ADOPTING DIGITIZATION
AND ITS IMPACT ON SKILLS

A Research Study Commissioned by Supply Chain Canada (SCC) - National

**SUPPLY CHAIN
CANADA**
PROFESSIONALS ADVANCING THE FUTURE.

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Acknowledgements

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OUR RESEARCH TEAM

We also wish to acknowledge our research team:
Drs. R. Bhatti and **S. Kang.**

Dr. Bhatti, the research lead at 2302347 Alberta Ltd., is an experienced supply chain expert who has a keen interest in investigating supply risk in global supply chains, using artificial learning (AI) and machine learning (ML) models towards designing improved SC prediction engines. Interested in advancing the realms of AI & ML in SCM, Dr. Bhatti is the recipient of a number of funded projects (SSHRC/Municipal/Provincial govt agencies) focussed on SC risk management, mitigation, quantification, data analytics, AI & ML. In 2020, Dr. Bhatti was recognized by Supply Chain Canada as one of the Canadian immigrants who have tirelessly contributed to enhancing the supply chain profession and their roles within it.

Dr. Kang has over ten years of experience working on research projects focused on cross-disciplinary approaches to address supply chain improvement and optimization problems across a wide range of industry sectors (Manufacturing, Fresh Produce Supply Chain, Construction, Transportation, Education, Airport Operations and Healthcare). Dr. Kang's passion for solving real-world problems using advanced data analytics and applied AI and ML started in 2009 as part of his Ph.D. project funded by InnovateUK and Perkins engines.

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Executive Summary

The ongoing conflict between Russia and Ukraine has caused significant disruptions to supply chains across the world. The COVID-19 pandemic has also had a significant impact on global supply chains, causing disruptions to trade and transportation and leading to shortages of essential goods and services. The COVID-19 pandemic has rekindled interest in supply chains and raised awareness of their robustness and resilience. Inflationary pressures were caused by pervasive worldwide supply shortages, pent-up consumer demand, and the reopening of the economy. Alberta experienced one of the worst economic downturns in the past three decades due to COVID-19's effect on oil prices. The global energy commodities market is crucial to Alberta's economic revival, and a $13.2 billion surplus is expected in the ongoing fiscal year.

This study is an early attempt to examine how adoption of digital skills in Alberta supply chains have evolved, where are we currently sitting on this file, the enablers, and the barriers to the adoption of digitization and what newer skills will be expected of supply chain professionals in times to come. The study also examines some roles in the supply chain sector that may either totally vanish or undergo some evolution. In continuation of the research, this study also explores some new roles in the sector that are likely to emerge as a result of the changes in technology around us, especially the digitalization of modern supply chains Real-time visibility is a key benefit of digitizing supply chains, allowing for more efficient problem identification and resolution, cost savings and improved productivity.

 Companies must continue to invest in technology as a strategic priority, with 61% of businesses believing that technology provides a competitive advantage. Cyber-physical systems, such as smart robots, are becoming increasingly important due to labour availability restrictions, fast-rising labour rates, and the residual implications of COVID-19. Automated network tools, devices, and applications, such as drones, robots, and connected vehicles, rely on edge ecosystems. Wi-Fi, Bluetooth, and 5G are data communications technologies that will strengthen peripheral ecosystems and supplement centralized supply chain models. 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.

The National Supply Chain Task Force recommended end-to-end supply chain visibility, accountability, the efficiency of supply chains and security. During the stakeholder consultations, the Task Force heard that funding and incentives for automation would speed up adoption of digital technologies at the organization and sector levels, thereby enhancing competitiveness. The federal government has announced plans to establish a Supply Chain Office to unify the federal government's responsibility/authority over transportation supply chain management across federal departments, develop, implement and regularly renew a long-term, future-proof (30- to 50-year) transportation supply chain strategy, address Canada's significant transportation supply chain labour shortage, make it easier to plan and coordinate transportation activities to alleviate bottlenecks, reduce congestion and be more resilient to disruptions, support industry-driven approaches to digital solutions, support evidence-based decision- making to further optimize existing networks and better plan infrastructure investments, and work with industry to optimize trade corridors and gateways across Canada. Digitalization of supply chains is now being recognized as a solution to many of our supply chain risks, and disruptions, and is being increasingly seen as a step towards designing resilient supply chains.

The study also re-established the knowledge that technical skills are essential for understanding and analyzing data, automating and streamlining supply chain operations, and protecting sensitive data and supply chain operations from cyber threats. These skills include data analysis, visualization, integration and interoperability, continuous learning, and learning and adapting to new technologies. Professionals must be able to identify trends and patterns in supply chain operations and use this information to make informed decisions. They should also have the ability to create data visualizations to communicate findings and insights to stakeholders.

It is clear that data-driven decision-making and predictive analytics are essential for digital supply chains. Data analysis and visualization skills are essential for identifying trends and patterns in data and using this information to optimize supply chain operations and improve performance. Supply Chain Performance Metrics are also important for measuring and evaluating supply chain performance. Communication is essential for effectively communicating data and insights to stakeholders.

Networking and collaboration skills are also essential for effective communication between different stakeholders. Finally, coordination is essential for coordinating the flow of goods and information between suppliers, customers, and partners. Professionals must be able to effectively communicate with internal and external stakeholders, build and maintain strong relationships with these stakeholders, and build trust and understanding with stakeholders.

The study makes it amply clear that there is a need to setup a multiyear, strategic study in this area to understand the province or country wide changes which the supply chain sector needs to be prepared for. Not all sectors within the SCM ecosystem are similar and hence a sector facing study is an immediate and urgent need. The exponential rate at which technologies like Artificial Intelligence, Chat-GPT, Machine Learning, and Natural Language Processing are growing, makes this an ideal time for us to explore in depth which specific skills will our middle and top-level leaderships in the SCM sector will need to be competitive in the future. AI is no longer relegated to the realms of data scientists but is now fast becoming a basic skill which will differentiate between a successful and an unsuccessful supply chain. The call to action for the C-Suite is to assume centerstage and grab the opportunity.

Call for Action

DIGITAL ADOPTION READINESS

Organizations must understand the readiness level of individuals, departments, and their value chain to   facilitate digital transformation. A lack of understanding and experience with digital technologies and tools can hinder new adoption. The research shows that 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.

There is room for improvement in the sector's digital adoption readiness.

- Importance of organizational readiness: Even if individuals and departments are ready to adopt digitization, there is much that can be done at the enterprise level. The low percentage of organizations reporting readiness indicates room for improvement in organizational readiness for digital adoption.

- Small and medium-sized organizations face challenges: The supply chain sector involves small, medium, and large-sized organizations. Working across an organization's value chain may help small and medium-sized organizations face resource, capital, and knowledge constraints.

- Support mechanisms for small players: Upstream and downstream players may differ on current adoption levels, strategic objectives, and technology adoption priorities. The sector may consider mechanisms to assist small players in the industry or provide pathways for technology adoption to improve the overall sector's technological innovation.

BARRIERS TO DIGITAL ADOPTION

Organizational, Managerial, and Attitudinal (OMA) barriers are the most significant barriers to digital adoption readiness. Organizations should address these barriers by providing information on the benefits and ROI of digital technology, incentivizing managers, and employees to embrace the changes, and training them on the use of new technologies.

- Commitment to Upskilling: Organizations should provide employee upskilling programs to improve readiness for digital adoption. Organizations, Supply Chain Canada, and other professional associations should focus on the provision of training to ensure that employees are comfortable using new technologies, incentivize them to embrace the changes, and create a culture that values digital literacy.

- Commitment to Learning and Professional Development: Individuals should seek opportunities to upskill or reskill and demonstrate their ability to lifelong learning and professional development.

- Organizations, Supply Chain Canada, and educational institutions should focus on providing training and skill development opportunities geared toward advanced tools and technologies, which can be available for current employees and future graduates.

- Financial Market and Business Context: Organizations should know that financial and market conditions may slow digital technology adoption, especially for organizations at the early stages of the digital journey or with limited access to resources, knowledge, and finances.

- Legal/Privacy/Data Management: Organizations should focus on providing training specifically developed for the selected organization on data governance principles, which Supply Chain Canada, government agencies or other third parties can provide.

- Correlation between Availability to Implement New Digital Tools and Financial Market and Business Context Drive: Organizations, Supply Chain Canada and governments should work collaboratively to promote the ROI and benefits of technology implementation. Together, they can create pathways and appropriate support mechanisms during the technology implementation and training process.

DIGITAL ADOPTION ENABLERS

Public/Private Funding and Financial Incentives to Adopt Innovative Technologies are essential enablers for organizations to implement projects related to emerging technologies. Technical Infrastructure, Digital Strategic Plan, Integration with Existing Systems, and Appropriate Consulting Services are all essential enablers for technology adoption projects.

- Awareness of Economic Benefits: There is a need to increase awareness of the economic benefits of past implementations and user cases. Governments and other bodies need to offer information and knowledge about different support programs offered by the government to enable information dissemination based on the industry sector, digital adoption journey, etc.

- Internal Capital and Market Potential: Organizations must evaluate these factors before investing in expensive hardware, software, or consulting services necessary for successful technology adoption.

- Internal/External Collaboration: Organizations must collaborate with multiple stakeholders to leverage digital technologies' full potential.

- Regulatory Environment and Intellectual Property Protection: Policymakers can work closely with the sector to develop policies and regulations to support technology adoption while protecting intellectual property rights.

- Investment in Research and Development: Policymakers can support organizations by investing in infrastructure development and research and development.

- Digital Adoption Readiness Assessment Tools: All stakeholders (organizations, Supply Chain Canada, educational institutions and policymakers) can promote such tools and work to develop customized tools for specific industry sectors.

Canadian Supply Chains Importance, Challenges & Re-emergence

Though crucial to the functioning of contemporary economies, supply networks have historically been overlooked by policymakers. This is mostly due to the fact that supply networks are generally undervalued, despite their critical role in fostering economic growth and development.

When policymakers fail to properly value supply networks, it can stunt economic growth and progress. Policymakers need to recognise the significance of supply chains in today's economies and adopt a more all-encompassing and integrated strategy for economic growth that takes into account all stages of the supply chain. This has the potential to result in more effective and robust supply chains, higher economic development, and higher global standards of living for all people.

Disruptions in the supply chain have been a worry for companies and sectors for several years, and various instances in the past have brought attention to the requirement for comprehensive supply chain risk planning. The earthquake and tsunami that struck Japan in 2011 caused major damage to infrastructure, affected transportation and logistics, and led to the closure of multiple enterprises. The earthquake and tsunami that struck Tokyo in 2011 also caused significant damage. This caused problems in the supply chains of numerous different industries, notably the automotive and electronics sectors, as Japan is a significant supplier of components and materials to both of these sectors. In a similar vein, the floods that ravaged Thailand in 2011 caused substantial damage to the country's infrastructure, interrupted the nation's transportation system, and prompted a number of manufacturing facilities to close down. As one of the largest shipping firms in the world at the time of its bankruptcy in 2016, South Korea's Hanjin Shipping, which was also one of the world's largest shipping corporations, caused substantial disruptions to global supply chains. This resulted in the delivery of goods being delayed, which in turn led to increased expenses for businesses. Another instance of supply chain disruption occurred in 2018 because of a trade dispute between the United States and China. This dispute led to the imposition of tariffs on a variety of goods, which in turn caused supply chain

disruptions as a result of businesses being forced to either find new suppliers or pay higher costs for existing suppliers.

Significant disruptions have been caused to supply chains across the world, notably in Europe, as a result of the ongoing conflict between Russia and Ukraine. As a result of Russia's annexation of Crimea in 2014, tensions rose between the two nations, and a full-fledged armed war broke out in eastern Ukraine on February 22, 2022.

Transportation infrastructure has been disrupted as a result of the conflict. This includes highways, trains, and ports. As a result, companies have experienced longer wait times and higher expenses associated with transportation., especially of grains, and minerals like aluminum and nickel have also severely affected the energy sector, largely in Europe, but also around the world. The conflict has resulted in limitations being placed on agricultural exports from Ukraine to Russia, which has had a negative impact on the agricultural industry in Ukraine. The impact of the conflict between Russia and Ukraine on supply chains has been particularly felt in the automotive and electronics industries. This is because both of these industries rely heavily on the transportation infrastructure in the region.

The importance of supply chains in modern economies has become increasingly apparent, especially in the wake of the COVID-19 pandemic. Supply chains are responsible for the efficient flow of goods and services from manufacturers to consumers, and disruptions to global trade and transportation have highlighted the need for resilient and adaptable supply chain systems. The COVID-19 pandemic has had a significant impact on global supply chains, causing disruptions to trade and transportation, and leading to shortages of essential goods and services. Companies have had to quickly adjust their supply chains to meet changing demands, such as increased online sales, and to ensure the continuity of essential goods and services. Governments have also recognized the importance of supply chains in maintaining economic stability and have implemented measures to support supply chain resilience.

Since the spread of COVID-19, there has been a resurgence of research on global distribution networks. Even though international supply chains held up well during the pandemic's period of closed borders, restricted movement of people and goods, and business closures, the event demonstrated the need for improved tools, especially for policymakers, to evaluate the state of international supply chains and their effect on all levels of the economy- right from national, to provincial and even on local economies.

The COVID-19 pandemic has rekindled interest in supply chains and raised awareness of their robustness and resilience. Supply chains might be affected by the tightening and closing of borders, the limitations placed on the movement of people and goods, the closing of enterprises as a means of containing the virus' spread, and the effects the virus had on workers. The condition of supply chains and the effect they have on their respective economies are therefore very important. Note Inflationary pressures were caused by pervasive worldwide supply shortages, pent-up consumer demand, and the reopening of the economy. In fact, after increasing by 0.7% in 2020, the Consumer Price Index (CPI) increased by 3.4% on an annual average basis in 2021, the fastest rate since 1991 (+5.6%). In 2021, international merchandise trade equalled around $1.24 trillion, a 16.8% increase from 2020 and the highest annual value of total trade on record. Alberta has experienced one of the worst economic downturns in the past three decades because of the COVID-19 pandemic.

