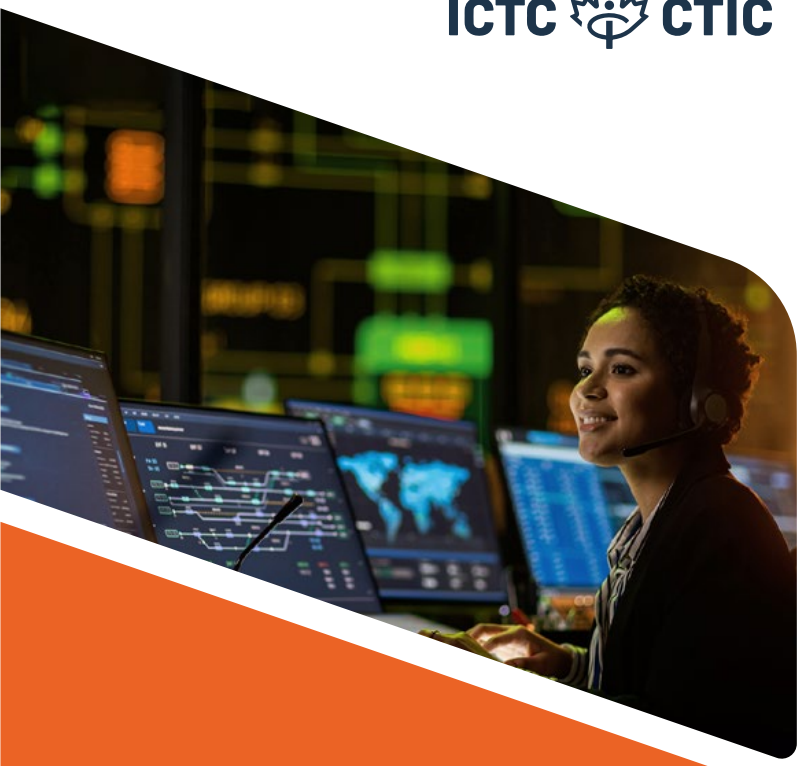
END TO END

The Need for Green and Digital Skills in Canada's Supply Chain Industry

ICTC CTIC



Funded in part by the Government of Canada's Student Work Placement Program

Canada

Financé en partie par le gouvernement du Canada par le biais du programme de stages pratiques pour étudiants

Canada

Research by

ICTC
CTIC
Information and
Communications
Technology Council
Conseil des technologies
de l'information
et des communications

Preface

The Information and Communications Technology Council (ICTC) is a not-for-profit, national centre of expertise for strengthening Canada's digital advantage in a global economy. Through trusted research, practical policy advice, and creative capacity-building programs, ICTC fosters globally competitive Canadian industries enabled by innovative and diverse digital talent. In partnership with an expansive network of industry leaders, academic partners, and policymakers from across Canada, ICTC has empowered a robust and inclusive digital economy for over 30 years.

To cite this report

Lubendo, N., Matthews, M., and McGeer, H., April 2024, *End to End: The Need for Green and Digital Skills in Canada's Supply Chain Industry*. Information and Communications Technology Council (ICTC). Ottawa, Canada. Author order is alphabetized.

Researched and written by Mairead Matthews (Manager, Digital Policy), Heather McGeer (Research and Policy Analyst), and Noah Lubendo (Research and Policy Analyst), with generous support from the ICTC Research & Policy team.

The opinions and interpretations in this publication are those of the authors and do not necessarily reflect those of the Government of Canada.

Acknowledgements

The contributions to this report by our key informant interviewees and other subject matter experts are greatly appreciated. We would like to acknowledge all the contributors to this report, along with the following specific individuals:

Allan To
President and CEO - West, Supply Chain Canada

Andrew Williamson
Sustainable Workforce Coalition

Corrie Banks
Senior Director Logistics Solutions, TrinityRail

Cory Searcy
Professor & Assistant Vice-President, International, Toronto Metropolitan University

Darren Tompkins
Purchasing Manager, City of Kelowna

Frances Edmonds
Head of Sustainable Impact, HP Canada

George P.R. Benson
Senior Manager, Vancouver Economic Commission

Hendrik Dullinger
VP Business Development, EFS-Plastics Inc.

Monica Da Ponte
Principal, Shift & Build

Olga Garcia
Director of Sustainable Procurement, AtkinsRéalis Canada

Palash Sanyal
Founder and Principal, Governing Water Inc.

Robert Klassen
Professor, Ivey Business School, Western University

Siobhan Finan
Manager, Real Estate Sustainability, Canada Post

Tanis Ostermann
Principal & Founder, CanSustain

Thiago Braga
Alberta Health Services

Victor S. Deyglio
Founding President, Canadian Professional Logistics Institute

Yaron Bazaz
Founder and CEO, EmissionZero.AI

We would also like to acknowledge CIPS Americas for their support as a professional development partner.

CONTENTS

Executive Summary 6

Introduction 8

Section I **Global Trends Shaping the Supply Chain Industry** 11

Sustainability and Global Supply Chains 11

Industry Responses to Environmental Sustainability 13

Environmental Sustainability Mandates 14
Environmental Sustainability Assessments 14
Sustainable Procurement 15
Eco-Design 18
Sustainable Logistics and Operations 18

Digitalization and Technology Adoption in Global Supply Chains 20

Digitalization and Organizational Readiness 20
The Role of Data in Supply Chains 22
Supply Chain 4.0 and Transformative Technologies 23

Section II **Labour Market Trends in the Supply Chain Industry** 25

Hiring Trends 26

Demand for Entry-Level Roles in the Supply Chain Industry 27

Operations Roles 28
Research and Development, Design, and Engineering Roles 30
Digital Technology Roles 30
Environmental Sustainability and Environmental Science Roles 32
Administrative and Other Business Function Roles 33
Trades Roles 34
Civil and Regulatory Roles 35

Demand for Knowledge and Skills in the Supply Chain Industry 35

"Traditional" Supply Chain Knowledge and Skills 35
Emerging Supply Chain Knowledge and Skills 39

Section III **Workforce Development Challenges and Solutions** 52

Barriers to Workforce Development 52

Widespread Labour Market Shortages 52
Knowledge and Skill Gaps 53
Organizational Inertia in Public and Private Sector Organizations 57

Workforce Development Solutions 51

Reskilling, Upskilling, and Education 58
Uniformity of Environmental Standards 59
Driving Innovation and Supporting Industry: The Role of Government and Large Industry Buyers 60

Conclusion 62

Research Methodology and Limitations 64

EXECUTIVE SUMMARY

The role of supply chains in mitigating global environmental crises cannot be understated. It has become evident that supply chains around the world, which are significant contributors to environmental harm, must become more resilient and environmentally sustainable for the world to achieve its environmental goals. Already, governments and large private sector organizations are implementing new initiatives to reduce the environmental impact of their supply chain activities. Due to the importance of big data to environmental sustainability, by extension, supply chains are becoming more digitalized. New technologies, particularly artificial intelligence, advanced robotics, and the internet of things (IoT), present opportunities to streamline operations across many functions of the supply chain and lower environmental impacts. As a result, supply chain professionals have to navigate a rapidly changing industry that depends on the development of new and more technical skills regarding sustainability and technology implementation, and their employers face talent gaps and disruptive labour shortages.

At present, many Canadian supply chain employers have reported that despite seeking to fill open roles, they struggle to find entry-level workers with the right mix of skills (60%). Difficulties finding talent, however, vary by subsector. For example, 100% of waste and management employers reported difficulty finding qualified entry-level professionals, whereas a significantly smaller percentage of employers in the enterprise supply chain management industry felt the same (34%). Despite variations, it is clear that Canada's supply chain industry is struggling to keep up with the rapid pace of knowledge and skill change.

Despite changing skill sets, traditional supply chain skills and roles are still needed. However, supply chain professionals, specifically those in supply chain management, will need to strike a balance between traditional competencies and evolving in-demand skills. That is to say, the supply chain professionals that will be best positioned to navigate current trends in the supply chain industry will be those who have married traditional supply chain knowledge, like sourcing best value materials and products and tracking the movement of goods, with green competencies like understanding sustainability standards and conducting lifecycle assessments, and digital skills like data analysis.

Fortunately, much can be done to improve supply chain workforce development issues, namely, the reskilling and upskilling of the current supply chain workforce, a multidisciplinary education for students hoping to work in the supply chain industry, uniformity of environmental standards, which would provide more clarity to supply chain professionals on how to conduct and implement sustainable supply chain practices, and increased attention to and investment in new technologies and training pathways relevant to supply chain management in the public and private sectors. Further, fundamental to solving Canada's supply chain workforce development issues is a paradigm shift away from near-term cost minimization toward step-wise approaches that move Canada closer to its net-zero ambitions.

INTRODUCTION

Global supply chains play a significant role in our ability to secure a more environmentally sustainable future. While supply chains bring about significant economic progress for many regions around the world, they also disrupt economic, social, and environmental paradigms: for example, it is estimated that up to 90% of a company's total environmental impacts can occur within its supply chain, as opposed to direct operations, making supply chains crucial for environmental sustainability.[1] Moreover, due to the expansiveness and complexity of supply chains, whether one considers the micro, such as individual apparel or household products, or the macro, such as building materials or electric vehicles, supply chains are an integral part of global, national, and local economies, and they have a profound impact on the environment. Often, what is cheaper or more efficient from a business perspective generates external costs for the environment. This makes it crucial for the supply chain industry to evaluate and formulate supply chains in ways that are holistically sustainable.

1 "Supply Chain Engagement," 2024, *The Carbon Trust*, https://www.carbontrust.com/value-chain-and-supply-chain-sustainability

The term "sustainability" was first used in the natural resources industry to describe the idea that humans should never harvest more than the earth can generate.[2] By ascribing to this rule, natural resource companies could sustain their extraction of resources over time. Today, the term sustainability is used in a much broader sense—to refer to practices that meet the economic, social, and environmental needs of present generations without compromising the ability of future generations to do so as well.[3] A comprehensive approach to sustainability, therefore, is comprised of these three dimensions: economic, social, and environmental. Economic sustainability relates to welfare, or the ability of present and future generations to acquire wealth and prosper.[4] Social sustainability goes beyond basic needs like food, water, and shelter to encompass the ability of present and future generations to meet higher-level social and cultural needs, such as freedom, education, and recreation.[5] Environmental sustainability relates to the present and future health of the planet: it involves practices that limit environmental degradation, reduce the depletion of natural resources, lower emissions and waste, and promote the resilience of natural ecosystems.

Building on this definition, sustainable supply chains produce, transport, store, recycle, and dispose of products and services without compromising the ability of present and future generations to meet their economic, social, and environmental needs. Sustainable supply chains acknowledge that products and services can have negative impacts during all stages of their lives—including raw material extraction and processing; production, manufacturing, and assembly; transportation and warehousing; use; and end-of-life disposal—and the need for supply chain actors to collaborate across organizational boundaries to reduce these impacts. Sustainable supply chains use resources and human capital sustainably and ethically, reduce their ecological footprints, and balance long and short-term efficiency needs in a variety of ways, including the use of efficiency-related technologies and solutions.[6]

2 Kulman, Tom and Farrington, John, "What is Sustainability," 2010, *MDPI*, https://www.mdpi.com/2071-1050/2/11/3436

3 "Our Common Future," 1987, *United Nations*, https://www.are.admin.ch/are/en/home/media/publications/sustainable-development/brundtland-report.html

4 Williams, Evan, "Blueprint for a sustainable economy," 2001, *Wiley Online Library*, https://onlinelibrary.wiley.com/doi/10.1002/bse.299

5 Brown, Becky et al., "Global Sustainability: Toward Definition," *Environmental Management*, https://www.researchgate.net/publication/226879595_Global_Sustainability_Toward_Definition

6 Adapted from "Green Agriculture: foundations for biodiverse, resilient and productive agricultural systems," 2011, *Taylor and Francis Online*, https://www.tandfonline.com/doi/abs/10.1080/14735903.2011.610206

Recognizing the role that human capital plays in meeting environmental sustainability goals, this report identifies the impact that sustainability initiatives are having on supply chain labour market needs. This report determines which jobs will be needed to implement sustainability initiatives in Canada's supply chain industry and what knowledge and skills are needed as a result of sustainability trends. While the report does include some information about mid- and senior-level roles, as well as potential career pathways in the supply chain industry, it mainly focuses on the demand for entry-level roles and skills. Additionally, given the breadth and complexity of modern supply chains, the report focuses largely on one facet of supply chain sustainability: the environment.

This study relies on a mixed methods approach, which includes the following: a preliminary review of existing publications about sustainability initiatives in the supply chain industry and their impact on demand for jobs, knowledge, and skills; web scraping and analysis of job postings by employers in Canada's supply chain industry to identify in-demand jobs, knowledge, and skills; qualitative interviews with 20 subject matter experts from the supply chain industry; a survey of 43 employers from Canada's supply chain industry; and a survey of 669 students in programs linked to supply chain professions. In addition to this, an advisory committee comprising 20 experts met three times over the course of the research project to contribute to and validate the research findings.

Section I of this report provides an overview of how sustainability trends are impacting the supply chain industry and how supply chain actors are responding to demands for sustainable practices and processes. Because of the integral role of information and communications technologies (ICT) in achieving environmentally sustainable supply chains, Section I also discusses the impact that digitalization and technology adoption are having within the supply chain industry. Section II of the report builds on this by discussing the types of entry-level jobs and skills that are needed in the supply chain industry as a result of sustainability and digitalization. It provides employer insights about which jobs, skills, and knowledge are most in demand and student insights about their perceived level of familiarity with different types of in-demand skills. Finally, Section III discusses the present availability of workforce development programs, as well as what changes or interventions can be undertaken to better prepare students for successful careers.

SECTION I

GLOBAL TRENDS SHAPING THE SUPPLY CHAIN INDUSTRY

Economic trends have reshaped supply chains for centuries. Until recently, supply chains existed to ensure an efficient, reliable, and growing supply of a limited range of economic inputs and products. Often, supply chains were constrained within specific geographic regions or jurisdictions. However, as products became more complex and competition between suppliers increased, supply chains began to incorporate increasingly complex networks of partners, suppliers, products, and services.[7] At the same time, advancements in free trade and transportation technology enabled economies to become more globalized, causing supply chains to become longer and more geographically distributed.[8] In this section, we discuss two additional trends that have altered the way supply chains work in recent years, namely, sustainability and digitalization.

SUSTAINABILITY AND GLOBAL SUPPLY CHAINS

Toward the end of the 20th century, two high-profile ideas changed the way economic actors would view supply chains going forward. In 1987, the Chair of the World Commission on Environment and Development introduced sustainability as the new guiding principle for the global economy and, in so doing, paved the way for later impactful ideas, including the idea of a "green" economy and, eventually, the sustainable development goals.[9]

7 Lummus, Rhonda and Vokurka, Robert, "Defining supply chain management: a historical perspective and practical guidelines," 1999, *Industrial Management and Data Systems*, https://www.proquest.com/docview/234918441

8 "The Evolution of Supply Chain Management: A Brief History," 2024, *SCMEDU*, https://scmedu.org/the-evolution-of-supply-chain-management-a-brief-history/

9 "Our Common Future," 1987, *United Nations*, https://www.are.admin.ch/are/en/home/media/publications/sustainable-development/brundtland-report.html

In 1994, John Elkington introduced a sustainability framework called the triple bottom line, which offered a way for companies to examine their social, environmental, and economic impacts simultaneously.[10] The triple bottom line framework laid the groundwork for a number of other sustainability frameworks that shape the way the global economy operates today, including environmental, social, and governance (ESG) frameworks and reporting requirements.[11]

Since the 21st century, many jurisdictions have enacted sustainability legislation with implications for the supply chain industry. New legislation has sought to reduce the impact that businesses and their supply chains have on the environment but also on social and governance issues, such as human rights and human health. In 2011, the United Nations released its "Guiding Principles on Business and Human Rights," creating new obligations for companies to protect human rights and fundamental freedoms within their operations.[12] Since then, the United Kingdom, France, Germany, United States, and European Union have enacted legislation to reduce the prevalence of human rights abuses within their supply chains, including slavery, human trafficking, and international conflict.[13] While the specifics vary, this legislation makes companies responsible for conducting due diligence and investigating and reducing human rights abuses within their supply chains. Some legislation requires businesses to report information about human rights abuses publicly to customers and shareholders, while other legislation imposes fines on businesses that violate specific rules.[14]

In addition to human rights abuses, governing institutions are increasingly making private sector organizations responsible for investigating, reporting on, and reducing supply chain environmental impacts. The European Union's RoHS Directive, for example, restricts companies from using hazardous substances in certain types of consumer-facing products.[15] In France, the Corporate Duty of Vigilance Law requires large firms to identify, manage, and prevent environmental risks that are generated from their business activities, including within their broader supply chain.[16] Most notably, the European Union's Corporate Sustainability Reporting Directive, which entered into force in 2023, requires approximately 50,000 large companies and subsidiaries of large companies to disclose standardized information about their climate-related risks, including their organization's impact on climate change and the impact that their scope 3 supply chain emissions have on climate change.[17] The European Union is also considering a new regulation that would require products placed on the European market to be equipped with "digital product passports."[18] The intention of the initiative is to increase supply chain transparency by making information about a product's environmental impact accessible to relevant actors across its supply chain.[19]

10 Elkington, John, "25 Years Ago I Coined the Phrase 'Triple Bottom Line.' Here's Why It's Time to Rethink It," June 2018, *Harvard Business Review*, https://hbr.org/2018/06/25-years-ago-i-coined-the-phrase-triple-bottom-line-heres-why-im-giving-up-on-it

11 Ibid.

12 "Guiding Principles on Business and Human Rights," 2011, *United Nations Human Rights Office of the High Commissioner*, https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf

13 "Supply Chain Due Diligence Laws," April 2022, Global HR Lawyers LUS Laboris, https://iuslaboris.com/insights/supply-chain-due-diligence-laws/; "Supply Chain Compliance with Human Rights and Environmental Obligations," February 2023, *White and Case LLP*, https://www.whitecase.com/insight-alert/supply-chain-compliance-human-rights-and-environmental-obligations

14 Ibid.

15 "REACH Regulation," 2024, *European Commission*, https://environment.ec.europa.eu/topics/chemicals/reach-regulation_en

16 "Supply Chain Due Diligence Laws," April 2022, Global HR Lawyers LUS Laboris, https://iuslaboris.com/insights/supply-chain-due-diligence-laws/; "Supply Chain Compliance with Human Rights and Environmental Obligations," February 2023, *White and Case LLP*, https://www.whitecase.com/insight-alert/supply-chain-compliance-human-rights-and-environmental-obligations

17 "Corporate sustainability reporting," 2024, *European Commission*, https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

18 "The EU Digital Product Passport shapes the future of value chains: What it is and how to prepare now," December 2022, *World Business Council for Sustainable Development* and *Boston Consulting Group*, https://www.wbcsd.org/contentwbc/download/15584/226479/1

19 Ibid.

In the private sector, 132 banks, including all of Canada's largest banks and 40% of global banking assets, have signed onto the Net-Zero Banking Alliance, which promises to bring GHG emissions from lending and investment portfolios—including scope 3 emissions—in line with net-zero-by-2050 pathways.[20] Meanwhile, approximately 929 companies from the Forbes 2000 list have set net-zero targets, representing $26.4 trillion in annual revenue.[21] According to a supply chain expert from the University of Tennessee Knoxville, "ESG initiatives have moved from a 'nice-to-have' public relations tactic to an enterprise-wide strategic imperative that deeply involves supply chain management. It's no longer enough to optimize procurement, operations, and logistics networks to create a competitive advantage; from the board and CEO down, leaders must manage the environmental and social impacts of their end-to-end supply chains or face stark financial consequences."[22] In this study, participants shared a similar perspective. As one interviewee noted, "More and more, companies are realizing that they are going to have to step it up with their sustainability strategies… [due to] increasing regulatory pressure, allegations, and litigations related to what greenwashing is, what it means to be a good steward for an organization, and what this means for its consumers."

INDUSTRY RESPONSES TO ENVIRONMENTAL SUSTAINABILITY

Climate change and other forms of environmental harm are making severe weather events, natural disasters, and international conflict more prevalent. This is, in turn, disrupting global supply chains and threatening businesses and industry resiliency. In 2023, public and private sector leaders reported that environmental risks like climate change and natural disasters were among their most critical concerns.[23] Economists warn that environmental destruction could undermine the very foundations of the global economy.[24] To comply with new legislation and account for growing climate-related risks, businesses need to exercise a high degree of surveillance and control over their supply chains. This reality is transforming the focus of modern supply chains. As one interviewee noted, "Green supply chains are one of the key ways for us to meet our sustainability goals… a lot of the low-hanging fruit is going to be accomplished by being more strategic within procurement and supply chain planning." In this study, interviewees highlighted a number of ways that supply chain professionals are adapting to environmental sustainability, including by incorporating environmental sustainability considerations into broader organizational strategies, procuring and designing products and services with environmental sustainability in mind, and building more environmentally sustainable supply chains from end to end. These and other approaches are described in more detail in the sections below.

