chronic labour shortage. Due to the competition for labour in agriculture and agri-food manufacturing, stakeholders have stressed that "pretty much anyone" could be hired and trained on the job. This crisis mode means that many farms and manufacturing companies are focusing on meeting the immediate labour gap rather than planning for long-term labour needs or

discussing specific skills and occupations in a current or future context. Additionally, farms have traditionally been family-owned or operated by a single owner, so there was no need to define job titles and skills profiles because there was essentially no division of labour and workers would find a way to complete their wide range of tasks. Although the composition of farms is changing, farming will always be needed. Understanding the future jobs and skills needs will help with being prepared to embrace opportunities like those associated with value-added agriculture's PBP products.

One important note about labour shortages is the issue of wages in the agriculture and food manufacturing sectors. The Canadian national average wage per hour was $31.96 in 2022, as compared to agriculture's national average of only $21.75 per hour and manufacturing's average wage of $31.01 per hour.[148] During conversations with stakeholders, several mentioned that 60% of worker shortages in Manitoba were concentrated in roles that offer less than $20 per hour. By far, the greatest number of vacancies in Manitoba are positions that do not require post-secondary education. These jobs are often lower paying and include occupations like general farm and manufacturing labourers.[149] We also heard from stakeholders in food manufacturing that it was often difficult to recruit workers in skilled trades like welders, electricians, operations managers, and engineers from other manufacturing sectors, like oil and gas, due to the relatively lower wages found in food manufacturing. In 2019 in Saskatchewan, the occupation "managers in agriculture" was projected to have the most job openings (6,520) between 2019 and 2023, and their annual wage estimate was $27,200.[150] For comparison, the provincial median wage was $59,300.[151] However, in the Saskatchewan job outlook for 2022 to 2026, managers in agriculture still had the most job openings at 14,450, but the median wage is $28.85. This equals to roughly $60,000/annually based on 40 hours per week and year-round employment and is a sign of some progress on compensation for this position.[152] Many respondents stated that the lower cost of living in the Prairies means that although wages are lower than in many cities across Canada, the purchasing power per dollar is stronger. Greater scale and growth of businesses producing PBP products could help improve this issue, as we have heard anecdotally that companies like NutriPea, AGT Foods, and Roquette are able to pay higher wages than local industry averages. However, without wider growth in workers or businesses in this sector, there is a risk that this will only serve to cannibalize the existing manufacturing workforce and increase consolidation.

Box 5

Forecasting novel skills as a result of changes within the PBP supply chain

Within the survey, 92% of respondents said that employees in their organization could adapt to future skills needs in their sector, showing that stakeholders have confidence in their existing workforce but also recognize there will be changes workers will need to adjust to. However, respondents were not yet clear on how well new additions to the workforce would fare in learning existing agriculture and agri-food manufacturing skills or adapting to future skills needs. For those future skills needs, we asked respondents what they thought would have the most significant shortages in the next three to five years.

One of the results from our survey that came up most often was technical knowledge in the form of digital knowledge, specific production technologies like fermentation or die extrusion, and mechanical knowledge of machines and vehicles. Knowing how to repair and maintain equipment, especially as automation and mechanization become more common in agriculture and agri-food manufacturing and processing, is a necessity, and this skill set is often absent in more remote and rural communities. What also came up many times in the survey and our interviews was the need for start-ups to have workers with research and microbiological skills combined with the support services of incubators and accelerators.

Another knowledge competency brought up in survey responses was related to regulatory and ESG requirements within Canada and how smaller businesses and farms will need to navigate increasingly common sustainability requirements from larger grocery supply chains and comply with existing and new environmental standards. Finally, some respondents covered the more nebulous skills of workers being more adaptable and autonomous within their positions so that they would be better able to take advantage of opportunities and change with the business.

Recommendations

Based on the initial understanding of the growth opportunity, as well as feedback from surveys and interviews, recommendations have been developed to facilitate growth in the PBP industry for Manitoba and Saskatchewan. Addressing key sticking points that have emerged along the supply chain—specifically attracting and retaining workers in the industry and rural needs—will be particularly valuable in helping Manitoba and Saskatchewan continue to benefit from the PBP industry. These recommendations are targeted at addressing three challenges being experienced in the PBP supply chain: mitigating labour shortages, increasing sectoral awareness, and widening the definition of readiness for growth.

Mitigating labour shortages

One need that came to the forefront quickly in our research was the significant labour shortage in primary agriculture and food manufacturing in both provinces. A scarcity of workers across the economy means that employers are primarily focused on hiring workers and are less concerned about which industry-specific skills they possess, particularly for entry-level jobs. They are instead willing to train key skills on the job.

Short-term recommendations:

Temporary foreign worker (TFW) visas should be modified to allow for greater flexibility.

Currently, Labour Market Impact Assessments are required for the TFW program application, and this serves as a barrier to hiring for smaller companies and prevents labour mobility. Rather than being for a specific occupation inside of a specific geographic area, if Labour Market Impact Assessments was instead for a specific region and industry, like certain NAICS codes within the census metropolitan area of Winnipeg, it would be easier for companies to recruit workers and for those workers to find opportunities. This approach would help create more pathways to employment and give greater flexibility to employers and workers.

Upskilling and training programs for existing workers in agriculture should be better positioned around the planting season.

There are excellent agricultural training programs that exist in Manitoba and Saskatchewan, but many of them follow traditional enrollment and teaching periods. Shifting to providing smaller course components from November to March could allow shorter and more intensive programs in the areas of farm operations, food safety, and agronomy. Some provincial colleges, like Red River College, already offer micro-credential courses in several fields, but not in agriculture. This structure and its associated skills would need to be recognized by agricultural employers, and the initiative could be supported by provincial rebates or tax incentives.

Medium-term recommendations:

The federal Agri-Food Pilot program should be expanded and made permanent.

The Agri-Food Pilot is a pilot immigration program that offers a pathway to permanent residency for experienced non-seasonal workers in several industries and occupations, mostly around meat manufacturing. Making it permanent allows for future planning for both the province in terms of immigration and communities preparing to accept immigrants. Additionally, the

existing eligible industries should be expanded to include PBP manufacturing, such as NAICS 3112 (Grain and oilseed milling), 3119 (Other food manufacturing), and 3114 (Fruit and vegetable preserving and specialty food manufacturing) at the very least. The current focus on primary meat manufacturing is necessary for a pilot program, but a permanent version should address labour shortages in food manufacturing more broadly.

Saskatchewan should remove the post-secondary education requirement from the Occupations in Demand stream of their Provincial Nominee Program and add more positions around food manufacturing and ingredient processing.

An expansion of this program across other provinces could also help to mitigate concerns in Manitoba that workers are using this program to get permanent residency after a few years before moving elsewhere in Canada, so the remaining immigrants who enter via the Manitoba Provincial Nominee Program are less likely to leave. One additional example of a successful provincial immigration program that could be used in both Manitoba and Saskatchewan is the Alberta Rural Renewal Stream. This program explicitly aims to increase the number of immigrants settling in small towns and communities in Alberta and involves a collaborative application from municipalities and local businesses. The application must demonstrate the labour needs in these small towns and communities that cannot be met with local labour, and these same communities must show how they are prepared for workers to arrive, such as with local housing, settlement services, and housing availability.

Both Saskatchewan and Manitoba should implement automatic spousal work visas for high-need agricultural and manufacturing industries and create clearer pathways to permanent residency that will strengthen programs like the TFW Program and the Post Graduate Work Visa.

