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Lost Opportunities

Measuring the Unrealized Value
of Skill Vacancies in Canada

Issue Briefing | March 2, 2022





The Future Skills Centre – Centre des Compétences futures (FSC-CCF) is a forward-thinking centre for research and collaboration dedicated to preparing Canadians for employment success. We believe Canadians should feel confident about the skills they have to succeed in a changing workforce. As a pan-Canadian community, we are collaborating to rigorously identify, test, measure, and share innovative approaches to assessing and developing the skills Canadians need to thrive in the days and years ahead.

The Future Skills Centre was founded by a consortium whose members are Ryerson University, Blueprint, and The Conference Board of Canada.

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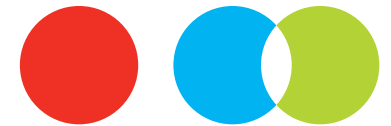
The Conference
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Blueprint

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Key Findings

- When an employer is looking to fill a vacant job, what they are really looking for is a set of skills to complete a series of tasks. So, job vacancies can be thought of as skill-set vacancies, or as unfilled skills demand.
- The unrealized value of skill vacancies in the Canadian economy rose from \$15 billion in 2015 to \$25 billion in 2020. Rising job vacancy numbers and wage rates, as well as changes in the mix of jobs with vacancies, all contributed to this increase.
- Measured as a share of the economy, this unrealized value increased from 0.85 per cent of GDP to 1.33 per cent—an important metric for understanding the impact of skill vacancies on prosperity and growth. This increase partially reflects the decline in GDP in 2020 due to COVID-19.
- The six most highly valued skill vacancies are active listening, critical thinking, reading comprehension, speaking, monitoring, and coordination. Vacancies related to each of these skills currently cost the Canadian economy \$1 billion or more annually in unrealized value owing to unfilled job vacancies.
- Skills tend to be found in sets, which has implications for how to develop skills and potentially address vacancies. There are five broad skill groups: basic, social and emotional, resource management, systems, and technical skills.
- Skills and skill groups can be valued using the average wage and vacancies for those occupations. Doing so allows policy-makers and educators to prioritize investments. The skill group with the highest wage-and-job vacancies value is social and emotional skills, worth \$8.5 billion in 2020—making up a third of the unrealized value of unfilled skills demand arising from job vacancies that year.



Introduction

When an employer is hiring, they are looking for a set of skills to complete a series of tasks. Until the employer can recruit a new employee, the needed skills remain missing. Job vacancies can thus be thought of as skill-set vacancies, or as unfilled skills demand.

Such sought-after skills are valuable. Salaries or wages reflect, in part, how valuable a certain skill set is to an organization. So, we can define the value of skill vacancies as the unrealized monetary value when a vacancy for particular skills goes unfilled.¹ By combining information on job vacancies, the skills profiles of those vacant jobs, and typical wages per role, we are able to assess the aggregate cost of skill vacancies to the Canadian economy.² We can then observe the value of skill shortages by looking through the lens of occupational data and computing the unrealized wages owing to vacant skills.³

We further explore the fact that skills tend to correlate together in clusters. Such skill groups give us insight into the importance of training more than one skill at a time. The relative vacancy values of these groups should help prioritize policy and educational investments to address those gaps and, in doing so, to recapture some of the lost economic value.

- 1 As embodied in job openings and the skills that an employer wants when trying to fill their open jobs. We look at each skill independently when estimating the value of skills vacancies. Though employers value skills in tandem, not in isolation, to simplify our analysis we have assumed that skills can be valued independently.
- 2 This approach does not account for all the costs associated with the mismatch between the supply of available skills and current employer demand for skills. For example, our approach does not account for the underutilization of skills among individuals who are overqualified for their current role. Instead, we are measuring the cost of the “friction” between labour demand and supply reflected by unfilled roles only.
- 3 For a detailed discussion about the concepts of labour and skill shortages, see Mantione, *What’s in a Name?*