Alberta's economy took the biggest hit from COVID19's effect on oil prices, which slowed economic activity across the country. In 2020, the province's GDP shrank by 8.2 percent in real terms. The global energy commodities market is crucial to Alberta's economic revival, and a $13.2 billion surplus is expected in the ongoing fiscal year. From February 2020 to January 2021, the number of operational businesses in Alberta decreased by 4%. Around the same period, unemployment rates in Alberta crossed the 9% mark with 223,000 Albertans looking for jobs. Early in the pandemic, the unemployment rates for Alberta, for the period between February 2020 and May 2020, shot up from 7.2% to 15.5%! The only certain thing is the fact that the road to recovery is long and painfully slow.

To better understand the environment businesses in Canada are functioning in today and their hopes for the future, Statistics Canada conducted the Canadian Survey on Business Conditions[1] from early January to early February 2022. According to the survey's findings, companies anticipate that supply chain problems will persist in the near future, particularly with regard to managing inventory levels and purchasing inputs, goods, or supplies both locally and internationally. Businesses have or plan to utilize a variety of techniques to manage supply chain concerns, and the clear majority of those that anticipated supply chain obstacles anticipate that the situation will remain the same or get worse over the next few quarters. Nearly one-third (32.1%) of businesses anticipate sourcing inputs, goods, and supplies domestically to be challenging over the next few years. This proportion has climbed over the previous quarter in 2021 when 27.2% of enterprises anticipated this challenge. Over half (52,4%) of businesses anticipating difficulties in the first quarter of 2022 anticipate that these difficulties will persist for six months or longer. Moreover, 33.1% are uncertain as to how long these obstacles will endure.

According to a 2017 survey conducted by the McKinsey Global Institute[2], 87 percent of global CEOs believe that their organizations are not prepared to meet the anticipated digital skills gap. McKinsey is of the opinion that by the year 2030, around fifty percent of the operations that are being performed today could, in theory, be automated, which would fundamentally alter the nature of supply chain work. However, according to data that was collected internally by McKinsey2, around 45% of the workforce in the global supply chain possesses a skill set that is too conventional to fulfill the requirements of the new expectations. If a company does not have personnel who are able to use its new digital technologies to their full potential, then the performance of their supply chain as well as its overall success will be in danger. Measuring digital adoption and its intensity is difficult due to the complexity and diverse nature of digitalization. It may include, but is not limited to, e-commerce between businesses and customers, robots automating chores, and the utilization of big data and artificial intelligence technology.

[1] https://www150.statcan.gc.ca/n1/pub/11-621-m/11-621-m2022006-eng.htm
[2] James Sanyika, Susan Lund, Michael Chui, Jacques Bughin, Jonathan Woetzel, Parul Batra, Ryan Ko, and Saurabh Sanghvi, "Jobs lost, jobs gained: What the future of work will mean for jobs, skills, and wages," McKinsey Global Institute, 2017: https://www.mckinsey.com/featured-insights/future-of-work/jobs-lost-jobs-gained-what-the-future-of-work-will-mean-for-jobs-skills-and-wages

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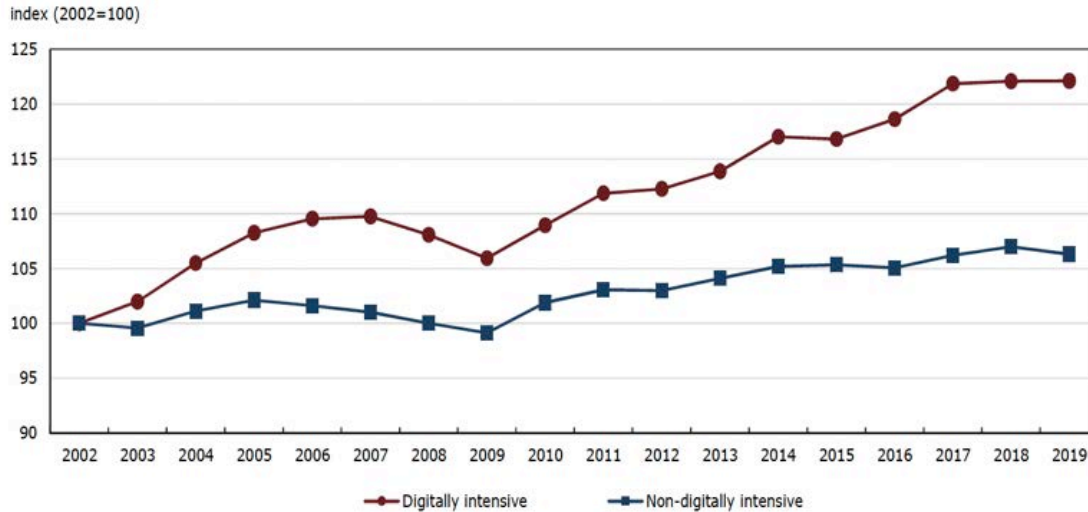
Sources: Statistics Canada, Tables 14-10-0202-01 and 36-10-0434-03.

EXHIBIT 1: LABOUR PRODUCTIVITY GROWTH IN DIGITALLY INTENSIVE VS NON-INTENSIVE SECTORS

During the COVID-19 crisis, the digitally intensive sector fared better than the non-digital sector (Chart 2). While the global spread of the COVID-19 virus has had detrimental effects on both sectors, the non-digital-intensive sector has been hit worse. Figure 2 below shows the year-over-year growth for the two sectoral divisions of digitally intensive and digitally non-intensive. Canada's business sector has profited from digitization efforts over the previous two decades. Although correlational data does not prove causation, it does indicate a link between digitization and

increased growth in labour productivity. Industries that had already adopted digitalization to a greater extent felt less of a hit from the COVID-19 pandemic and were more resilient as a result.[3] This was likely due to the increased adaptability and flexibility afforded by digitalization (e.g., pre-existing digital infrastructure or platforms, greater telework capacity).

[3] https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00026-eng.htm
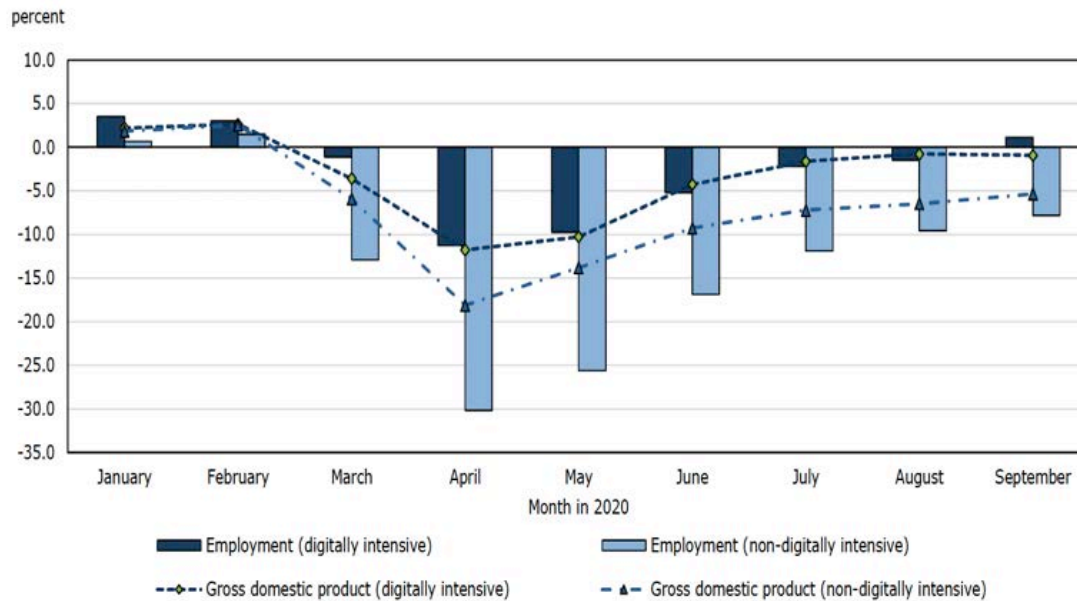
Sources: Statistics Canada, Labour Force Survey and Table 36-10-0434-01.

EXHIBIT 2: YEAR-OVER-YEAR-GROWTH IN EMPLOYMENT (2020)

To address these challenges, governments have implemented measures to support supply chain resilience. These include measures to ensure the continuity of essential goods and services, such as prioritizing the transportation of medical supplies and personal protective equipment and measures to support the recovery of the economy, such as financial assistance to businesses affected by the pandemic. The pandemic has brought to light the need for resilient and adaptable supply chain systems that can quickly respond to changing demands and disruptions. The role of supply chains in economic recovery and growth will continue to be crucial in the post-pandemic world. Companies and governments must work together to ensure the resilience and adaptability of supply chains in order to maintain economic stability and support the recovery of the global economy.

Digitization of Supply Chains - Opportunitues Ahead

The term "digitization of supply chains" refers to the implementation of data analytics and digital tools into supply chain management in order to increase both efficiency and visibility. In this context, software and online platforms can be used to keep tabs on stock, handle logistics, and keep in touch with vendors and clients. Supply chain digitalization is gaining significance as companies strive to maintain competitiveness in the dynamic global economy. Supply chain operations can benefit from the application of digital technology and data analytics in terms of their efficacy, openness, and longevity.

The profession of supply chain management, along with the skills and capabilities required to deliver value to all stakeholders, is undergoing a sea change as a direct result of the rapid advancement of technology and automation. Robotics, artificial intelligence, and advanced analytics can all be used to automate and improve processes that contain repeating parts. Some examples of these types of processes include planning, monitoring, and forecasting. Whereas in the past performance improvement may have concentrated on optimizing certain operational areas, it today needs to harness a larger picture that understands, for instance, how the supply chain affects profitability. At the same time, soft skills and people skills are also assuming a more than ever important role in the supply chains of the future. These skills will have a direct bearing on our communication of critical information amongst various levels in a digitally connected, complex supply chain.

REAL-TIME VISIBILITY

A significant benefit of digitising our supply chains of the future is a higher degree of transparency into individual processes, in (almost) real-time. This allows for more efficient problem identification and resolution, which ultimately results in cost savings and improved productivity for businesses. Furthermore, the use of digital tools and platforms for stocktaking, logistics management, and two-way communication with vendors and customers can further improve supply chain efficiency. The potential of digitalization to improve communication and coordination along a supply chain is one of its most valuable features. Digital platforms and solutions make it easier for businesses to share data and information, which can result in cost savings and improved supply chain performance.

"Digital transformation is not just about technology, it's about people. Soft skills such as communication, collaboration, and adaptability are the real enablers of digital success, allowing individuals to navigate the constantly evolving digital landscape with ease

SUSTAINABILITY

In addition, digitization can also help to improve the sustainability of supply chains. Digital tools can be used to track the environmental impact of different products and suppliers, allowing businesses to make more informed decisions about how to reduce their carbon footprint. In the future, supply chain digitization will become even more important as global supply chains become increasingly complex and interconnected. Businesses that can leverage digital technologies to improve the efficiency, transparency, and sustainability of their supply chains will be better positioned to compete in the global economy. Business Leaders rely on supply chain specialists to understand how the market is shifting, to support business agility through foresight, and to enable differences with suppliers through innovation. The professionals working in supply chains need to swiftly improve their skills, capabilities, and knowledge to keep up with the rapid rate of change. Companies that invest in the creation of future-ready workforces and the use of cutting-edge technology and automation to

Supply chain impact from digital change

Total impact from digital change
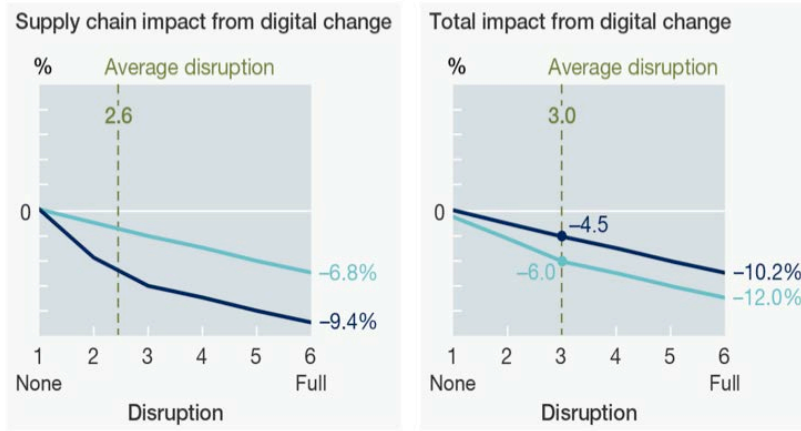
McKinsey&Company | Source: McKinsey Digital Global Survey; McKinsey Global Institute analysis

EXHIBIT 3: SUPPLY CHAIN IMPACT OF DIGITAL CHANGE

differentiate their supply chains will emerge as strong rivals. Despite this, many people are not prepared for the new era. Despite all the work businesses put into optimizing the operation of their supply chains, only a small portion of them have fully utilized digital technologies. The average supply chain has a digitization level of 43%, the lowest of the five business domains analyzed, according to a 2017 McKinsey report . Only 2% of the executives polled stated their digital initiatives are centred on the supply chain. Do they have the wrong priorities? Perhaps. According to the same McKinsey report, businesses that aggressively digitize their supply chains should anticipate increases in yearly revenue growth of 2.3 percent and earnings before interest and taxes of 3.2 percent, which is the greatest increase from digitizing any company segment. There has been much talk about the importance of digitization in maintaining supply chains and allowing the continued seamless operations of transportation networks, ships, and ports during the COVID-19 pandemic.

A 2016 McKinsey Digital Global Survey revealed that the end-to-end digitalization of the supply chain will contribute more than two-thirds of expected annual revenue growth and more than seventy-five percent of yearly EBIT increase (Figure 3). Yet despite this potential impact, survey respondents reported that in making digital investments, their company's attention is mainly on other functions.