This would increase the available pool of workers, especially for more entry-level positions, and increase the ability of workers to settle in a community and put down roots. Both provinces have successful immigration pilots and policies, such as in Manitoba, where its Provincial Nominee Program already allows businesses to nominate workers for permanent residency even if they are working in Canada on a TFW permit or as international students. Saskatchewan also has its version of the Provincial Nominee Program, and both its Farmer and International Skilled Worker categories are excellent programs for newcomers but could be expanded along these lines.

Increasing sectoral awareness

Many stakeholders expressed a need to increase the understanding of the jobs available around the PBP supply chain. Numerous local stakeholders noted how new Canadians, international students, and recent graduates, among others, do not know the variety of careers available to them within their province in the agriculture and food and beverage manufacturing sectors of the economy.

Short-term recommendations:

Design more programs to attract students to careers in agriculture.

Attracting new workers begins with students, either in high school or post-secondary educational institutions. Students are often unaware of the wide range of careers available and might have inaccurate perceptions about what working in agriculture or agri-food would look like. This could be accomplished using a combination of existing curriculum coordination between industry and education, like Agriculture in the Classroom which provides accurate, balanced, and current curriculum-linked resources, programs and initiatives for students and educators at all levels.[153] The organization's Agriculture Literacy Month in March uses experiential learning for students of all grades to inform children about the realities of the Canadian agricultural system, the narrative of food security in Canada, and how they can get involved.[154] Coupling this type of informational content with the use of job fairs and experiential learning can help to encourage more students who are graduating high school to understand where they can start their career without additional training or education.

Existing and new programs need to tell a better story about why students should enter agriculture and agri-food.

Combining promotional materials that discuss the critical needs of food security, opportunities for career advancement, and the willingness for on-the-job training can help to encourage students and younger workers to enter these fields. These programs should also be marketed to post-secondary students in wider studies than those focused on agriculture. Making students in communications, biology, business, marketing, engineering, and other non-agronomy or agricultural-focused disciplines aware of the opportunities will help to bring in a wider range of potential workers with unique skill sets.

Medium-term recommendations:

Provincial governments should work with industry and educational institutions to develop work-integrated learning opportunities for students that include access to equivalent wage subsidies for international students.

Currently, international students are ineligible for federal wage subsidy programs like the Student Work Placement Program, and this prevents agricultural and agri-food industries from bringing on more students for hands-on learning. Work-integrated

learning opportunities help bridge the gap between education and the workforce by allowing students to learn key skills, gain experience in their field, and start working in a career of their choice. Businesses benefit by building up the next generation of workers and creating awareness of career opportunities. Educational institutions already partner with businesses to provide training programs on an ad-hoc basis, and this system could be formalized as well as provided with support in the form of financial incentives. This is a clear place for Manitoba and Saskatchewan to step up and fill this programming gap.

Widening definition of readiness for growth

What is also needed is an expansion of what is understood as infrastructure and readiness for growth. Normally, when we think of what is required for economic growth in a region or sector, we think about workers, factories, capital investment, or government regulation. However, there is much more to creating supportive communities that are prepared for growth. Both pea and lentil processing require a great deal of water for current fractionization techniques, and we heard that municipalities in Saskatchewan and Manitoba do not have the connections and infrastructure ready for these businesses and that such infrastructure needs to be built. Workers need affordable and available housing as well as transportation to where they work. Local infrastructure around bus routes between rural areas and cities, as well as more specialized bus routes to major plants and factories, help increase the available potential workforce and improve worker conditions. Workers need to have local facilities for daycare and senior care. And, if we are committed to bringing in international workers, we need to have settlement services and culturally appropriate support available in these smaller towns and more rural areas. Municipalities will often be on the front line of handling these issues and serve a key role in coordinating between businesses, workers, and higher levels of government.

Short-term recommendations

Local and provincial policymakers need to incorporate a holistic approach to support businesses in their jurisdictions.

This involves collaborating with local businesses to identify the needs of their workers for transportation, housing, and access to services. Steps taken could include creating bus routes from residential areas to workplaces to cut down on travel time and reduce the cost of personal transportation or adjusting zoning requirements in the proximity of businesses to support denser and more available housing, including rentals. As so much of the projected worker demand will be supported by newcomers to Canada, ensuring that suitable settlement services are made available in these communities and include language and culturally appropriate programming is essential.

Businesses should explore providing flexible supports to workers beyond wages and benefits.

Companies need to recognize the specific and holistic needs of their workers as well as help bridge the barriers to entering more rural communities and careers in agriculture or food manufacturing. This could include looking at new ways to retain workers, such as shuttle services from a larger nearby city, offering on-site or nearby daycare, and creating flexible working arrangements when possible. Research from the Food Processing Skills Centre found that younger workers are much more likely to examine a career opportunity from a holistic support perspective than just compensation, increasing the importance of supportive programming when attracting younger workers.[155]

Medium-term recommendations:

Municipalities should invest in projects that will enhance and build off this holistic approach.

This should focus not only on business preparedness in terms of tax structures or road connections but also on soft infrastructure. Affordable and accessible housing is a major challenge across Canada, but especially for rural and remote communities. Building more housing in these communities will help make it easier for workers to move into new positions and for businesses to attract workers. More and denser housing with the option to rent will also help with attracting workers to the area and the settlement of newcomers. This increased focus on dense housing will help build local communities and provide new immigrants with connections and proximity to newcomers from similar backgrounds. This method of recruiting immigrants was done successfully by HyLife Foods, a pork processing company located in Neepawa, MB, that focused on bringing over new workers from the Philippines through the Manitoba Provincial Nominee Program and has been recognized by federal and provincial governments for the support of workers through housing, skills development, and local community services.[156] Another positive example is the recent success of the Portage la Prairie Regional Childcare Project. This award-winning collaboration brought together the Rural Municipality of Portage la Prairie and the City of Portage la Prairie, MB, to design a childcare facility with seven other municipalities and one First Nation using the same project management and legal team in partnership with the Manitoba government.[157] This project was designed to address the critical need for childcare that accompanied the investment Roquette put into the community. The hope now is to expand the pilot using the same model, design, and project structure to build 11 more facilities in smaller Manitoba towns and communities to support their childcare needs.[158] This type of innovative program comes from widening the understanding of what communities need to be ready for growth and could be expanded into other rural towns and communities.

Conclusion

Plant-based protein products represent a genuine opportunity for communities to contribute to clean growth by meeting increasing consumer demand for more ecologically-friendly food sources. PBP products build off the historically strong agricultural sector existing in many communities in the Prairies, combine those agricultural strengths with groundbreaking new technologies, and have the potential to transform cities and towns in Manitoba and Saskatchewan into new regional economic hubs. But this will only be possible if we ensure their provincial workforces have the skills required to fill new roles as their sectors adapt to these trends. Manitoba and Saskatchewan may have the vision and recipe for this growth opportunity, but they do not yet have all the ingredients required to fulfil the PBP industry's potential. Even though Canada's PBP industry is well-positioned to meet the global demand for protein, more coordination and attention to our current and future workforces will be needed to reach our full growth potential. Investments alone, both public and private, will not be enough to ensure PBP is a strong regional growth engine if there are not enough skilled workers in these communities.