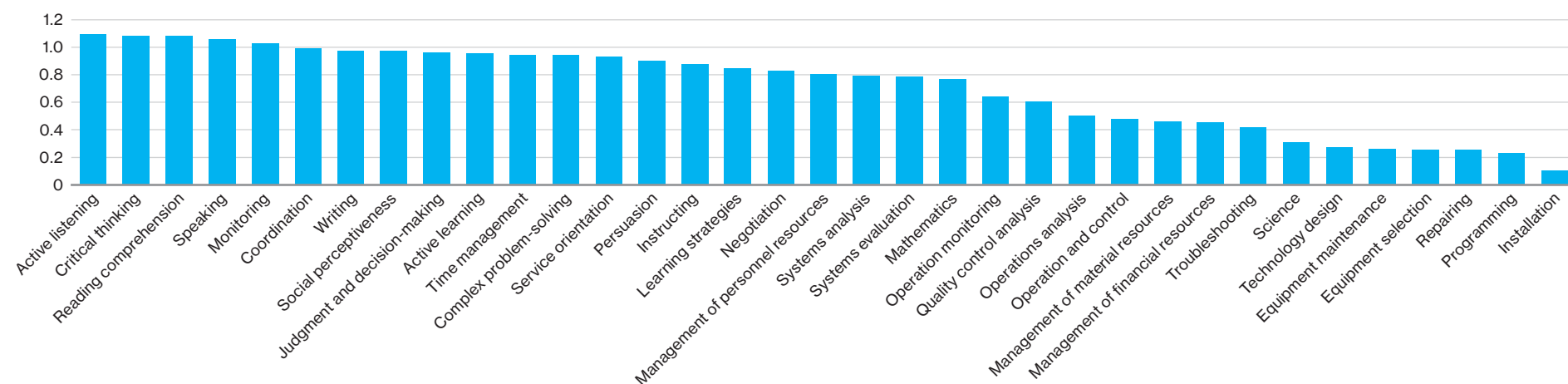


Valuing Skill Vacancies

We estimate that the unrealized value of skill vacancies in the Canadian economy was \$25 billion in 2020, which is equivalent to 1.3 per cent of GDP. This represents the sum of the unrealized skill vacancies across all 35 skills in the O*NET framework.⁴ The six skills for which vacancies incur the highest costs are active listening, critical thinking, reading comprehension, speaking, monitoring, and coordination. (See Chart 1.) The cost of vacancies related to these skills equalled \$1 billion or more for each of them.

Conversely, the skill vacancy with the lowest unrealized value was installation, for which the value in 2020 was just over \$100 million, slightly less than one-tenth the value associated with vacancies in active listening. We also found that *task and technically oriented skills*, such as operations analysis, operations and control, equipment maintenance, and equipment selection, are typically at the bottom of the list in terms of unrealized value.

Chart 1
The Value of Skill Vacancies Varies Widely by Skill
 (value in 2020, \$ billions)



Sources: The Conference Board of Canada; O*NET; Statistics Canada.

⁴ O*NET classifies these 35 skills into six groups. (See O*NET, “Skills Search.”) Employment and Social Development Canada has extended the O*NET framework to 47 skills, divided into five groups. (See Employment and Social Development Canada, “Skills.”) For more details about using O*NET for Canadian labour market analysis, see Labour Market Information Council, *What Skills Do I Need?*

One notable skill for which the value of vacancies is low is programming. This may be surprising given that digital skills are frequently cited as being in short supply.⁵ This can be explained by the fact that relatively fewer jobs require detailed knowledge of programming languages or a strong background in computer sciences.

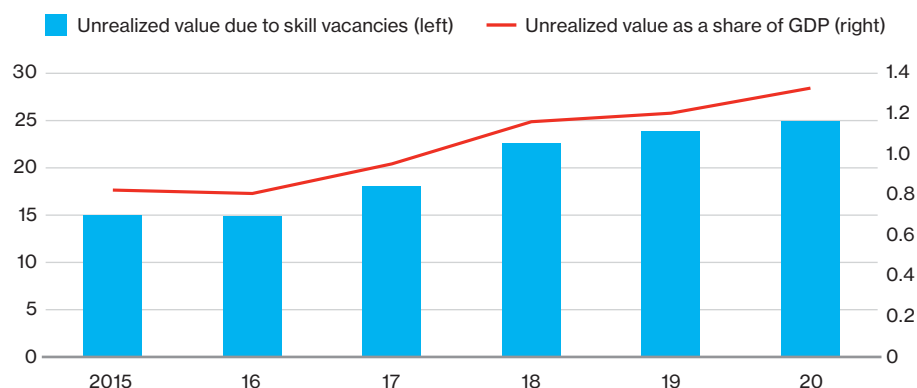
We can also see that the cost of skill vacancies is rising over time. Between 2015 and 2020, the unrealized value of skill vacancies rose from \$15 billion to \$25 billion. (See Chart 2.) They even rose in 2020 despite the impacts of the COVID-19 pandemic, which led to significant job losses and reduced vacancies in certain types of roles. Indeed, the increase in the value of skill vacancies has outpaced growth in GDP. As a result, the unrealized value of skill vacancies as a share of GDP has risen from 0.8 per cent to 1.3 per cent. In short, skill vacancies are imposing an increasing burden on the overall Canadian economy.