20 "Net-Zero Banking Alliance," 2024, *United Nations Environment Programme – Finance Initiative*, https://www.unepfi.org/net-zero-banking/

21 "Net zero targets among world's largest companies double, but credibility gaps undermine progress," June 2023, *Net Zero Tracker*, https://zerotracker.net/insights/net-zero-targets-among-worlds-largest-companies-double-but-credibility-gaps-undermine-progress

22 Amling, Alan, "The Simple Guide to ESG in the Supply Chain," November 2021, *The University of Knoxville Tennessee Global Supply Chain Institute*, https://supplychainmanagement.utk.edu/blog/the-simple-guide-to-esg-in-the-supply-chain/

23 "Climate change: 5 charts from the IPCC report that show why every increment of warming matters,"

24 Altenburg, Assmann, "Green Industrial Policy: Concept, Policies, Country Experiences," 2017, United Nations Environment Program Partnership for Action on Green Economy, https://drodrik.scholar.harvard.edu/files/dani-rodrik/files/altenburg_rodrik_green_industrial_policy_webversion.pdf

Environmental Sustainability Mandates

Interviewees in this study felt that organization-wide sustainability mandates are a crucial first step to achieving a "green" supply chain. While specific departments and individuals are responsible for incorporating environmental sustainability into their day-to-day practices, organizational mandates are what empower individual employees to prioritize environmental sustainability in their work, particularly when other considerations, such as cost or timeline, may be compromised. As one interviewee shared, "There are ethics and standards that we aspire to as a profession…but we really do look to our employers, whoever they are, to be clear and precise about what they're expecting…and set the aspirational goals and tone of the corporation, whether that be…lowering greenhouse gas emissions or reducing our impact on air or water." Another interviewee similarly indicated that "you need a vision from the top—you need boards of directors, CEOs, and chief supply chain officers to understand why [sustainability] is important." When employees lack a sustainability mandate, they may be unable to make supply chain decisions based on sustainability outcomes. For example, a third interviewee shared that because their senior leadership has not set a sustainability mandate, they are unable to include ESG or sustainability-related criteria in procurement documents. In many cases, they noted, "It takes a courageous leader to say, 'Hold on, slow down, we're going to make this real.'"

Adopting a sustainability mandate will look different depending on the kind of organization. For government actors, adopting a sustainability mandate may mean amending existing bylaws, regulations, or guidelines to give staff the freedom and authority to prioritize sustainability in supply chain decisions. For example, one interviewee, a municipal government employee, shared how their city council amended city bylaws to enable municipal staff to choose "the best value" as opposed to "the lowest cost" when making procurement decisions. For a private sector company or a not-for-profit organization, adopting a sustainability mandate may mean changing organizational bylaws, adopting a formal ESG or environmental sustainability strategy, or creating a culture that encourages eco-design or green procurement. Irrespective of how sustainability mandates are set, they should be deeply engrained into broader organizational strategy and decision-making structures so they can influence material decisions like business strategy, product and service design, hiring, promotions, compensation, and performance reviews. For example, an interviewee in this study explained that their organization had embedded environmental sustainability considerations in the financial and decision-making processes to consider and approve new capital projects. As they explained, "In addition to knowing how you will benefit from a capital investment, you have to know what the environmental footprint is."

Environmental Sustainability Assessments

Sustainability assessments help organizations assess their existing approach to environmental sustainability and identify areas for improvement. For example, environmental sustainability assessments help organizations identify which of their environmental impacts are most material, which environmental best practices they are not using, how transparent their supply chains are, identify gaps in data collection, and solidify baseline statistics that can be used to benchmark progress.

To ensure their findings are comparable with other economic actors, organizations should adopt a standardized approach to environmental assessment, such as:

- Sustainability Advantage's Basic or Advanced Sustainability Assessment Tool[25]
- B Corp's B Impact Assessment[26]
- The Responsible Business Alliance's RBA Self-Assessment Questionnaire[27]
- S&P Global's Corporate Sustainability Assessment[28] or Private Benchmarking Service[29]
- EcoVadis' EcoVadis Sustainability Assessment[30]

To address environmental impacts that occur in their broader supply chain, as opposed to just their direct operations, organizations should adopt a framework that considers scope 1, 2, and 3 environmental impacts, assesses partners and suppliers, and touches on best practices like sustainable procurement and eco-design.

Sustainable Procurement

Sustainable procurement, or "green procurement," was the most widely discussed strategy for reducing environmental impacts among interviewees in this study. Interviewees described sustainable procurement as an "often overlooked" but "very strong function within an organization," as well as "the only tool that can give Canada a fighting chance at meeting our climate and sustainable development goals." They felt that small to medium-sized businesses are unlikely to invest in environmental sustainability initiatives if their customers and clients do not incentivize them to do so by engaging in sustainable procurement, and because of this, they saw sustainable procurement as a necessary precursor to sustainable supply chains. As evidenced by the list below, interviewees discussed a number of different methods that organizations can use to engage in sustainable procurement:

The Triple Bottom Line (TBL) Framework — The TBL framework guides firms to consider more diverse metrics when making business decisions or evaluating business success. It encourages firms to go beyond traditional metrics like revenue growth, cost savings, and profit to include metrics related to their social and environmental impact. For example, procurement and sourcing teams could incorporate social and environmental metrics into their frameworks to evaluate partners and suppliers or their procurement documents, such as requests for proposals (RFP), requests for quotes (RFQ), and requests for information (RFI). Overall, interviewees saw environmental sustainability metrics as an important way for buyers to communicate to suppliers that environmental and social performance matters and are a significant factor in deciding who wins bids. When choosing metrics, interviewees cautioned that it is important for firms to consider a broad range of environmental impacts, and not just those related to GHG emissions.

25 "Free Open-Source Tools for Sustainability Champions," 2024, Sustainability Advantage, https://sustainabilityadvantage.com/
26 "B Impact Assessment," 2024, B Lab Global, https://bcorporation.eu/become-a-b-corp/b-impact-assessment/
27 "RBA Self-Assessment Questionnaire," 2024, Responsible Business Alliance, https://www.responsiblebusiness.org/tools/saq-faqs/
28 "CSA," 2024, S&P Global, https://www.spglobal.com/esg/csa/getting-an-assessment#private
29 "Benchmarking Services," 2024, S&P Global, https://pages.marketintelligence.spglobal.com/Benchmarking-Demo-Request-Form.html
30 "EcoVadis," 2023, EcoVadis, https://support.ecovadis.com/hc/en-us

As one interviewee noted, many organizations are hyper-focused on climate change as a result of government policy and, therefore, only concern themselves with metrics related to climate change. They encouraged firms to consider whether GHG emissions are indeed their most material environmental impact and to broaden their focus to things like biodiversity loss and water toxicity. Interviewees also noted that to have real-world impact, environmental and social metrics need "real teeth." In the context of an RFP, this might mean associating a minimum number of points with environmental criteria. To sway a procurement process, interviewees felt it was necessary to allocate at least 20% of an RFP's total points to environmental or social criteria.

Technical Specifications for Environmental Sustainability — Technical specifications can be incorporated into procurement documents, such as supplier contracts, RFPs, RFQs, and RFIs, to help ensure products and services meet environmental best practices. Technical specifications for environmental sustainability differ from environmental metrics: environmental metrics are broad and optional, such as "indicate what measures you are taking, if any, to reduce energy consumption in your data centre operations," whereas technical specifications are usually mandatory and very specific, such as specifying that "the power distribution in the data centre must be 400 V DC to reduce overall power conversion and distribution losses within the facility."[31] Technical specifications correlate to a mandatory requirement that a product or service must meet to be considered by the buyer. For example:

- Insulation materials that are made of at least 70% recovered or post-consumer materials
- A retail space where rainwater is collected, filtered, and stored to be used for non-drinking purposes
- Paper products that have been certified by PEFC Canada[32]
- Concrete with a total content of alkalis not above 0.6 percent[33]
- Network equipment where all plastic parts exceeding 25g contain no greater than 1000 ppm chlorine or greater than 1000 ppm bromine[34]

When choosing technical specifications, interviewees felt that it is important for procurement and sourcing teams to follow industry standards to ensure that specifications are reasonable and achievable.

Environmental Sustainability Standards—Sustainability standards have been developed by international standards-setting organizations like the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telecommunication Union (ITU) for a wide variety of products and services. Indeed, in the information and communications technology sector alone, more than 150 standards focus on some aspect of environmental sustainability.[35]

31 "L.1300 : Best practices for green data centres," 2014, *International Telecommunications Union of the United Nations*, https://www.itu.int/rec/T-REC-L.1300-201406-I/en

32 "PEFC Canada," 2024 PEFC Canada, https://www.pefccanada.org/

33 Lemay, Lionel et al., "Specifying Sustainable Concrete," 2020, *Build With Strength*, https://www.nrmca.org/wp-content/uploads/2020/09/SpecifyingSustainableConcreteDecember2019.pdf

34 "Criteria for the Sustainability Assessment of Network Equipment for the Global Electronics Council EPEAT® Ecolabel and the TÜV Rheinland Green Product Mark," 2021, *TÜV Rheinland and Global Electronics Council*, https://globalelectronicscouncil.org/wp-content/uploads/EPEAT-Network-Equipment-Criteria_FINAL-April-2021.pdf

35 Carr, Kaitlyn, Clark, Allison, and Matthews, Mairead, "Building a Sustainable ICT Ecosystem: Strategies and Best Practices for Reducing Environmental Harms in a Digital World," 2024, *ICTC*, https://ictc-ctic.ca/reports/building-a-sustainable-ict-ecosystem

One of the benefits of environmental sustainability standards is that they can help procurement and sourcing teams identify environmental specifications and criteria informed by industry experts and conform to international standards. International standards "help to harmonize specifications of products and services, making industry more efficient, breaking down barriers to international trade," and reassuring "consumers that products and services are safe, efficient, and environmentally responsible."[36] The International Trade Centre's Standards Map enables users to easily search more than 300 standards by product, sector, and area of focus, as well as compare more than 1,650 criteria for up to four standards side by side.[37]

Ecolabels — Officially referred to as "environmental ecolabels," are specialized marks that suppliers can place on their products, services, parts, or materials to distinguish them as environmentally sustainable. Interviewees in this study noted that ecolabels can be easily incorporated by supply chain professionals into their existing processes with little additional work—"especially for low-value purchases, labels are a great way for people to start incorporating sustainability into their procurements." One well-known example of an ecolabel is ENERGY STAR, which helps buyers identify energy-efficient appliances and equipment. However, there are more than 456 ecolabels around the world, spanning 199 countries and 25 industry sectors.[38] With so many ecolabels to choose from, procurement and sourcing personnel should standardize the use of "Type I environmental labels," which are ISO 14024 certified. Certification requires ecolabel managers to follow specific best practices when defining their ecolabel product categories, determining what environmental criteria their ecolabel will rely on and whether companies are complying with environmental criteria and requirements.[39]

Lifecycle Assessments — Lifecycle assessments (LCAs) use a specific methodology to estimate the environmental impacts of products and services during each stage of their lifecycle. They can be used by buyers at any point in the supply chain to estimate the environmental impact of a product or service or compare similar versions of a product, service, part, or material to identify the most sustainable option. To account for the full scope of a product or service's environmental impact, LCAs should be multivariate, taking into account a range of environmental impacts, such as climate change, ozone depletion, human toxicity, respiratory inorganics or particulate matter, aquatic and terrestrial eutrophication, acidification, ecotoxicity, land use, and resource depletion.[40] To ensure LCAs by different organizations are comparable, LCAs should follow a standardized approach—such as the International Organization for Standardization's ISO 14044:2006: Lifecycle Assessment Requirements and Guidelines[41]—and use standardized indicators and datasets for environmental impact.

36 "Standards and Environmental Sustainability," October 2022, Geneva Environment Network, https://www.genevaenvironmentnetwork.org/resources/updates/standards-and-environmental-sustainability/

37 "ITC Standards Map App," 2024, International Trade Centre, https://standardsmap.org/en/identify

38 "Ecolabel Index," 2024, Ecolabel Index, https://www.ecolabelindex.com/

39 "ISO 14024:2018 Environmental labels and declarations Type I environmental labelling Principles and procedures," 2023, ISO, https://www.iso.org/standard/72458.html

40 Carr, Kaitlyn, Clark, Allison, and Matthews, Mairead, "Building a Sustainable ICT Ecosystem: Strategies and Best Practices for Reducing Environmental Harms in a Digital World," 2024, ICTC, https://ictc-ctic.ca/reports/building-a-sustainable-ict-ecosystem

41 "ISO 14044:2006 Environmental management Lifecycle assessment Requirements and guidelines ," 2023, ISO, https://www.iso.org/standard/38498.html

Eco-Design

Due to the complex nature of modern supply chains, many organizations are both buyers and suppliers of a wide variety of products and services. Accordingly, interviewees noted that it is important for firms to not just procure sustainable products and services from other suppliers but also ensure they follow best practices for eco-design within their own organization. Eco-design encompasses "any form of design that minimizes environmentally destructive impacts."[42] It requires product and service designers to investigate what environmental sustainability standards or regulations apply to their products and services and ensure their products and services meet these standards and regulations. It also requires product and service designers to assess the environmental impacts of their products and services across their lifecycle, determine how design decisions might improve or worsen these impacts, and, as much as possible, reduce them. Product and service designers can use many of the same tools for eco-design as buyers can for sustainable procurement, including using the TBL framework to make design decisions, performing lifecycle assessments, and adhering to technical specifications for environmental sustainability, environmental sustainability standards, or ecolabel requirements.

Sustainable Logistics and Operations

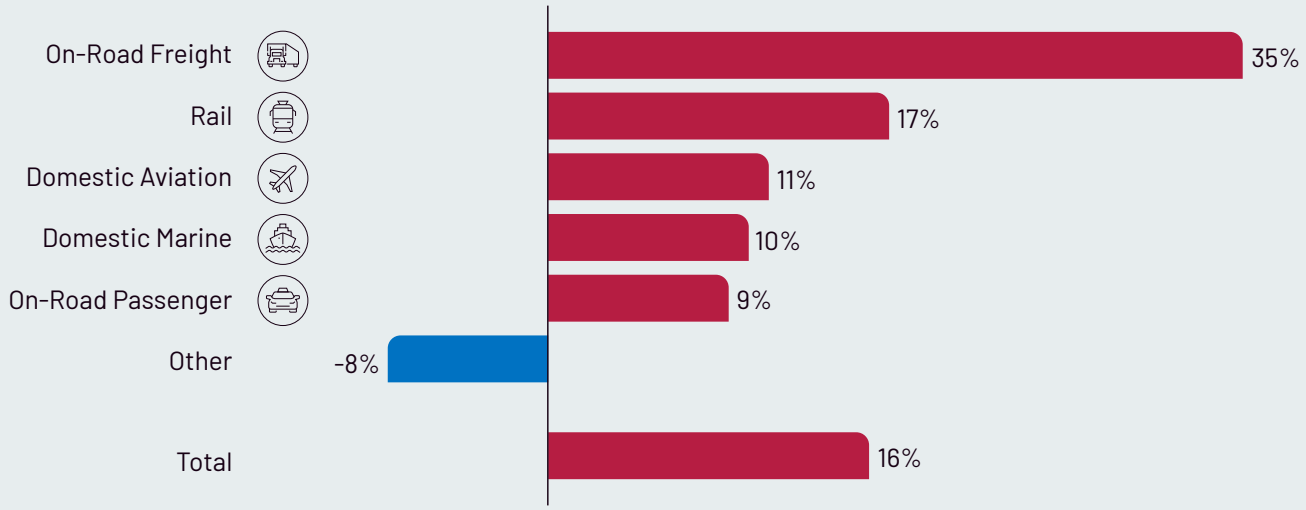
Interviewees highlighted that it is important for supply chain professionals to consider environmental sustainability not just in the way individual procurement processes are run or in the way specific products, services, or components are designed but in the way entire supply chains are planned from end to end. Supply chains have become longer and more globalized over the past 50 years as products have become more complex and as free trade agreements and advancements in transportation have enabled products and services to be more easily traded and transported between countries. The ubiquity of product movement across vast geographic distances has increased transportation's share of environmental impacts. For example, Canada's transportation sector generated 160.03 million tonnes of GHG emissions in 2019, an increase of approximately 16% over 2005 levels.[43] During this time, on-road freight saw the largest increase in GHG emissions, growing by a staggering 35% (see Figure 1). Despite having a high carbon footprint, on-road freight accounts for approximately 92% of the cargo transported within Canada, 71.5% of the cargo that is transported from Canada to the United States, and 54.2% of the cargo transported from the United States to Canada.[44]

42 Van der Ryn, Sim and Cowan, Stuart, "Ecological Design," 1996 and 2013, *Island Press*, https://www.google.ca/books/edition/Ecological_Design_Tenth_Anniversary_Edit/PEBs_eolOdgC

43 "Transportation in Canada 2021: Greenhouse gas emissions," 2022, *Transport Canada*, https://tc.canada.ca/en/corporate-services/transparency/corporate-management-reporting/transportation-canada-annual-reports/2021/greenhouse-gas-emissions

44 Fan, Dana and Heminthavong, Khamla, "Road Transportation: Heavyweight of the Canadian economy," May 2022, *Library of Parliament*, https://lop.parl.ca/staticfiles/PublicWebsite/Home/ResearchPublications/HillStudies/PDF/2022-04-E.pdf

Figure 1: Transport-related GHG emissions from 2005 to 2009



Data source: Environment and Climate Change Canada, National Inventory Report, as cited in https://tc.canada.ca/en/corporate-services/transparency/corporate-management-reporting/transportation-canada-annual-reports/2021/greenhouse-gas-emissions

Interviewees shared a number of specific strategies for reducing environmental impacts across supply chains. For example, one interviewee suggested asking ocean and air carriers to submit information about their environmental impacts, such as their GHG emissions, so that this information can be considered when choosing a provider. They also suggested opting for carriers that use cleaner fuel alternatives, such as natural gas, biofuels, or synthetic fuels. Another interviewee suggested opting for rail in place of on-road freight, and when rail is not a possible alternative, opting for electric vehicles or otherwise upgrading internal combustion engine fleets to improve air quality and fuel performance. In addition to choosing more sustainable transportation, supply chain managers can regionalize supply chains. In a regional supply chain, material inputs, production and manufacturing facilities, storage facilities, and end markets are co-located or moved closer in proximity to one another, reducing the need for transport altogether. Regional supply chains may contain less risk and have more positive impacts on the environment than global supply chains. For example, locally manufacturing products in North America instead of importing them from distant locations can reduce GHG emissions by up to 10 times.[45] In a 2023 survey by McKinsey & Company, "two-thirds of respondents [said] they were obtaining more inputs from suppliers located closer to their production sites over the past 12 months," while nearly 64% indicated that "they are currently regionalizing their supply chains," up from 44% the previous year.[46] At the same time, 89% of respondents who are dependent on inputs from another region "indicated that they want to reduce their dependency on other regions over time."[47]

45 Doheny, Mike et al., "To regionalize or not? Optimizing North American supply chains," December 2022, *McKinsey & Company*, https://www.mckinsey.com/capabilities/operations/our-insights/to-regionalize-or-not-optimizing-north-american-supply-chains

46 Alicke, Knut et al., "Tech and regionalization bolster supply chains, but complacency looms," November 2023, *McKinsey & Company*, https://www.mckinsey.com/capabilities/operations/our-insights/tech-and-regionalization-bolster-supply-chains-but-complacency-looms

47 Ibid.

DIGITALIZATION AND TECHNOLOGY ADOPTION IN GLOBAL SUPPLY CHAINS

Interviewees in this study indicated that sustainability has made inroads in the supply chain industry over the past five to 10 years—in many cases, the goal is no longer to convince supply chain actors that sustainability is a valuable endeavour but to equip supply chain actors with the data, tools, and skills needed to make environmentally sustainable supply chain decisions. As one interviewee noted, "We're well past the point of having to convince people that there is ecological damage resulting from their activities and that this damage counts for something." Despite this increased awareness, interviewees indicated that it has not had a material or broad impact on supply chain practices. "There is obviously a lot of stickiness in the system [that prevents] getting us to where we need to be." One of the barriers interviewees identified was a lack of knowledge among supply chain practitioners about how to facilitate real change. A second was an overall reliance on outdated methodologies and a lack of sophisticated solutions for calculating and incorporating environmental impact.