There are many trends and challenges that we have found for the sectors and occupations which make up the PBP supply chain. In agriculture, the increasing size of farms will require more farm managers with additional skills, and the lack of entry-level workers increases the skill requirements for those who enter this labour pool. For example, increasing technology use in tractors and cropping plans will require new skills in precision and digital agriculture. Within manufacturing, current and future skills will look similar to production processes today, but persistent worker shortages will make it difficult for any employer to attract and retain plant workers with knowledge of food processing. Automation and digitization will change the types of skills required for machine operation, digital literacy, and operations monitoring, but may not fundamentally change the number of workers. Crop and food scientists will continue to be an important and highly in-demand part of the industry as well, working to improve plant flavour and protein content either in the field as a crop or in the lab as a manufacturing process. However, businesses could struggle to attract scientifically skilled workers from other industries and opportunities.

Overall, employers generally believe their workers will be ready for the new skills they will need in their workplace, but they do not know if they will be able to afford the training investment in terms of time and money. We found from stakeholders and experts that the most likely scenario was a persistent employment shortage due to the difficulties of attracting workers to rural and remote communities, the infrastructure gap in those communities, the lack of awareness about employment opportunities, and the high levels of retirement as compared to younger workers workforce entry rates. Unless we act together to create a more knowledgeable, capable, and flexible workforce, we may not be able to fully achieve the benefits of this clean growth opportunity.

Appendix A: Forecasting scenario process

Foresight exercise

Survey setup and parameters

The PBP industry in Canada is still in its early stages, even as the technology and consumer demand for such products has expanded significantly in recent years.[159] Due to the novelty of the industry, there are many open questions about how large it will grow and if it will become a major economic driver for Manitoba (MB) and Saskatchewan (SK). As part of the survey preparation and our wider research project, we undertook a foresight exercise to better understand how actors within the industry think about its future and some of the problems it faces. This section of research focused on identifying the necessary inputs and components for the success of the PBP industry. This was done through conversations with key stakeholders, research on existing reports and statistics, and projections for the industry from governmental, academic, and industry sources. From this analysis, we identified three key areas of concern and focus for PBP: technological availability, capital availability, and skills availability.

Table 4. Key areas of concern and focus for plant-based proteins (PBP)

Metrics	High Adoption Examples	Low Adoption Examples
Technological availability: die extrusion to fermentation, to product development, to plant genetics, to the availability of lab testing facilities for rent and experimentation	• Regulatory approval within reasonable timeframes and costs. • Capitalize better on market trends such as lab-grown meat, fermentation, and plant genetics. • Access to scale-ready laboratory conditions. • Factory expansion through mechanization, automation, and digitization reduces labour bottlenecks and increases margins.	• Pernicious issues with developing new products and ingredients. • Less able to compete in the international market. • Companies have smaller market share, making more niche and less valuable products. • Lack of high-level research talent. • Less mechanization and automation.
Capital availability: Both private and public investment. Also includes improvements to local infrastructure. Includes not only capital for this sector but the broader economic picture including potential inflationary and recessionary pressures.	• Interest rates reduce, and inflationary pressures subside by mid-decade. • Wider venture capital awareness of the industry's growth potential. • Multiple medium and small-sized enterprises are able to start and expand. • Manitoba is able to reach their projections for investment of $1.5 billion by 2024, leading to more provincial and municipal funding. • Local investment leads to a more interconnected supply chain and infrastructure	• We would expect high inflation and poor economic conditions. • Reduced investor availability and anemic provincial economic growth. • Existing companies are less able to scale to meet opportunities and new entrepreneurial ventures are unable to enter the market. • The lack of private investment is coupled with a lack of interest and support from governments. • Facilities and companies remain isolated from the province and do not build up local industry connections.
Skills and workers availability: Canadian companies' ability to find, hire, train, and retain the employees they need. It also represents the difficulty of finding and attracting appropriately trained workers.	• The PBP industry is able to acquire, train, and retain high-skilled employees when needed to scale and reach opportunities. • Provincial and federal immigration programs are expanded where necessary to fill immediate skills gaps. • Industries can present competitive compensation for employees coming into both these provinces and the PBP industry. • Local and provincial training institutions create educational programs in partnership with industry groups. • Overall employment in the sector grows significantly over the next decade.	• We would expect to see persistent labour shortages and reductions in provincial labour forces. • Companies are unable to scale at sufficient levels to meet national and global demand opportunities. • This inability to attract and retain skilled workers leads to inter-sectoral competition and conflict among employees. • Educational institutions are not able to pivot appropriately, and there are fewer pathways to enter the industry. • Overall PBP employment remains stagnant in manufacturing and declines in primary agriculture.

Using these three areas, we created various matrices of results for these provinces where different combinations of technology, capital, and skills were available for the PBP industry and assessed what could happen in each of these futures. Through this process and consultations, we arrived at three future scenarios, titled Significant Sectoral Challenges (low tech, low capital, and low skills), Persistent Worker Shortages (high tech, high capital, and low skills), and Major Economic Driver (high tech, high capital, and high skills). These three scenarios were first reviewed by key stakeholders and compared against previous interview discussions to assess their relevance and then were included in the research survey.

Significant sectoral challenges

In this scenario, plant-based alternative proteins are a small, regional industry. Growth is slow despite global demand, and companies cannot attract skilled talent to non-urban areas or workers from other industries. The local labour pool shrinks, and laboratory space, new machinery, and access to researchers remain scarce, leading to less commercially viable products. Finally, reduced investment and tighter financial markets lower available capital, limiting automation or expansion opportunities.

Persistent employment shortages

This scenario covers scenarios where funding and technology are available, but there are persistent and critical shortages of skilled workers. The PBP industry faces several growth bottlenecks related to production capacity, lower revenue, higher costs, and slower production across the supply chain. Existing investment is spent on adapting to labour shortages through adaptation and mechanization, but this reduces available resources for other critical growth areas. Slow growth in the sector leads to reduced future investment, and while the sector still grows and expands over the next decade, overall employment remains stagnant.

Major economic driver

This scenario projects that PBP companies can access the capital, technology, and skilled workers necessary for growth. Investment expands significantly and the sector attracts skilled international and domestic talent. Local educational and not-for-profit institutions provide job-ready training through collaborative programs and available and cost-effective laboratory space with access to emerging technologies, such as automation, digital agriculture, die extrusion, and fermentation. The provincial supply chain is interconnected, allowing access to a major share of the global market.

Appendix B: Methodology

This research included a mix of quantitative and qualitative methods to determine the future skills needs of the PBP industry in Saskatchewan and Manitoba. Stakeholder interviews, a literature review, and survey comments were qualitative, while industry, occupation, and employment data were used in the quantitative analysis. Ultimately, results include skills of importance and what industry stakeholders think is the outlook for PBP.

Supply and value chain mapping

One major initial step for the research was to create a supply and value chain map of the entire PBP ecosystem and the associated North American Industry Classification System (NAICS) codes for all core and adjacent industries. Initial desk research and conversations with stakeholders and experts helped to inform the structural understanding of the PBP supply chain and its component industries. We used Miro, the digital whiteboard system, to map the production process from beginning to end and document all associated NAICS codes for each step. Additional production information, provincial-specific information, and examples of each step were also added. This conceptual mapping was combined with geographic mapping by taking the production facilities' and businesses' locations and plotting them along maps of Manitoba and Saskatchewan to better understand the key communities and places for the PBP industry. This supply chain map helped to inform all future work and was fundamental in assessing the industries, occupations, and skills involved in the PBP industry.

Skills

The top skills and knowledge attributes were determined using quantitative methods. NAICS codes and National Occupational Classification (NOC) codes related to the PBP supply chain were selected to be included in the analysis based on their title and description. The chosen NAICS codes were grouped into sectors: agriculture, manufacturing, retail trade, transportation and warehousing, utilities, and wholesale trade. Relevant NOC codes were included within those sectors.