The upward trend is driven in part by a combination of a rising number of vacancies⁶ and rising wages over the past six years. (See Chart 3.) Rising vacancy numbers can stem from higher labour demand or more job turnover, and these different causes are important when considering vacancy reduction strategies. The overall composition of vacancies across the 500 National Occupation Classification (NOC) occupations may also play a role in this variation. It appears that the annual occupational mix of job vacancies has tended toward jobs that place a greater weight on social and emotional skills, as well as basic daily skills. In contrast, the skill set profiles by occupation did not change over the analysis period.

5 Stuckey and Munro, *The Need to Makes Skills Work*; Bieler, *Bridging Generational Divides*; Shortt, Robson, and Sabat, *Bridging the Digital Skills Gap*.

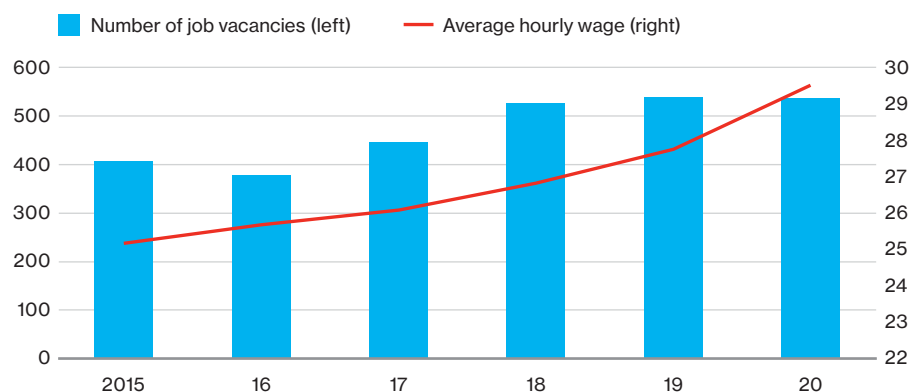
6 Not only have the absolute number of job vacancies trended upward over the past several years, so too have vacancy rates. At the beginning of 2015, the vacancy rate stood at 2.5 per cent. By the end of 2020, the rate had crept up to 3.5 per cent. See Statistics Canada, "Job Vacancies, Fourth Quarter 2020," for more details.

Chart 2
The Value of Skill Vacancies Has Been Growing Steadily
 (value, \$ billions; share, per cent)



Sources: The Conference Board of Canada; O*NET; Statistics Canada.

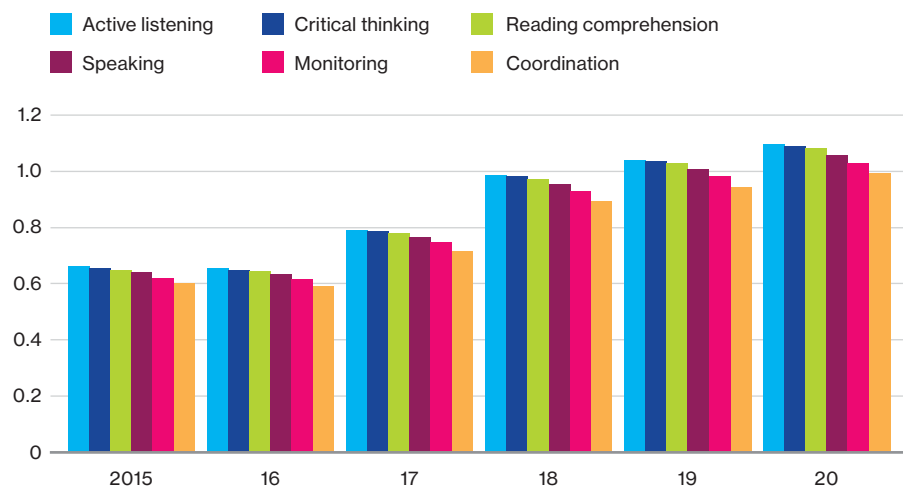
Chart 3
Rising Valuation of Skill Vacancies Driven in Part by Higher Wages and Job Vacancies
 (job vacancies, 000s; average hourly wage, \$)



Sources: The Conference Board of Canada; O*NET; Statistics Canada.