One of the most fundamental catalysts to the proliferation of environmentally sustainable supply chains is the development of new technologies and their integration with supply chain practices. In response to a 2023 survey, 80% of supply chain executives cited "a lack of digital skills among employees" as the most common challenge to integrating ESG into supply chains. This was followed by "the availability of data and digital tools," selected by 73% of responses.[48] New technologies, including but not limited to artificial intelligence (AI), advanced robotics, cyber-physical systems (CPS), internet of things (IoT), and cloud systems, present challenges for workers but also present opportunities to green and digitalize supply chain practices across several functions and sectors. For example, technology presents an opportunity to make supply chains more efficient by streamlining processes and more resilient by providing supply chain professionals with the means to model and anticipate supply chain disruptions. In this section, we review some of the ways that digitalization and technology adoption are changing Canada's supply chain industry.

Digitalization and Organizational Readiness

Although digitalization is fundamental to the greening of supply chain practices around the world, due to reported low levels of digital adoption by supply chain executives, for the most part, digitalization in the global supply chain industry remains more of a future goal and less of a present reality.[49] As things currently stand, "the supply chain sector is not ready to provide seamless, end-to-end digital information highways for all modern supply chains to be more agile and resilient."[50]

48 "How much is technology transforming supply chains?" 2023, *PwC*, https://www.pwc.com/us/en/services/consulting/business-transformation/digital-supply-chain-survey.html

49 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

50 Ibid.

At the core of the organizational readiness gap is a lack of understanding of new technologies, the opportunities they present and the risks they pose, the cost of purchasing new technologies, and the lack of standardization relating to digital technologies in the supply chain industry. Further, digitalization raises concerns surrounding data collection and data security, organizational inertia, limited resources, and challenges in operationalizing digital solutions in a way that is both harmonious and affordable.[51]

While the digitalization of supply chain operations is needed to promote and facilitate sustainable business practices, early adopters of digital solutions report mixed reviews: 80% of respondents to a 2018 survey conducted by McKinsey Global said that their organizations introduced digital technologies to realize specific performance benefits.[52] However, only 16% of respondents reported that digital solutions improved performance and that these improvements could be sustained. Only 7% reported that digitalization improved performance but noted these improvements were not long-lived.[53] In ICTC's study, in reference to the challenges of tech adoption in supply chains, one interviewee also said:

> *Adoption of tech to streamline [operations] is slowly happening right now. But one of the challenges is that we have a half dozen different technologies involved in our supply chain process, which creates a whole different host of problems because none of them necessarily talk to each other. And we're constantly moving data from one system to another and that kind of thing. So, finding the right solutions that are affordable [has proven to be difficult].*

A survey of supply chain professionals by Supply Chain Canada revealed that the most pressing barriers to digitalization in Canada were organizational, managerial, and attitudinal.[54] As a response to low levels of organizational readiness for digital transformation in Canada, the federal government "announced a $136 million Advancing Industry-Driven Digitalization of Canada's Supply Chain initiative" that aims to help operationalize digital solutions throughout Canadian value chains.[55] Given that private sector actors, particularly small or medium enterprises, are not prepared for the digital transformation, the public sector and its support is a critical enabler: "Overall, policymakers must focus on providing financial incentives, promoting awareness of the benefits of technology adoption, and developing policies and regulations to support technology adoption while protecting intellectual property rights."[56]

51 "Adopting Digitalization and Its Impact on Skills," 2023, Supply Chain Canada, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

52 "Unlocking success in digital transformations," October 2018, McKinsey & Company, https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/unlocking-success-in-digital-transformations

53 Ibid.

54 "Adopting Digitalization and Its Impact on Skills," 2023, Supply Chain Canada, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

55 Ibid.

56 Ibid.

The Role of Data in Supply Chains

In the wake of the COVID-19 pandemic, which severely impacted global supply chains due to quarantines, labour shortages, and closed borders, supply chain resiliency has emerged as a core concern for businesses, governments, and consumers around the world. Members of this study's advisory committee noted that data collection and visualization are central to sustainable supply chains and supply chain resiliency. Among other things, data collection and visualization can enable supply chain professionals to react to supply chain disruptions in real time, monitor emissions, and track the movement of goods. As one study participant, a transportation supply chain and data specialist, noted, "We are in the process of putting GPS telematics on rail cars and helping the industry digitalize and get better, more advanced, faster data. It's been a long process, but we're finally starting to get traction and we're finally starting to get visibility. It's all about digitalizing the rail supply chain and increasing and improving the visibility that we have to the rail network. We're using 1980s technology right now in the rail industry to track railcar locations, and that is causing a number of issues overall in the Canadian supply chain."

Research by McKinsey found that data analytics were key to the future of supply chain practices.[57] Through the use of big data, supply chain professionals can improve demand forecasting accuracy, enhance inventory management practices, and optimize transportation routes and delivery schedules.[58] Marrying real-time visibility from IoT technologies with supply chain operations allows organizations to proactively identify bottlenecks, mitigate risks, and improve overall efficiency. Further, data-driven insights enable organizations to identify points of growth and reduce carbon emissions, minimize waste, and optimize energy consumption throughout the supply chain.[59] For example, a 2022 report by Capgemini found that "on average, organizations have seen a 4.6% reduction in emissions annually due to their emissions measurement and analytics efforts."[60] For procurement professionals, data-driven decision-making and increased visibility as a result of data collection are enabling forces that can help procurement teams limit the environmental impacts of day-to-day purchasing decisions.[61] "For instance, procurement teams can use emissions data to assign carbon scores to suppliers in order to facilitate the selection of suppliers with smaller emissions footprints."[62] Additionally, investment in data analytics presents opportunities to phase out redundancies. According to research by McKinsey, organizations that apply data analytics to demand forecasting can improve forecast accuracy and, by extension, cut inventory holding costs by up to 20%.[63]

57 "Big data and the supply chain: The big-supply-chain analytics landscape," February 2016, *McKinsey & Company*, https://www.mckinsey.com/capabilities/operations/our-insights/big-data-and-the-supply-chain-the-big-supply-chain-analytics-landscape-part-1

58 Ibid.

59 Ibid.

60 "Data for Net Zero: Why data is key to bridging the gap between net zero ambition and action," 2022, *Capgemini*, https://prod.ucwe.capgemini.com/wp-content/uploads/2022/09/CRI_Data-Net-Zero_Report_For-Web-1.pdf

61 Ibid.

62 Ibid.

63 "Amar Jorge et al, "AI-Driven operations forecasting in data-light environments," February 2022, *McKinsey & Company*, https://www.mckinsey.com/capabilities/operations/our-insights/ai-driven-operations-forecasting-in-data-light-environments

Supply Chain 4.0 and Transformative Technologies

Supply chain 4.0 and its realization is in many ways key to and inseparable from the development and proliferation of green supply chain practices. Supply chain 4.0 is characterized by the integration of digital technologies and cyber-physical systems and presents new opportunities and challenges for supply chain professionals. More specifically, supply chain 4.0 is the digitalization of supply chain management and connects physical technologies like sensors to digital technologies, "such as the cyber-physical systems, IoT, AI, robotics, blockchain technology, [and] cloud systems."[64] Key technologies driving supply chain 4.0 include advanced robotics, autonomous vehicles, additive manufacturing (3D printing), blockchain, and augmented reality. These technologies enable automation, connectivity, and intelligence across the supply chain, transforming traditional supply chain practices and processes.[65] For example, advanced robotics and autonomous vehicles enable autonomous material handling and transportation while reducing labour costs and improving operational efficiency.[66]

Considering persistent labour shortages, advanced robotics, automation, and AI have emerged as a potential mitigating force, specifically for lower-level warehousing and distribution roles. The COVID-19 pandemic made it clear that supply chains needed to be more resilient to avoid a largely unexpected worldwide economic downturn. Automation offers opportunities to streamline warehousing operations, enhance efficiency, and mitigate labour shortages. Although automating large portions of the supply chain will not erase workforce challenges, demographic shifts necessitate creative solutions to keep many sectors and industries afloat. A case in point is that in 2021, more than 20% of Canada's working-age population was close to retirement, falling between the ages of 55 and 64,[67] a proportion representing "an all-time high in the history of Canadian censuses."[68]

Automation has a long history in supply chains and has been the core of many innovations that improved processes and increased efficiency. Today, through advanced robotics, AI, IoT technologies and other transformative technological developments, automation offers a potential solution to Canada's labour shortages in warehousing and distribution, allowing employers to avoid disruptions due to job vacancies. Automation can reduce supply chain reliance on general labour. It can also improve the efficiency of supply chain processes by performing repetitive, low-value tasks, thereby freeing up employees to focus on higher-value functions that require skills unique to humans and their ingenuity.[69] Further, automation can reduce safety concerns in warehousing and distribution by taking over dangerous tasks otherwise completed by humans.

64 Demiralay, Enes, Paksoy, Turan, "Strategy development for supplier selection process with smart and sustainable criteria in fuzzy environment," 2022, *Cleaner Logistics and Supply Chain*, https://www.sciencedirect.com/science/article/pii/S277239092200049X?via%3Dihub

65 "What are Industry 4.0, the Fourth Industrial Revolution, and 4IR?," August 2022, *McKinsey & Company*, https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-are-industry-4-0-the-fourth-industrial-revolution-and-4ir

66 "Alicke Knut et al, "Autonomous supply chain planning for consumer goods companies," March 2022, *McKinsey & Company*, https://www.mckinsey.com/capabilities/operations/our-insights/autonomous-supply-chain-planning-for-consumer-goods-companies

67 "In the midst of high job vacancies and historically low unemployment, Canada faces record retirements from an aging labour force: number of seniors aged 65 and older grows six times faster than children 0-14," 2022, *Statistics Canada*, https://www150.statcan.gc.ca/n1/daily-quotidien/220427/dq220427a-eng.htm

68 Ibid.

69 Mcrary, Jonatham, "Bridging the Labor Gap: Warehouse Automation's Role in Addressing Labor Shortages," October 2023, *Bastian Solutions*, https://www.bastiansolutions.com/blog/bridging-the-labor-gap-warehouse-automations-role-in-addressing-labor-shortages/

According to a McKinsey report, "Autonomous supply chain planning can lead to an increase in revenue of up to 4%, a reduction in inventory of up to 20%, and a decrease in supply chain costs of up to 10%."[70] As one interviewee in this study noted, "Technologies… take heavy grunt work out of the equation and allow me to focus on refining and improving our operations at a more granular level."

Amid the collection of unprecedented amounts of supply chain data, AI provides supply chain organizations the opportunity to automate tasks, predict trends, and enhance operational efficiency. Using AI, organizations can quickly and efficiently analyze large amounts of historical data and predict trends, thereby "enhancing logistics demand forecasting, route optimization, warehouse layout redesign, and automated inventory management."[71] AI can also be incorporated into maintenance systems to anticipate equipment failures, automatically schedule maintenance activities, reduce maintenance costs, and mitigate productivity losses.[72] In addition to the benefits of AI solutions, AI technologies are integral to many other transformative technologies in the supply chain industry, such as advanced robotics, autonomous cars, trains, drones, and computer vision. Early adopters of AI have cut logistics costs by 15%, increased inventory levels by 35%, and service output by 65%.[73]

70 "Alicke Knut et al, "Autonomous supply chain planning for consumer goods companies," March 2022, *McKinsey & Company*, https://www.mckinsey.com/capabilities/operations/our-insights/autonomous-supply-chain-planning-for-consumer-goods-companies

71 Junghanns, Jorg, "The Future of Logistics," September 2023, *Capgemini*, https://www.capgemini.com/in-en/insights/expert-perspectives/the-future-of-logistics-how-ai-is-revolutionizing-decision-making/

72 "Using AI in predictive maintenance to forecast the future," *Deloitte*, 2024, https://www2.deloitte.com/us/en/pages/consulting/articles/using-ai-in-predictive-maintenance.html

73 "Succeeding in the AI supply-chain revolution," April 2021, *McKinsey & Company*, https://www.mckinsey.com/industries/metals-and-mining/our-insights/succeeding-in-the-ai-supply-chain-revolution

SECTION II

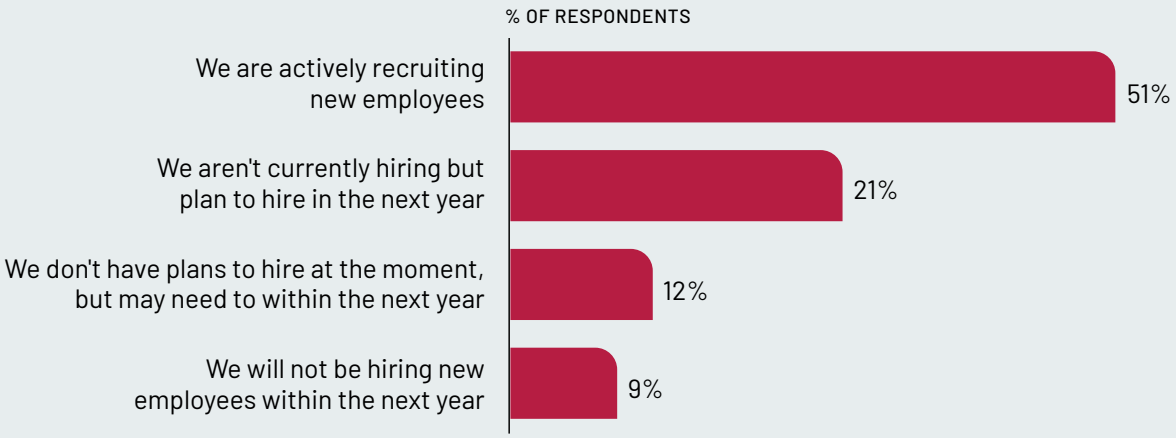
LABOUR MARKET TRENDS IN THE SUPPLY CHAIN INDUSTRY

Environmental sustainability initiatives are driving nuanced but impactful changes in the supply chain labour market. In addition to driving demand for new types of professionals in the supply chain industry—such as sustainability specialists, data analysts, and software developers—environmental sustainability initiatives are leading traditional supply chain workers to embrace new knowledge and skills. In this section, we draw from interviews with supply chain practitioners and experts, as well as two surveys with supply chain employers and students, to highlight some of the changes that are taking place in the supply chain labour market. First, we identify recent hiring trends and the diversity of roles that are needed to enable sustainability in the supply chain industry. Second, we discuss what traditional knowledge and skill sets remain important for supply chain professionals, even amid environmental sustainability and technology trends. Third, we identify how the supply chain profession is changing and what new knowledge and skill sets supply chain professionals will need to drive positive changes for the environment.

HIRING TRENDS

Participants in this study signalled that the supply chain labour market is highly active, with considerable hiring activity taking place across the industry over the next year. A majority (79%) of the businesses that were surveyed for this study indicated that they were either actively hiring at the time the survey was distributed or had plans to hire soon. Meanwhile, 12% indicated that they did not have any hiring plans at the time the survey was distributed but may need to hire within the next year, and just 9% indicated that they would not be hiring employees within the next year.

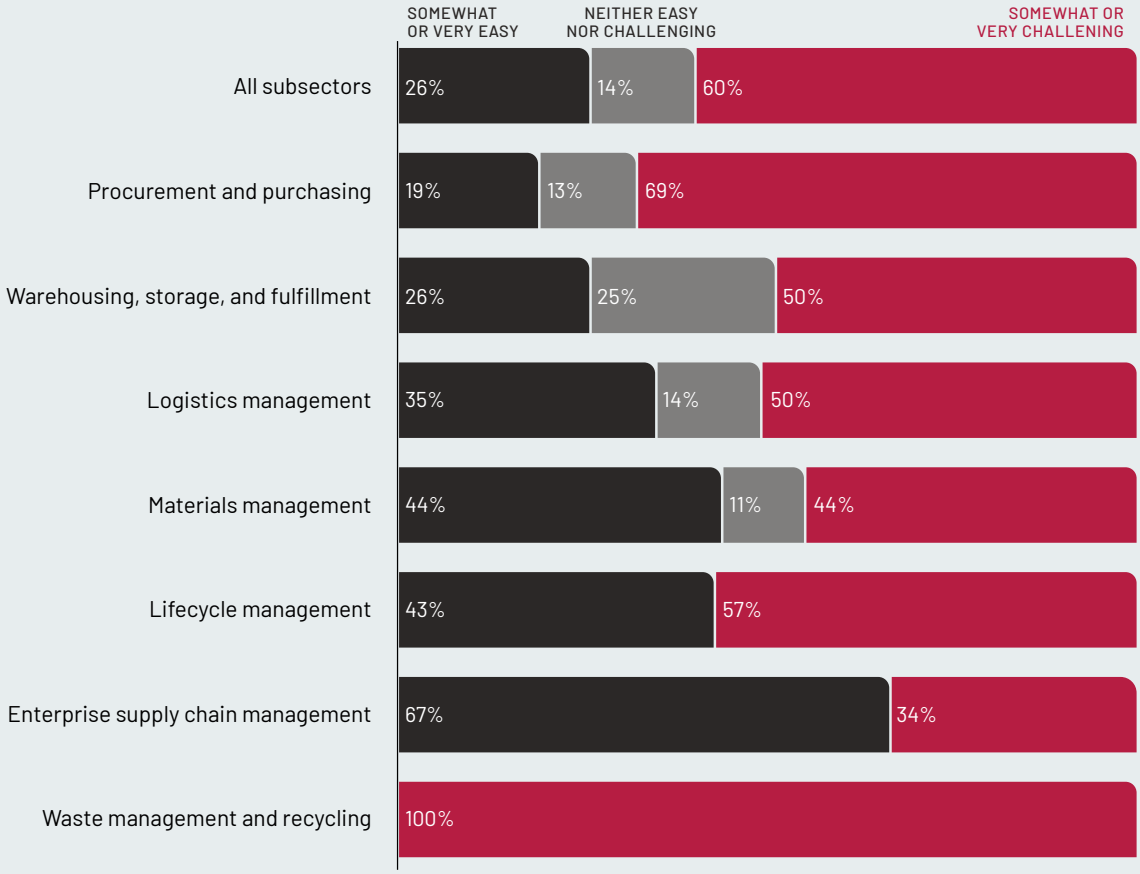
Figure 2: General hiring plans over the next year



Data source: ICTC's employer survey.

When asked how easy or challenging it is to hire entry-level employees with the right mix of skills, approximately 60% indicated that it is either somewhat or very challenging, 14% indicated that it is neither easy nor challenging, and 26% indicated that it is either somewhat or very easy (see Figure 3). Looking at these responses by subindustry, we find that respondents from the waste management and recycling industry are most likely to find it challenging to hire entry-level employees with the right mix of skills, with 100% of respondents in this category selecting either somewhat or very challenging. This was followed by respondents from the procurement and purchasing industry, 69% of whom indicated that it is challenging to hire entry-level employees with the right mix of skills. Meanwhile, respondents from the enterprise supply chain management industry were the least likely to find it challenging to hire entry-level employees with the right mix of skills (34%), as well as the most likely to find it easy (67%).

Figure 3: Level of difficulty hiring entry-level employees with the right mix of skills

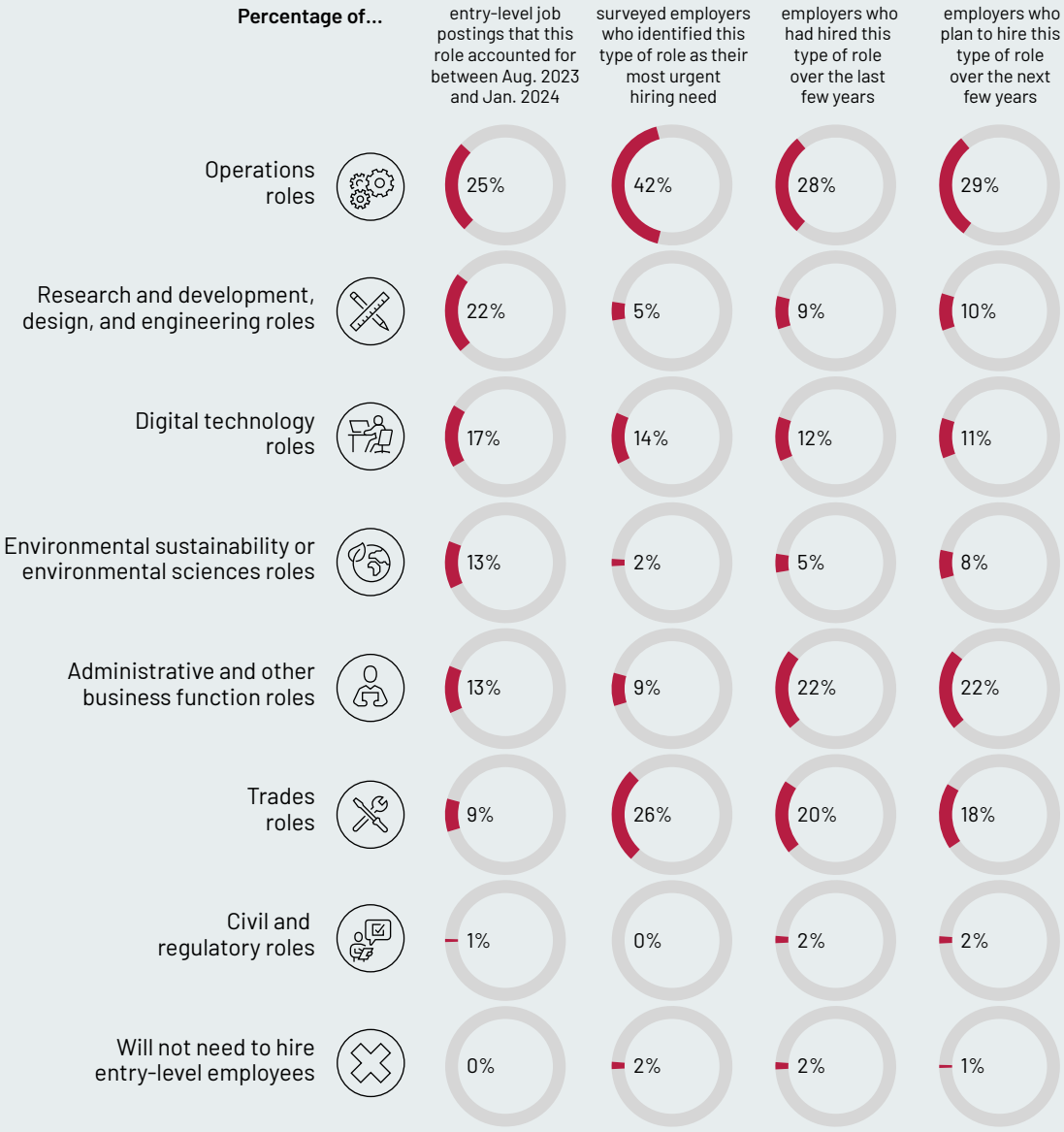


Data source: ICTC's employer survey.