The Employment and Social Development Canada (ESDC) concordance table and the United States' Standard Occupational Classification crosswalk from the Occupational Information Network (O*NET) Resource Centre were used to convert Canadian NOC codes to the US equivalent in their classification system. This way, NOC codes and the corresponding NAICS could be matched to O*NET occupations and the associated skills and knowledge attributes.

The 2021 Labour Force Survey (LFS) data was retrieved from Statistics Canada using the Real-Time Remote Access tool and includes the 2021 employment numbers by NOC occupation per NAICS code for Saskatchewan and Manitoba.

The importance levels for O*NET's 35 skills and 33 knowledge attributes for US occupations were retrieved and their standardized scores were calculated.[160] The standardized scores were used to determine the top skills and knowledge attributes for specific occupations in certain sub-sectors. The LFS employment data was used to calculate the weighted averages of the standardized scores. The weighted averages were used to determine the top skills and knowledge attributes for Saskatchewan and Manitoba for each sector. This information was used to get a better understanding of current skills profiles and to inform the survey response options.

Knowing the skills and knowledge needed for jobs throughout this sector is important information for education and training institutions to efficiently prepare workers and job seekers planning for their future. Most of the top skills and knowledge attributes were quite similar or the same between the two provinces and throughout the supply and value chain. Differences in important skills were primarily between entry-level labourers and supervisors, managers, and other more specialized positions. The most needed skills across sectors are essentially the same in Manitoba and Saskatchewan due to the nature of our evaluation, so skills and knowledge will be presented together instead of differentiated across the provinces. However, the provinces do have differences in the proportions of workers in each job and sector. This variation will change which skills are in higher demand in each province.

Survey

One major component of our research was a survey of skills, occupations, and future projections for the PBP industry. This survey covered materials from our data analysis, supply chain research, ecosystem mapping, and foresight exercise. This section will cover the process and methodology for the survey design and dissemination as well as the foresight exercise. The survey was intended to verify current skills and provide options for identifying future skills.

Survey design

The final survey version had a total of 42 questions across nine categories. With branching logic and conditional questions, respondents were likely presented with fewer than 42 questions. An initial version of the survey was designed to be customized by three clusters studying different industries in the early stages of research. The three research clusters took an iterative approach where the questions were refined to improve response rates and get at key research questions. The PBP cluster focused on primary agriculture production, commodity and ingredient processing, and food and beverage manufacturing, but also included outreach to, and questions about, plant genetics research and food shipping and logistics. One key change was to increase the focus on qualitative data responses by changing

pre-set lists of options to open text boxes and prompts to allow for the input of future skills or labour force needs.

Branching logic was built both into the structure of the survey and the format in which it would be presented to the respondents. This was intended to help shorten the survey for respondents so they would only be presented with questions suited to their sectors and experience or have to answer specific follow-up questions if they said they had knowledge of a relevant research question. Additionally, in several places throughout the survey, respondents were asked questions about picking from a list of occupations that were most in demand, had been hired, and had the largest skills gap. Once a respondent had identified which occupations they were aware of, only those occupations would appear in the immediate follow-up questions asking for more detail to cut down time and unnecessary blank answers.

Survey analysis

For the survey, SurveyMonkey was used for the quantitative analysis and the NVivo program was used for the qualitative analysis. Additionally, select quotes were extracted from survey comments and paraphrased in the report.

Table 5. National Occupational Classification (NOC) codes used in data analysis

NOC Code	Description
0621	Retail and wholesale trade managers
0821	Managers in agriculture
1215	Supervisors, supply chain, tracking and scheduling co-ordination occupations
1311	Accounting technicians and bookkeepers
1521	Shippers and receivers
2011	Facility operation and maintenance managers
2121	Biologists and related scientists
2132	Mechanical engineers
6211	Retail sales supervisors
6221	Technical sales specialists – wholesale trade; grain elevator operators
6332	Bakers
6411	Sales and account representatives – wholesale trade (non-technical)
6421	Retail salespersons
6622	Store shelf stockers, clerks and order fillers
7312	Heavy-duty equipment mechanics
7452	Material handlers (manual and equipment operators)
8252	Agricultural service contractors, farm supervisors and specialized livestock workers
8432	General farm workers
9201	Supervisors, food and beverage processing
9213	Supervisors, food, beverage and associated products processing
9461	Process control operators and machine operators, food and beverage processing
9465	Testers and graders, food and beverage processing
9510	Labourers in processing, manufacturing, and utilities
9526	Mechanical assemblers and mechanical inspectors

Table 6. North American Industry Classification System (NAICS) codes used in data analysis

NAICS Code	Description
1111	Oilseed and grain farming
111111	Soybean Farming
111112	Oilseed (except soybean farming)
111113	Dry Pea and Bean Farming
111114	Wheat Farming
111115	Corn Farming
111116	Rice Farming
1119	Other Crop Farming
1151	Support Activities for Crop Production
3112	Grain and Oilseed Milling
3119	Other Food Manufacturing
3114	Fruit and Vegetable Preserving and Speciality Food Manufacturing
3115	Dairy Product Manufacturing
3118	Bakeries and Tortilla Manufacturing
4931	Warehousing and storage
4132	Food merchant wholesalers
4111	Farm product merchant wholesalers
4244	Grocery and Related Product Merchant Wholesalers
5417	Research and development in the physical, engineering and life sciences

Appendix C: Assumptions and limitations

As with any work, there are limitations and challenges to our own work that we must consider and recognize. In addition to the inherent uncertainty of assessing multiple different businesses and occupations that comprise the PBP industry and using interviews and survey responses to look at broader sectoral trends, there are a few discrete assumptions and limitations that we list below.

Despite significant outreach to over a hundred identified contracts through multiple points of engagement and the use of partner mailing lists and newsletters, the total responses to the survey were low for a study of this size and scale. The limited number of complete responses impacts our ability to draw broad concepts and trends. Where possible, we have supplemented this limitation with expert interviews, data analysis, and literature reviews of relevant materials. However, this limitation demonstrates the difficulty of getting data from populations that are over-surveyed. Many of those we spoke to during this project identified that they were tired of being surveyed or asked to participate in focus groups. Instead, they wanted policymakers to do things that would help them. Where possible, we did not take individual answers as broadly generalizable responses.

Another difficulty inherent in this work was the specific and limited nature of both NOC and NAICS codes to identify and codify these newer types of businesses. The PBP industry exists across several NAICS codes that also encompass other industries and types of work, and the NOC codes that we identified for these industries are also shared by similar workers in adjacent industries. A machine operator for seafood processing and one for PBP might have the same NOC code but may not have the same skills or knowledge requirements. Additionally, the NAICS codes used to identify this sector in our supply chain analysis are, by their very definition, generalizations which include other adjacent industries. This could throw off the specificity of our skills analysis if the PBP industry and its associated skills move more away from other existing industries over time.

One general challenge was the lack of specificity regarding occupations and skills from stakeholders and experts. This means that our future skills analysis is broader across sectors and offers fewer insights at the occupation level. There are a few reasons why future skills have not been a significant focus point for stakeholders in these two provinces along the supply chain. One is that both provinces have been impacted by significant labour shortages along the entire supply chain for years. Another is that agriculture and its workers are undergoing rapid changes. In comparison to the owner-operator model, larger farms are changing what labour looks like, meaning thinking about specific skills and division of labour is a relatively newer process in this changing sector.