Finally, it is noteworthy that the ranking of skills by forgone value has not changed appreciably over time. We found that the same skills topped the list in each of the past six years. (See Chart 4.) We see social and emotional skills and basic daily skills tending toward the top of the list for unrealized value, while management-oriented and task- and technical-oriented skills are found mostly in the bottom half of the distribution. This persistence in the results suggests that there are systemic challenges to closing the identified gaps.

Chart 4
Vacancy Costs Highest for Basic and Social and Emotional Skills
 (\$ billions)



Sources: The Conference Board of Canada; O*NET; Statistics Canada.

Policies Should Focus on Skill “Sets”

Job postings clearly show that employers want to hire people who can bring certain mixes of skills to the positions they need to fill. Given this, we’d expect to find that some skills coexist more frequently with certain other skills, and that these skills then combine into useful sets. We also realize that combining skills creates synergies, which implies that the true value of skill sets may exceed the sum of its parts. It also implies that the value of an individual skill may be conditional on the presence of complementary skills.⁷

To investigate this, we identified pairwise cross-correlations for all the skill values across each of the 500 NOC occupations. The results (see Exhibit 1) show that many skills are positively correlated to varying degrees. For example, we see that critical thinking and systems analysis are commonly found together in many roles, as are management of financial resources and management of material resources skills.

⁷ The values of individual skills within a skills set are likely codependent, and the value ascribed to any skill is conditional on the presence of other skills that combine into a valuable skill set. In essence, our analysis estimates an unconditional value for each skill, though in reality the value of an individual skill depends on its co-occurrence with other skills. Our methodology does not account for conditional values that may stem from synergies that exist in real-world skill sets.

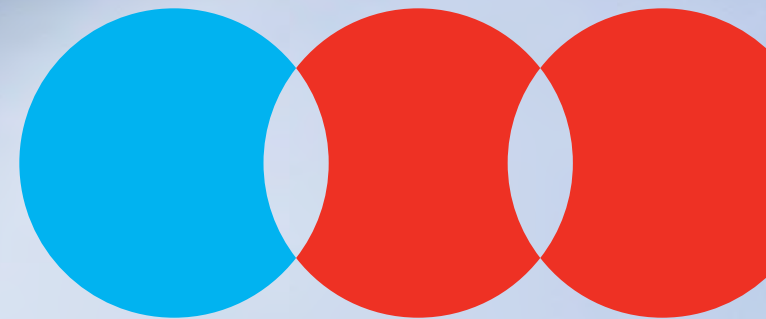
We also found that some skills are negatively correlated. This means that some skills exhibit an inverse relationship with other skills. For example, roles that require a high degree of skill in equipment maintenance rarely require active listening or active learning skills. Taken together, we see that certain skills tend to form sets, while other skills are typically excluded from those same skill sets.

Exhibit 1
Some Skills Show High Positive Correlation, Implying the Existence of “Skill Sets”
 (ordered by similarity scores)

	Active learning	Active listening	Complex problem-solving	Coordination	Critical thinking	Equipment maintenance	Equipment selection	Installation	Instructing	Judgment and decision-making	Learning strategies	Management of financial resources	Management of material resources	Management of personnel resources	Mathematics
Active learning	1.0														
Active listening	0.89	1.0													
Complex problem-solving	0.91	0.85	1.0												
Coordination	0.74	0.72	0.75	1.0											
Critical thinking	0.93	0.93	0.91	0.73	1.0										
Equipment maintenance	-0.41	-0.53	-0.28	-0.31	-0.43	1.0									
Equipment selection	-0.29	-0.43	-0.15	-0.22	-0.33	0.91	1.0								
Installation	-0.17	-0.29	-0.08	-0.18	-0.18	0.66	0.61	1.0							
Instructing	0.84	0.77	0.81	0.78	0.81	-0.27	-0.18	-0.12	1.0						
Judgment and decision-making	0.92	0.86	0.94	0.77	0.92	-0.38	-0.26	-0.15	0.80	1.0					
Learning strategies	0.87	0.79	0.81	0.77	0.82	-0.34	-0.24	-0.16	0.93	0.80	1.0				
Management of financial resources	0.64	0.57	0.67	0.74	0.63	-0.26	-0.16	-0.18	0.60	0.69	0.62	1.0			
Management of material resources	0.61	0.51	0.65	0.74	0.58	-0.14	-0.02	-0.12	0.62	0.64	0.63	0.94	1.0		
Management of personnel resources	0.73	0.69	0.77	0.88	0.73	-0.23	-0.14	-0.18	0.82	0.76	0.80	0.83	0.83	1.0	
Mathematics	0.72	0.60	0.74	0.52	0.72	-0.19	-0.06	-0.05	0.64	0.71	0.64	0.59	0.57	0.59	1.0