DEMAND FOR ENTRY-LEVEL ROLES IN THE SUPPLY CHAIN INDUSTRY

Figure 4, below, combines two separate data sources to portray demand for entry-level roles in the supply chain industry. For a six-month period from August 2023 to January 2024, ICTC used publicly available job postings to track overall demand for different types of entry-level roles in Canada's supply chain industry. In addition to this, in 2023, ICTC surveyed 43 employers from Canada's supply chain industry about their present and future hiring plans. Employers were asked what types of entry-level roles their organization had hired over the past few years and what types of entry-level roles they plan to hire over the next few years. While a more detailed discussion follows, Figure 4 provides a high-level overview of the data.

Figure 4: Demand for entry-level roles in the supply chain industry



Data source: ICTC's employer survey and web-scraped data from publicly available job sites.

Operations Roles

Operations roles were the most in-demand type of entry-level roles in Canada's supply chain industry, both according to job postings data and according to surveyed employers. From August 2023 to January 2024, operations roles accounted for roughly 25% of entry-level job postings in Canada's supply chain industry. This included roles such as dispatcher, warehouse associate, customer service associate, sales associate, delivery associate, and storage and distribution associate. Additionally, in response to ICTC's employer survey, 29% of supply chain employers indicated that they had hired entry-level operations roles over the past few years, and 28% indicated that they plan to hire this type of role over the next few years.

Breaking down the employer survey responses by subindustry, procurement and purchasing respondents were most likely to have hired or plan to hire operations roles, followed by respondents from the warehousing, storage, and fulfillment industries.

Entry-Level Operations Roles:

- Customer Service Associate
- Delivery Associate
- Dispatcher
- Driver
- Operations Associate
- Operations Worker
- Warehouse Associate
- Sales Associate
- Retail Associate
- Storage and Distribution Associate
- Shipping and Receiving Clerk
- Rail Transportation Worker
- Rail Conductor

Mid- to Senior-Level Operations Roles:

- Assistant General Manager
- Customer Service Manager
- General Manager
- Industrial Production Manager
- Operations Manager
- Regional Operations Manager
- Retail Manager
- Sales Manager
- Supervisor, Operations
- Warehouse Manager

While operations roles, such as customer service associate, delivery associate, and warehouse associate, are presently in high demand, supply chain experts speculate that the adoption of AI and automation solutions will see a portion of these roles phased out over time.[74] In 2023, Supply Chain Canada published a study about the impact of digitalization and technology adoption on the supply chain industry, noting that "any job or role that requires repetitive work, with low levels of innovation, is susceptible to being replaced."[75] For example, Supply Chain Canada indicated in its report that warehousing and distribution roles are at risk of being phased out due to the increased adoption of warehouse management solutions, such as automated storage and retrieval systems. As technology solutions become more advanced, it may become possible for robots and machines to operate warehouses more efficiently than humans.[76] (In addition to warehousing and distribution roles, Supply Chain Canada indicated that in-store retail positions are at risk of being phased out due to the growing popularity of e-commerce and direct-to-consumer sales.[77])

74 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

75 Ibid.

76 Ibid.

77 Ibid.

Research and Development, Design, and Engineering Roles

While research and development, design, and engineering roles were not selected by a very high percentage of employers as part of their present and future hiring plans, this category of roles did account for the second largest share of entry-level job postings, at 22%. In terms of specific job titles, the research and development, design, and engineering categories included roles like industrial engineer, commercial designer, civil engineering technician, mechanical engineer, materials scientist, and validation engineer. These types of roles work in collaboration with a variety of other departments to meet product and service specifications, comply with regulatory requirements, troubleshoot customer complaints, and engage in sustainable approaches to product and service design, such as eco-design.

Entry-Level Research and Development, Design, and Engineering Roles:

- Chemist
- Civil Engineering Technician
- Commercial Designer
- Electrical Engineer
- Electronics Engineer
- Industrial Engineer
- Landfill Engineer
- Materials Scientist
- Mechanical Designer
- Mechanical Engineer
- Mechatronics Technician
- Scientist
- Validation Engineer

Mid- to Senior-Level Research and Development, Design, and Engineering Roles

- Director of Engineering
- Director of Research and Development
- Engineering Manager
- Intermediate Electrical Engineer
- Intermediate Industrial Designer
- Intermediate Mechanical Engineer
- Senior Materials Scientist
- Senior Mechanical Designer
- Senior Mechanical Engineer
- Senior Process Engineer
- Senior Scientist

Digital Technology Roles

Digital technology roles accounted for the third largest share of entry-level job postings (17%) and were also the fourth most common type of role for survey respondents to have hired or plan to hire. With respect to the job posting data, the most common type of digital technology role was software developer, some variation of which accounted for roughly 52% of all digital technology job postings. This was followed by data analyst, some variation of which accounted for 46%, and blockchain engineer, which accounted for 3%. Meanwhile, according to the survey data, slightly more employers plan to hire digital technology roles over the next few years (11%) than have hired digital technology over the past few years (10%). This is primarily due to a reported increase in future hiring activity among lifecycle management respondents and warehousing, storage, and fulfillment respondents.

While being the least likely to have hired digital technology roles over the past few years, respondents in these two industries were the most likely to report hiring digital technology roles over the next few years, suggesting that digitalization and digital adoption are becoming more important in these two industries.

Entry-Level Digital Technology Roles:

- Blockchain Developer
- Data Analyst
- Data Scientist
- Embedded Software Developer
- Full Stack Software Developer
- Software Developer or Engineer
- Web Developer

Mid- to Senior-Level Digital Technology Roles

- Director of Data Analysis
- Director of Data Science
- Lead Software Developer
- Principal Software Engineer
- Senior Software Developer or Engineer
- Senior Data Analyst
- Senior Data Scientist
- Staff Developer

In addition to the above roles, which are focused on the design and development of supply chain technology solutions, a number of "digital supply chain roles" are emerging within the supply chain industry as a result of technology adoption.[78] For example, in its 2023 report about the impact of technology adoption on the supply chain industry, Supply Chain Canada highlighted growing demand for the following roles:

- **Supply Chain Analytics Manager:** Collects, analyzes, and interprets data from different sources to identify relevant patterns and trends, improve supply chain performance, and overall make more informed decisions.
- **Digital Supply Chain Manager:** Manages digital technology solutions that organizations use to manage or optimize their supply chains, such as automation and AI.
- **Blockchain Coordinator:** Manages and implements blockchain solutions—for instance, to increase supply chain transparency and traceability.
- **3D Printing Coordinator:** Manages and implements 3D printing solutions, including "the design, production, and delivery of 3D printed parts and products."
- **Supply Chain Cybersecurity Manager:** Identifies and mitigates cybersecurity risks and cybersecurity attacks.
- **Traceability Expert:** Gathers data from suppliers and subcontractors to trace the journey that materials, components, and finished products take as they move through the supply chain.

78 "Adopting Digitalization and Its Impact on Skills," 2023, Supply Chain Canada, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

Environmental Sustainability and Environmental Science Roles

Environmental sustainability and environmental science roles accounted for the fourth largest share (13%) of entry-level job postings, including roles like sustainability operations specialist, sustainability reporting coordinator, environmental technician, environmental coordinator, sustainability specialist, and environmental compliance specialist. While just 5% of survey respondents indicated that they had hired environmental sustainability and environmental science roles over the last few years, when reporting future hiring plans, this increased slightly to 8% due to increased hiring activity among materials management, logistics management, procurement and purchasing, waste management and recycling, and enterprise supply chain management employers. Overall, environmental sustainability or environmental science roles were most in demand in the enterprise supply chain management, lifecycle management, and logistics management industries.

Entry-Level Environmental Sustainability and Environmental Science Roles:

- Carbon Reduction Specialist
- Environmental Communications Officer
- Environmental Engineer
- Environmental Remediation Specialist
- Environmental Technician
- Environmental Coordinator
- Sustainability Consultant
- Sustainability Specialist
- Sustainability Officer
- Sustainability Operations Coordinator
- Sustainability Operations Specialist
- Sustainability Reporting Coordinator

Mid- to Senior-Level Environmental Sustainability and Environmental Sciences Roles:

- Director of Sustainability
- Director of Sustainability and Public Affairs
- Global Operations Manager, Sustainability
- Environment Manager
- Principal Environmental Engineer
- Senior Consultant, Environmental, Social, and Governance
- Senior Environmental Engineer
- Senior Environmental Scientist
- Senior Sustainability Analyst
- Senior Sustainability Specialist
- Sustainability Manager

Administrative and Other Business Function Roles

Administrative and other business function roles represent a significant portion of entry-level roles in Canada's supply chain industry. Nearly one-quarter (22%) of employers reported hiring administrative and other business function roles over the past few years, and this type of role also accounted for 13% of entry-level job postings. The most common job title in this category was project coordinator, which accounted for approximately 13% of job postings for administrative and other business function roles. This was followed by purchasing agent, supply chain intern, logistics coordinator, and materials coordinator. Interestingly, when conducting interviews for this study, ICTC heard that it is common for supply chain organizations to first place entry-level talent into administrative roles focused on purely administrative tasks and then upskill them internally to take on more complicated tasks, such as risk analysis, strategic planning, strategic procurement, and project management.

Entry-Level Administrative and Other Business Function Roles:

- Cost Estimator
- Data Entry Clerk
- Entry-Level Buyer
- Inventory Analyst
- Lifecycle Management Specialist
- Logistics Analyst
- Logistics Coordinator
- Logistics Engineer
- Material Resource Planner
- Procurement Analyst
- Procurement Assistant
- Purchasing Agent
- Project Coordinator
- Research Analyst
- Supply Chain Analyst
- Supply Chain Coordinator
- Supply Chain Intern
- Transportation Coordinator

Mid- to Senior-Level Administrative and Other Business Function Roles:

- Account Manager
- Inventory Manager
- Logistics Manager
- Logistics Supervisor
- Manager, Logistics Pricing
- Manager, Planning and Purchasing
- Materials Manager
- Project Manager
- Purchasing and Inventory Control Manager
- Purchasing Manager
- Regional Sourcing Manager
- Senior Procurement Analyst
- Senior Project Management Specialist
- Senior Project Manager
- Strategic Buyer
- Supply Chain Logistics Manager
- Transportation Manager

As with operations roles, repetitive administrative roles are at risk of being phased out over time due to the adoption of AI and automation solutions. For example, in their 2023 report about the impact of technology adoption on the supply chain industry, Supply Chain Canada highlighted logistics coordinators, inventory managers, and transportation planners as being at risk of automation due to the increased adoption of advanced logistics software and tracking systems, such as transport management systems; inventory management software, such as warehousing management systems; and transportation planning software, such as transportation management systems.[79]

Trades Roles

Trades roles accounted for approximately 9% of entry-level job postings in the supply chain industry, including job titles like electrician, electrical technician, maintenance technician, industrial technician, and mechanical technician. Because many opportunities in trades are shared internally as opposed to being posted on publicly accessible job sites, roles in trades likely account for a higher percentage of total employment demand in the supply chain industry than this data suggests. Trades roles were also the third most common type of role for businesses to report hiring, however, hiring activity for this type of role was primarily concentrated in three specific industries:

1. Waste management and recycling
2. Materials management
3. Warehousing, storage, and fulfillment subindustries. Respondents from other industries were, on the other hand, not likely to hire trades roles, including respondents from the logistics management industry, enterprise supply chain management industry, and procurement and purchasing industry

Entry-, Mid-, and Senior-Level Trades Roles

- Electrical Technician
- Electrician
- Fleet Mechanic
- Foreperson
- Gasfitter
- Industrial Electrician
- Industrial Technician
- Machine Mechanic
- Maintenance Technician
- Mechanical Technician
- Truck and Coach Technician
- Truck-Trailer Service Technician

79 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

Civil and Regulatory Roles

Civil and regulatory roles were the least in-demand type of role, both according to the job posting data and according to surveyed employers. Civil and regulatory roles, such as compliance specialist and regulatory affairs specialist, accounted for just 1% of the entry-level job postings that were posted between August 2023 and January 2024. Moreover, just 2% of employers indicated that they had hired civil and regulatory roles over the past few years and that they plan to hire civil and regulatory roles over the next few years.

Entry-Level Civil and Regulatory Roles

- Advisor, Government Affairs
- Compliance Intern
- Compliance Specialist
- Government Risk and Compliance Specialist
- Governance Risk and Compliance Specialist
- Regulatory Affairs Analyst
- Regulatory Affairs Specialist
- Regulatory Analyst
- Risk Advisor
- Safety and Compliance Specialist

Mid- to Senior-Level Civil and Regulatory Roles

- Compliance and Risk Manager
- Compliance Lead
- Director, Compliance
- Director, Compliance and Regulatory
- Fiscal and Regulatory Affairs Manager
- Manager, Portfolio Compliance
- Manager, Compliance
- Safety and Compliance Manager
- Senior Government Risk and Compliance Specialist
- Regulatory Affairs Manager

DEMAND FOR KNOWLEDGE AND SKILLS IN THE SUPPLY CHAIN INDUSTRY

When discussing the demand for knowledge and skills in the supply chain industry, interviewees shared that sustainability initiatives are driving demand for a unique combination of traditional and emerging skills. While seasoned professionals are acquiring new knowledge and skills related to sustainability, environmental assessment and reporting methodologies, big data, and software tools, traditional knowledge and skills remain fundamental to a successful career in the supply chain industry.

"Traditional" Supply Chain Knowledge and Skills

Before discussing the demand for new knowledge and skills in the supply chain industry, it is important to acknowledge that many traditional roles and skill sets remain highly relevant to sustainability initiatives. Even for emerging roles labelled "sustainability-focused" or "green," there remains a strong expectation for employees to possess traditional knowledge and skills related to supply chains. As one advisory committee member commented, "You can't address sustainability in supply chains if you do not have those table stakes skills that enable you to work in the [supply chain] industry." As supply chain professionals embrace environmental sustainability initiatives, it will be important for talent development programs to continue to hone in on traditional roles and skill sets, too.

In addition to supply chain professionals, these "table stakes skills" are becoming increasingly important for broad sustainability professionals to have. Supply chains can account for up to 90% of a company's environmental impact, making them a crucial part of any organization's sustainability plan.[80] Indeed, supply chains can account for up to 81% of a company's GHG emissions in the basic consumer goods industry, up to 86% of a company's GHG emissions in the financial services industry, and up to 87% of a company's GHG emissions in the automotive and components industry.[81] Because of this, there is a growing need for broad sustainability professionals to possess supply chain knowledge and skills and be able to engage with supply chain actors to create change. As one advisory committee member noted, "Sustainability is embedded into many of the traditional skills that make up supply chain work… skills and abilities that may not be thought of as 'green' per se can be very crucial to sustainability."

Study participants identified a number of traditional knowledge and skill areas as fundamental to sustainable supply chains:

Supply Chain Industry Knowledge and Skills

Supply Chain Processes — Study participants highlighted a number of "technical skills" that supply chain professionals need to have in order to carry out their everyday processes. For example, interviewees said that supply chain professionals need to know how to fill out a purchase order; draft and send out procurement documents, such as RFIs, RFQs, and RFPs; draft and send out contracts for signatures; collect, organize, and compare supplier data; and use software programs like enterprise resource planning software. These technical skills are crucial for supply chain professionals, particularly in the early stages of their careers. Once entry-level employees have acquired these base-level skills, however, the supply chain profession quickly advances to systems-level thinking, strategy, people, and project management. As one interviewee shared, "Once you get past the first level of, 'How do I fill out a purchase order,' it becomes a people problem, a people task, a people career." Moreover, study participants said that the supply chain profession has undergone a significant shift in recent years. While it was once very focused on operational tasks, such as transacting purchases or finalizing contracts, supply chain roles increasingly involve strategy, problem solving, and creative thinking.

Systems-Level Knowledge of Supply Chains and Logistics — Understandably, study participants felt that it is crucial for supply chain professionals to have a good understanding of what supply chains and logistics networks are and how they work. Building on this, interviewees indicated that supply chain professionals need to be able to engage in systems-level thinking—to be able to look at logistics networks or supply chains at the macro level and as a whole, understand different stakeholders' motivations and challenges, and identify what outcomes might be mutually beneficial to different parties. Interestingly, interviewees felt that the ability to engage in systems-level thinking is only made more important by sustainability initiatives. As one interviewee noted, "No matter who you are or what you're doing, if you can't see what part of the system you are working in and how it relates to all of the other parts, there is a good chance you are doing a disservice to the causes you believe in."

80 "Supply chain engagement," 2024, Carbon Trust, https://www.carbontrust.com/value-chain-and-supply-chain-sustainability

81 Sundberg, Niklas, "Sustainable IT Playbook for Technology Leaders," 2022, Packt Publishing, https://www.packtpub.com/product/sustainable-it-playbook-for-technology-leaders/9781803230344

Regulatory and Public Policy Skills — Study participants stressed the importance of being familiar with regulations and public policies that apply to supply chains, particularly in public sector roles. As one interviewee noted, "Anyone who is interested in the field of procurement should know how government procurement works… policies, treaties, and regulations…. These are the foundation of how we operate in procurement settings in government and public sector organizations." Another interviewee—also from a public sector organization—similarly shared that procurement professionals are "bound by treaties and policies, whether related to procurement processes, privacy, security, or other regulations." Still another interviewee, this time from a private sector organization, shared similar sentiments: "While we're not governed by public procurement law… regulations and controls are very important for us [to understand]. We report out to financial markets and are custodians of donor funds and must spend them according to best practices."

Transferable Knowledge and Skills

Project Management Skills — Project management skills were identified by study participants as being one of the most important skill requirements for supply chain professionals. As one interviewee noted, "Anyone who has been in a project management role tends to be very good at logistics because logistics is really just project management. That is supply chain 101, making sure things get done on time and arrive where they are supposed to on time." Still another interviewee shared that, "I like people who are self-starters, who know how to get something underway, keep it organized, and keep things going on a day-to-day level." Job postings data similarly identified "leadership," "planning," "scheduling," "responsibility," and "time management" as among the top 10 transferable skills requirements in the supply chain industry, with these skills being mentioned in 44%, 21%, 16%, 11%, and 9% of job postings respectively.