The global distribution of essentials like food, medicine, and energy has been greatly aided by the computerization of shipping and transportation networks. During the epidemic, businesses that had not yet begun their digital transformation realized that continuing to operate in the analogue environment and relying on paper transactions was not a sustainable strategy.

The effects of COVID-19 on supply chains in Canada and around the world have been significant and may persist for some time. The future holds a promise for businesses willing to learn from their mistakes over the past two decades and strengthen their organization's supply chains. Resilience needs to be an integral part of Supply Chain Design, and digitization has a significantly high role to play in making supply chains of the future more robust. Rethinking operational techniques can lead to a more agile digital supply chain with enhanced connection and end-to-end visibility, more accurate forecasting, and seamless communication and coordination between vendors and their clientele. Ninety-two percent of Canadian CEOs surveyed for the most recent KPMG CEO Outlook Report[5] that they want to accelerate digital transformation to face COVID-19 problems. Supply chains are all about efficient networks and connections providing goods and services to end customers.

Going forward, organizations need to invest in capabilities that enable them to gather end-to-end supply chain insights and guide both strategic and operational choices. Several digital tools and platforms can help, including concepts like the establishment of control tower systems that monitor and communicate information on the whole operation of a supply chain, and the usage of blockchain to enable supplier financing and transactions and secure the chain's integrity.

Additionally, enhanced tracking can assist in boosting the usage of third-party logistics, combating counterfeiting, and enhancing visibility – the latter being especially useful for cold-chain distribution, where the temperature of supplies such as vaccinations must be maintained at a constant low. Establishing cognitive decision centres that take a cross-functional view of the supply chain (i.e., covering products, suppliers, distributors, and customers) can be crucial for organizations seeking to leverage other new technologies that support human decision-making, such as machine learning and artificial intelligence. In line with this, predictive analytics also holds the promise to assist in increased resilience and reduced risks of supply or demand disruptions, whilst advanced analytics can make supply chains more sustainable by enhancing network architecture and implementing circular waste management, thereby increasing reuse and recycling. The technologies exist, and the opportunities are within grasp.

Investments in an organization's capacity to make efficient use of technology, data and analytics, and robotics will free up personnel to concentrate on activities that are more strategic and create more value. For instance, intelligent automation can help a firm increase production while simultaneously lowering error rates and improving working conditions for its employees. Or, automating the risk clearance process for suppliers can create substantial benefits, especially for enabling the onboarding process and continued monitoring.

It is necessary to place a greater emphasis on developing new digital skills and making strategic use of emerging technologies such as artificial intelligence and robotics to meet the demands of the new supply chain ecosystem This also entails boosting the organization's data literacy through suitable training and recruitment tactics to derive more value from prescriptive and predictive analytics.

Going forward, both customers and suppliers need to be prioritized in successful supply chains. Increased customer sophistication necessitates a nimbler response to issues like access to data on lead times and "real-time" delivery. To better communicate and integrate with their internal and external customers, and suppliers, businesses need to be invested in the adoption of technology, digital capabilities, and data to link the front, middle, and back offices. This may involve shifting to an "as-a-service" model for supply chain platforms.

Future Directions
in Digitization

Companies in the supply chain must continue to invest in technology as a strategic priority. 61% of businesses surveyed by Gartner[6] believe that technology provides a competitive advantage. As well as investing in robots, many people highlight other developing technologies as crucial investment sectors. Most businesses will increase their investment in cyber-physical systems, particularly smart robots that can be used in warehouses and distribution centres, in response to labour availability restrictions, fast-rising labour rates, and the residual implications of COVID-19.

These robots answer the call for supplementary human labour through the automation of previously labour-intensive tasks. Conveyor sortation and automated guided vehicles are two examples of older forms of automation that take longer and cost more to implement than the latter. Seventy-five percent of large companies, according to Gartner, will deploy intralogistics smart robots in their warehouse operations by 2026. Seventy-five percent or more of commercial supply chain management

application providers will offer built-in support for advanced analytics (AA), artificial intelligence (AI), and data science. The "edges" of a supply chain are the nodes at which various nodes in the network (such as operators, machines, sensors, and devices) exchange information and communicate with one another. Because of edge ecosystems, decisions can be made in close proximity to the data's initial point of collection.

Automated network tools, devices, and applications, such as drones, robots, and connected vehicles, rely on the infrastructure provided by edge ecosystems. Wi-Fi, Bluetooth, and 5G are just a few examples of the data communications technologies that will strengthen peripheral ecosystems and supplement centralized supply chain models. Decisions are already being made at the "edge" of the network in many supply chains, and over the next three years, the focus will be on identifying additional use cases that could benefit from the deployment of such linked, automated, and autonomous networks. By 2026, 80% of businesses that haven't merged their digital supply chain twins and control tower programs, would witness a major loss in valu

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[6] https://www.gartner.com/smarterwithgartner/gartner-predicts-the-future-of-supply-chain-technology

Canada's Digital Supply Chains

Since 1992, international trade has consistently contributed more than half of the value of Canada's GDP, reaching a peak of more than 80% in 2000. As the COVID-19 supply chain shutdowns peaked in 2021, 61% of Canada's GDP was still generated through trade. There was a 16.8% increase in the value of Canada's overall merchandise exports in 2021, bringing the total to an all-time high of about $1.24 trillion. The United States was Canada's main trading partner in 2021, with a total trade volume of $774 billion ($476 billion exported and $298 billion imported)[7]. The transportation supply chain is the backbone of this trade. Digitization of supply chains was one of the three major recommendations of the National Supply Chain Task Force[8]. End-to-end supply chain visibility, accountability, the efficiency of supply chains and security were some of the main benefits of digital supply chains as cited by the task force recommendations. The task force also recommended that the Government of Canada provide "small and medium-sized businesses with funding and incentives for automation to speed up adoption and enhance competitiveness".[9] Some of the other key recommendations of the report include:

- "Immediately undertake actions to "unstick" the transportation supply chain. These include addressing congestion at port container terminals and prioritizing government attention on regulations, policies and procedures that are impeding the effective operation of a reliable supply chain."

- "Digitalize and create end-to-end transportation supply chain visibility for efficiency, accountability, planning, investment and security."

- Establish a Supply Chain Office to unify the federal government's responsibility/authority over transportation supply chain management across federal departments"

- "Develop, implement and regularly renew a long-term, future-proof (30- to 50-year) transportation supply chain strategy."

- "Immediately address Canada's significant transportation supply chain labour shortage."

In October 2022, Canada's federal Minister of Transport, The Hon'ble Omar Alghabra, announced a $136 million Advancing Industry-Driven Digitalization of Canada's Supply Chain initiative. The initiative aims "to develop digital solutions and optimize Canada's supply chains". This program, which would constitute a crucial aspect of Canada's National Supply Chain Strategy, would increase both the efficiency and the resiliency of Canada's supply chain by achieving the following goals:

- Making it easier to plan and coordinate transportation activities to alleviate bottlenecks, reduce congestion and be more resilient to disruptions by collecting and sharing data and analytics in real-time;

[7] https://tc.canada.ca/en/corporate-services/transparency/corporate-management-reporting/transportation-canada-annual-reports/2021/transportation-canada-2021
[8] https://tc.canada.ca/en/corporate-services/supply-chain-task-force-glance
[9] According to the September 2018 "Report from Canada's Economic Strategy Tables: Seizing Opportunities for Growth" quoting a Brookfield Institute for Innovation & Entrepreneurship news release dated June 8, 2017, "Industries with the highest proportion of autom¬atable work activities include: accommodation and food services; manufacturing; transportation and warehousing; agriculture, forestry, fishing and hunting; and mining, quarrying, and oil and gas extraction. About 62% of work activities could be automated within these industries." Canada's Economic Strategy Tables. September 25, 2018, p. 3. Available at: https://ised-isde.canada.ca/site/economic-strategy-tables/sites/default/files/attachments/ISEDC_SeizingOpportunites.pdf

- Supporting industry-driven approaches to digital solutions, especially in the areas of data collection, coordination, and improving the visibility of the transportation network for carriers, shippers and governments;

- Supporting evidence-based decision-making to further optimize existing networks and better plan infrastructure investments; and

- Working with industry to optimize trade corridors and gateways across Canada, such as the Pacific Gateway and the Windsor-Quebec trade corridor".

The announcement points to the fact that digitization of supply chains is now being recognised as a solution to many of our supply chain risks, and disruptions and is being increasingly seen as a step towards designing resilient supply chains.

All of this takes us to the next logical question "what skills do we require to support a digital supply chain"?

Talent management capabilities must keep pace with the development of supply chain technologies and supply chain concepts. One way to do this is to utilize the growing gig economy to find new sources of talent. Having the proper people on your team is crucial, and in the future, experts in the supply chain will be expected to drive the organization's strategy rather than just the supply chain plan. Research has shown four key personas that will play important roles in the supply chain of the future. Success in the future supply chain will require a team with a diverse set of skills and perspectives, rather than just one of each type of character. A recent report by EY[10] presents four future personas for a digital supply chain of the future (Exhibit 4).

[10] https://assets.ey.com/content/dam/ey-sites/ey-com/en_uk/topics/advisory/ey-supply-chain-skills-for-the-digital-era.pdf

Technologist

The technologist will 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. Where emerging technology is a suitable option, they will then determine how best to deploy and manage them. They will enable the rapid integration of new supply chain partners and reconfigure machine learning algorithms to incorporate new demand data. They embrace disruption and seek opportunities to pioneer technology to the business.

Orchestrator

The orchestrator unlocks opportunities for improvement and drives internal and external collaboration from a holistic view of the ecosystem. If you are breaking down the silos in the supply chain and you have data that provides end-to-end visibility, you will need the skills to be able to understand that end-to-end view and decide what to do with it. The orchestrator maintains a deep understanding across operations and external partners and makes key business decisions based on their insight into interdependencies, cause and effect. They work with customers to optimise ordering behaviour and can take decisions based on all pertinent factors.

Collaborative

Style

← - - - - - - - - Data driven - - - - - - - - **Mindset**   **Mindset** - - - - - - Vision led - - - - - - - - →

Style

Investigative

Analyst

The analyst drives data-led modelling and scenario planning to assess their impacts on the supply chain. They possess the conceptual analysis skills to approach scenarios with a logical, systematic perspective and the process analysis skills to identify gaps that could be filled by technology or changes in business approach. 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. They are open minded and driven by insight. New skills are required to work in this way. Supply chain professionals will need to look at how they manage divergent views from the automated and human planning decisions, guiding machine learning algorithms to align with business strategy, integrating new data sources and supply chains, and acting on the insight from scenario based simulations.

Innovator

The overarching role for the innovator is to drive new opportunities and sales and bring a commercial lens to the business. They are the horizon gazers that look at the big picture and drive innovation to create new commercial options. They will work with the customer facing organisation as well as R&D and engineering to define the right service portfolio for target customer segments and draw out different ideas. People in this role will configure multiple, unique supply chains and build effective and agile networks that enable a differentiated service and increase overall profitability. The innovator will work closely with the analyst and technologist to model scenarios and the orchestrator to implement changes to the supply chain.

EXHIBIT 4: FOUR FUTURE PERSONAS FOR THE SUPPLY CHAIN
(Source : https://assets.ey.com/content/dam/ey-sites/ey-com/en_uk/topics/advisory/ey-supply-chain-skills-for-the-digital-era.pdf

Workforce Skills in the New Era of Digital Supply Chains

The talent gap is a top constraint to growth. In the future of digital supply chains, there will be a growing need for professionals with diverse sets of skills to effectively manage and optimize supply chain operations. As digital technologies continue to evolve and disrupt traditional supply chain models, professionals will need to possess a combination of technical, analytical, and strategic skills.

- Procurement experts, for instance, will need to understand and apply the data from artificial intelligence systems to address business issues. They should also be good at managing money and forming partnerships within an ecosystem.

- Algorithms will assist factory managers in making decisions that maximize plant operations in the face of a deluge of data. Because there will be so much more data at their disposal, they will need to have strong analytical skills to make sound decisions.

- Artificial intelligence systems have a much greater ability to foresee and recognize patterns than people do. As a result, AI will handle the bulk of the planning, while humans will handle notifications and other tasks the computer cannot. Consequently, planners will have a greater grasp of the supply chain, allowing them to respond more rapidly and precisely to changes.

PEOPLE FIRST APPROACH TO DIGITIZATION:

Many businesses (across the transportation, energy, manufacturing, aviation, and EPC sectors) that we spoke to claim that they are making rapid strides toward becoming more digital. However, many seem to have forgotten that it is their responsibility to assist people in adjusting to the changes that are brought about by new technologies. Employees are not likely to accept new technologies if they are not provided with the appropriate training and support to work in the digital supply chain. This can result in the wasteful expenditure of money and discourages businesses from pursuing new business prospects. However, some businesses are succeeding, by putting an emphasis on people rather than technology.

The size, composition, and skillsets of the workforce will be particularly sensitive to the effects of digital disruption across the board. Roles will change, be redefined, and even disappear as more and more back-office tasks are automated. New technologies like machine learning (ML), cognitive planning (CP), demand signal interpretation (DSI), and robotics will require increasingly specialized personnel to implement effectively. This creates a difficult situation for company heads, who may need to retrain or acquire new skills and resources to maintain a competitive advantage.

"Digital transformation is not just about technology, it's about people. Soft skills such as communication, collaboration, and adaptability are the real enablers of digital success, allowing individuals to navigate the constantly evolving digital landscape with ease."

Doug Romanuk, Sr. Vice President

To train their staff, many top companies are investing in learning platforms - with or without third-party material and setting up learning ecosystems[11] to ensure learning is developed across departments. In this manner, employees can learn about the possibilities of new technologies, how they function, and the myriad ways in which they might be applied in the workplace. New methods of ideation, solution design, and implementation are also receiving investment from businesses. These encompass ideas from design thinking, customer journey mapping, and self-improvement.