Sources: The Conference Board of Canada; O*NET; Statistics Canada.

The relative value of the five skills groups mirrors the ranking patterns seen among individual skills, with the most valuable vacancies in the social and emotional and basic skills groups.



One of these sets includes several social and emotional skills, such as active listening, social perceptiveness, and critical thinking, as well as other knowledge-based skills, like writing and management of financial or personnel resources. Conversely, versatile and relatively manual technical skills, such as repairing, tend to correlate with similar skills, like equipment selection, maintenance, and operations monitoring. These technical skills are often negatively correlated with social and emotional skills. For example, equipment installation, selection, and maintenance are negatively correlated with learning strategies, negotiations, service orientation, and social perceptiveness.

In a subsequent report, we'll be taking a deeper dive into how skills clustering provides us with insights about broad occupational categories. Focusing on this top level of analysis, however, we can use the five skill "groups" defined by O*NET: basic skills, social and emotional skills, resource management skills, technical skills, and systems skills. Table 1 lists which skills fall into each of the five skill groups.⁸

Table 1
Correlated Skills Can Be Sorted Into Five Main Groups

Basic	Social and emotional	Resource management	Systems	Technical
Active learning	Active listening	Management of personnel resources	Judgment and decision-making	Equipment maintenance
Critical thinking	Speaking	Management of financial resources	Systems analysis	Equipment selection
Learning strategies	Coordination	Management of material resources	Systems evaluation	Installation
Mathematics	Social perceptiveness	Time management		Operations and control
Monitoring	Complex problem-solving			Operations analysis
Reading comprehension	Instructing			Operations monitoring
Science	Service orientation			Programming
Writing	Negotiation			Quality control analysis
	Persuasion			Repairing
				Technology design
				Troubleshooting

Sources: The Conference Board of Canada; O*NET.

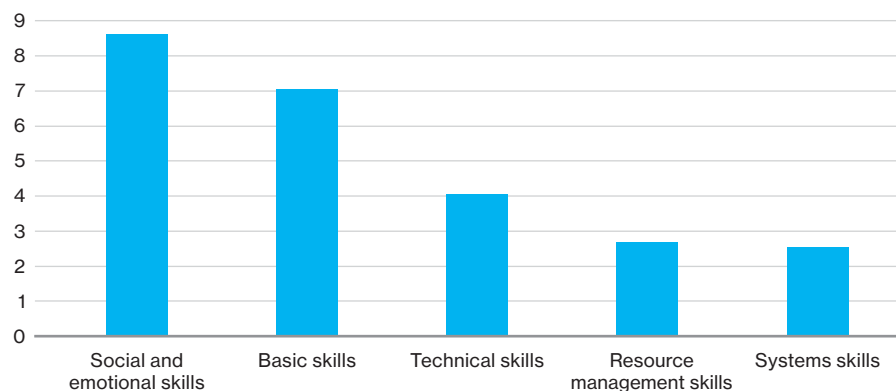
⁸ This grouping for social and emotional skills is based on prior Conference Board of Canada research and differs slightly from the O*NET social skills group. For instance, we have included complex problem-solving in social and emotional skills, as opposed to categorizing this one skill as its own group as done in O*NET. See Gorea and Fadila, *Searching for Strengths*, for more information on social and emotional skills and how these skills are used in the tourism and hospitality sector.

One implication of these results is that when individuals are developing and learning, it is important to nurture synergistic skills as a group. Teaching skills in combinations will also help build the skill sets demanded by employers.