Stakeholder Engagement Skills — Interviewees highlighted good stakeholder engagement, including communication, conflict management, and relationship building, as key for supply chain professionals to have. As one interviewee highlighted, "There are so many different departments and teams that you have to work with as a supply chain professional, so you need to be able to communicate across a variety of different departments and user groups." Another interviewee said, "It's not just about knowing the process but about stakeholder engagement… how to get a group of people together to meet your project deadlines, expectations, and outcomes… you need to guide them through the process." Still another indicated that supply chain professionals need to know "how to handle conflict, how to manage people… how to coordinate with different business areas." Finally, interviewees felt that the skill set associated with stakeholder engagement is becoming more important as sustainability initiatives permeate the supply chain industry. As one interviewee noted, "We're now seeing the need for [employees who can] open up conversations and facilitate an acceptance of the required change." A study by Supply Chain Canada about the impact of technology adoption on the supply chain industry similarly identified "networking and collaboration" as a broad category of skills and abilities that supply chain professionals need to possess, including strong communication skills; the ability to build trust with external stakeholders and understand their needs; the ability to coordinate activities between suppliers, customers, and partners; and the ability to work with different stakeholders to identify and solve problems and innovate.[82]

82 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

Written, Verbal, and Visual Communication Skills — Both secondary data and interviewees identified good communication as key to an effective career in the supply chain industry. "Communication" was the most commonly mentioned transferable skill in supply chain job postings from August 2023 to January 2024, having been mentioned in approximately 58% of supply chain job postings during this time. "Written communication" was meanwhile mentioned in 10%. As one interviewee stated, "[Supply chain professionals] provide a service within our corporations. You have to be able to connect with people and have good, clear communication… The technical skills will only get you so far." Another interviewee similarly shared that "if people can only think about the concepts but can't execute, that's challenging… And what does that mean in terms of skills? Communication, communication, communication. I want people with impeccable writing skills who are very organized and know how to structure their thoughts… who can take a complicated idea or a complicated process and turn it into a diagram, map it out, or come up with a great metaphor… If you have good communication, we can teach you most of the other things."

Strategic Thinking Skills and Good Business Acumen — Supply chain professionals sit at the centre of nearly all business activities within an organization, making them an important venue for strategic planning and decisions. Many interviewees highlighted strategic thinking, planning, and decision-making as one of the supply chain industry's core skill sets. As one interviewee noted, "There is more and more demand at lower and lower levels within the supply chain function to have a strategic outlook or strategic viewpoint, an understanding of how everything is connected." Specifically, interviewees highlighted the ability to understand how one employee's technical work ties into the overall strategy of the organization; the ability to make strategic decisions using methodologies like risk assessment, multi-criteria analysis, decision tree analysis, or flow diagrams; and the ability to design supply chains strategically, end-to-end. In a separate study about the impact of technology adoption on the supply chain industry, Supply Chain Canada similarly identified "strategic thinking" skills as a critical category of skills for supply chain professionals. According to that study, strategic thinking includes the ability to identify and capitalize on new opportunities, align supply chain activities with broader organizational goals, manage risk and uncertainty, identify pain points, and continuously improve supply chain performance.[83] Related to strategic thinking skills is good business acumen. Study participants felt that it is important for supply chain professionals to have "good business sense," a general "baseline of good business acumen," and a strong understanding of businesses writ large. Elaborating on these comments, they stressed the need for supply chain professionals to be good with numbers and budgets, understand corporate finance, and be able to prioritize task lists according to business needs. Overall, interviewees shared that while the supply chain profession used to be very transactional in nature—with the main goal being to transact a purchase or finalize a contract—today, the role of supply chain professionals is to add value to their organizations via strategic thinking, consulting, and business advisory services.

83 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

Problem Solving Skills — Study participants highlighted the importance of problem solving to the supply chain profession. Problem solving was the 12th most commonly mentioned transferable skill in job postings for the supply chain industry between August 2023 and January 2024, having been mentioned in approximately 8% of job postings during this time. As one interviewee noted, supply chain professionals need to be able to "understand competing interests and find a path that balances them in a reasonable way." Another interviewee similarly shared that supply chain professionals need to be able to "recognize what the real problems are [in a situation] and identify pathways to address them." Still, another commented that supply chain professionals need "the ability to influence, the ability to manage ambiguity, to really look at problems… and actively seek opportunities to correct and overcome them."

Willingness and Ability to Learn — The supply chain industry is ever changing and regularly subject to new policies, regulations, and customer expectations. The products and services that supply chain professionals oversee are also extremely diverse, meaning domain knowledge from one project or organization may not transfer to the next. This makes it extremely important for supply chain professionals to have a continuous learning mindset and be highly adaptive and able to quickly learn about new fields of practice. As one interviewee shared, "My organization purchases everything from vehicles to building services, to global financial custody services… Given the breadth of everything we do, one of the things we specifically need in the people we hire is a willingness to learn." Another interviewee said, "You need to have a learning mindset… You may be asked to buy relocation services for refugees one day and actuarial services the next, so you have to be willing to learn, be flexible, and grow with the job, whatever the business is." Another comment was, "[Entry-level employees] just need to learn fast. I'm much more interested in people's ability to learn than in having every possible skill set and knowledge base integrated into them from day one."

Emerging Supply Chain Knowledge and Skills

Despite the ongoing importance of traditional knowledge and skills, the supply chain labour market is undergoing significant changes. Study participants discussed how, in recent years, the supply chain profession has undergone a considerable shift, moving away from a focus on transactional and operational tasks and toward a focus on business strategy, creative thinking, advisory services, and stakeholder engagement. At the same time, supply chain professionals are adapting their traditional skill sets to a new context focused on environmental sustainability so that they can contribute to their organization's sustainability goals and help solve sustainability changes in a fulsome way. Finally, the implementation of new technologies in the supply chain industry, including AI, big data, and software tools, is introducing a new generation of data and digital technology skills.

Interviewees highlighted the following emerging skill sets and knowledge areas that supply chain professionals need to be familiar with to advance sustainability in their industries.

Supply Chain Knowledge and Skills

Challenge-Based Procurement — Challenge-based procurement, sometimes referred to as problem-based procurement or outcome-based procurement, makes use of traditional procurement tools, such as RFIs, RFQs, and RFPs, but with a twist: instead of outlining a specific product, service, or solution that they would like to buy, the buyer references a problem they would like to overcome or an objective they want to achieve. Suppliers then respond with relevant approaches or solutions.[84] The benefit to challenge-based procurement is that buyers do not need to know what solutions they want before issuing an RFI, RFQ, or RFP, which both limits the amount of expertise they need to have in-house and ensures they do not accidentally write out innovative or leading-edge solutions.[85] In effect, the buyer can crowdsource solutions from the market.[86] While challenge-based procurement has existed for some time, interviewees felt it is not used as often as it should be, particularly for the purposes of obtaining more environmentally sustainable products and services. As one interviewee shared, "One tool that is really underutilized is outcome- or problem statement-based RFPs… You'll hear entities say they don't have the right expertise in-house to define everything they need to [in their procurement documents], but you don't need that expertise in-house if you can rely on the market to tell you what you need to know… As much as we procurement professionals learn over the years, we don't know everything, and so tapping into the market is critical for us to achieve that next level of success." Several interviewees shared that the skill set associated with outcome-based procurement is becoming more relevant as sustainability permeates the industry. They felt that supply chain professionals need to respond to this trend by moving away from a procurement process defined by specifications and rules toward one defined by creativity and open-ended questions.

Environmental Sustainability Knowledge and Skills

Environmental Knowledge, Concepts, and Terminology — Supply chain professionals are well-positioned to make strategic business decisions on behalf of their organizations but to do so effectively, they must have a baseline understanding of environmental sustainability concepts. Interviewees said that environmental sustainability concepts are becoming crucial to applying even traditional supply chain skills in a fulsome way. For example, candidates who are familiar with environmental sustainability concepts conduct more effective supply chain maps and risk assessments because they can account for climate risks deep within the supply chain. When asked what concepts supply chain professionals should be familiar with, interviewees indicated that it is important for supply chain professionals to:

- Have a basic understanding of how supply chain activities impact ESG strategies — for instance, knowing how to use sustainable packaging, transport, and storage solutions to reduce environmental impacts from supply chains or knowing what parts of supply chains have the greatest environmental impacts, and therefore where to drive the most significant change.

84 Farmer, Tyler, Matthews, Mairead, and Rice, Faun, "Procurement Office or 'Living Lab'? Experimenting with procurement partnerships for smart cities technology in Canada," February 2021, *Information and Communications Technology Council*, https://www.ictc-ctic.ca/wp-content/uploads/2021/03/ICTC_Report_SmartCities_ENG.pdf

85 Ibid.

86 Ibid.

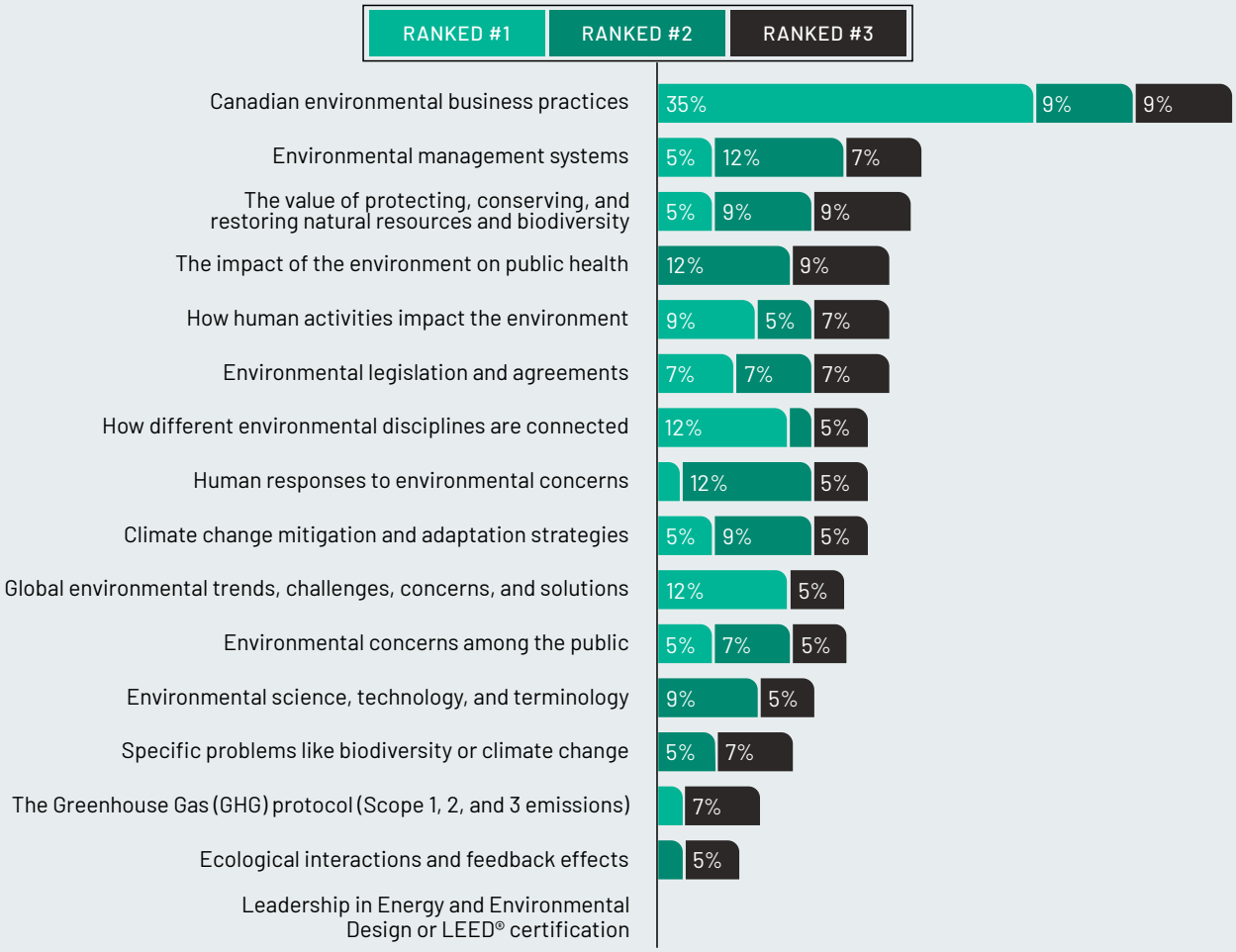
- Be able to use tools like ecolabels and sustainability ratings to assess the sustainability performance of different types of products and services—while it is unreasonable to expect entry-level employees to be deeply familiar with environmental sustainability standards, they should be able to analyze products and services at a high level to determine whether they are harmful or beneficial to the environment.

- Have a good understanding of circular economy principles, such as which types of materials are more conducive to circular economies and why it can be more beneficial to procure some items as a service as opposed to buying and owning goods.

As part of this study, ICTC surveyed employers and post-secondary students about a number of environmental knowledge areas, which were originally published by the labour market research organization ECO Canada in 2016.[87] Employers were asked to rank the top three knowledge areas by order of importance, while students were asked about their level of familiarity with each. As shown in Figure 5, employers were most likely to rank knowledge of Canadian environmental business practices as important for entry-level employees. Indeed, more than half (53%) of surveyed employers ranked this knowledge area among their top three most important knowledge requirements, demonstrating that while an academic or theoretical understanding of environmental sustainability is important, employers ultimately need talent who can apply their knowledge to real-world problems and business scenarios. Apart from Canadian environmental business practices, many of the other knowledge areas were ranked as having a similar level of importance. These included knowledge of environmental management systems; the value of protecting, conserving, and restoring natural resources and biodiversity; the impact of the environment on public health; how human activities impact the environment; and environmental legislation and agreements. Specific standards for environmental sustainability were, on the other hand, ranked as less important for entry-level talent to be familiar with. These included the Greenhouse Gas Protocol for measuring and reporting scope 1, 2, and 3 emissions, and the Leadership in Energy and Environmental Design (LEED) Certification.

87 "Competencies for Environmental Professionals in Canada," August 2016, *ECO Canada*, https://info.eco.ca/action/attachment/42902/f-65f916cd-d7be-432b-9bce-6f8bcbb92dce/1/-/-/-/-/NOS-for-Environmental-Professionals-ECO-Canada.pdf

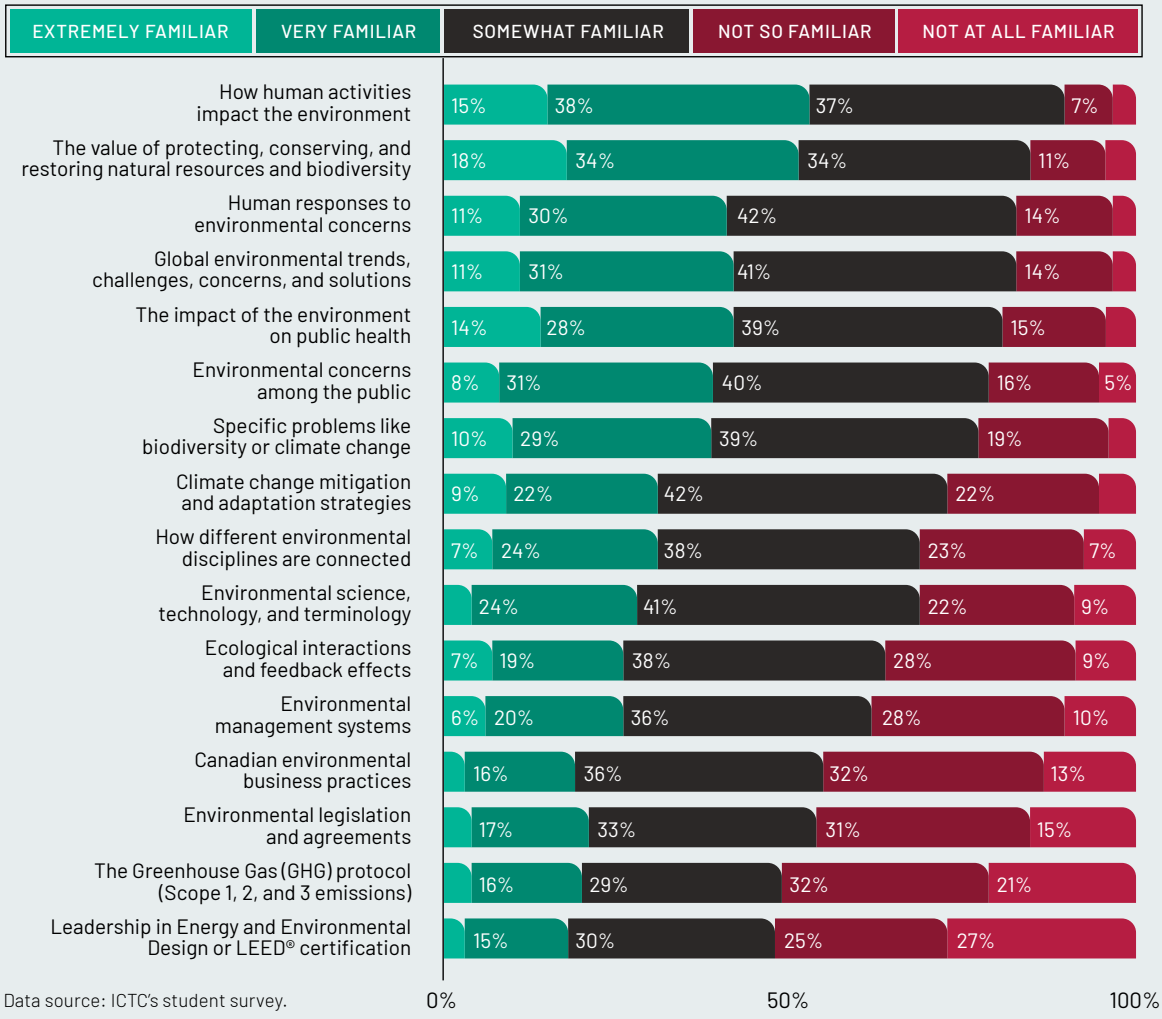
Figure 5: Employer perspectives on environmental knowledge areas



Data source: ICTC's employer survey.

When combined with the student responses, the survey data reveals several important knowledge gaps. First and foremost, while employers identified Canadian environmental business practices as the single most important knowledge area for entry-level employees to be familiar with, students reported an overall lack of familiarity with this knowledge area. Indeed, 13% of students reported being "not at all familiar" with this knowledge area, 32% reported being "not so familiar," 36% reported being "somewhat familiar," 16% reported being "very familiar," and just 3% reporting being "extremely familiar." Similarly, while employers ranked environmental management systems and environmental legislation and agreements as important knowledge areas for entry-level employees, students reported a low level of familiarity with these. Overall, students reported a high level of familiarity with the scope of humanity's impact on the environment, as well as the impetus for why humanity needs to reduce its environmental impacts. On the other hand, students reported a low level of familiarity with real-world strategies for reducing environmental impacts, such as environmental management systems, Canadian environmental business practices, environmental legislation and agreements, GHG measurement and reporting methodologies, and best practices for environmentally sustainable design.

Figure 6: Student perspectives on environmental knowledge areas



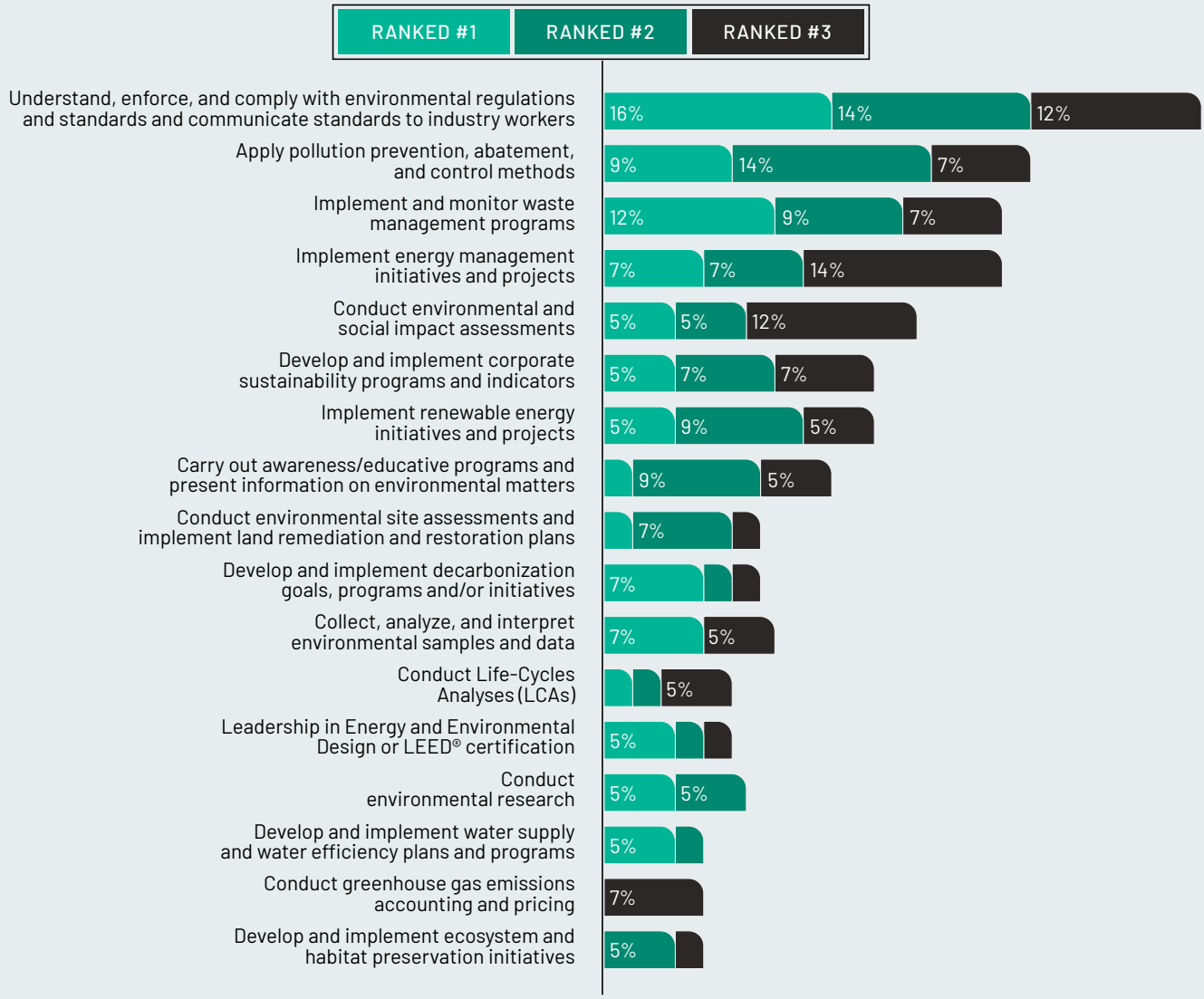
Data source: ICTC's student survey.