[11] Fluor University https://youtu.be/xl09GY0aw-Q

TECHNICAL SKILLS:

Technical skills are essential for understanding and analyzing data, automating and streamlining supply chain operations, cybersecurity, integration and interoperability and continuous learning. Professionals with strong technical skills will be able to manage and optimize supply chain operations by leveraging these technologies.

- **Understanding and Analyzing Data:** Digital technologies such as IoT, Artificial intelligence, and Blockchain generate large amounts of data. Professionals with technical skills will be able to understand and analyze this data and use it to optimize supply chain operations and make data-driven decisions.

- **Automation and Streamlining Supply Chain Operations:** Technical skills are also important for automating and streamlining supply chain operations. By understanding how to use digital technologies, professionals can automate repetitive tasks, reduce errors and increase efficiency. This includes using technologies like IoT sensors to monitor and control supply chain operations in real-time, using AI-based systems to predict demand, and using blockchain-based systems to improve supply chain transparency and traceability.

- **Cybersecurity:** With the increasing use of technology in supply chain management, cybersecurity has become a crucial skill to protect sensitive data and supply chain operations from cyber threats. Professionals with technical skills will be able to understand and implement cybersecurity best practices and understand how to protect their organization from cyber-attacks.

- **Integration and Interoperability:** Technical skills are also 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 digital supply chain.

- **Continuous Learning:** Digital technologies are constantly evolving, and professionals need to keep up with the latest developments and advancements. Technical skills include being able to learn and adapt quickly to new technologies, and continuously update their skills to stay relevant in the field.

DATA ANALYSIS AND VISUALIZATION:

With the increasing amount of data generated by digital technologies, the ability to collect, analyze, and interpret large amounts of data has become critical for making data-driven decisions. Professionals working in digital supply chains must be able to identify trends and patterns in supply chain operations and use this information to make informed decisions. They should also have the ability to create data visualizations to communicate findings and insights to stakeholders.

- **Data-Driven Decision-Making:** Digital supply chains generate vast amounts of data, including data on customer demand, supplier performance, logistics, and inventory. Data analysis and visualization skills allow professionals to make sense of this data and use it to make data-driven decisions. This includes identifying trends and patterns in data and using this information to optimize supply chain operations and improve performance.

- **Predictive Analytics:** Data analysis and visualization skills also allow professionals to use predictive analytics to forecast future demand, identify potential supply chain disruptions, and optimize logistics and inventory. By analyzing historical data and identifying patterns, professionals can make predictions about future performance and take proactive measures to address potential issues.

- **Supply Chain Performance Metrics:** Data analysis and visualization skills are also important for measuring and evaluating supply chain performance. By analyzing data on key performance indicators (KPIs), such as delivery times, inventory levels, and supplier performance, professionals can identify areas for improvement and develop plans to optimize supply chain operations.

- **Communication:** Data analysis and visualization skills are also essential for effectively communicating data and insights to stakeholders. Professionals with data visualization skills can create clear and compelling visualizations that communicate findings and insights in an easy-to-understand format.

- **Continuously Improving:** The ability to analyze and visualize data is not a one-time task, but a continuous effort that requires professionals to be able to update and improve their analysis as new data is generated.

NETWORK AND COLLABORATION:

Digital supply chains rely on collaboration and communication between different stakeholders, so skills related to networking and relationship building are essential. Professionals working in digital supply chains must be able to effectively communicate with internal and external stakeholders, including suppliers, customers, and partners. They must also be able to build and maintain strong relationships with these stakeholders to drive collaboration and innovation.

- **Communication:** Networking and collaboration skills are essential for effective communication between different stakeholders in the digital supply chain. This includes the ability to communicate with internal and external stakeholders, such as suppliers, customers, and partners, and to understand their needs and requirements.

- **Relationship Building:** By building trust and understanding with stakeholders, professionals can drive collaboration and innovation, and work together to optimize supply chain operations.

- **Coordination:** This includes coordinating the flow of goods and information between suppliers, customers, and partners, and managing the logistics and transportation of goods.

- **Problem-Solving:** This includes the ability to work with stakeholders to identify problems and develop solutions, as well as the ability to mediate conflicts and resolve disputes.

- **Collaborative Innovation:** Networking and collaboration are important for fostering a culture of innovation and continuous improvement within a digital supply chain. By working closely with stakeholders and partners, professionals can identify new opportunities and develop new processes and technologies that can drive supply chain performance.

ADAPTABILITY AND FLEXIBILITY:

The digital supply chain is constantly evolving and changing, so professionals must be able to adapt to new technologies and processes quickly. They must also be able to work in a fast-paced environment and be comfortable with ambiguity and uncertainty. This requires a willingness to take risks, think creatively, and continuously learn and grow.

In the digital supply chain, adaptability and flexibility are key to success. With new technologies and digital processes emerging all the time, professionals must be able to adapt to change and take advantage of new opportunities.

STRATEGIC THINKING:

Strategic thinking is a critical skill that will be essential for professionals working in digital supply chains of the future. It allows professionals to identify new opportunities, align digital supply chain initiatives with organizational goals, manage risk and uncertainty, build, and manage digital supply chain ecosystems and continuously improve digital supply chain performance.

- **Identifying and Capitalizing on New Opportunities:** Strategic thinking allows professionals to identify new business opportunities that arise from digital supply chain transformations. This includes identifying new markets, products, and services, as well as new ways of working and collaborating with partners and suppliers. By thinking strategically, professionals can help organizations take advantage of new opportunities and stay ahead of the competition.

- **Aligning Digital Supply Chain Initiatives with Organizational Goals:** Strategic thinking is also essential for aligning digital supply chain initiatives with organizational goals. This includes understanding the organization's overall strategy and objectives and ensuring that digital supply chain initiatives are aligned with them. It also includes making decisions about which technologies and processes to implement, and how to optimize digital supply chain operations to support the organization's goals.

- **Managing Risk and Uncertainty:** Strategic thinking is also important for managing risk and uncertainty in digital supply chains. As digital supply chains become more connected, the risk of cyber-attacks, supply chain disruptions, and other threats increases. By thinking strategically, professionals can identify potential risks and develop plans to mitigate them.

- **Building and Managing Digital Supply Chain Ecosystems:** Strategic thinking is also essential for building and managing digital supply chain ecosystems. This includes understanding the role of different stakeholders and partners in the ecosystem, and how to effectively collaborate and communicate with them. It also includes understanding the different technologies and processes that are used in the ecosystem and how to optimize them to support the organization's goals.

- **Continuously Improving Digital Supply Chain Performance:** Strategic thinking is also important for continuously improving digital supply chain performance. By thinking strategically, professionals can identify areas for improvement and develop plans to optimize digital supply chain operations. This includes understanding the different metrics used to measure digital supply chain performance and using them to make data-driven decisions.

Currently, employees lack the authority to act with agility. If supply chain leaders truly want to establish an agile workforce, they must restructure work and prioritize digital-supporting capabilities. Ensure that workflows (processes, tools) provide beneficial work results while rethinking work. The focus must be on simplification and removal. Start by eliminating specific procedures, partners, rules, and policies that employees must adhere to complete workflows or accomplish particular work outputs. Next, consolidate systems, giving priority to innovative solutions that lessen the requirement for technical skills among supply chain personnel. Then, remove less necessary competency criteria from supply chain roles when new, critical abilities are added to guarantee that talent is concentrating on demonstrating and growing the appropriate skills. Adapting to new technology and exploiting data and analytics efficiently in the supply chain will demand new skills. For employees to work digitally and support the efforts of becoming a digital enterprise, supply chain positions will require digital dexterity skills. And as the supply chain places a greater emphasis on data and analytics, the average employee will need to gain data literacy abilities.

The attitudes, mindsets, and behaviours that drive digital business transformation make up what we refer to as digital dexterity. It is possible to express it using two different dimensions, the employees:

> (1) ambition and capacity to establish digital firms, and

> (2) ambition and ability to operate digitally

Adoption of Digitization in Supply Chain

The current situation in the world of business places an ever-increasing premium on the implementation of digital technology in the industrial sector. During the last ten years, manufacturing companies have been investigating how emerging digital technologies, such as the Internet of Things (IoT), big data analytics (BDA), and artificial intelligence (AI), can be implemented into their production and supply chain management systems (SCM). It is believed that these technologies will prove to be effective ways to enhance several operations of supply chains, including logistics, scheduling, and inventory management.

The Internet of Things has seen widespread application in manufacturing facilities, as well as in transportation, to track and trace logistics and warehouse operations, as well as monitor the production process. When integrated with data from other supply chain activities, the real-time data acquired from IoT devices have the potential to provide significant commercial value through the application of both BDA and AI. It could assist businesses in improving their ability to estimate client requests, reveal inventory problems, optimizing resource allocation, and manage relationships with suppliers. These newly developed digital technologies are not only influencing product and process modifications, but also value chains, business model renovations, and industrial structure alterations.

However, there is no guarantee that the implementation of digital technology would be successful. A significant number of manufacturing companies made substantial expenditures in digital transformation, yet many were unable to provide the anticipated business value[12]. The divergence between the process of formulating the strategy and carrying it out is frequently the root reason for failed attempts[13]. Inefficiently adopting digital technology could result in disruptive change, which would then lead to a significant increase in risk and uncertainty during the transformation. Researchers have suggested that the structure of supply chains might shift from a paradigm of centralized production to one of distributed production as a result of the rise of digital manufacturing. This typically results in a significant shortening of the supply chain, which results in the potential hazards to other participants within the supply chain as a result of the fact that they,

too, need to quickly adjust to this disruptive change[14]. The technological, organizational, and environmental elements all have a considerable impact on the rate of adoption of digital technology. Therefore, before implementing any technologies, businesses need to understand the aims of the technology, evaluate these variables, assess what could happen during the process, and analyze how each activity could potentially affect the supply chain. In other words, businesses need to begin by analyzing "why" (which represents the drivers, purposes, and motives), then "how" (which represents the processes or procedures), and then "what" (which represents the impacts, outputs, or results). The current understanding of these three layers (i.e., why adopt digital technologies in the supply chain, how to adopt digital technologies, and what digital technologies to adopt) of adopting digital technologies in the supply chain is still limited. This is despite the growing research interests in the area. When it comes to aligning their implementation procedures with their drivers to achieve the intended outcomes of adopting digital technology, managers continue to struggle with the obstacles that this alignment presents.

ENABLERS FOR THE ADOPTION OF DIGITIZATION

The digitization of supply chains is becoming increasingly important as companies look to stay competitive in an ever-evolving business landscape.

TECHNOLOGICAL ADVANCEMENTS:

The development of new technologies such as IoT, blockchain, and AI has made it possible for companies to digitize their supply chains and improve efficiency and transparency. IoT devices, for example, can be used to track and monitor the movement of goods through the supply chain, providing real-time visibility of inventory levels and enabling companies to respond quickly to changes in demand. Blockchain, on the other hand, can be used to create a tamper-proof record of transactions, improving transparency and reducing the risk of fraud.

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[12] Correani, A., De Massis, A., Frattini, F., Petruzzelli, A. M., & Natalicchio, A. (2020). Implementing a Digital Strategy: Learning from the Experience of Three Digital Transformation Projects. California Management Review, 62(4), 37–56. https://doi.org/10.1177/0008125620934864

[13] Rai, Arun. "Editorial preface: Developing sense-and-respond capabilities for the digital economy." Information Resources Management Journal 13.4 (2000): 3.

[14] Holmström, Jan, and Jouni Partanen. "Digital manufacturing-driven transformations of service supply chains for complex products." Supply Chain Management: An International Journal (2014).

SUPPLY
CHAIN
TRENDS

COST SAVINGS:

Digitization can lead to significant cost savings through the automation of processes and the reduction of errors. Automation of manual processes, such as data entry and order tracking, can reduce the number of errors that occur and increase efficiency. This can also lead to reduced labour costs, as fewer employees are needed to perform these tasks. Additionally, digitization can also lead to reduced costs associated with inventory management, as companies can more accurately track their inventory levels and reduce the risk of overstocking or stockouts.

IMPROVED VISIBILITY:

Digitization allows companies to have real-time visibility of their supply chain, allowing them to make data-driven decisions and respond quickly to changes in demand. This can be achieved using sensors, RFID tags, and other IoT devices that can track the movement of goods through the supply chain. This real-time visibility can also help companies to accurately forecast demand and plan accordingly.

INCREASED EFFICIENCY:

Digitization can lead to faster and more accurate processing of data, resulting in improved efficiency across the supply chain. For example, the use of blockchain technology can reduce the time it takes to process transactions, as all parties can access the same data in real time. This can also lead to reduced lead times, as companies can more quickly respond to changes in demand.

BETTER CUSTOMER SERVICE:

Digitization allows companies to provide better customer service by giving them access to real-time data on the status of orders and shipments. This can help companies to more quickly resolve issues and provide more accurate tracking information to customers. Additionally, digitization can also enable companies to identify and respond to customer needs and preferences, resulting in improved customer satisfaction more easily.

BARRIERS TO THE ADOPTION OF DIGITIZATION

There are several barriers to the adoption of digitization in supply chains. The adoption of digitization in supply chains is hindered by a range of factors. To overcome these barriers, companies need to invest in educating their workforce, developing standardization, and investing in security and infrastructure development. Some of the most significant include:

LACK OF UNDERSTANDING:
Many companies and individuals in the supply chain industry are not familiar with the technology and its capabilities. This can make it difficult to identify the potential benefits and make informed decisions about implementation.

COST:
Implementing digital technology can be expensive, especially for smaller companies. The costs of hardware, software, and training can be prohibitive for some organizations.

LACK OF STANDARDIZATION:
There is currently no standardization in the supply chain industry when it comes to digital technology. This can make it difficult for companies to integrate different systems and can lead to increased costs.

DATA SECURITY:
Supply chain companies handle a lot of sensitive data, such as financial information and the personal information of customers. Ensuring the security of this data is a major concern for many organizations and can be a barrier to adoption.