A lack of deep dives into specific skills needs was also found in the food manufacturing space, but we suspect for a different reason than in primary agriculture. In this part of the supply chain, labour shortages have persisted for years.[161] Students, new Canadians, and anyone eligible to work in the provinces are able to find roles. Stakeholders have noted that many will be hired out of high school and that competition for workers in the sector is very high between employers, leading to what is sometimes a poor environment for skills growth. The presence of this crisis makes it difficult for employers to focus on future skills when they cannot fill current positions.

Finally, the PBP industry is still rapidly emerging and changing, and this volatility makes future predictions and trend analysis uncertain. Compared to much more mature industries and sectors, the technology and consumer demand for PBP products is not even a decade old. Its very newness is one of the reasons it is both so attractive as a clean growth opportunity and also how it leaves volatility in its projections. Newer technologies, like laboratory-grown animal proteins, could disrupt this market, as could wider shifts in consumer preferences or unknown health or environmental risks. Furthermore, PBP manufacturing, from the farm to the workshop floor, has not been perceived as particularly novel or separate from the larger sector (outside of food and plant research). Rather, stakeholders in food manufacturing and agriculture seem to see this novel industry as an addition to their business as usual. While new techniques and changes in what is grown on-farm may be impacted, it seems that stakeholders perceive this to be within the norm of changes that would occur anyway. This also made it more difficult to tease out the changes brought about by increased jobs from PBP in the two provinces from the changes that would occur in the sector without this new industry.

Appendix D: Additional sectoral graph analysis

These sectors were included in the O*Net analysis of skills and knowledge as a portion of the total research but were not relevant for inclusion in the main body of the report outside text boxes. For reference, here the following figures outline the skills and knowledge analysis of the Transportation and Warehousing, Utilities, Trade, and Sales sectors for Manitoba and Saskatchewan.

Figure A1. The relative importance of skills for transportation and warehousing in Manitoba and Saskatchewan (absolute scores, 0-100).

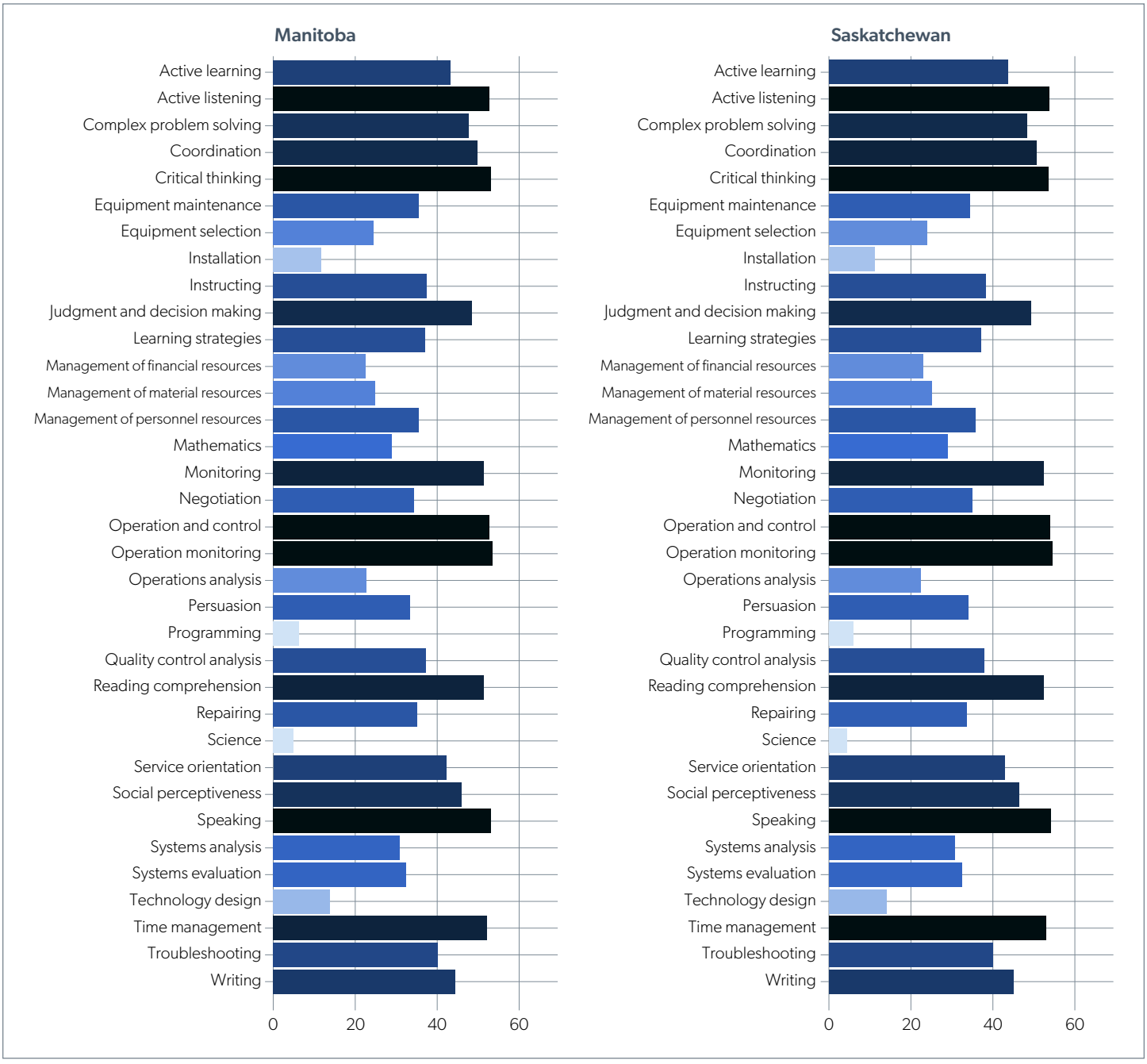


Figure A2. The relative importance of knowledge attributes for transportation and warehousing in Manitoba and Saskatchewan (absolute scores, 0-100).