Eco-Design — Due to the complex nature of modern supply chains, many organizations are both buyers and suppliers of a wide variety of products and services. This makes it crucial for firms to not just procure sustainable products and services but also implement eco-design for their own products and services. In order to engage in eco-design, supply chain professionals need to possess a variety of related skills and abilities, such as the ability to interpret and apply environmental sustainability standards and regulations; assess the environmental impacts of their products and services; propose, model, and prototype new products, processes, or technologies with environmental sustainability benefits; consult engineering personnel to troubleshoot and solve product- and service-related challenges; prepare engineering requisitions, datasheets, technical specifications, and other engineering documents; and create checklists for review or inspection of completed components, products, or projects. When post-secondary students surveyed for this study were asked about how confident they are in their knowledge of green procurement, logistics, and supply chain management related to research and development, design, and engineering, just 21% indicated that they were either extremely or very confident in their knowledge, while 40% indicated that they were either not so confident or not at all confident. The remaining 40% fell somewhere in the middle, indicating that they were somewhat confident in this knowledge.

Environmental Science, Assessment, and Reporting Skills — While not all supply chain professionals need to have a background in environmental science, interviewees did share that when job candidates approach sustainability issues from an environmental, natural, or physical sciences background, they tend to have a more sophisticated understanding of environmental sustainability challenges and solutions. Study participants also said that in more senior positions in the supply chain industry, there is "tremendous demand" for people who are qualified in methodologies like carbon accounting, lifecycle assessment, and GHG emissions footprints and who can calculate, report on, and disclose environmental impacts in a standardized way. While not all supply chain professionals need these technical skills, they should at least have a baseline understanding of what environmental footprints or lifecycle assessments are so that they can incorporate these into their work. Still, candidates who do have these abilities will be seen by prospective employers as having an extremely valuable skill set.

As part of this study, ICTC surveyed employers and post-secondary students about a list of environmental sustainability skills and abilities. Employers were asked to rank the top three skills and abilities by order of importance, while students were asked about their level of familiarity with each. As shown in Figure 7, employers were most likely to rank the ability to understand, enforce, and comply with environmental regulations and standards and communicate standards to industry workers as important for entry-level employees to have. Indeed, 42% of surveyed employers ranked this ability as among their top three most important. The abilities to "apply pollution prevention, abatement, and control methods," "implement and monitor waste management programs," and "implement energy management initiatives and projects" were closely ranked as second, third, and fourth. Again, specific standards and methodologies related to environmental sustainability were ranked as least important for entry-level employees to be familiar with, including lifecycle assessment, the LEED certification, and methodologies for GHG emissions accounting. Overall, employers expect entry-level talent to be able to understand and implement standards, programs, and projects developed by other staff members, as opposed to developing plans or projects themselves.

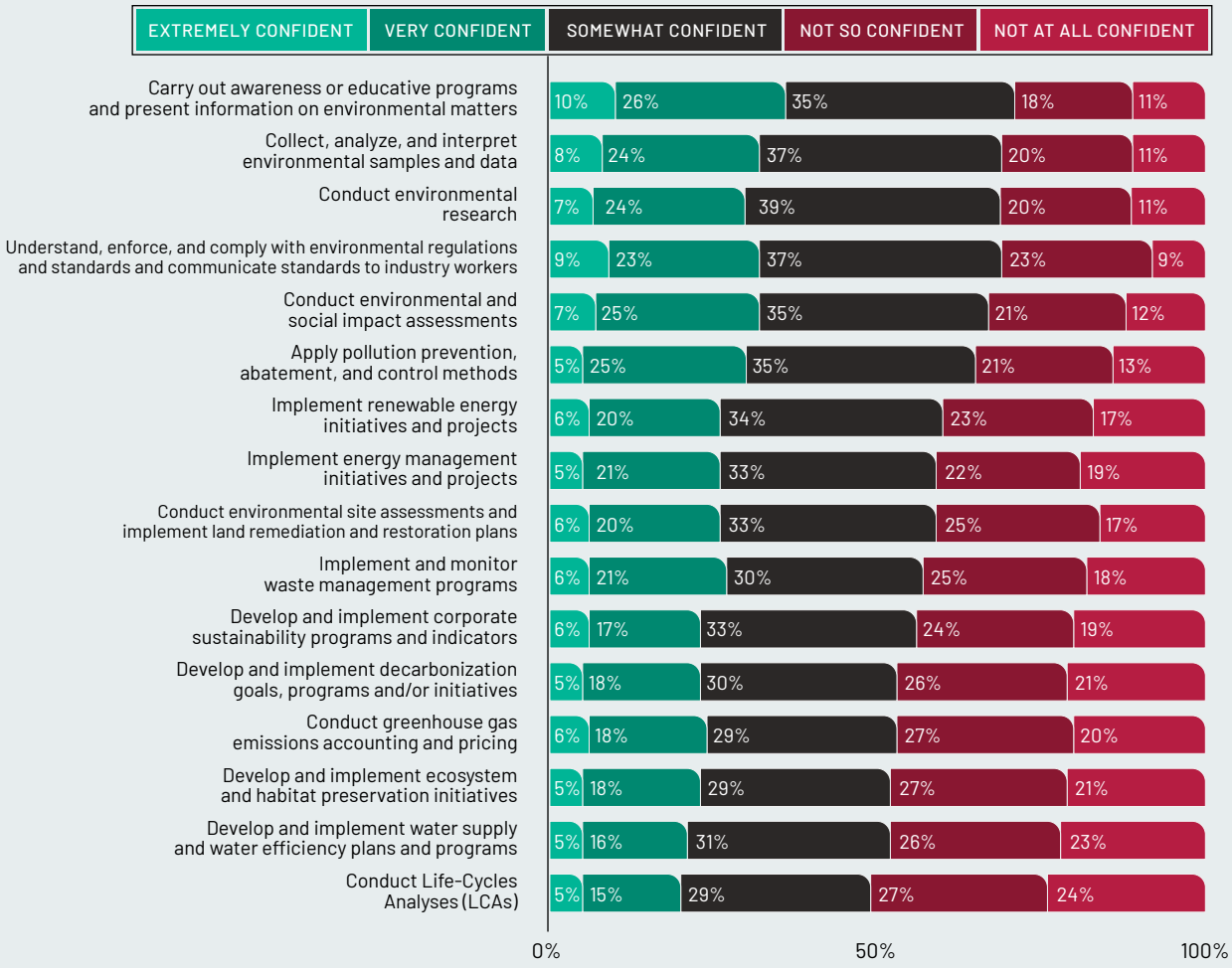
Figure 7: Employer perspectives on environmental sustainability skills and abilities.



Data source: ICTC's employer survey and the U.S. Department of Labour's Occupational Information Network or "O*Net" online database.

In comparison to the environmental knowledge areas, students' self-reported environmental sustainability skills and abilities were much more aligned with employer demand. Overall, students reported a high level of confidence in the environmental sustainability skills and abilities that employers indicated as important for entry-level talent to have. While not overly significant, the largest skills gap is observed in the ability to "implement and monitor waste management programs." While 28% of employers ranked this ability among their top three most important requirements for entry-level employees, 43% of students reported being not so confident or not at all confident in this ability. Additionally, students were not as confident as they could be in their ability to "implement energy management initiatives and projects" and "develop and implement corporate sustainability programs and indicators." Lastly, while students reported very high confidence in their ability to "carry out awareness or education programs and present information on environmental matters," this ability was not ranked as important by employers.

Figure 8: Student perspectives on environmental sustainability skills and abilities.



Data source: ICTC's employer survey and the U.S. Department of Labour's Occupational Information Network or "O*Net" online database.

Ability to Collaborate with Sustainability Experts and Consultants —It is common for supply chain teams to either outsource their sustainability expertise to external consulting firms or hire a dedicated staff member/department to provide advisory or consulting services internally to other staff. For example, one interviewee shared that their company created a position called "sustainable procurement lead" to help build internal knowledge related to environmental sustainability and provide advisory services to the remainder of the procurement team. Regardless of whether team members were responsible for buying construction services, technology hardware, or MRI machines, this singular employee could help perform a deeper dive into the sustainability considerations. Similarly, another interviewee shared that their organization has a dedicated sustainability department that can provide relevant technical details. Still, another interviewee said that their organization has in-house experts that they can leverage to incorporate environmental sustainability considerations into their daily work. Given how common it is for supply chain teams to approach environmental sustainability in this way, it is crucial for supply chain professionals to know how to collaborate with environmental sustainability experts. For example, interviewees shared that it is important for supply chain professionals to have good teamwork skills, know how to collaborate across departments and between organizations and understand when they should rely on their own expertise versus engaging a subject matter expert.

Data-Related Skills

Data Discovery, Cleaning, and Processing Skills — Because of the role that data plays in measuring, tracking, and validating environmental sustainability claims, participants in this study considered skills related to data discovery and processing as crucial for supply chain professionals. Regulations and standards are being developed in some sectors to standardize supply chain data, however, many sectors face challenges with data availability, transparency, and comparability. Because of this, interviewees felt it is important for supply chain professionals to be able to track down relevant data sources from third parties, request and obtain data from suppliers and partners, and process, clean, standardize, and combine data from different sources so that they can be compared. Additionally, because organizations are accountable for sourcing and purchasing decisions, interviewees felt it is important for supply chain professionals to be able to track where different data are from and be able to locate original sources as needed. As one interviewee shared, "Whether it is a PowerPoint or a six-page report… when I put statistics out on [a product]… I need to be able to tie them to the source material."

Data Analysis and Data Science — A significant number of interviewees discussed the need for skills related to data analysis and data science. Interviewees shared that many companies require internal departments and external partners and suppliers to track data about the environmental impact of their operations, products, and services, but a lesser number are actually analyzing and using this data in a structured way to inform supply chain decisions. Interviewees also added that the amount of data supply chain professionals are required to work with is growing at an extremely fast pace, making it important for supply chain organizations and departments to have individuals who are comfortable with processing and analyzing large amounts of data efficiently. As one interviewee shared, "The more data we get, the more we need people who can manage, transform, and interpret that data." There is also a need for people who "are able to work with data and use it to make decisions… that is a skill set that is in high demand." In a separate study about how supply chain skills are changing as a result of digitalization, EY identified "analysts" as one of four key "personas" that are driving digitalization in supply chains.[88] According to EY, analysts "drive data-led modelling and scenario planning to assess impacts on the supply chain… Using advanced analytics, they model different scenarios to test them and drive business decisions. For instance, they may highlight gaps in material availability for emerging supply scenarios, which then triggers an automated communication to the supplier to ring-fence the increased quantities."[89] Similarly, a 2023 study about the impact of technology adoption on Canada's supply chain industry identified "understanding and analyzing data" as a crucial ability for supply chain professionals.[90] Supply Chain Canada also indicated in a study that, "digital technologies, such as internet of things, AI, and blockchain leverage large amounts of data," and that "professionals with technical [data analysis] skills will be able to understand and analyze this data and use it to optimize supply chain operations and make data-driven decisions."[91] More specifically, they indicated that supply chain professionals need to have skills related to data analysis and visualization, predictive analytics, and the use of supply chain performance metrics and key performance indicators, such as delivery times and inventory levels, to optimize and improve supply chain operations.[92]

88 "Supply Chain: skills for the Digital Era," 2019, Ernst & Young, https://assets.ey.com/content/dam/ey-sites/ey-com/en_uk/topics/advisory/ey-supply-chain-skills-for-the-digital-era.pdf

89 Ibid.

90 "Adopting Digitalization and Its Impact on Skills," 2023, Supply Chain Canada, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

91 Ibid.

92 Ibid.

Digital Technology Knowledge and Skills

Familiarity with Digital Technology and Supply Chain Technology Solutions — Many interviewees commented on the need for supply chain professionals to have basic digital technology skills so that they can use supply chain technology solutions. While previous job postings for the supply chain industry would require proficiency with Microsoft tools, such as Word, PowerPoint, and Excel, interviewees noted that the modern supply chain industry is populated by a vast number of digital technology solutions. One interviewee said, "We use technology for everything—warehousing, inventory, forecasting, calculating efficiencies, procurement and contracting… so I would say it's an important skill set to have." Similarly, another interviewee commented, "What drives a lot of supply chain systems are 20, 30, maybe 40 different tools. While you don't need to know all of these, there are some key ones that you need to be aware of and understand how they operate." Some other solutions mentioned by interviewees were enterprise resource planning; remote collaboration tools like Miro; tools that outsource the verification of supplier credentials to third parties; tools that enable supply chain professionals to quickly compare data from different suppliers to determine whether one is better quality from a sustainability perspective; tools that enable organizations to track and reduce specific environmental impacts, such as water consumption; and tools that enable supply chain professionals to organize and track shipments.

The Ability to Digitalize Supply Chain Processes — Several interviewees commented on how it is important for supply chain professionals to be able to experiment with new technology solutions and have a general understanding of how they can use technology solutions to digitalize, optimize, or automate existing processes. For example, interviewees shared that it is important for supply chain professionals to be able to investigate what technology solutions are available, quickly familiarize themselves with key features and functionalities, understand how they will be integrated with other technology solutions, build a business case for their adoption, and incorporate them into existing workflows. As one interviewee shared, "I don't expect anyone to be proficient with coding or programming… but I am expecting entry-level employees to be aware of tools, know how to interact with [technologies], and then if we need to pilot something, be open and willing to try… You don't know everything… but you do need to know how things work, how they fit in with your processes and your other technology solutions." In a separate study, Supply Chain Canada similarly identified "integration and interoperability" as one the of the key technical skills that supply chain professionals need to have as a result of digitalization.[93] Supply Chain Canada noted that "[digital technology] skills are important for integrating and making different technologies and systems interoperable… this includes understanding how different systems and technologies work together, and how to integrate them to create a seamless and efficient supply chain."[94]

93 "Adopting Digitalization and Its Impact on Skills," 2023, Supply Chain Canada, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf
94 Ibid.

Supply Chain Technology Design and Development — The supply chain industry is increasingly populated with emerging startups and legacy firms that build and deliver supply chain technology solutions. Economic data provider Pitchbook suggests that globally, more than 23,300 technology companies use "supply chain" as a keyword in their marketing materials, company descriptions, or product and service descriptions.[95] Further, nearly 6,000 companies specialize in supply chain technology solutions, with common areas of focus being enterprise supply chain management solutions, warehousing technology, freight technology, and last-mile delivery.[96] In this study, several interviewees shared that individuals need unique skills to build and deliver digital technology solutions for the supply chain industry. For example, they said these professionals need to understand software development concepts, processes, and languages, be familiar with cloud architecture, technologies, and solutions, and have general transferable skills related to information and communications technology hardware and software. In a separate study about how supply chain skills are changing as a result of digitalization, EY identified "technologists" as one of four key "personas" that are driving digitalization in supply chains.[97] According to EY, technologists "work to design, configure, implement and maintain emerging technologies such as robotics, AI and machine learning tools… With a high aptitude in data and emerging technology, the technologist understands whether a human capability or technology solution is required, [and] where emerging technology is a suitable option, they will then determine how best to deploy and manage them."[98]

In addition to discussing digital skills requirements with interviewees, ICTC surveyed employers and post-secondary students about a list of digital technology skills and abilities. Employers were asked to rank the top three skills and abilities by order of importance, while students were asked about their level of familiarity with each. As shown in Figure 9, employers were most likely to rank specific types of supply chain technology solutions as important for entry-level employees to be familiar with. For example, 44% of respondents "business, management, and customer relations software," 37% of respondents selected "facilities or inventory management software," 28% selected "materials requirements planning, logistics, and supply chain software," 25% selected "operating systems software," and 23% selected "procurement software" and "enterprise resource planning software" respectively. A lower percentage of employers selected skills related to the design and development of supply chain technology solutions, such as "data analysis and visualization," "programming languages," "cloud or server infrastructure tools," and "version control software."

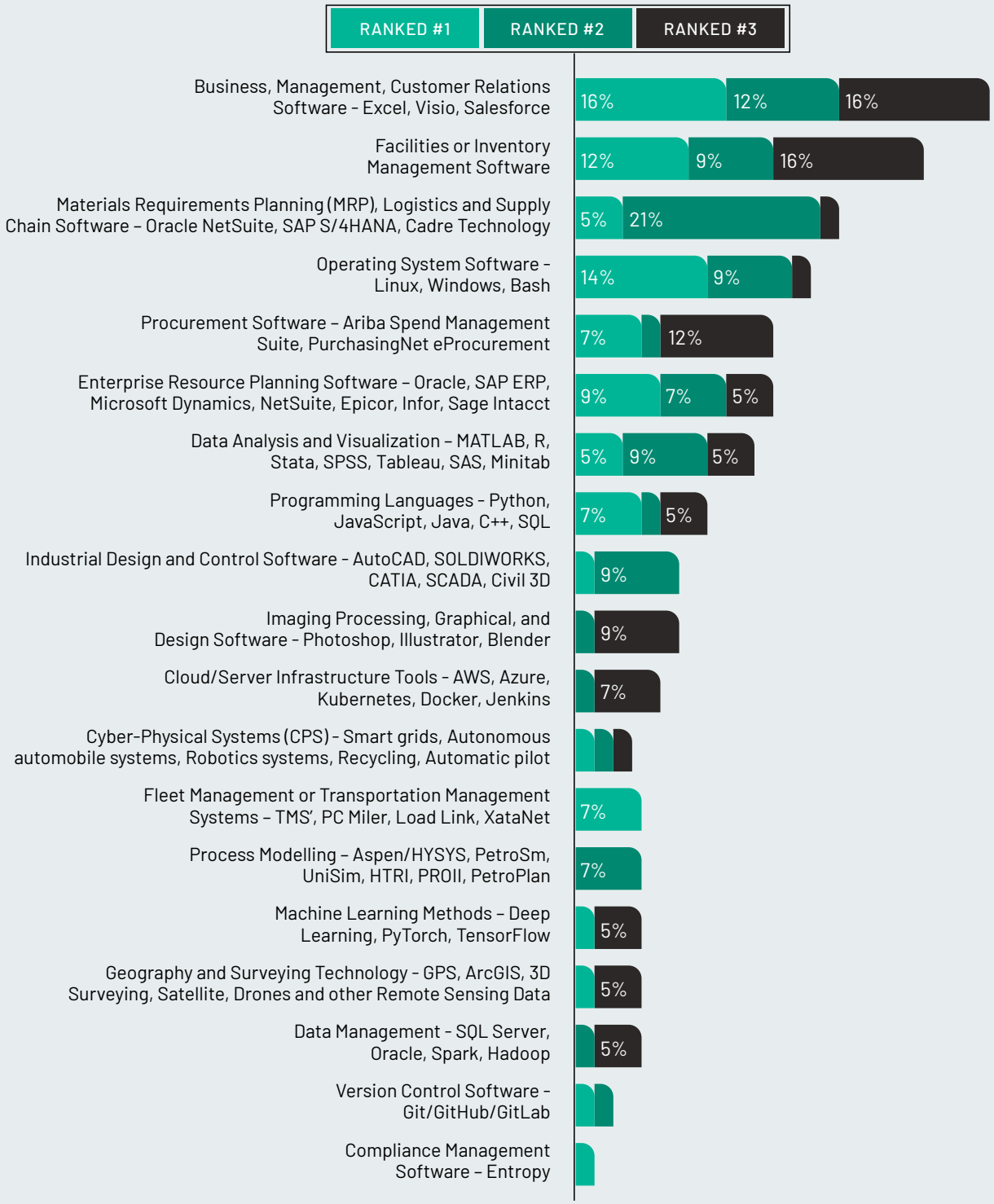
95 Pitchbook data, 2024, Pitchbook, https://pitchbook.com/