We can estimate the value of skill group vacancies just as we could with individual skills, and use these values to help policy-makers and educators prioritize and direct skill development investments. As we'd expect, the relative value of the five skill groups mirrors the rankings seen among individual skills in the previous section. (See Chart 5.) Vacancies in the social and emotional and basic skill sets have the highest costs, reflecting both the ubiquity of skills in these groups and their relative value. At the opposite end of the spectrum are resource management and systems skill sets. This reflects both the smaller number of skills in these groups, the limited number of roles for which these skills are required, and the lower relative cost of skill vacancies in these groups. To account for the different number of skills in each group, we also calculated the average value of skill vacancies per group. We can then see that the most valuable vacancies are in the social and emotional and basic skills groups, while vacancies for technical skills tend to be the least valued on average. (See Chart 6.)

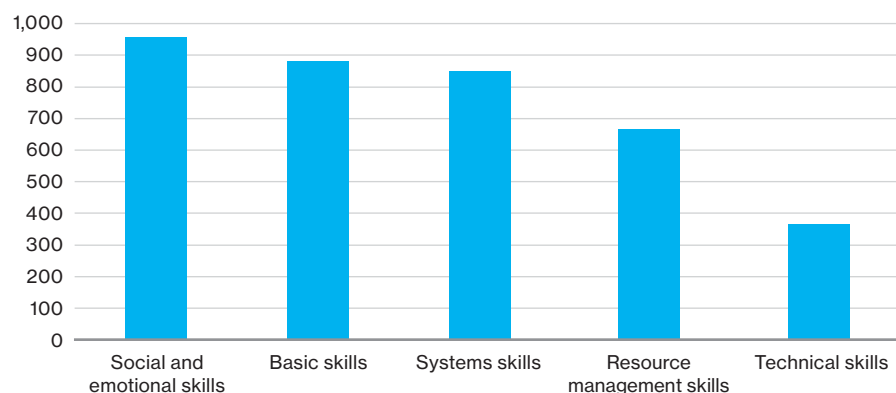


Chart 5
Aggregate Value of Skill Vacancies, by Skill Group
 (value of skill group vacancies in 2020, \$ billions)



Sources: The Conference Board of Canada; O*NET; Statistics Canada.

Chart 6
Average Value of Skill Vacancies, by Skill Group
 (value of skill group vacancies in 2020, \$ millions)



Sources: The Conference Board of Canada; O*NET; Statistics Canada.

Next Steps

Skills have value through their impact on earnings, and skill vacancies represent \$25 billion of unrealized economic value. By looking at how skills correlate with each other, we can define and value fundamental skill sets, helping policy-makers and educators prioritize their efforts to address skill gaps. To minimize the unrealized value going forward, action—whether in the form of public policies or innovative business practices—is needed that can help narrow the gap between the demand for and the supply of skills.

One way to reduce the unrealized value of skill vacancies is to better match training and educational programs with the identified gaps. This would suggest that programs focused on active listening, critical thinking, reading comprehension, speaking, monitoring, and coordination skills should be prioritized. The growing cost associated with these skill vacancies, and their persistence as the skills with the highest unrealized value suggest that addressing these gaps should be prioritized.

These skills are usually most developed among individuals with a university-level education.⁹ Other educational programs should also try to increase their focus on these in-demand skills. In short, prioritizing scarce funds by addressing the highest value skill groups first is likely to provide the best returns on investment.

Further Areas of Research

We have identified two related research questions that will be explored further in an upcoming report:

- Can we explain the variability in earnings by building a model based on skills and other variables like abilities or knowledge areas that together explain the total variability in occupation-specific earnings?
- How do skills correlate into “occupational clusters,” and what other variables might distinguish these groups? How should each of these groups be described or characterized? Investigating possible inter-group differences among occupational clusters will be informative.



⁹ Conference Board of Canada, The, “OpportuNext.”

Appendix A

Methodology

Valuing Skill Vacancies

Our approach to measuring the value of skill vacancies requires careful relational database analysis. The idea that job vacancies reflect and can be used to measure employer demand is not entirely new. A few studies have pursued this line of research.

A recent Statistics Canada report¹⁰ treated job vacancies as a proxy for employer demand and unemployment figures as the measure of worker supply. Using these two measures—job vacancies and unemployment—the report analyzed the imbalances between labour market demand and supply in Canada. A more recent OECD study¹¹ used online job postings to measure skill vacancies in several countries, including Canada. However, this study did not use the exact term “skill vacancy,” nor did it utilize a consistent skills taxonomy. It also tended to conflate skills with education and knowledge areas. For example, this study reported that the top 10 skills sought by Canadian employers were dental care, communication, teaching, English, radiology, teamwork/collaboration, budget management, organizational, medical support, and detail oriented. While detail orientation and communication can be construed as skills, dental care, radiology, and medical support should be regarded as knowledge areas.