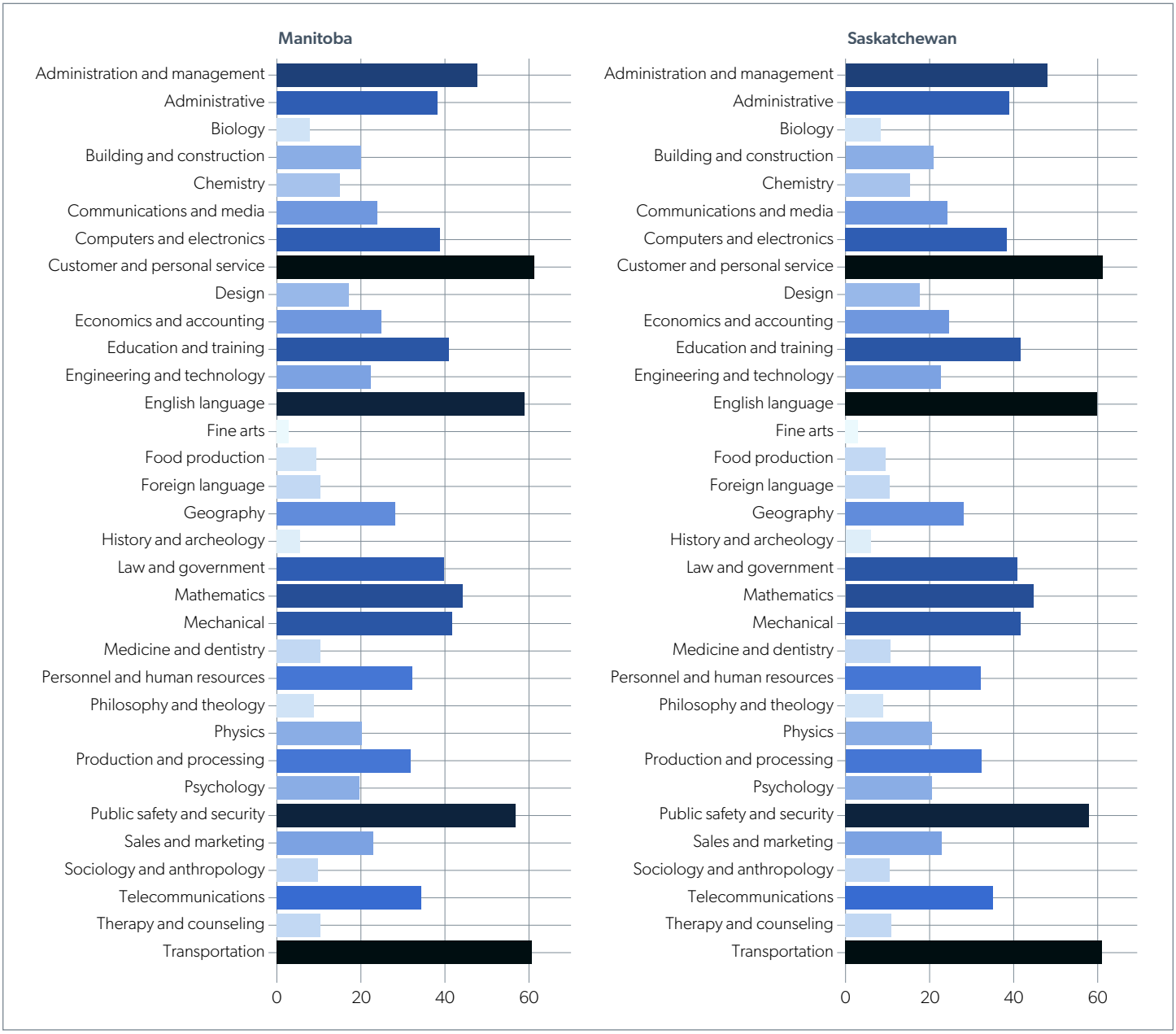


Figure A3. The relative importance of skills for utilities in Manitoba and Saskatchewan (absolute scores, 0-100).

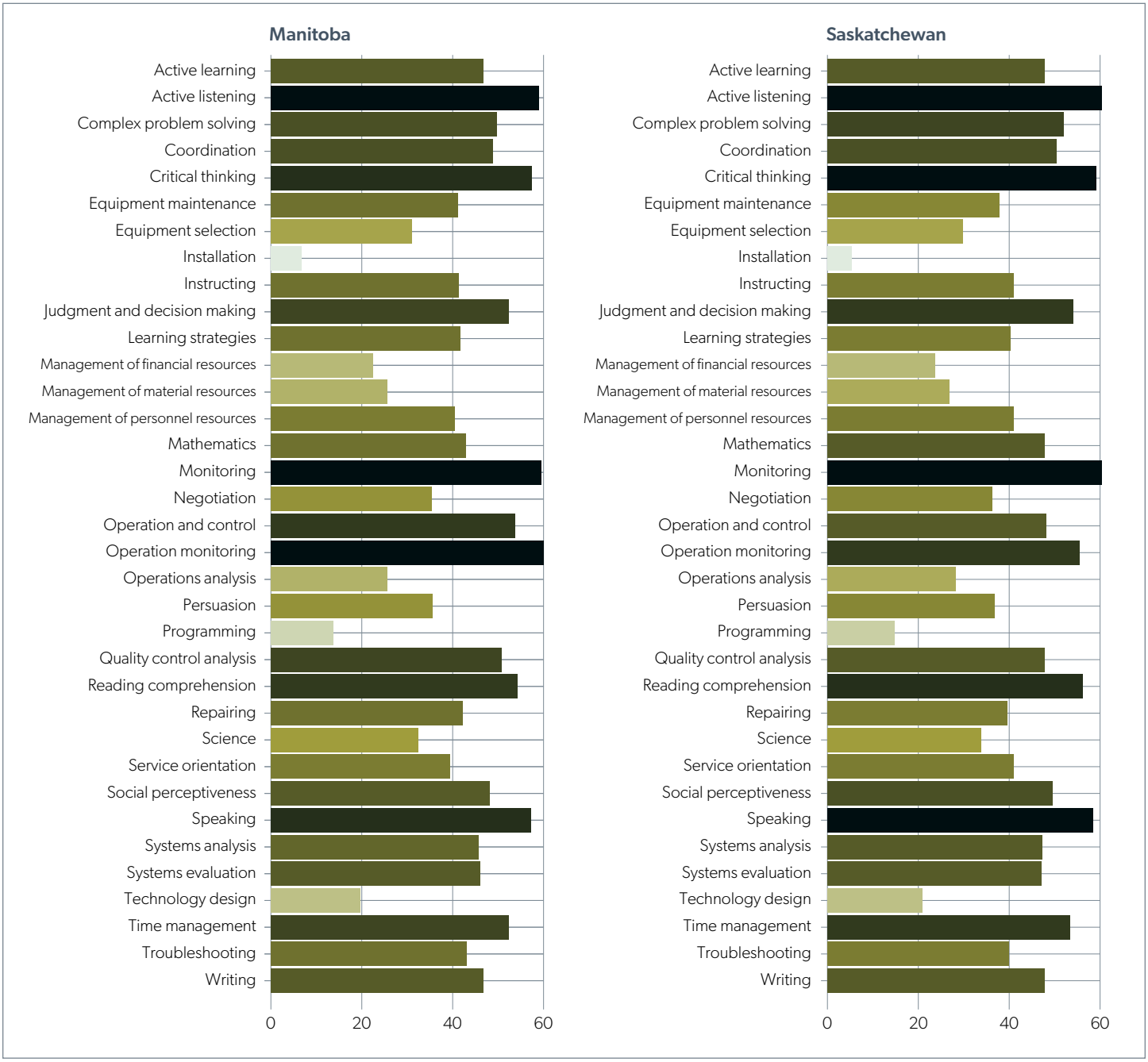


Figure A4. The relative importance of knowledge attributes for utilities in Manitoba and Saskatchewan (absolute scores, 0-100).