96 Ibid.

97 "Supply Chain: skills for the Digital Era," 2019, Ernst & Young, https://assets.ey.com/content/dam/ey-sites/ey-com/en_uk/topics/advisory/ey-supply-chain-skills-for-the-digital-era.pdf

98 Ibid.

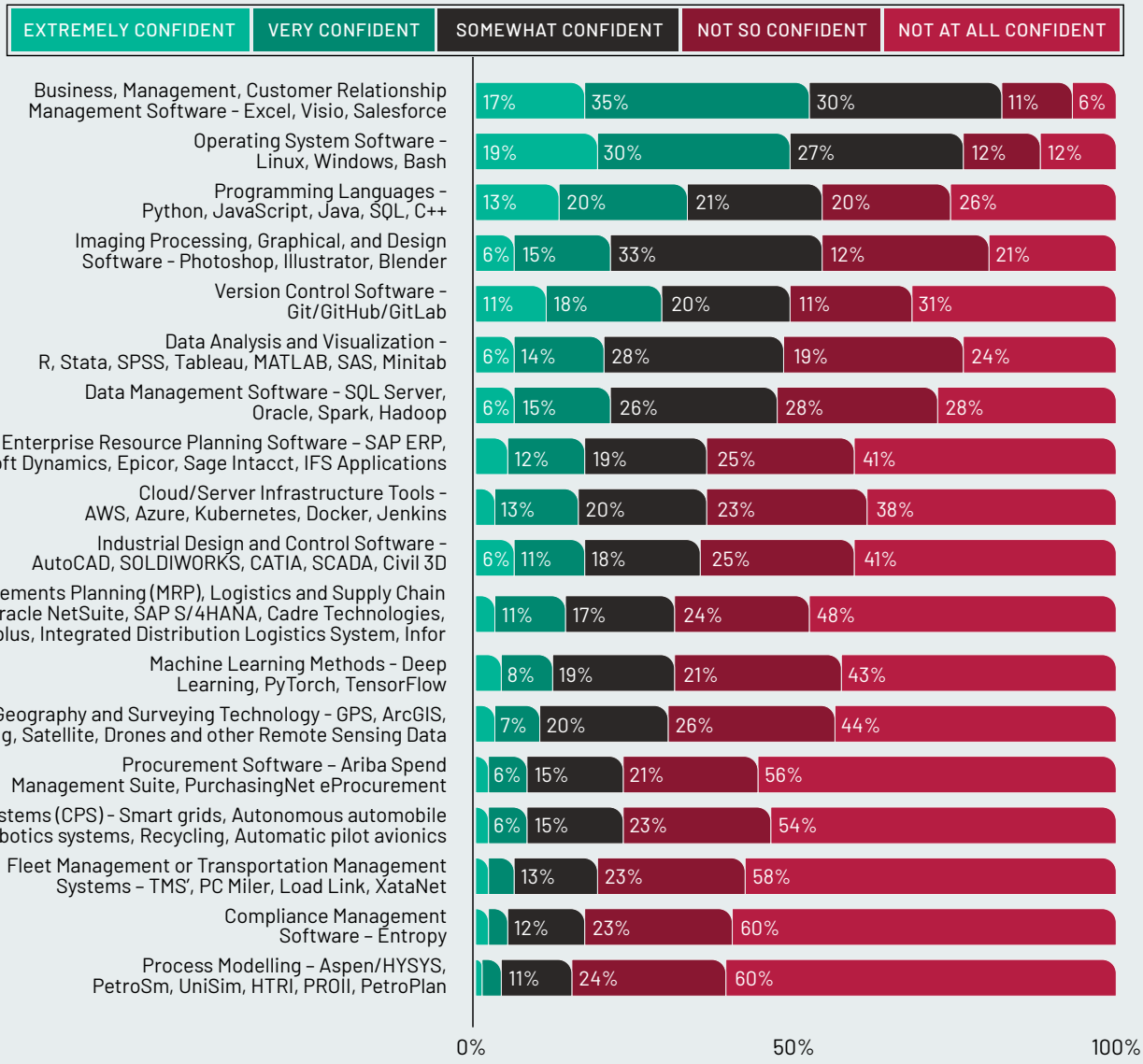
Figure 9: Employer perspectives on software skills and abilities.



Data source: ICTC's employer survey and the U.S. Department of Labour's Occupational Information Network or "O*Net" online database.

As seen in Figure 10, students reported a high degree of familiarity with business, management, and customer relationship management software, as well as operating systems software, which, according to the employer survey data, is in line with employer needs. Conversely, students reported a low level of familiarity with many of the supply chain technology solutions that employers indicated were important for entry-level level employees to be familiar with, including inventory management software, materials requirements planning software, logistics and supply chain software, procurement software, and enterprise resources planning software. Moreover, students were generally more familiar with programming languages and version control software than is required by broad-based supply chain employers; however, this skill set is well aligned with the needs of employers who specifically build supply chain technology solutions.

Figure 10: Student perspectives on software skills and abilities.



Data source: ICTC's employer survey and the U.S. Department of Labour's Occupational Information Network or "O*Net" online database.

SECTION III

WORKFORCE DEVELOPMENT CHALLENGES AND SOLUTIONS

BARRIERS TO WORKFORCE DEVELOPMENT

Interviewees in this study highlighted a number of challenges that could make it difficult to implement widespread changes to the supply chain workforce, whether by upskilling or reskilling large portions of the supply chain industry or by attracting and retaining new entrants into the field. Among these are persistent labour market shortages, particularly in the case of public sector procurement, knowledge and skill gaps, and organizational inertia, or the speed at which institutions and organizations are able to retool and refocus their practices.

Widespread Labour Market Shortages

A 2022 report by the Canadian Collaboration for Sustainable Procurement and Reeve Consulting found labour shortages to dramatically affect the supply chain industry: "On the buyer's side, struggles with maintaining internal staffing pose a barrier to upholding consistency of effort or taking on new initiatives. On the supplier's side, there are challenges in remaining competitive and meeting commitments for social value and diverse hiring, especially for construction projects."[99]

99 "The State of Sustainable Public Procurement in Canada," 2023, Reeve Consulting, https://www.reeveconsulting.com/wp-content/uploads/2023/03/CCSP-2022-Annual-Report_The-State-of-Sustainable-Public-Procurement-in-Canada.pdf

In ICTC's study, many interviewees echoed these findings, reporting that their organizations are regularly understaffed or already have trouble finding talent for open roles. Labour shortages are also widespread, in that they impact many functions of the supply chain workforce—materials sourcing, procurement, and end of life. As one interviewee, a public procurement specialist, shared, "It's a struggle and a challenge, and in recent years, it has gotten harder. I don't think we're dissimilar from many sectors of the market—even in our profession, positions go unfilled for a while. We're struggling to find candidates. There are more positions than there are people. On the one hand, there can be the temptation to find candidates and fill positions, but if you don't have the correct selection and fit, that's worse than having an empty chair." Widespread labour shortages are important because they are more difficult for a single industry to address and because they make it more difficult to implement workforce development programs. When businesses and organizations are understaffed, they have less capacity to provide mentorship, give employees time off to train, and take on interns, co-op students, and entry-level talent.

Knowledge and Skill Gaps

Interviewees indicated that prevalent skill gaps play a part in hiring struggles. That is to say, some interviewees, particularly in procurement, reported that job postings received sufficient applicants but that applicants lacked the required or in-demand skills to succeed in open roles. Further, several interviewees stressed that they were in need of applicants with diverse skill sets, such as supply chain professionals with an understanding of sustainability, people management, and/or other in-demand technical skills. One interviewee stressed that "it is very difficult to find qualified labour, [specifically] qualified labour that isn't high cost. So, as an example, a lot of the work that we do is in the data science field. [However,] trying to find a qualified data scientist who has experience in the rail industry is like looking for a unicorn." Still another interviewee indicated that "there are many people out there that can do supply chain or procurement…. It's not a lack of people. It's more a lack of qualifications."

The gaps between the skills of potential entrants into the supply chain industry and those needed by employers are particularly problematic because they are indicative of education and training pathways lagging behind quickly shifting industry needs. As digitalization and sustainable practices are adopted by vendors, manufacturers, shipping companies, and other large players in Canada's supply chains, workers' skill sets are becoming more digitalized, technical, and sustainability focused. Procurement specialists, for example, will need to make use of data from AI systems to address sourcing shortages and business needs. Factory managers will be assisted by algorithms to maximize operations and will need the analytical skills to make decisions based on collected data, and AI will increasingly take on lower-level tasks like data entry.[100]

100 "Adopting Digitalization and Its Impact on Skills," 2023, Supply Chain Canada, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

Environmental Sustainability Knowledge and Skill Gaps

Sustainability knowledge and skills are foundational and absolutely necessary to Canada's green transition. In the supply chain industry, supply chain professionals will need to have a general understanding of environmental knowledge and concepts, as well as a variety of multidisciplinary skill sets related to sustainability. For procurement professionals, this may mean weighing sustainability criteria more heavily when selecting suppliers. For data scientists, this may mean learning how to predict and track carbon emissions. For accountants, this may mean learning how to conduct carbon accounting. Fundamental to the green transformation is a widespread "skills shift" that asks professionals to develop new skills and deepen their understanding of sustainability. It also asks employers to think more holistically about their environmental impact and their hiring needs.

> *The one thing that I've seen over my career is that what we expect our procurement people and our supply chain people to manage has gotten more and more complex. It's not just thinking about what's the cheapest price or what's going to get things here on time. It's what's the best value that's going to get me what I need when I need it but also minimize the impact on the environment while maximizing Indigenous work opportunities.*
> – Procurement Specialist

However, several interviewees, particularly those working in consulting, mentioned that supply chain professionals often lack sufficient training and knowledge on sustainability. For example, one interviewee stated, "In supply chain and logistics, each person has a very specialized role. Because of that, [supply chain professionals] have not been trained to think about the broader organizational objectives or to think about sustainability and its connections to their roles. So, that is a fundamental shift that is required." Another interviewee went as far as to say, "Procurement people need training. [Some] literally do not know what a carbon footprint is. They don't know plastic is made from oil. The lack of knowledge is staggering. I train every new hire that comes into [our company] with a two-hour basic orientation to get them up to speed. I have fresh graduates showing up at my door. They don't know what a carbon footprint is either."

Given that scope 3 emissions account for more than 70% of many businesses' carbon footprints,[101] there is a great need for supply chain professionals to acquire the environmental sustainability skills necessary to facilitate Canada's net-zero transition. It is anticipated that approximately 3.1 million jobs—15% of the Canadian labour force—will be impacted as Canada moves toward net zero, while eight out of 10 sectors will be affected.[102] Further, the sectors projected to be the most disrupted are, in many ways, the backbone of Canada's value chains; "Canada's transportation, energy, and manufacturing sectors will undergo the most significant early shifts, as 46% of new jobs in natural resources and agriculture and 40% of new jobs in trades, transport, and equipment require an enhanced skill set.[103] This skills gap is further problematized by the aforementioned labour shortages.

101 "Scope 1, 2, and 3 emissions," 2024, Deloitte, https://www2.deloitte.com/uk/en/focus/climate-change/zero-in-on-scope-1-2-and-3-emissions.html

102 "Green Collar Jobs: The skills revolution Canada needs to reach Net Zero," February 2022, RBC, https://www.rbccm.com/en/insights/story.page?dcr=templatedata/article/insights/data/2022/02/green_collar_jobs_the_skills_revolution_canada_needs_to_reach_net_zero

103 "The skills revolution Canada needs to reach Net Zero," February 2022, RBC, https://www.rbccm.com/en/insights/story.page?dcr=templatedata/article/insights/data/2022/02/green_collar_jobs_the_skills_revolution_canada_needs_to_reach_net_zero

> *The one win we had earlier this year was the federal government introducing a requirement for bidders on deals over $25 million--and there aren't that many of those—that require you to measure your carbon footprint, set a Paris aligned target to reduce it and disclose it. That's absolutely fundamental. We need that at every level. For anything over $5,000, they should be doing that. Suppliers should be doing that. The problem is, if [governments] did require that, we wouldn't have enough people to do the work in Canada. We don't have enough trained people.*
>
> – Supply Chain Expert and Training Provider

As demand for environmental sustainability skills soars, gaps in the supply of workers possessing these skills become evident. A 2022 study by RBC Thought Leadership found that by 2025, Canada could be short more than 25,000 environmental workers, which includes both those in roles involving some green tasks and those employed by environmental firms.[104]

> *The thing that's needed in supply chain is a deep understanding of the issues. [Supply chain professionals] superficially know the issue, so if you talk to someone in logistics or procurement, they'll know that climate change is an issue, but they won't be able to connect it to their specific work. When purchasing computer products, we need them to understand the issues as they relate to their roles. From an environmental perspective, it's material usage, it's carbon, it's e-waste. How is that related to my procurement strategy? Do I have criteria for a material reuse percentage for this particular product? From a social perspective, is there child labour and slave labour in the mining of those materials? How do I integrate that? So, generally, there's superficial knowledge of the issues, but there isn't enough depth for individuals to be able to connect their roles [to the bigger picture].*
>
> – Supply Chain Expert, Educator, and Consultant

Digital Technology Skills Gaps

As discussed in Sections I and II, digital technology is a significant enabler of environmental sustainability initiatives in the supply chain industry, which makes digital technology skills relevant for environmental sustainability progress. A 2023 study by Supply Chain Canada explains that the digitalization of functions across supply chains means a considerable disruption to traditional supply chain practices and a shift toward technical skills that make use of newly integrated technologies.[105] Namely, the study reports that the demand for soft skills and technical skills relating to data analysis and visualization, automation, cybersecurity, and risk management, among others, is on the rise and will continue to be for the foreseeable future. Unfortunately, due to staffing issues and ongoing labour shortages, many supply chain employers report that they are unprepared for digital transformation.

104 "The skills revolution Canada needs to reach Net Zero," February 2022, RBC, https://www.rbccm.com/en/insights/story.page?dcr=templatedata/article/insights/data/2022/02/green_collar_jobs_the_skills_revolution_canada_needs_to_reach_net_zero

105 "Adopting Digitalization and Its Impact on Skills," 2023, Supply Chain Canada, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

Namely, the study reports that the demand for soft skills and technical skills relating to data analysis and visualization, automation, cybersecurity, and risk management, among others, is on the rise and will continue to be for the foreseeable future.[106] Unfortunately, due to staffing issues and ongoing labour shortages, many supply chain employers report that they are unprepared for digital transformation. A study conducted by MHI and Deloitte, which surveyed 2,000 supply chain executives and professionals, found that 74% of respondents planned to increase their technology investments from the previous year, 2022, in areas including inventory and network optimization, cloud computing and storage, sensors and automatic identification, advanced analytics, wearable and mobile technology, robotics and automation, 3D printing, AI, IoT, Blockchain, and driverless vehicles and drones.[107] However, 57% reported that recruiting and retention of qualified employees was the biggest challenge facing supply chains, and 56% reported talent and labour shortages.[108] The vast majority (93%) of supply chain executives and professionals reported that using technology to improve organizational performance is important to their organization's success, however, just 22% said their organization is ready to implement technology to improve organizational performance.[109] The consequences of knowledge and skill gaps will be widespread for both businesses and Canadians generally: Supply Chain Canada estimates that "by 2026, 80% of businesses that haven't merged their digital supply chain twins and control tower programs will witness a major loss in value."[110]

Organizational Inertia in Public and Private Sector Organizations

Another challenge slowing the proliferation of green supply chain management practices is organizational inertia, or "the inability to enact change in the face of a changing external environment."[111] While there are a number of confounding reasons for organizational inertia, some examples include a lack of qualified personnel to lead and implement sustainability initiatives, a lack of competition between suppliers with large market shares, high costs or lengthy timelines associated with sustainability initiatives, and a lack of pressure from external stakeholders, such as regulators, partners, customers, or clients. Irrespective of the cause, interviewees in this study saw organizational inertia as a common barrier and serious threat to green supply chains.

For instance, interviewees stressed that many RFPs lack serious considerations relating to sustainability. One interviewee remarked, "If I had to look at the average RFP today, [there would be] no change in six years of lobbying—so, there's obviously a lot of stickiness in the system, preventing us from getting where we need to be."

106 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

107 "2023 MHI Annual Industry Report, The Responsible Supply Chain: Transparency, Sustainability and the Case for Business," *MHI & Deloitte*, March 20, 2023, https://www.mhi.org/publications/report.

108 Ibid.

109 Ibid.

110 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

111 Johnson, P. Fraser, Klassen, Robert D., "New Directions for research in green public procurement: The challenge of inter-stakeholder tensions," 2021, *Cleaner Logistics and Supply Chain*, https://www.sciencedirect.com/science/article/pii/S2772390921000172

Another added, "I have seen so many recommendations on how to procure circularly in RFPs, and yet for 90% of [RFPs], there's nothing substantive in them whatsoever. It's a series of bullet points that say something to the effect of, 'You should think about making your product nicer to the planet.' Are the points weighted differently? No. Is there an actual technical specification? Do we want concrete with this much limestone in it? Do we want forks and knives that are fully washable and won't degrade every time we throw them in the dishwasher? Do we want trucks where we can take off and replace the panels easily and cheaply so we can keep these vehicles in our fleets longer? No." Still another said, "We have sustainable procurement policies, which is great, but there's no teeth to them. There's no mechanism for accountability. There are no specific targets." While the majority of these comments were made with reference to public sector RFPs, such as those distributed by the federal government, it is important to note that private sector organizations also face similar criticism.

The above sentiments are supported by other research studies, too. In 2020, researchers from York University and EcoVadis found that despite promises made by the Canadian government to move toward net zero, most contracting organizations that issued public sector RFPs either hardly consider sustainability in their projects or do not consider sustainability at all.[112] The authors found that 22% of RFPs reviewed did not consider sustainability in any way, while 78% met only the minimum requirement for sustainability (the inclusion of any sustainability considerations at all).[113] Further, none of the RFPs that were reviewed met the highest standard, "meaningful inclusion of sustainability as an independent consideration in the evaluation and mechanisms for accountability."[114] Without a paradigm shift in public sector procurement and public sector spending, Canada's environmental sustainability goals, such as GHG emissions reduction targets, will not be realized. "Public sector spending represents a significant portion of gross domestic product in most countries and holds much promise to advance calls to improve the sustainability of goods and services provided by supply chain partners."[115] Relating back to workforce development, it is difficult for companies to justify reskilling and upskilling their staff when public and private actors are not actively and earnestly implementing green supply chain practices.

WORKFORCE DEVELOPMENT SOLUTIONS

In the face of prevalent and persistent challenges, it is imperative that creative solutions are developed and implemented to alleviate workforce development issues. Evidently, there is no solution for the list of problems presented by decoupling supply chain practices from normative bottom-line approaches. However, more can be done to mitigate supply chain workforce development challenges.

112 Da Ponte, Monica, Foley, Megan, Cho, Charles H., "Assessing the Degree of Sustainability Integration in Canadian Public Sector Procurement," 2020, *Sustainability*, https://www.mdpi.com/2071-1050/12/14/555c0

113 Ibid.

114 Ibid.

115 Johnson, P. Fraser, Klassen, Robert D., "New Directions for research in green public procurement: The challenge of inter-stakeholder tensions," 2021, *Cleaner Logistics and Supply Chain*, https://www.sciencedirect.com/science/article/pii/S2772390921000172

Specific to the training and education of supply chain professionals, talent gaps in both digital and green skills necessitate that supply chain workers are reskilled and upskilled, that students and potential entrants to the industry have access to experiential learning opportunities and are provided with multidisciplinary learnings that match industry needs, and that efforts to attract workers to the industry and youth to development programs are increased. As a result of ongoing labour shortages, automation, and advanced robotics pose threats to lower-level jobs, particularly in warehousing and distribution.[116] Concerning environmental standards related to traceability and environmental reporting, increased uniformity and cohesion can provide clarity to potential entrants into supply chain management on training pathways and provide employers with much-needed guidance to address industry knowledge gaps. Regarding organizational inertia and its impacts on workforce development, it is important that private and public sector actors invest in training and facilitating technologies and that large buyers like governments earnestly require sustainability in supply chain processes, like RFPs.

Reskilling, Upskilling, and Education

Traditional skill sets for many supply chain roles are being transformed to meet the demands of a rapidly evolving industry, and professionals must be prepared to adapt to new technologies and emerging trends to meet industry needs. At present, the convergence of digitalization and sustainability in supply chain management has made it clear that gaps exist in talent across several sectors.

Investing in reskilling and upskilling initiatives is essential to preparing supply chain professionals with the necessary competencies to be future-ready. Supply chain professionals need to possess a holistic understanding of environmental issues related to their day-to-day tasks and have the multidisciplinary knowledge needed to collaborate closely with relevant stakeholders to develop and implement sustainable practices. Employers can provide training programs, workshops, and information on needed certifications to help employees develop their competencies. Additionally, supply chain professionals can leverage online learning platforms and industry connections to expand their skill sets and stay on top of industry developments. Further, companies should encourage collaboration and knowledge sharing between supply chain teams and other departments to prevent siloing and improve organizational flexibility.