RESISTANCE TO CHANGE:
Change can be difficult for many people, and this is especially true in the supply chain industry. Many employees have been doing things a certain way for a long time and may be resistant to new technology and new ways of working.

LIMITED RESOURCES

Many small and mid-sized companies in the supply chain industry have limited resources and may not have the personnel or financial resources to invest in new technology.

COMPLEXITY:

Digitization in the supply chain is complex and requires a significant amount of planning and coordination across different departments and organizations. This can be difficult to achieve and can slow down the adoption process.

LACK OF INTEROPERABILITY:

Different systems used in the supply chain are often not able to communicate with one another, making it difficult to share information and track goods as they move through the supply chain.

LEGACY SYSTEMS:

Many companies in the supply chain industry still rely on legacy systems that are not able to integrate with newer digital technology. This can make it difficult for these companies to adopt digitization.

INADEQUATE INFRASTRUCTURE:

In many developing countries, inadequate infrastructure can be a major barrier to digitization in the supply chain. This includes a lack of reliable internet access, lack of access to electricity, and limited access to technology.

"Digital technologies play a critical role in modern day supply chains. Automation, data analytics, and AI have the potential to streamline logistics processes, reduce costs, and enhance supplier relationships. However, the top barrier to adoption is data privacy and cyber security."

James Auld, Director of Strategy, CN Rail

New Roles in Digital Supply Chains

Using the capabilities that artificial intelligence provides, businesses are reducing the complexity of their supply chains and increasing their responsiveness. Companies are improving their knowledge-intensive operations, such as supply chain planning, client order management, and inventory tracking, with the use of artificial intelligence (AI), machine learning (ML), robotics, and advanced analytics. Walmart employs AI algorithms to improve the efficiency of its supply chain. The firm has built a system called Eden that is powered by AI and helps forecast the demand that customers will have for items. It also guarantees that inventory levels are maintained to satisfy the demand that is predicted. Additionally, to improve the efficiency of its logistics network and cut down on the expenses of transportation, Walmart has adopted machine learning algorithms. Similarly, Amazon has been employing artificial intelligence (AI) for many years to better its supply chain. The firm utilises machine learning algorithms to forecast the demand for its items and to optimise its warehouse operations to speed up the delivery of such products to the company's consumers. Another example of such deployment of AI can be seen in Coca-Cola. The firm has deployed a system driven by an artificial intelligence known as the Dynamic Scheduling System. This system makes use of machine learning algorithms to maximise the efficiency of the company's product manufacturing and distribution. The system takes into account a broad variety of parameters, including things like transportation costs, manufacturing capacity, and inventory levels, in order to ensure that items are delivered to clients on time and at the most cost-effective price feasible. Closer to the world of logistics, AI has been put to use at the world's largest container shipping firm, Maersk. "TradeLens" is the name of the AI-powered system that the firm has created. TradeLens uses machine learning algorithms to improve the flow of commodities throughout their global supply chain. To guarantee that items are delivered to clients in the most timely and cost-effective manner possible, the system takes into consideration a broad variety of criteria, including shipping routes, customs restrictions, and port congestion, among many others.

It does not mean that humans will be rendered obsolete as labourers. In fact, Paul Daugherty and H. James Wilson have written a new book titled "Human+Machine: Reimagining Work in the Age of AI"[15] that dispels the common myth that artificial intelligence systems would eventually replace humans in all areas of business. The fundamental strength of artificial intelligence lies in its ability to complement human capacities; while it will be used to manage specific jobs, including decision-making at a higher level, this technology's ultimate potential will not be realized until it is applied to the supply chain. Both human beings and machines are necessary components of this new environment: The potential of humans and robots working together in jobs such as supply chain planning and inventory management will produce new sources of value for enterprises.

AI, when coupled with advanced analytics, will empower supply chain planners to make decisions with a greater focus on the long-term strategy of their operations and reduce the amount of time they spend on reactive problem solutions. These planners will take the lead in the transition from an outdated operating model for supply chains, which is characterized by a lack of flexibility and a slow pace, to a new dynamic model that features genuine end-to-end segmentation. This necessitates the management of both commercial relationships and exceptions, in addition to the development of different supply chains that are tailored to the requirements of specific client micro-segments. Concurrently, a new role for digital engineers is likely to come into existence. This person will be a highly analytical data scientist who is also proficient in digital technology. They will be responsible for managing, modelling, and modifying the algorithms, alert protocols, and parameters that direct automated decision-making planning systems. The rising demand for human workers who possess the skill set of digital engineers will cause the importance of having strong analytical skills to increase.

The most successful businesses are aware that this shift is on the horizon and have already begun to adapt their supply chain workforces. Research conducted by Accenture Strategy found that 90% of executives believe that the current workforce would become proficient in digital

15   https://store.hbr.org/product/human-machine-reimagining-work-in-the-age-of-ai/10163

technologies such as augmented reality, 3D printing, and automation over the next five years. In addition, ninety-two percent of CEOs who were surveyed claimed that supply chain workforces will be upskilled and enabled to engage and operate smoothly with machines.

In other words, workers in the supply chain are already beginning to adjust to working efficiently with a variety of intelligent technologies, such as robots, cobots, and virtual agents, in order to complete the tasks that will be required of them in the future. These technologies can, for instance, assist reinforce the right procedures on the work floor, monitoring how staff execute jobs and advising them to do so in the most effective way possible. Through the use of AI, Thyssenkrupp can overcome talent mismatches. An augmented reality device made by Microsoft called HoloLens is provided to the elevator technicians employed by the industrial services company so that they can confer with subject-matter experts.

Leaders in the supply chain have a responsibility to prepare their teams for the change that is inevitably coming and is now underway. That includes committing to reskilling individuals and moving them to other parts of the company where they can provide more value and where they will be more productive. A significant consumer goods company implemented machine learning as an adjunct to more conventional methods of forecasting. This led to an improvement in the accuracy of forecasts and the management of inventories, as well as the elimination of the need for manual reviews and calculations, which had previously consumed almost 80 percent of the available time. As a consequence of this, the corporation redirected the efforts of its human workers to give insightful market intelligence.

The following is a list of other methods in which leaders of supply chains can maintain this momentum and enable human workers to collaborate with AI most effectively :

- **Encourage the next generation of workers.** It is time to find unique talent by exploring outside of the supply chain at this point. Data scientists, risk managers, and business development leads are

examples of the kinds of personnel who have the potential to contribute significantly to the supply chain's bottom line. Companies should also make sure that their workplaces reflect the ethos of the new supply chain by integrating mobility, technology, and collaboration tools and by reinforcing new behaviours and mindsets throughout the talent development life cycle. This should be done to ensure that their workplaces are in line with the new supply chain. When it comes to recruitment, performance measures, and career advancement, you need to approach everything through the prism of innovation that is driven by technology.

- **Separate the human and the Robot.** Determine which opportunities may be realized immediately and which can be realized in the medium term and prioritize them according to the individual roles and responsibilities involved. Artificial intelligence (AI) systems will only continue to advance and become more intelligent in their ability to make decisions. As a consequence of this, it is necessary to reorient and retrain human workers so that they may concentrate on high-value endeavours such as improving the customer experience and innovating new products.

- **Put your money where your innovation is.** Think big but start small by mapping opportunities to integrate AI with already existing technology solutions. Think big but start small. Up until this point, technology such as robotics, big data, analytics, and others have been employed in conjunction with people but independently of one another. Increasing the effectiveness of the process is their responsibility. All of that has changed, however, with the introduction of AI systems that can feel, communicate, interpret, and learn. AI has the potential to assist organizations in moving beyond automation and elevating human capabilities, both of which generate new value for the company.

16 https://hbr.org/2018/08/new-supply-chain-jobs-are-emerging-as-ai-takes-hold

As supply chain management continues to evolve and adapt to new technologies and business models, new roles will be created to address the changing needs of companies. Some of the roles that may be created in the future include:

SUPPLY CHAIN ANALYTICS MANAGER:

With the increasing amount of data available in the supply chain, companies will need individuals with the skills to analyze and interpret this data to make informed decisions. Supply Chain Analytics Managers will be responsible for collecting and analyzing data from various sources, such as ERP systems, sensor data, and social media, to identify patterns and trends that can improve supply chain performance.

DIGITAL SUPPLY CHAIN MANAGER:

As more companies adopt digital technologies to manage their supply chains, roles dedicated to managing these technologies will become more prevalent. Digital Supply Chain Managers will be responsible for implementing and managing digital solutions, such as automation and artificial intelligence, to improve supply chain efficiency and visibility.

SUSTAINABILITY AND RESPONSIBLE SOURCING MANAGER:

As more companies prioritize sustainability and responsible sourcing, roles focused on these areas will become more important. Sustainability and Responsible Sourcing Managers will be responsible for implementing sustainable practices and ensuring that suppliers meet the company's standards for responsible sourcing.

BLOCKCHAIN COORDINATOR:

Blockchain technology has the potential to revolutionize supply chain management by improving transparency and traceability. Blockchain Coordinators will be responsible for implementing blockchain solutions in the supply chain and ensuring that all stakeholders, including suppliers and customers, can access and utilize the information stored on the blockchain.

3D PRINTING COORDINATOR:

With the increasing adoption of 3D printing in manufacturing, roles focused on managing the integration of this technology into the supply chain will become more important. 3D Printing Coordinators will be responsible for managing the design, production, and delivery of 3D printed parts and products.

SUPPLY CHAIN CYBERSECURITY MANAGER:

As supply chains become increasingly digital, cybersecurity will become a more important concern. Supply Chain Cybersecurity Managers will be responsible for identifying and mitigating cyber risks and ensuring that the supply chain is protected from cyber-attacks.

SUPPLY CHAIN RESILIENCE MANAGER:

As supply chains become more complex and global, the ability to respond to disruptions will become increasingly important. Supply Chain Resilience Managers will be responsible for developing and implementing strategies to ensure that the supply chain can respond quickly and effectively to disruptions, such as natural disasters or pandemics.

SUPPLY CHAIN NETWORK OPTIMIZATION MANAGER:

As companies look to optimize their supply chains and reduce costs, roles focused on network optimization will become more important. Supply Chain Network Optimization Managers will be responsible for analyzing and optimizing the supply chain network to identify opportunities for cost savings and efficiency improvements.

ADVANCED PLANNING AND SCHEDULING MANAGER:

As companies look to improve demand forecasting and production planning, roles focused on advanced planning and scheduling will become more important. Advanced Planning and Scheduling Managers will be responsible for using advanced techniques, such as machine learning, to improve demand forecasting and production planning.

SUPPLY CHAIN TALENT DEVELOPMENT MANAGER:

As the supply chain industry continues to evolve and new roles are created, companies will need to focus on developing the talent needed to fill these roles. Supply Chain Talent Development Managers will be responsible for identifying the skills and training needed for new roles and developing programs to help employees acquire these skills.

SUPPLY CHAIN COMMUNICATION EXPERT

The importance and vulnerability of global supply networks are increasingly acknowledged by business leaders, financiers, and even politicians. Supply chain information professionals will be in high demand as a result of the increased need for more complete supply chain representations.

In today's fast-paced business environment, supply chain communicators must distill the complexities of global supply chains into clear, actionable messages. Of course, they'll require an extensive understanding of the subject matter, but they'll also need to be able to see each supply chain problem from the eyes of many stakeholders. What information is crucial for the CEO to have on the material flow of the company? Supply chain generalists may fill this function at smaller businesses. When it comes to managing, visualizing, and explaining intricate global supply chains, however, team members at big and multinational organizations may devote a disproportionate amount of effort to building key performance indicators, dashboards, and other innovative tools.
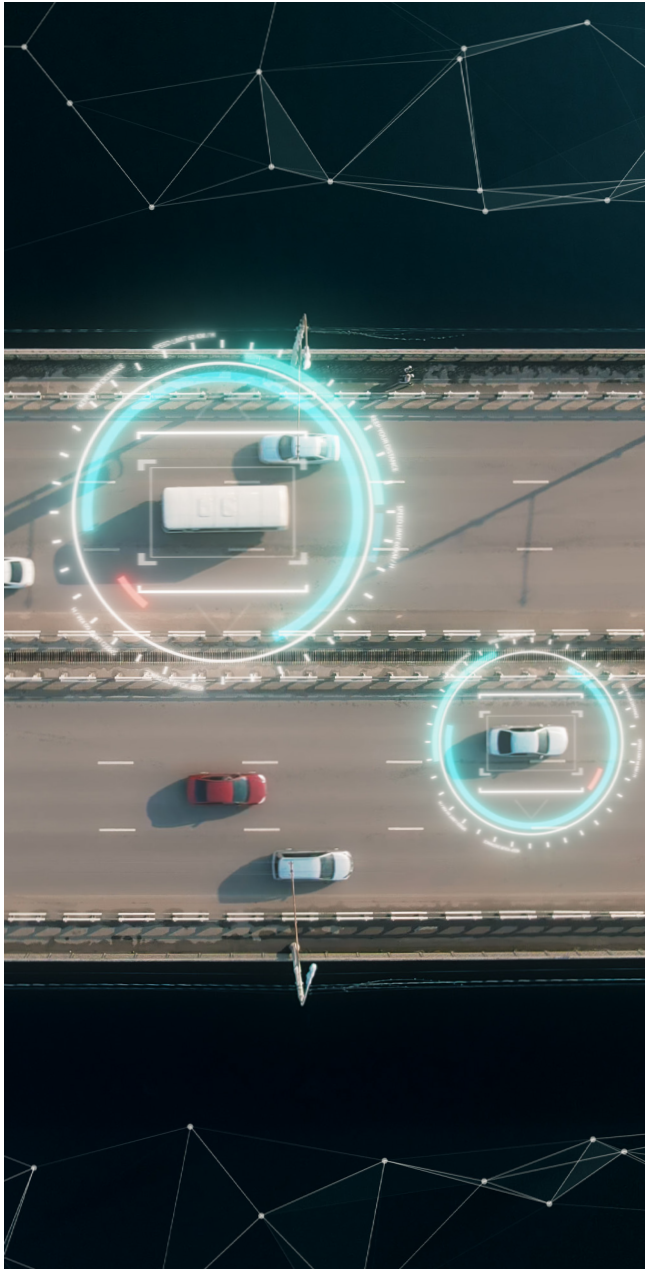
TRACEABILITY EXPERT

Companies' lack of control over their supply networks is open knowledge. For a long time, all businesses needed to do was know their immediate superiors and their immediate subordinates, or their suppliers and their customers. The fact that most businesses are unaware of their suppliers' subcontractors increases the likelihood of adverse events. COVID-19 exposed this open secret of the industry. Forty percent of the Fortune 500 companies of the world had supply chains that ended up in a single province. of China.