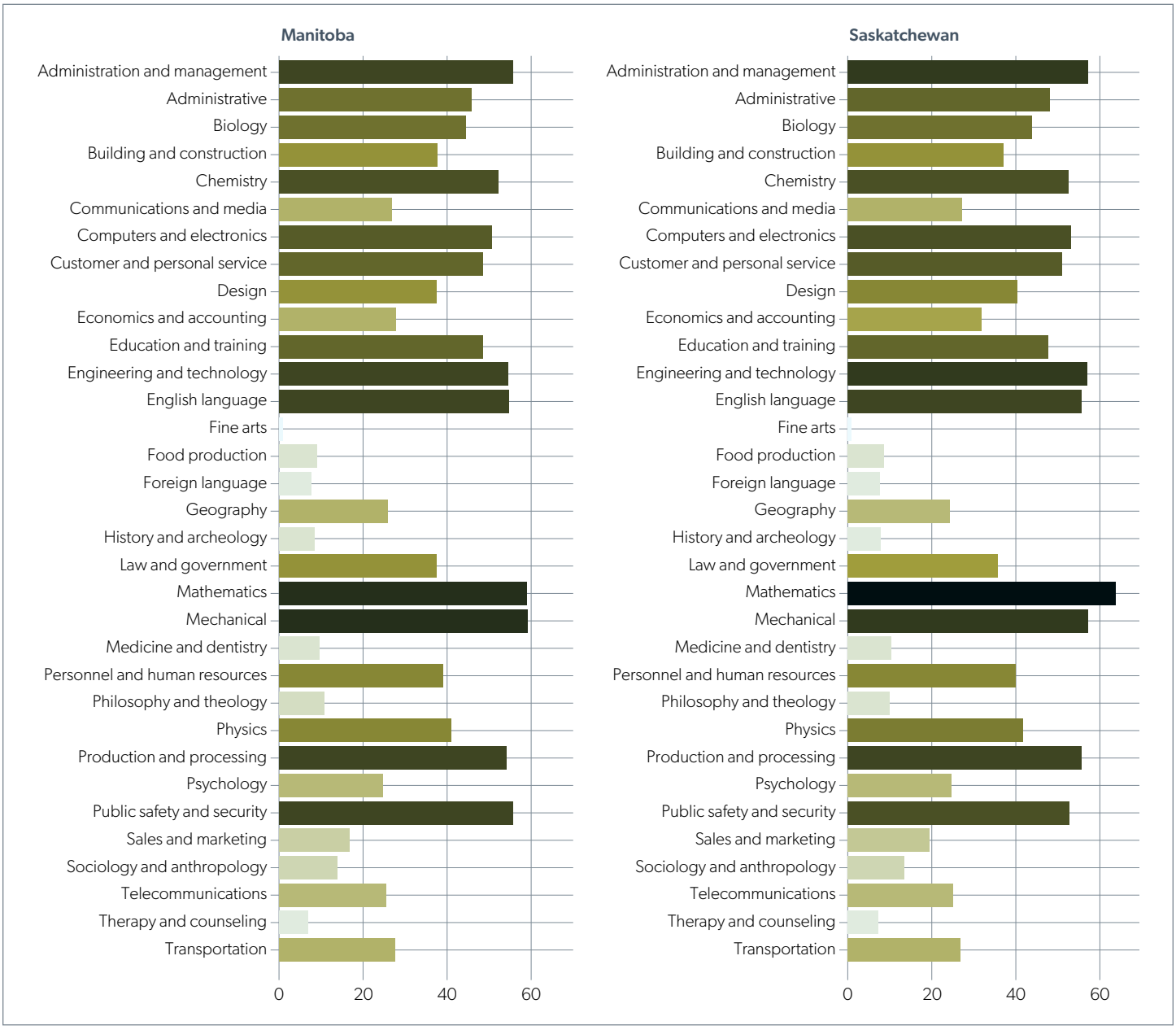


Figure A5. The relative importance of skills for retail and wholesale in Manitoba and Saskatchewan (absolute scores, 0-100).

Figure A6. The relative importance of knowledge attributes for retail and wholesale in Manitoba and Saskatchewan (absolute scores, 0-100).

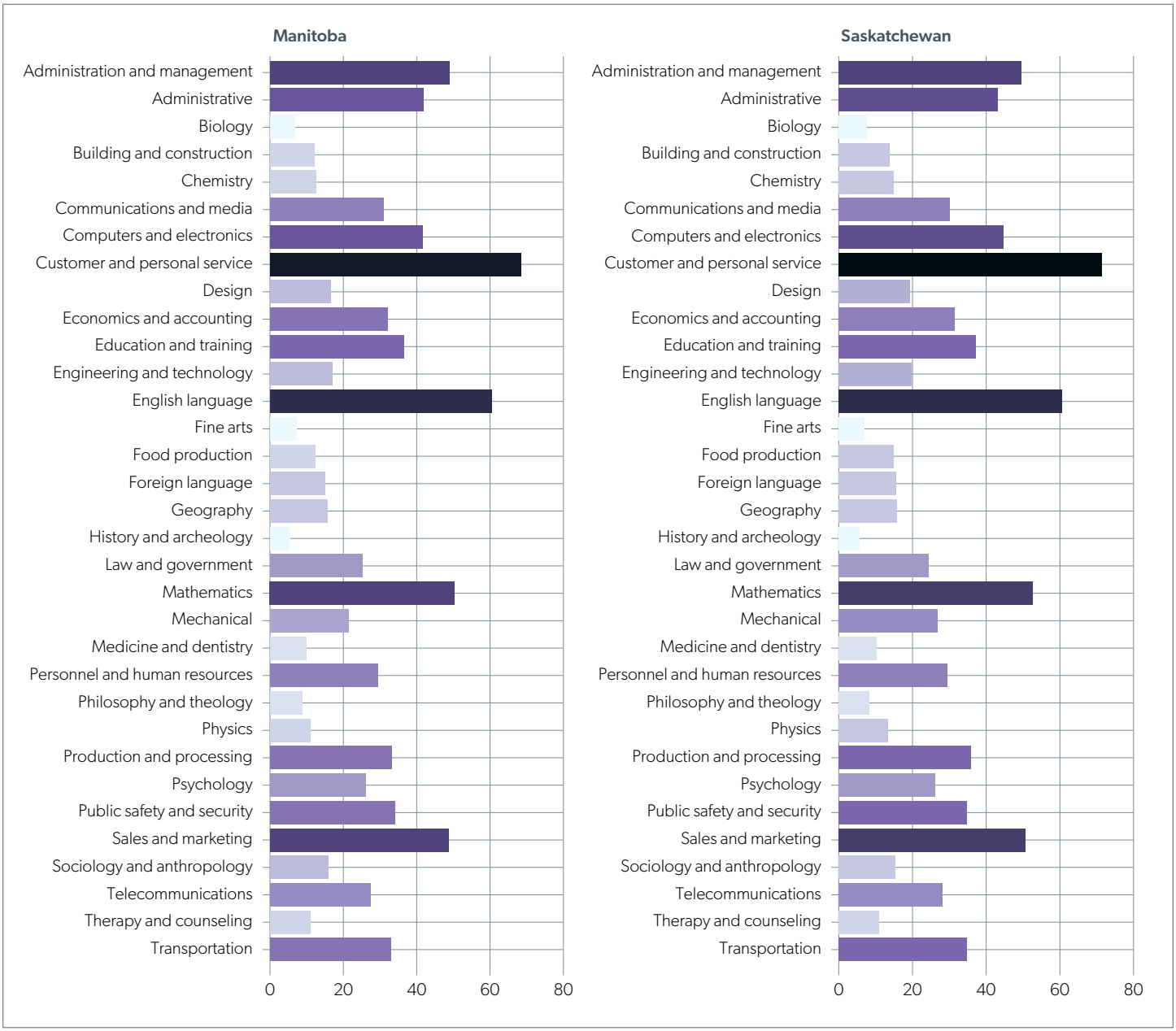


Figure A7. The relative importance of skills for other occupations in Manitoba and Saskatchewan (absolute scores, 0-100).