> *We teach in silos, but a business operates as a whole organism. So, you have to understand the different levers within an organization. You have to understand the business as a whole. That's kind of the role of a sustainability professional. Being the golden thread that ties everything together – [building] partnerships.*
> – Supply Chain Professional

Specific to post-secondaries and student education and engagement, more needs to be done to give students opportunities to obtain much-needed on-the-job experience before graduation and to ensure they are job ready. Most interviewees in this study mentioned concerns with traditional education pathways, either due to the length of programs, the applicability of the focus of programs, a lack of focus on technologies or software programs used in industry, or the need for more industry involvement and career development.

116 Dekhne, Hastings et al, "Automation in logistics: Big opportunity, bigger uncertainty," April 2019, McKinsey & Company, https://www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/automation-in-logistics-big-opportunity-bigger-uncertainty

Specifically, interviewees reported that traditional post-secondary education often misses the mark in preparing graduates for work in supply chain management or sustainability: "I think this is very typical across a lot of different degrees, but they're not really teaching the skills you might use day to day in a sustainability job. I find [universities] teach more at the broader end of topics, or they teach you what you would need to know in a research-based sustainability role or more of an academic sustainability profession. But in my experience, it's not a direct 'study this, and then you're prepared to do this job.'"

Echoing this sentiment, another interviewee mentioned that some programs overly glamorize sustainability. Their pitch is, "'Learn about sustainability, become a sustainability leader, learn about sustainability reporting, circular economy, apply circular principles.' I get how these types of programs attract more people. But I wish they would better prepare students in terms of what reality looks like… [What's needed is] more applied practical knowledge rather than the theory of the circular economy and sustainability. There's a clear mismatch between what [graduates] learned in school and what they thought the industry would be like." As was discussed in Section II, students who responded to ICTC's survey about environmental sustainability knowledge skills were very familiar with how to explain environmental sustainability issues and why humans need to reduce their impact on the environment but lacked knowledge about how businesses and organizations actually accomplish this in the real world.

Another interviewee mentioned that more needs to be done to attract youth for supply chain careers and that universities could not meet the demand for talent alone: "We need to find other ways of certifying people and reaching more people. I know some institutions are now starting to look at online learning and offering courses that are a little bit more accessible. And that's a good start, but the traditional, go to school, get your degree in four years, that's just not going to meet the demand that we have. And so, we need to look at different ways to get people trained, and we need to start earlier. We need to start in high school, not post-secondary institutions. We need to be having feeder systems into supply chain starting in high school." Bringing about these changes will require both private and public investment, but given talent gaps and opportunities for economic growth, job creation, and innovation in the supply chain industry, investment is critical.

Uniformity of Environmental Standards

As discussed in Section I, insofar as supply chain management is becoming increasingly concerned with sustainability, it is necessary for supply chain professionals to be aware of environmental standards, ESG guidelines, ecolabels, and regulatory frameworks regarding emissions tracking and reporting. Generally, sustainability standards, labels, and certifications are crucial to the standardization, implementation, legitimization, performance evaluation, and proliferation of sustainability practices.[117] Specific to supply chains, sustainability standards, labels, certifications, and other forms of information-based environmental governance (IBEG) programs can provide clearly defined guidelines for organizations to follow in an area of business operations that is burgeoning in theory but nebulous in practice. They can also help facilitate collaboration and transparency across supply chain networks.

117 Moser, Christine, Hildebrandt, Tina, Ballis, Robert, "International Sustainability Standards and Certification," 2014, *Springer Science*, https://www.researchgate.net/publication/259563702_International_Sustainability_Standards_and_Certification

Standardized metrics for performance evaluation would provide organizations with ready-made ESG policies, which in turn would benefit decision makers and remove the need to develop in-house policies. This would also prevent greenwashing and enable stakeholders and investors to identify opportunities for improvement and track progress toward sustainability goals.[118]

Unfortunately, sustainability standards and the like are plagued by fragmentation and a lack of governmental regulation. As things currently stand, ESG reporting is not mandated for the vast majority of Canadian companies.[119] This leaves many Canadian businesses and institutions free from the requirement to disclose their carbon emissions and environmental impacts. There is also no standardized framework for ESG reporting, nor for measuring the efficacy of in-house ESG policies, making greenwashing rampant. This reduces the overall consolidation of ESG policies and disclosure procedures, which creates confusion for businesses, consumers, and workers.

For supply chain professionals, the absence of a uniform environmental reporting standard poses significant challenges, including compliance complexities, operational inefficiencies, and a lack of general knowledge that could influence decisions concerning supplier selection, material usage, shipping and distribution, etc. For new entrants to the industry and for supply chain professionals needing being reskilled or upskilled, uniformity in environmental standards would provide clearer pathways for training and education on much-needed competencies. This would also provide post-secondary institutions and training providers with clear standards to teach students, thereby making them more job ready. Many of those interviewed for the development of this report discussed a shortage of sustainability knowledge within the supply chain profession. Uniformity in environmental standards, ESG reporting, and sustainability best practices could help address these knowledge gaps by providing clear directives to relevant parties.

Driving Innovation and Supporting Industry: The Role of Government and Large Industry Buyers

At present, significantly more can be done by both the public and private sectors to improve supply chain workforce development. Firstly, governments and large industry buyers need to lead by example. Large organizations across the country need to develop more sustainability-minded approaches to procurement—ones that take serious consideration of sustainability in supplier selection and project bids and that embed accountability in RFPs. Substantially weighing sustainability in government and large industry buyer contracts would make bidders consider their own environmental impact more seriously, as well as the environmental impact of their suppliers and partners.

118 Bullock, Graham, van der Ven, Hamish, "The Shadow of the Consumer: Analyzing the Importance of Consumers to the Uptake and Sophistication of Ratings, Certifications, and Eco-Labels," 2020, Organization & Environment, https://journals.sagepub.com/doi/full/10.1177/1086026618803748

119 "2024 Canadian ESG Reporting Insights," November, 2023, PricewaterhouseCoopers International Limited, https://www.pwc.com/ca/en/today-s-issues/environmental-social-and-governance/esg-reporting-insights.html#1

> *We recognize that the ecosystem is not conducive to circularity or leadership and sustainability. And until we can change that, nothing is really going to change because all of Canada's small and medium businesses are sitting back and going, 'Well, I can't afford to do that. Why would I do that?' No sensible business is going to invest in sustainability if their customers are not asking them to do it. Now, there are odd companies like mine where we're a purpose-driven company, but we do it anyway. But we're reaching the point where, when you're in a competitive, lowest-price marketplace, you can't price yourself out of the marketplace. You can be a leader, and you can do so much. But then we're getting to the crunch point where it's going to make us uncompetitive.*
>
> – Sustainable Procurement Expert

Governments also have a role to play in driving innovation: "Procurement is another area where government decision-making overemphasizes near-term cost minimization while failing to account for longer-term economic and societal benefits. Governments can play an important role as first or early customers for new innovations, helping to de-risk products and technologies for subsequent buyers."[120] Similarly, a sustainability and procurement expert interviewed for this study pointed out that we need to "change the way Canada buys so that we have a race to the top in terms of sustainability performance in all of Canada's businesses, as opposed to a race to the bottom, which is what we see today."

That being said, Canadian governments have taken some steps to green supply chains and mitigate supply chain disruptions. As one interviewee remarked, "More legislation is coming and being introduced to the market. In Canada, for example, we see a number of laws related to extending producer responsibility, where producers have to pay for all the packaging that they put on the market in order to subsidize the recycling system and steer investments into the [sustainable packaging and recycling] sector[s]. That will change the business model that we operate under completely." At the federal level, the federal government has announced that it plans to "establish a Supply Chain Office to unify the federal government's responsibility and authority over transportation supply chain management across federal departments."[121] As part of this initiative, the federal government will "develop, implement and regularly renew a long-term, future-proof, 30- to 50-year transportation supply chain strategy"; address labour shortages in the transportation supply chain; create a supply chain ecosystem that is more resilient to disruptions; address bottlenecks and congestion; and work with industry leaders to support the implementation of digital solutions and improve trade corridors across Canada.[122]

Beyond this, Canadian governments can incentivize businesses to invest in workforce development through targeted policies and incentives. This includes offering tax credits for training programs, grants for skills upgrading initiatives, and subsidies for apprenticeship programs. By reducing the financial barriers to workforce development investments, the government can encourage businesses to prioritize skill-building and talent retention strategies, ultimately strengthening the supply chain workforce.

120 "Sink or Swim: Transforming Canada's economy for a global low-carbon future," October 2021, *Canadian Institute for Climate Choices*, https://climatechoices.ca/wp-content/uploads/2021/10/CICC-Sink-or-Swim-English-Final-High-Res.pdf

121 "Adopting Digitalization and Its Impact on Skills," 2023, *Supply Chain Canada*, https://www.supplychaincanada.com/media/files/supply-chain-trends-precis.pdf

122 Ibid.

CONCLUSION

Environmental sustainability and climate-related risks are becoming more significant factors in supply chain decisions. In order to respond to environmental sustainability challenges and account for climate-related risks in a more effective way, supply chain professionals will need to expand their existing knowledge and skills to include new knowledge and skills related to environmental sustainability. For example, it is important for supply chain professionals to be familiar with Canadian environmental business practices, understand environmental regulations and standards, and possess skills related to ecolabels, sustainability ratings, circular economies, and eco-design.

In addition to environmental sustainability initiatives, digital technology solutions are being adopted across the supply chain industry to increase efficiency, reduce risk, and mitigate negative impacts on social systems and the environment. This study identified a number of data-related skills as important for supply chain professionals to have, including the ability to obtain, clean, and standardize data from different sources and the ability to use data analysis and data science techniques to analyze large amounts of data and make data-informed decisions. In addition to data-related skills, this study found that it is important for supply chain professionals to understand how to use new technologies to digitalize their traditional supply chain processes, be comfortable researching and building business cases for new solutions, and be able to quickly adopt new technologies into their workflows. For the subset of supply chain professionals who design and build technology solutions, skills related to software development, data analysis, and data science are also important.

Building on the above information, this report identified a number of knowledge and skill gaps that will need to be addressed by workforce development programs to ensure Canada's supply chain industry can address environmental sustainability challenges in a fulsome way. For example:

- While employers identified "Canadian environmental business practices" as the most important environmental knowledge area for entry-level employees to be familiar with, students reported an overall lack of familiarity with this knowledge area.
- Employers ranked "environmental management systems" and "environmental legislation and agreements" as important knowledge areas for entry-level employees to be familiar with, yet students reported a low level of familiarity with these.
- Students reported a high level of familiarity with the scope of humanity's impact on the environment, as well as why humanity needs to reduce its environmental impacts, yet a low level of familiarity with strategies for reducing environmental impacts in the real world.
- While students reported a high level of confidence in their ability to "carry out awareness or education programs and present information on environmental matters," this ability was not seen as important by employers.
- Employers ranked software programs like inventory management software and enterprise resource planning software as important for entry-level employees to be familiar with, yet students reported a low level of familiarity with these.

Fortunately, the supply chain industry is well-positioned to reduce these knowledge and skill gaps and meet the demand for new knowledge and skills. Study participants highlighted how the supply chain industry is, at its core, a continuous learning environment, regularly subject to new legislation, shifting customer demands, and product and service innovation. Still, organizations face barriers to providing workforce development solutions to upskill and reskill the existing labour force, namely, widespread labour shortages, knowledge and skill gaps, organizational inertia, and other barriers related to cost and human resource capacity. To help the supply chain industry overcome these barriers, it will be important for Canada to consider standardization and efficiency tools, such as environmental sustainability standards; revamp post-secondary programs to account for new knowledge and skill needs; ensure supply chain practices within Canadian governments and large private sector organizations are incentivizing small- and medium-sized businesses to prioritize environmental sustainability; and provide incentives for small- and medium-sized businesses to invest in upskilling, reskilling, talent attraction, and work-integrated learning programs for students. With the right workforce development programs and incentives in place, Canada's supply chain industry will be better poised to help Canada meet its environmental sustainability targets and goals.

RESEARCH METHODOLOGY AND LIMITATIONS

RESEARCH METHODOLOGY

Secondary Research

Existing Literature

This project was supported by a thorough review of available literature about the supply chain industry, sustainability and digitalization trends in the supply chain industry, and their impact on the supply chain labour market. The literature review helped shape research methods and questions and provided information to help further validate the findings in the report. The initial literature review helped identify interviewees and advisory committee participation and form a methodology for the quantitative portion of the research.

Web Scraping

ICTC's data science team used web scraping and machine learning techniques to web scrape jobs and skills-related data from online job posting sites. The scraped data was parsed and analyzed to assess the most in-demand jobs and skills related to sustainability in Canada's supply chain industry. While job postings provide valuable data for jobs and skills analysis, it is worth noting that web-scraped data may not be reflective of all in-demand roles due to sectoral differences in how job opportunities are shared and how employers find suitable candidates.

Primary Research

Key Informant Interviews

ICTC conducted 20 key informant interviews with diverse experts on sustainability in Canada's supply chain industry. Interviews were conducted from September 2023 – January 2024. Interviewees held influential positions within their organizations, including that of Vice President, Sustainability, Senior Director Logistics, Head of Sustainable Impact, and others. The interview questions were tailored to collect information about the interviewee's experiences within their companies and within the supply chain industry, such as their opinions about sustainability practices and trends in Canadian supply chains and the impact of sustainability on Canada's supply chain labour market. The interviewees were coded in NVIVO using a combined inductive and deductive approach.

Employer Survey

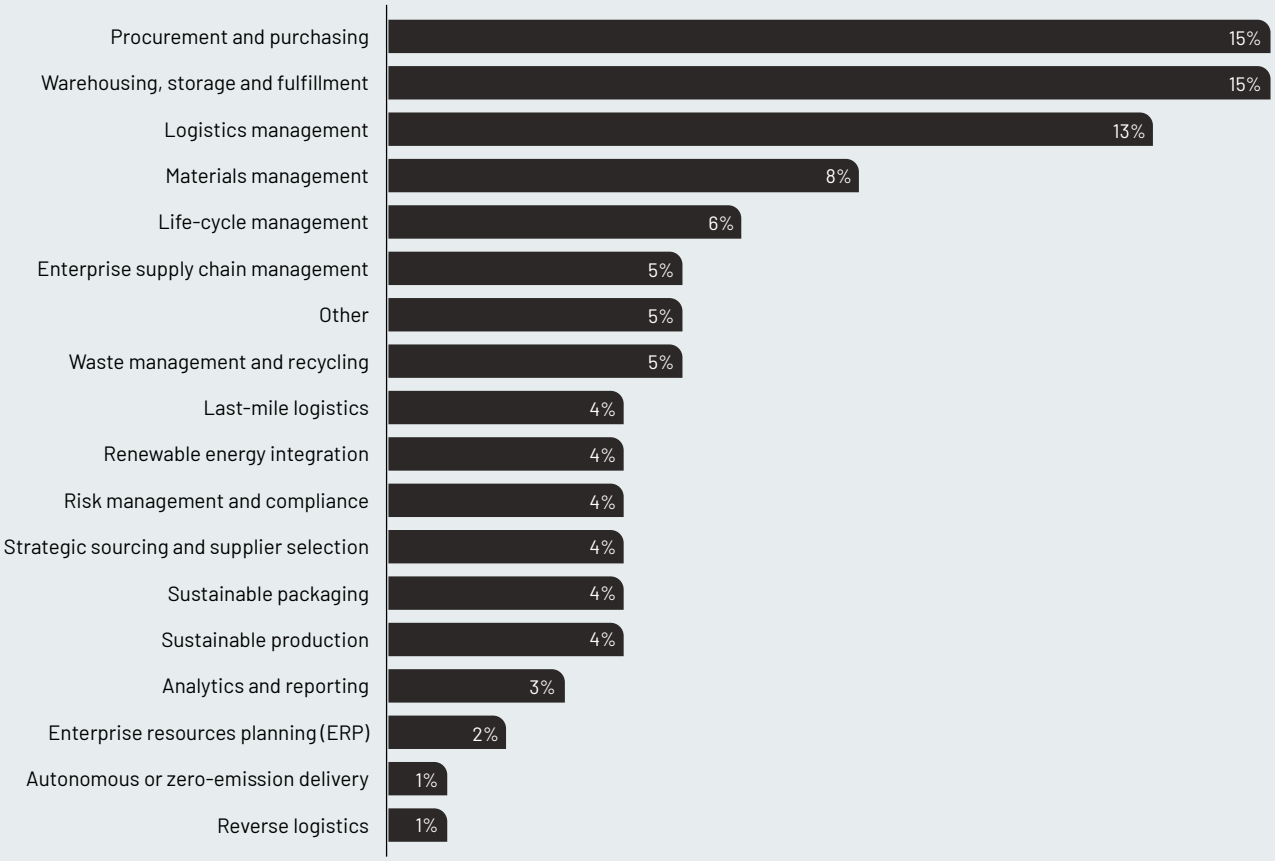
ICTC contracted a vendor to conduct a survey of 43 supply chain professionals from August to September 2023. To be included in the survey, respondents had to, at the time of responding, be involved in hiring or skills assessment for an organization involved in the supply chain industry, where the said organization is trying to improve the environmental sustainability or efficiency of the sector. Respondents were asked about their recent entry-level hiring activity, entry-level hiring plans for the next few years, training and education preferences, and entry-level skills needs.

In developing the survey questions, ICTC utilized data from O*NET OnLine, which is hosted by the Occupational Information Network and the United States Department of Labour, Employment, and Training. In addition to this, ICTC utilized ECO Canada's list of core knowledge areas for environmental workers, published in 2016.[123] The employer survey questions were aligned with the questions posed in the student survey in order to allow for comparability between the survey responses.

Large businesses with 500 employees or more made up 21% of the respondents; medium businesses with 100 to 49 employees made up 9%; small businesses with 1 to 99 employees made up 70%. There was a bigger proportion of large businesses in the survey sample than there are in the Canadian economy, which could impact the comparability of the survey results with the general economy. That said, large businesses conduct a lot of hiring, making their hiring insights useful. Warehousing and storage and fulfillment; and procurement and purchasing were the two most common industries among respondents, at 15%, respectively. These were followed by logistics management, materials management, and lifecycle management. Notably, 5% of respondents selected "other." When asked which other industry they were a part of, respondents indicated "airport operations," "anti-idling technology," "distribution," "fleet management," "freight forwarding," and "parts."

123 "Competencies for Environmental Professionals in Canada," August 2016, *ECO Canada*, https://info.eco.ca/acton/attachment/42902/f65f916cd-d7be-432b-9bce-6f8bcbb92dce/1/-/-/-/-/NOS-for-Environmental-Professionals-ECO-Canada.pdf

Figure 11: Breakdown of Employer Survey Respondents by Subsector



Data source: ICTC's employer survey

In terms of geography, 33% of respondents were located in Ontario, 26% were located in BC, 16% were located in Alberta, 14% were located in Quebec, 7% were located in Manitoba, and 2% were located in Nova Scotia and Prince Edward Island, respectively.

In terms of gender, 79% of the respondents were men, and 21% were women. In terms of visible minorities, 79% of the respondents did not identify as a visible minority, while 21% did.

Student Survey

ICTC conducted an in-house survey of 669 students across Canada who are registered in post-secondary and college programs relevant to sustainable supply chains. To deliver the survey, ICTC partnered with a number of college and university faculties and departments across Canada, in addition to utilizing its own repositories of student contacts. Students were asked about their plans for future employment and education, which industries they want to work in and why, and how comfortable they are with a variety of sustainable supply chain skill sets.

In developing the survey questions, ICTC utilized data from O*NET OnLine, which is hosted by the Occupational Information Network and the United States Department of Labour, Employment, and Training. In addition to this, ICTC utilized ECO Canada's list of core knowledge areas for environmental workers, published in 2016.[124] The student survey questions were aligned with the questions posed in the employer survey to allow for comparability between the survey responses.

RESEARCH LIMITATIONS

While efforts were made to mitigate potential biases, there are certain limitations that may be embedded in this study, nonetheless. While ICTC made a concerted effort to speak with a diverse range of sustainable supply chain stakeholders, the trends identified through key informant interviews and advisory committee meetings should be interpreted only as the experiences of those interviewed. In total, ICTC conducted 20 interviews, a sample that is too small to be considered representative of the entire industry. Similarly, while ICTC made a concerted effort to reach a comprehensive survey sample, there may be inherent biases in the data provided by survey respondents.

124 "Competencies for Environmental Professionals in Canada," August 2016, *ECO Canada*, https://info.eco.ca/acton/attachment/42902/f65f916cd-d7be-432b-9bce-6f8bcbb92dce/1/-/-/-/-/NOS-for-Environmental-Professionals-ECO-Canada.pdf