To a large extent, that mentality is to blame for the worldwide interruptions that most businesses are facing right now. Those who do not have complete insight and awareness into their supply chain may not be aware of an impending deficiency at the farthest reaches. Consider the far-reaching effects of the recent worldwide semiconductor shortages, which have hit even the biggest automakers hard.

The growing interest in tracking down sources might provide the solution. The pharmaceutical industry was an early adopter of traceability because of the need for meticulous monitoring of potentially dangerous chemicals and other pharmaceutical items. Companies depending on a growing array of technical tools and people to track their supply chains from raw material acquisition to final customer fulfillment are spreading the practice to the food production industry as well.

Analysts and specialists in the field of traceability will soon be in high demand, and they will require many of the same fundamental abilities as other supply chain professionals. They'll require strong interpersonal skills since they'll be responsible for gathering data from several sources and using that data to serve a wide variety of internal and external partners and clients in real-time.

These roles in supply chain management are based on current trends and predictions of future developments. However, it's important to note that the field of supply chain management is constantly changing and evolving, and new roles may emerge as the industry continues to evolve and adapt to new technologies and business models.

Supply Chain Roles that may Disappear

Any job or role that requires repetitive work, with low levels of innovation, is most susceptible to being replaced.

MANUAL DATA ENTRY POSITIONS:

With the increasing use of automation and artificial intelligence, tasks such as data entry will likely be completed by machines, rather than by human workers. This could lead to a reduction in the number of manual data entry positions within the supply chain. Automation of data entry can help to reduce errors, increase efficiency, and free up human workers to focus on more complex and valuable tasks. For example, using optical character recognition (OCR) technology to automatically capture and process data from invoices, purchase orders, and other documents can save time and reduce the risk of errors. Additionally, using machine learning algorithms to automatically classify and categorize data can improve the accuracy and speed of data analysis.

LOGISTICS COORDINATION ROLES:

With the use of advanced logistics software and tracking systems, it may become possible for machines to coordinate the movement of goods more efficiently than human workers. This could lead to a reduction in the number of logistics coordination roles within the supply chain. Automation of logistics coordination can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For example, using transportation management systems (TMS) to plan and optimize routes, schedule deliveries, and track shipments in real time can improve the efficiency and cost-effectiveness of logistics operations. Additionally, using advanced analytics and machine learning algorithms to predict demand, identify bottlenecks, and optimize inventory levels can improve the responsiveness and agility of the supply chain.

RETAIL STORE MANAGERS:

As e-commerce continues to grow in popularity, roles such as retail store managers may become less necessary. With more customers shopping online, there may be less need for human workers to manage physical retail locations. This could lead to a reduction in the number of retail store manager roles within the supply chain. However, e-commerce and digital marketing skills may become more valuable as the shift toward online sales continues. For example, using digital platforms and marketplaces to reach new customers, personalize the shopping experience, and optimize pricing and promotions can help to drive online sales and improve customer loyalty. Additionally, using data analytics and machine learning algorithms to track customer behaviour, preferences, and feedback can help to improve the effectiveness of marketing campaigns and product development.

INVENTORY MANAGEMENT ROLES:

Inventory management roles that rely heavily on manual processes may become less necessary in the future. With the use of advanced inventory management software and automation, it may become possible for machines to manage inventory more efficiently than human workers. This could lead to a reduction in the number of inventory management roles within the supply chain. Automation of inventory management can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For example, using warehouse management systems (WMS) to automate the tracking, storage, and movement of inventory can help to improve the accuracy, speed, and security of inventory operations. Additionally, using advanced analytics and machine learning algorithms to predict demand, optimize stock levels, and identify patterns and trends can help to improve the responsiveness and agility of the supply chain.

TRANSPORTATION PLANNING POSITIONS:

With the use of advanced transportation planning software and automation, it may become possible for machines to plan transportation routes and schedules more efficiently than human workers. This could lead to a reduction in the number of transportation planning positions within the supply chain. Automation of transportation planning can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For example, using transportation management systems (TMS) to plan and optimize routes, schedule deliveries, and track shipments in real time can help to improve the efficiency and cost-effectiveness of transportation operations.

WAREHOUSING AND DISTRIBUTION ROLES:

Warehousing and distribution roles that involve mainly manual labour may become less necessary in the future. With the use of advanced warehouse management software and automation, it may become possible for machines to manage warehouses and distribute goods more efficiently than human workers. This could lead to a reduction in the number of warehousing and distribution roles within the supply chain. Automation of warehouse and distribution management can help to improve efficiency, reduce costs, and increase transparency in the supply chain. For instance, using warehouse automation technology like automated storage and retrieval systems (ASRS) can help to automate the handling of inventory, increasing the speed and accuracy of inventory tracking, and reducing the need for manual labour.

Talent Sources for Emerging Sectoral Requirements

There is not a sufficient pool of expertise to go around. Therefore, many IT firms have developed their digital training and certification networks. We need to go beyond the ad hoc technique that most firms have been using to source their personnel if we want to restore a sustainable employment rate.

It's a multi-step process that needs precise orchestration to manage the influx of talented employees into the market. As an added caution, remember that once employees go, they won't magically return. Employers will need to improve their ability to source talent internally and actively develop employees' abilities if they want to guarantee a steady supply of workers for both the now and the future.

The supply chain sector is a vital and rapidly growing industry that plays a crucial role in the global economy. As such, the sector must be able to attract and retain talented individuals to ensure its continued growth and success. The talent needs of the supply chain sector are likely to be filled through a combination of hiring new employees with the necessary skills and training current employees to acquire new skills.

One of the main sources of talent for the supply chain sector will likely be new graduates from relevant educational programs. Universities and colleges are increasingly offering courses and degrees in supply chain management, logistics, and related fields, which will provide a steady stream of qualified candidates for the sector. Additionally, many of these programs are now incorporating technology and data analysis into their curriculum, which will help to prepare graduates for the digitalization of the supply chain.

Another source of talent for the supply chain sector will be experienced professionals from related industries. As technology and automation become more prevalent in the supply chain, professionals with experience in areas such as data analytics, artificial intelligence, and digital logistics will be in high demand. Additionally, professionals with experience in areas such as sustainability, ethics, and risk management will be needed as these become increasingly important to the sector.

In addition to hiring new employees, companies in the supply chain sector will also need to focus on developing the skills of their current employees. This can be done through training programs, mentoring, and internal career development opportunities. As technology and data analysis become more important in the supply chain, employees will need to be trained in these areas to ensure they can perform their jobs effectively. Additionally, training programs that focus on areas such as sustainability and ethical sourcing will be important as these become more important to consumers and companies.

The supply chain sector is also expected to see a significant increase in the demand for remote and flexible working arrangements. This will require employers to have a more diverse and inclusive workforce, which will be reflected in their recruitment and retention strategies. This means that companies will have to be more open to recruiting candidates from diverse backgrounds and create inclusive working environments that support flexible working arrangements.

To attract and retain top talent, companies in the supply chain sector will need to offer competitive compensation and benefits packages. This includes not just salary but also other benefits such as health insurance, retirement plans, and professional development opportunities. Additionally, companies will need to offer a positive and engaging work culture that allows employees to feel valued and supported. This can be achieved through employee engagement programs, open communication, and a focus on employee well-being.

Supply Chain Training Provider Groups

This research identified four kinds of supply chain training providers:

- Certification-Focused Professional Organizations,
- Consultancies
- MOOC Providers and
- University / Micro Masters Programs.

TRAININGS BY CERTIFICATION-FOCUSED PROFESSIONAL ORGANIZATIONS:

SUPPLY CHAIN MANAGEMENT PROFESSIONAL (SCMP)

The SCMP accreditation is Canada's premier supply chain management designation and may help you stand out in the profession. Through different agreements with provincial and territory educational institutions, Supply Chain Canada provides the certification program. With the SCMP or Certified Supply Chain Management Professional (CSCMP) title, you can demonstrate your understanding of modern supply management strategies, concepts, and technologies.

The curriculum consists of eight modules on strategic supply chain management, six interactive workshops on advanced business skills, a leadership residency program, and a final case-based examination. the program, and a final test. Designation candidates must be Supply Chain Canada members, competent in English or French, and possess a degree or certification in a business-related discipline, or a minimum of five years of work or military experience in supply chain management. In addition, candidates must have at least three years of work or military experience in supply chain management.

SUPPLY CHAIN FRAUD CERTIFICATION

The supply chain fraud certification is a post-SCMP designation certification that supply chain managers can pursue to further their awareness of fraud-related issues affecting the supply chain. The curriculum explains the many types of fraud that influence supply chains and the preventative measures that may be used to safeguard a business from such conduct. Participants can utilize the online program to complete the webinar, seminar, and certification exam.

Participants are prepared to work in an industry that prioritizes high-efficiency production and global trade. Participants learn how to safeguard integrity across the supply chain. As the certification is an extension of the SCMP designation, Supply Chain Canada also offers it, and membership is required.

HEALTHCARE SUPPLY CHAIN CERTIFICATION

The accreditation for the healthcare supply chain is offered by Supply Chain Canada. This certification allows professionals in the healthcare supply chain field to practice strategies that will help them bring value to their firm. Three modules consisting of two webinars and one in-person seminar are available to both Supply Chain Canada members and non-members.

The first module offers a foundation for understanding and managing strategic sourcing objectives, such as competitive and non-competitive sourcing, contract management, and supplier relationship management. The second session provides learners with an in-depth examination of sophisticated supply chain elements. This involves doing a value analysis to ensure economic sustainability, aligning service levels with performance criteria, identifying, and analyzing procurement risks, and negotiating contracts. The last module emphasizes process re-engineering to boost the organization's value. This course examines the effects of changes in corporate procedures on cash flow, service performance, and customer satisfaction.

SUPPLY MANAGEMENT TRAINING (SMT)

The SMT program is offered by Supply Chain Canada for persons who do not work in supply management but do certain procurement, logistics, transportation, or operational activities. Participants who complete all thirteen technical courses, three seminars on the development of soft skills, and three seminars on the understanding of business management may be eligible for a diploma or certificate in Supply Management. Included in the course material are procurement, logistics, transportation, operations, management, accounting and finance, marketing, contract management, negotiation skills, and business planning.

Ideal candidates for the SMT program include junior buyers, purchasing assistants, production planners, logistics administrators, warehouse clerks, material handlers, associates, analysts, and experts. The program shapes, strengthens, and guides the future careers of early to mid-career professionals in the sector. Different provincial and territory institutes affiliated with Supply Chain Canada offer the SMT program, with differing entry criteria. There is the opportunity to pursue advanced standing and exemption courses within the program.

CITT CERTIFIED LOGISTICS PROFESSIONAL (CCLP)

The Canadian Institute of Traffic and Transportation (CITT) provides the CCLP certification to those seeking entry to supply chain logistics management roles. The CITT is Canada's logistics association and a non-profit organization that offers career advancement opportunities to people working in supply chain logistics or logistics in general. Successful participants must finish five specialized logistic courses and five company management courses. If you already possess a degree or diploma in a business subject, you may apply for advanced standing in the CCLP program and bypass the business management courses.

CERTIFIED IN PRODUCTION & INVENTORY MANAGEMENT (CPIM)

The Association for Supply Chain Management (ASCM) confers a professional certification known as the Certified in Product Information Management (CPIM). The goal of this certification programme is to equip individuals with the skillset they will need to oversee production and inventory management across a variety of sectors. To earn your CPIM credential, you must complete two courses:

- **Module 1:** Basics of SCM, inventory management and scheduling are only some of the materials covered in this unit. It is a synopsis of supply chain management's fundamental ideas and concepts.

- **Module 2:** In the second unit, you will learn all about developing an operational plan, a management strategy for your resources, allocating those resources, and developing a detailed schedule. A deeper dive into the production and inventory management process is presented.

Anyone interested in focusing their career on inventory and production management would benefit from this certification. Practitioners in the fields of production scheduling and control would benefit greatly from this qualification.

CERTIFIED SUPPLY CHAIN PROFESSIONAL (CSCP)

The "Association for Supply Chain Management" provides the "CSCP certification" as a professional certification. The certification is intended to provide individuals with the knowledge and abilities necessary to manage end-to-end supply chain operations in a variety of sectors. The CSCP certification is comprised of the following three modules: Fundamentals of Supply Chain Management

- **Module 1:** Fundamentals of Supply Chain Management
  This module covers supply chain design, planning, and execution, as well as demand planning, capacity management, and supplier relationship management. It describes the fundamental concepts and principles of supply chain management.

- **Module 2:** Supply Chain Strategy, Risk, and Compliance
  Supply chain planning, risk management, and compliance are just a few of the subjects covered in Module 2. It offers a deeper comprehension of the strategic elements of supply chain management.

- **Module 3:** Implementation and Operations
  Implementing a supply chain, managing operations, and pursuing continuous improvement are some of the topics covered in Module 3. It offers a more concrete grasp of how to establish and manage supply chain operations.

Professionals who wish to specialize in "end-to-end supply chain management" are ideal candidates for the "CSCP certification."

CERTIFIED IN LOGISTICS, TRANSPORTATION, AND DISTRIBUTION (CLTD)

The Certified in Logistics, Transportation, and Distribution (CLTD) is a professional certification offered by the Association for Supply Chain Management (ASCM). The certification is designed to enhance the logistics, transportation, and distribution knowledge and skills of professionals in the supply chain industry.