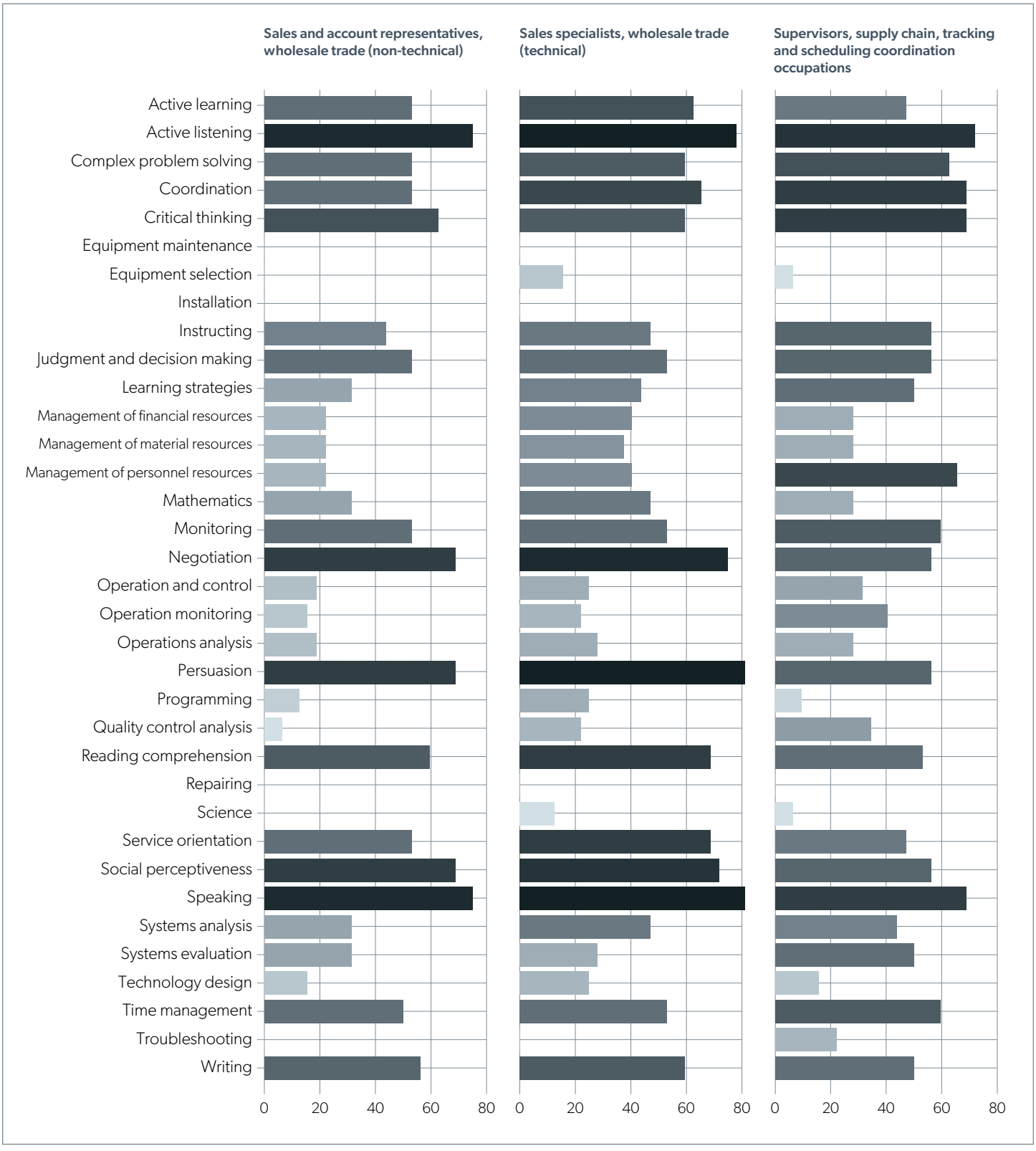
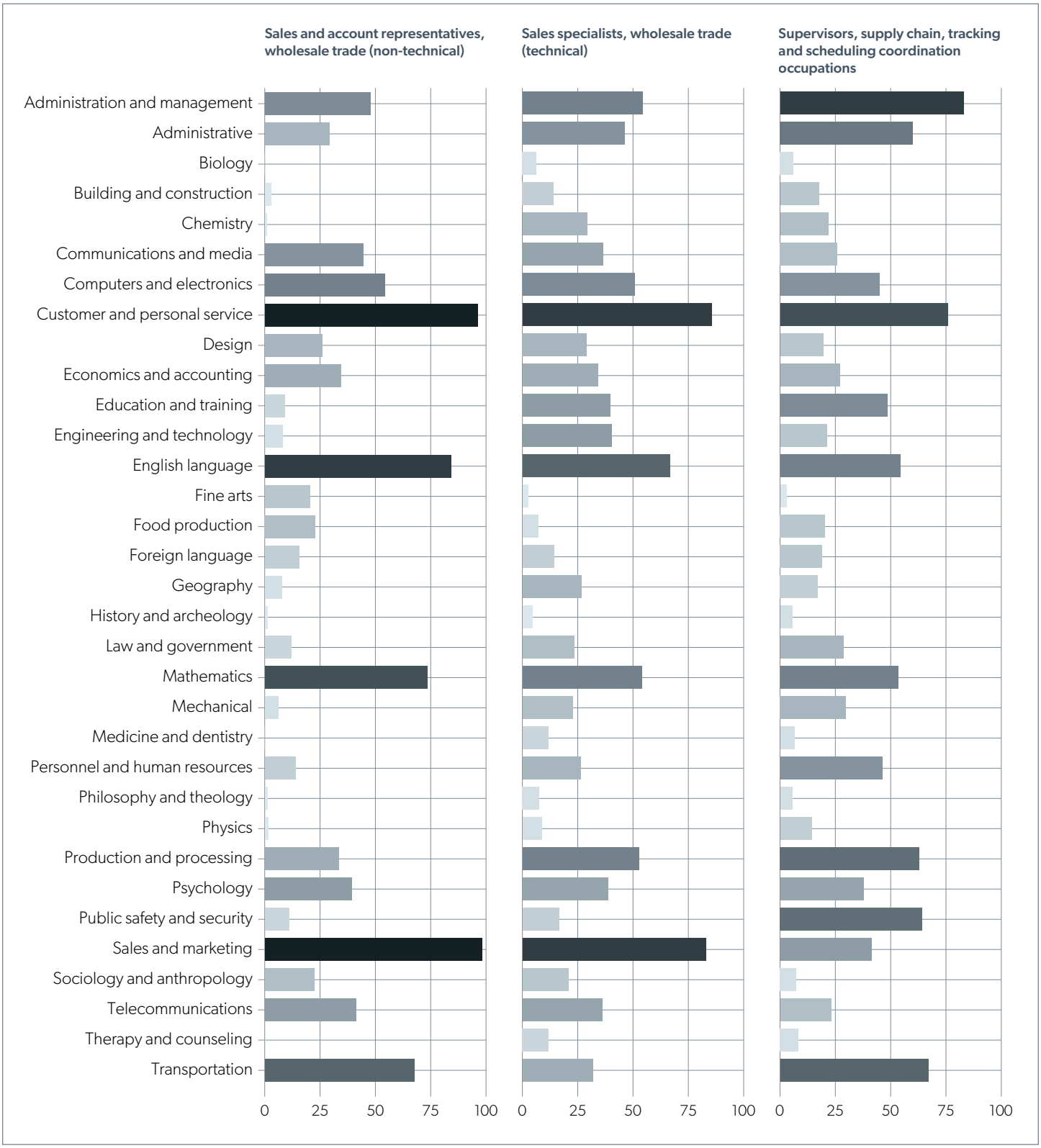


Figure A8. The relative importance of knowledge attributes for other occupations in Manitoba and Saskatchewan (absolute scores, 0-100).



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