Our approach is novel and has never been applied to Canadian labour market data; no other studies have translated job vacancies into their respective skill vacancies per se.

Starting with the Conference Board’s new OpportuNext database, which maps the Canadian National Occupation Classification (NOC) system to the 35 job skills described in the U.S.-based O*NET database,¹² we were able to specify the unique skill sets for each of the 500 occupations listed at the four-digit level of NOC. We then merged this occupation-skills data with the results of Statistics Canada’s Job Vacancy and Wage Survey (JVWS). Since our skills data from O*NET and JVWS vacancy data are defined at the four-digit NOC level, we can associate O*NET skills with job vacancies.¹³ We then aggregated across occupations by O*NET skills, using the number of vacancies per occupation as weights and arriving at a measure of skill vacancies. Lastly, we used annual earnings for each of the 500 occupations listed at the four-digit NOC level to find the dollar value that could otherwise be realized had all skill set vacancies been filled.

However, we also needed to create estimates for annual income changes across all 500 occupations. To do so, we started with the annual earnings data for all 500 occupations reported in the 2015–16 census. We then computed annualized earnings growth based on weekly wages for the higher-level two-digit NOC occupational groups, which is regularly tracked as part of Statistics Canada’s Labour Force Survey. Finally, we applied the annual wage growth rates computed at the two-digit NOC occupational group level to their respective subset of four-digit NOC occupations. By doing this for the five years spanning 2016 to 2020,

10 Drolet, *Linking Labour Demand and Labour Supply*.

11 Organisation for Economic Co-operation and Development, *An Assessment of the Impact of COVID-19 on Job and Skills Demand*.

12 OpportuNext was developed by The Conference Board of Canada for the purpose of integrating standard Canadian labour market data with information on occupational skills. For more details, visit <https://www.opportunext.ca/>.

13 To avoid the complexities of variable duration and seasonal effects on intra-year job vacancy figures, we decided to use annualized job vacancies data. Using annualized job vacancies also matches the time frame of our yearly salaries data, allowing for clear interpretation of our estimated valuations on a per annum basis.

we were able to extrapolate annual incomes from the 2015–16 census out to 2020. The main assumption in this extrapolation is that wages for all four-digit NOC occupations belonging to a particular two-digit NOC group are growing at the same rate.

As a result, there are three moving parts that drive inter-year variability in the value derived for skill vacancies. First is the change in the aggregate number of job vacancies over time. Then, within any specific year, the mix of occupations that aggregate up into total job vacancies changes as well. Finally, the changes in job earnings—the compensation for an employee’s skills set—also fluctuates.¹⁴ The one constant throughout is the skills profile for each occupation. In the OpportuNext database, a skills profile for any job is reflected by an array of scores across all 35 skills measured on a standardized basis. These scores measure the importance or complexity of a particular skill for an occupation.¹⁵

After merging the data on occupational skills, job vacancies, and annual salaries, we then proceeded to estimate the value of unrealized skill vacancies across the Canadian economy. The following formula lays out our computation for the value of skill vacancies:

$$\sum_{j=1}^{35} \sum_{i=1}^{500} \left[\left(\frac{\text{Standard Skill Score}_{i,j}}{\sum_{j=1}^{35} \text{Standard Skill Scores}_{i,j}} \right) * \text{Income}_i * \text{Job Vacancies Count}_i \right] \text{ for all } i,j$$

where j indexes 1–35 skills and i indexes 1–500 occupations

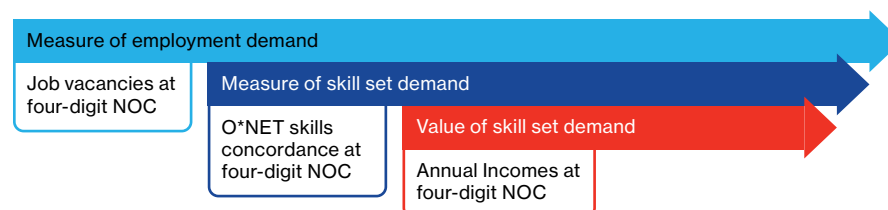
14 We previously noted that earnings and the number of job vacancies per annum have trended upward during the analysis period, thereby helping to push up the estimated value of skill vacancies.