The CLTD program consists of eight modules that cover a wide range of topics related to logistics, transportation, and distribution:

1. Logistics and Supply Chain Overview
2. Capacity Planning and Demand Management
3. Order Management
4. Inventory and Warehouse Management
5. Transportation Management
6. Global Logistics Considerations
7. Logistics Network Design
8. Reverse Logistics and Sustainability

Each module provides a detailed understanding of the topics covered, and the overall certification program is intended to help professionals develop the knowledge and skills needed to manage complex supply chains in a global business environment.

The CLTD certification is suitable for individuals who are involved in logistics, transportation, and distribution, including supply chain managers, transportation planners, warehouse supervisors, and logistics analysts. It is also beneficial for individuals who are interested in pursuing a career in these areas or for those who want to enhance their existing knowledge and skills in these fields.

SCOR PROFESSIONAL (SCOR-P) PROFESSIONAL PROGRAM

The Supply Chain Operations Reference (SCOR) Professional program is a certification program offered by the Association for Supply Chain Management (ASCM). It is designed to enhance the knowledge and skills of supply chain professionals by providing a common language, framework, and set of performance metrics to evaluate and improve supply chain operations.

The SCOR Professional program consists of four modules:

- SCOR Framework and Performance
- Process Modeling and Analysis
- Performance Measurement
- SCOR Implementation

Each module provides a comprehensive overview of the SCOR framework and how it can be applied to improve supply chain operations. The program is designed to help professionals understand the interconnectivity and integration of various supply chain processes and functions, including planning, sourcing, manufacturing, delivery, and returns.

The SCOR Professional program is suitable for supply chain professionals at all levels, including supply chain managers, analysts, consultants, and engineers. It is particularly beneficial for individuals who are involved in supply chain improvement initiatives or who are responsible for designing and implementing supply chain strategies. The program can also be useful for individuals who are interested in pursuing a career in supply chain management or for those who want to enhance their existing knowledge and skills in this field.

THE CHARTERED INSTITUTE OF PROCUREMENT AND SUPPLY (CIPS)

The Supply (CIPS) offers a range of certifications for procurement and supply chain professionals. Some of the available certifications and their suitability for supply chain professionals are discussed below:

- **Level 2:** Certificate in Procurement and Supply Operations - This certification is suitable for individuals who are new to the field of procurement and supply chain management, as well as for those who are in supporting roles within the procurement function.

- **Level 3:** Advanced Certificate in Procurement and Supply Operations - This certification is suitable for individuals who have some experience in procurement and supply chain management and are looking to develop their skills further.

- **Level 4:** Diploma in Procurement and Supply - This certification is suitable for individuals who are responsible for leading procurement and supply chain initiatives within their organizations and are looking to gain more in-depth knowledge and skills in procurement and supply chain management.

- **Level 5:** Advanced Diploma in Procurement and Supply - This certification is suitable for senior procurement professionals who are responsible for strategic procurement and supply chain management within their organizations.

- **Level 6:** Professional Diploma in Procurement and Supply - This certification is suitable for individuals who have significant experience in procurement and supply chain management and are looking to enhance their leadership and strategic skills.

Overall, the CIPS certifications are suitable for a wide range of supply chain professionals, including procurement managers, buyers, contract managers, and supply chain analysts. The program provides a comprehensive understanding of procurement and supply chain management, and the certifications are recognized globally, making them highly valued by employers in the procurement and supply chain industry.

CERTIFIED PROFESSIONAL IN SUPPLY MANAGEMENT (CPSM)

The Certified Professional in Supply Management (CPSM) is a certification offered by the Institute for Supply Management (ISM) for supply chain professionals with at least three years of experience in supply management. The CPSM program covers a range of topics related to supply chain management, including supply chain strategy, supplier relationship management, risk management, and logistics.

The CPSM certification program is designed to enhance the skills and knowledge of supply chain professionals, enabling them to become more effective in their roles. It is particularly suitable for individuals who are responsible for managing supply chain activities within their organizations, such as procurement managers, supply chain analysts, and logistics managers.

To obtain the CPSM certification, candidates must pass three exams that cover the following areas:

1. Foundation of Supply Management: This exam covers topics such as procurement process, negotiation, and contract management.

2. Effective Supply Management Performance: This exam covers topics such as supplier performance management, risk management, and compliance.

3. Leadership in Supply Management: This exam covers topics such as supply chain strategy, change management, and stakeholder engagement.

CERTIFIED PROFESSIONAL IN SUPPLIER DIVERSITY (CPSD)

The Certified Professional in Supplier Diversity (CPSD) is a certification offered by the Institute for Supply Management (ISM) for professionals who are responsible for managing supplier diversity initiatives within their organizations. The CPSD program covers a range of topics related to supplier diversity, including supplier diversity strategy, supplier selection, and supplier performance management.

The CPSD certification program is designed to enhance the skills and knowledge of supply chain professionals around supplier diversity, enabling them to develop and implement effective supplier diversity programs within their organizations. It is particularly suitable for individuals who are responsible for managing supplier diversity initiatives, such as supplier diversity managers, procurement managers, and supply chain analysts.

To obtain the CPSD certification, candidates must pass two exams that cover the following areas:

- Supplier Diversity Program Development: This exam covers topics such as supplier diversity strategy, program design, and supplier selection.

- Implementation and Execution of Supplier Diversity Programs: This exam covers topics such as supplier performance management, measurement and reporting, and stakeholder engagement.

The CPSD certification demonstrates a commitment to promoting diversity and inclusion within the supply chain, and a high level of expertise in supplier diversity management. Overall, the CPSD certification is suitable for professionals who are looking to advance their careers in supplier diversity and enhance their skills in this specialized area of supply chain management.

CPM (CERTIFIED PURCHASING MANAGER)

The Certified Purchasing Manager (CPM) is a certification offered by the Institute for Supply Management (ISM) for professionals who are responsible for managing purchasing activities within their organizations. The CPM program covers a range of topics related to purchasing, including procurement strategy, contract management, and supplier performance management.

The CPM certification program is designed to enhance the skills and knowledge of supply chain professionals in the area of purchasing, enabling them to develop and implement effective purchasing strategies within their organizations. It is particularly suitable for individuals who are responsible for managing purchasing activities, such as procurement managers, purchasing agents, and supply chain analysts.

To obtain the CPM certification, candidates must pass three exams that cover the following areas:

1. Purchasing Process: This exam covers topics such as sourcing, supplier selection, and negotiation.

2. Effective Supply Management Performance: This exam covers topics such as contract management, risk management, and compliance.

3. Leadership in Supply Management: This exam covers topics such as supply chain strategy, change management, and stakeholder engagement.

APSM SUPPLY MANAGEMENT STUDENT CERTIFICATION

The ISM's APSM Supply Management Student Certification is a program designed for students who are interested in pursuing a career in supply chain management. This certification program aims to provide students with a basic understanding of the fundamentals of supply chain management and procurement.

The APSM certification program covers the following topics:

1. Introduction to Supply Chain Management: This module covers the basic concepts and principles of supply chain management, including supply chain networks, logistics, and procurement.

2. Procurement: This module covers the procurement process, including sourcing, supplier selection, and contract management.

3. Supply Chain Operations: This module covers the operational aspects of supply chain management, including inventory management, demand planning, and production scheduling.

4. Supply Chain Risk Management: This module covers the identification and management of supply chain risks, including supply chain disruption, compliance, and cybersecurity.

The APSM certification program provides a foundational understanding of the concepts and principles of supply chain management, enabling students to make informed decisions and contribute to the success of their organizations. The APSM certification provides a competitive advantage when applying for entry-level positions in supply chain management or procurement.

NIGP'S CERTIFIED PROCUREMENT PROFESSIONAL (CPP) PROGRAM

The National Institute of Governmental Purchasing (NIGP) offers a certification program for professionals in the public procurement field known as the Certified Procurement Professional (CPP) program. The CPP program is designed to enhance the skills and knowledge of public procurement professionals, including those in the supply chain management field.

The CPP program covers a broad range of topics related to public procurement, including sourcing strategies, contract management, risk management, and ethics. The program is divided into two levels: the CPP Level 1, which focuses on the basic concepts and principles of public procurement, and the CPP Level 2, which focuses on advanced topics in public procurement.

The CPP certification program is suitable for professionals in the supply chain management field who work in the public sector, including procurement managers, purchasing agents, and supply chain analysts. The program provides a comprehensive understanding of the complex regulations and policies associated with public procurement and enables professionals to develop and implement effective procurement strategies within their organizations.

To obtain the CPP certification, candidates must meet specific education and experience requirements and pass a comprehensive exam. The certification is recognized nationally and internationally, demonstrating a commitment to ongoing professional development and a high level of expertise in public procurement.

Overall, the CPP certification program offered by NIGP is a suitable option for supply chain management professionals working in the public sector who are looking to enhance their skills and knowledge in public procurement. It provides a competitive advantage and is highly valued by employers in the public procurement field.

THE UPPCC CERTIFICATIONS

The Universal Public Procurement Certification Council (UPPCC) offers two certifications for procurement professionals, the Certified Public Procurement Officer (CPPO) and the Certified Professional Public Buyer (CPPB). Both certifications are recognized as highly regarded in the field of public procurement and demonstrate an individual's expertise and commitment to professional development.

- The CPPO certification is designed for experienced public procurement professionals who have a minimum of five years of public procurement experience and who have completed a minimum of 60 contact hours of formal procurement education. The certification focuses on advanced procurement topics, including strategic planning, leadership, and risk management. The CPPO certification is suitable for procurement professionals who are in leadership or management roles, such as procurement directors, managers, and supervisors.

- The CPPB certification is designed for procurement professionals who have at least two years of public procurement experience and who have completed a minimum of 45 contact hours of formal procurement education. The certification covers fundamental procurement topics, including procurement law and regulations, ethics, and contract administration. The CPPB certification is suitable for procurement professionals who are new to the field of procurement, such as procurement specialists or buyers.

Both certifications require passing a rigorous exam and ongoing continuing education to maintain the certification. Additionally, UPPCC offers a recertification program that enables professionals to maintain their certification by earning continuing education credits.

ADOPTING DIGITIZATION AND ITS IMPACT ON SKILLS · 55

Project Background &
Data Analysis
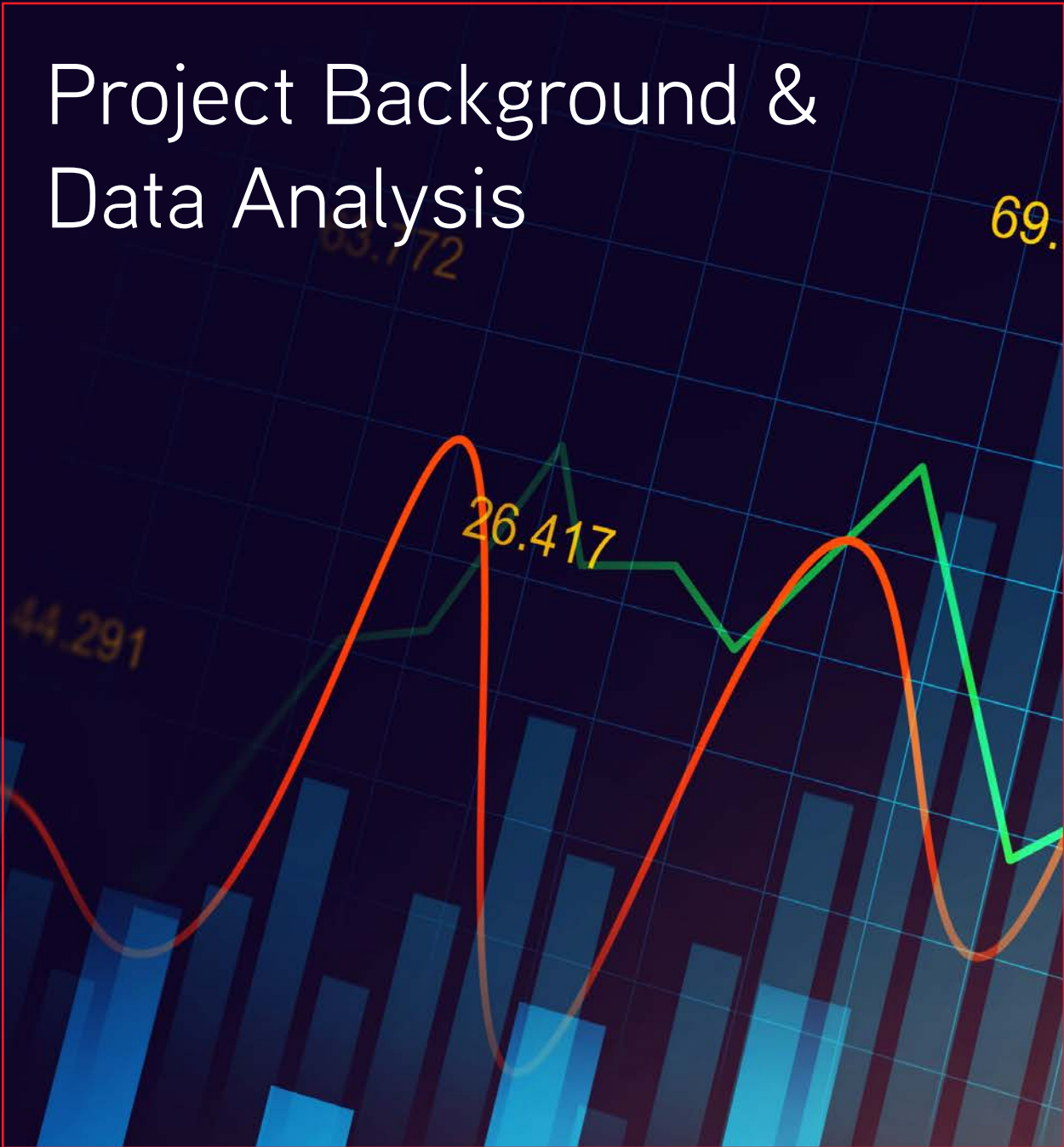
In June 2018, the Canadian Supply Chain Sector Council (CSCSC), now Supply Chain Canada (SCC), released the "Accelerator 2.0- A Call to Action" report. This report focussed on the questions around "…the opportunities and challenges facing employers and their workforce in Alberta's supply chain sector." To ensure that all Albertans have access to the benefits of transformative technologies and the evolving skill requirements impacting the labour market, the Call-to-Action strategies discuss what policymakers, employers, educational institutions, and individuals can do to boost competitiveness, stimulate innovation, and remove barriers to labour force participation.