15 See O*NET, “Scales, Ratings, and Standardized Scores,” for a detailed explanation of standardized skill scores.

This formula is summed across the 500 NOC occupations. We also used annualized data for job vacancies and incomes to provide a yearly measure of the monetary value attributable to skill vacancies. We then computed this metric for each year from 2015 to 2020. Exhibit 2 shows our approach.

Exhibit 2 A Schema for Measuring the Unrealized Monetary Value of Skill Vacancies

(value of skill group vacancies in 2020, \$ billions)



Source: The Conference Board of Canada.

For added clarity, Exhibit 3 illustrates how the value of skill vacancies was computed for firefighters. This partial spreadsheet shows how the computation was performed for this one occupation. The results for firefighters also mirror our aggregate level findings; skills like active listening, social perceptiveness, and critical thinking command a higher value than do skills like installation and programming.

Exhibit 3 Computing the Unrealized Value of Skill Vacancies for Firefighters in 2020

$$0.037485 * 480 * \\ \$112,737 = \$2,028,472$$

O*NET Skill	Skill Score	Skill Share = Skill Score / Σ Skill Scores	Number of Job Vacancies – 2020	Annual Income – 2020	Skill Value – 2020
Reading comprehension	50.00	50 / 1334 = 0.037	480	\$112,737	\$2,028,472
Active listening	46.43	0.035	480	\$112,737	\$1,883,581
Writing	42.86	0.032	480	\$112,737	\$1,738,691
Speaking	44.57	0.033	480	\$112,737	\$1,808,238
Mathematics	32.14	0.024	480	\$112,737	\$1,304,018
Science	34.00	0.025	480	\$112,737	\$1,379,361
Critical thinking	55.43	0.042	480	\$112,737	\$2,248,706
Active learning	42.86	0.032	480	\$112,737	\$1,738,691
Learning strategies	42.86	0.032	480	\$112,737	\$1,738,691
Monitoring	51.71	0.039	480	\$112,737	\$2,098,020
Social perceptiveness	44.57	0.033	480	\$112,737	\$1,808,238
Coordination	53.57	0.040	480	\$112,737	\$2,173,363
Persuasion	42.86	0.032	480	\$112,737	\$1,738,691
Negotiation	42.86	0.032	480	\$112,737	\$1,738,691
Instructing	42.86	0.032	480	\$112,737	\$1,738,691
Service orientation	44.57	0.033	480	\$112,737	\$1,808,238
Complex problem-solving	41.14	0.031	480	\$112,737	\$1,669,143
Operations analysis	25.00	0.019	480	\$112,737	\$1,014,236
Technology design	16.00	0.012	480	\$112,737	\$649,111
Equipment selection	34.00	0.025	480	\$112,737	\$1,379,361
Installation	0.00	0.000	480	\$112,737	\$–
Programming	3.57	0.003	480	\$112,737	\$144,891
Operation monitoring	44.57	0.033	480	\$112,737	\$1,808,238
Operation and control	44.57	0.033	480	\$112,737	\$1,808,238
Equipment maintenance	41.14	0.031	480	\$112,737	\$1,669,143
Troubleshooting	41.14	0.031	480	\$112,737	\$1,669,143
Repairing	41.14	0.031	480	\$112,737	\$1,669,143
Quality control analysis	39.29	0.029	480	\$112,737	\$1,593,800
Judgment and decision-making	50.00	0.037	480	\$112,737	\$2,028,472
Systems analysis	42.86	0.032	480	\$112,737	\$1,738,691
Systems evaluation	39.29	0.029	480	\$112,737	\$1,593,800
Time management	42.86	0.032	480	\$112,737	\$1,738,691
Management of financial resources	12.57	0.009	480	\$112,737	\$510,016
Management of material resources	23.14	0.017	480	\$112,737	\$938,893
Management of personnel resources	37.43	0.028	480	\$112,737	\$1,518,456

Sources: The Conference Board of Canada; O*NET; Statistics Canada.

Determining Skill Sets

Evidence that skills come in sets can be found in the regular patterns of how skills are distributed and interrelated. To highlight these patterns, we calculated each pairwise correlation for all 35 occupational skills (as defined in the O*NET database). The resulting correlation matrix and overlaid heat map indicated which combinations of skills—i.e., skill sets—tended to have high positive and negative correlations.

Get the Data

See how skills are correlated.



Appendix B

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