Before Accelerator 2.0, the CSCSC and the Calgary Logistics Council collaborated in 2011 and 2012, to create "Accelerator: A Call to Action". The research concluded with suggestions for enhancing the industry's labour force. With the Asia-Pacific Gateway and Corridor already having such a noticeable effect on Alberta's supply chains, this realization served as the impetus for the Accelerator effort.

With this background, in 2022, Supply Chain Canada commissioned this present study to gather sector and value chain analyses by gathering in-depth knowledge of the existing performance, potential, and constraints of individual value. The results, it proposed, would be used to pinpoint several entry sites for interventions to boost employment levels and quality while closing gaps in the labour market. While the Economic dimensions of the analyses are a part of the study, the major focus is on the Social Dimensions – how people interact with the sector in terms of employment, skills supply demand, gender equality etc. Adopting an "employment lens" was the motivation to dig deeper into the social dimension of this work.

Three prominent sectors – aviation & logistics, agriculture and energy & cleantech, were targeted in this study. The pilot was planned to highlight the key foci for future studies (potentially at a pan-Canada level). Senior leaders from the identified sectors and those who are responsible for technology and related project adoptions and implementations were shortlisted to represent the sectors.
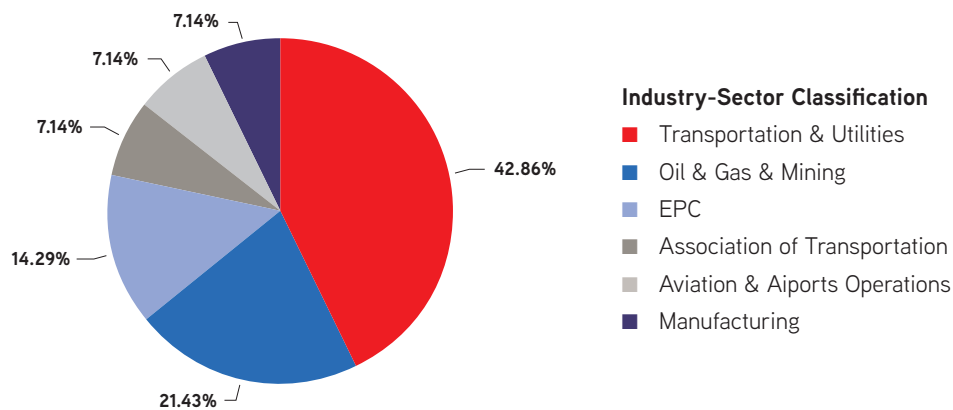
METHODOLOGY AND PARTICIPANT PROFILE:

Utilizing the networks of Supply Chain Canada, economic development agencies, chambers of commerce, and other business groups in each region, as well as direct appeals through the professional and academic networks of the research team, recruitment was conducted. Multiple emails, web messages, blogs and social media postings on LinkedIn were delivered to promote attendance and increase interest in the study. A mixed methods research study approach has been used to collect, analyse, and report data. A survey was designed to capture participant feedback and responses on key themes and questions. The data was cleaned and wrangled using traditional research methodologies and by also using Machine Learning approaches in data wrangling, pre-processing, and sentiment analysis. Data collection focused on understanding the digital adoption trends within supply chain management or supporting functions, the impact of these adoptions on the organization and sector, and the support required to promote digital adoption.

The following list of organisations provided access to their decision maker and supply chain leaders (Exhibit 5):

Alberta Motor Transport Association (AMTA)	CEO	Transportation Association
Alberta Motor Transport Association (AMTA)	Senior Manager	Industry Advancements
Bayer Canada	Lead	Distribution and Warehousing
Bison Transport	Associate Vice President	Analytics
Bision Transport	Senior Vice President	West Region Transportation
Cenovus	Senior Leader	Supply Chain Management
Canadian National Rail (CN Rail)	Senior Manager	Corporate Development
Edmonton International Airport (EIA)	Director	Supply Chain Managment
Enbridge	Manager	Supply Chain Innovations
Fluor Canada	Director	Supply Chain Management
Fluor Canada	Manager	Materials Management
TC Energy	Manager	Supply Chain Management
WestJet	Vice President	Procurement and Supply Chain

Industry-Sector Classification
- Transportation & Utilities
- Oil & Gas & Mining
- EPC
- Association of Transportation
- Aviation & Aiports Operations
- Manufacturing

EXHIBIT 6 PARTICIPANTS BY INDUSTRY SECTOR

One-to-one meetings were conducted with participants from the abovesaid organisations in both formats- in-person and online (via Google Meets/Zoom/Teams). Interview sessions were 60-90 minutes long. Online meetings were transcribed using the in-built captions option in the platform being used.

- All the participants reported having at least ten years of experience in supply chain management (ranging from 10 to 30+ years) - Exhibit 7.

- The significant majority of participants (92%) represented the male population (Exhibit 8). This represents a concerning picture of the number of women hired in senior roles in the supply chain sector. A future study can be conducted to understand the difference in the perception towards digital adoption and approaches by involving more female participants.
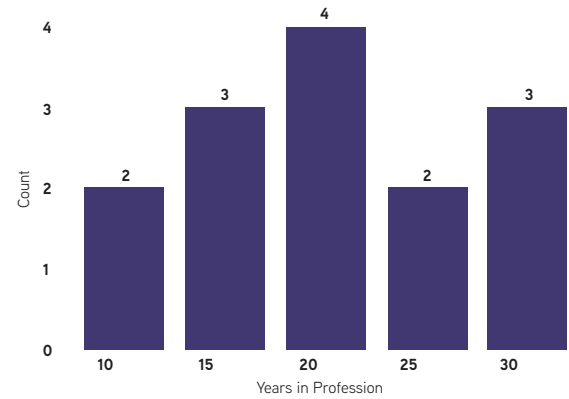
EXHIBIT 7 YEARS OF EXPERIENCE
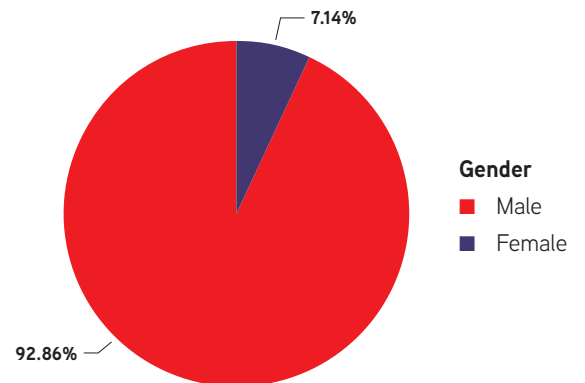
EXHIBIT 8 PARTICIPANTS BY GENDER

- Most participants were also from Alberta (app, 86%) - Exhibit 9, whereas 77% were from Calgary representing Transportation & Utilities, Oil & Gas & Mining, EPC, Aviation & Airport Operations, and Manufacturing. However, results are not specific to the Albertan supply chains; these barriers & enablers to digital adoption and opportunities can be generalized based on the industry and the organizational size. The focus of this study was to understand the current state and challenges to digital adoption and to identify the pathways to promote digital adoption.

- Approximately 79% of the participants represented larger organizations, and 14% and 7% were from medium and small organizations, respectively (Exhibit 10).

7.14%
7.14%
7.14%
78.57%

- Calgary
- Edmonton
- London
- Winnipeg
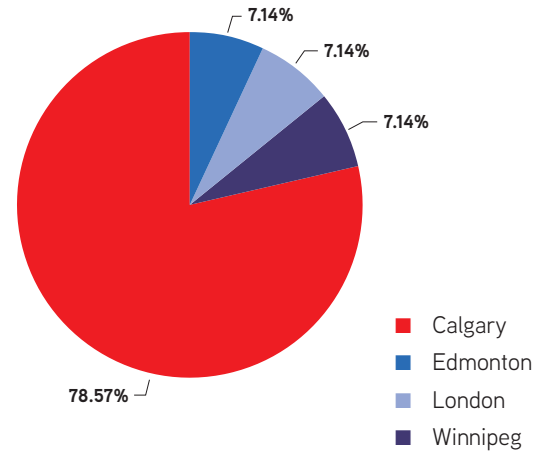
EXHIBIT 9 PARTICIPANTS BY LOCATION

7.14%
14.29%
78.57%

- Large
- Small
- Medium
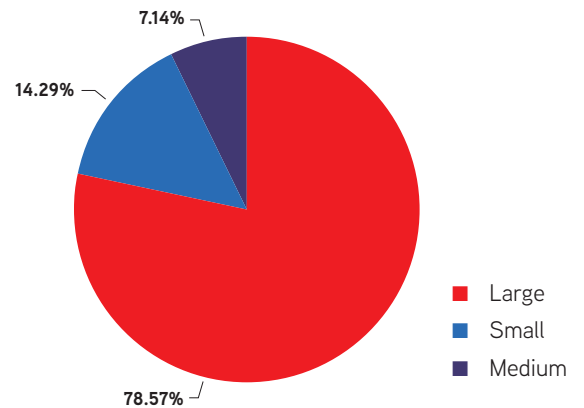
EXHIBIT 10 PARTICIPANTS BY ORGANIZATION SIZE

DIGITAL ADOPTION READINESS:

Digital adoption readiness was accessed on a scale of 1 (not ready at all) to 5 (already highly functioning) for individuals, departments, organizations and sectors. It is crucial to understand readiness level; for instance, a manager lacking understanding and experience with digital technologies and tools may not facilitate the digital transformation and act as a barrier to new adoption. From a system thinking perspective, individuals, departments, organizations, and industry sectors are all part of the supply chain systems. Failure/success of these individual components determines the supply chain system's success/failure. At an individual level (Exhibit 11), all participants responded with their digital adoption readiness level above "readiness level 3", appx. 64% of participants responded above level 3. At the department level most individuals (appx. 86%) indicated digital adoption readiness level at "levels 3 & 4". The digital adoption readiness at the organizational, however, was interesting. Only 14 % of organizations reporting readiness at level 5 was a clear indicator of the fact that no matter how ready individuals are (or believe they are) to adopt digitization, at the enterprise level, there is much

that can be done. At the sector level (Exhibit 14), no participant reported readiness at level 5 and appx. 88% of the participants choosing levels 2 & 3 readiness levels, is a serious and damning indictment of how the supply chain sector as a whole, is just not ready to provide seamless, end-to-end digital information highways for modern supply chains to be more agile and resilient. Exhibit 15 shows the distribution and individual relationships for digital adoption readiness between the individual, department, organization, and industry. It is evident from the industry column that the department and individual responses demonstrate a greater digital adoption readiness.One of the reasons behind the low digital adoption level for the sector is that sector involves small, medium, and large-sized organizations. Mainly, small & medium-sized organizations will have resources, capital, & knowledge constraints. Also, supply chains are complex networks where upstream & downstream players may differ on current adoption levels, strategic objectives, and technology adoption priorities.

35.71%
28.57%
35.71%

- 5
- 4
- 3

EXHIBIT 11 DIGITAL ADOPTION READINESS (INDIVIDUAL)

7.14%
7.14%
42.86%
42.86%

- 5
- 4
- 3
- 2
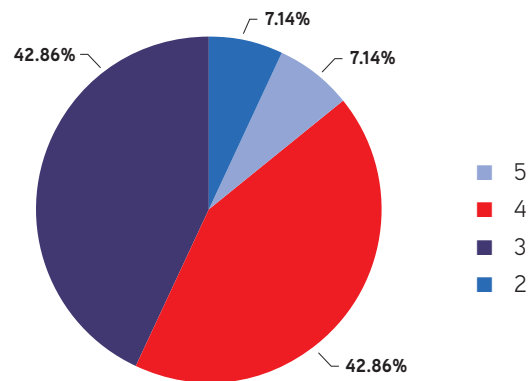
EXHIBIT 12 DIGITAL ADOPTION READINESS (DEPARTMENT)

	5
	4
	3

14.29%
57.14%
28.57%
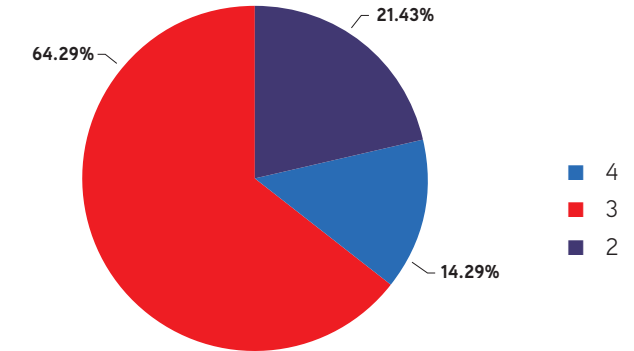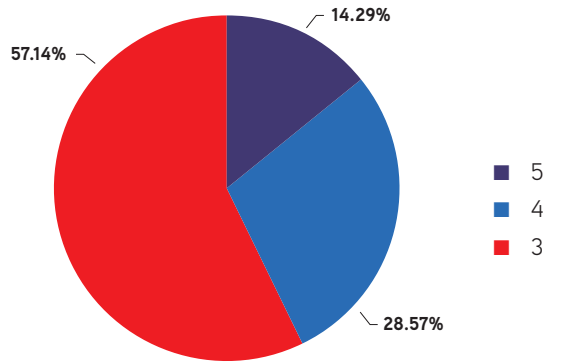
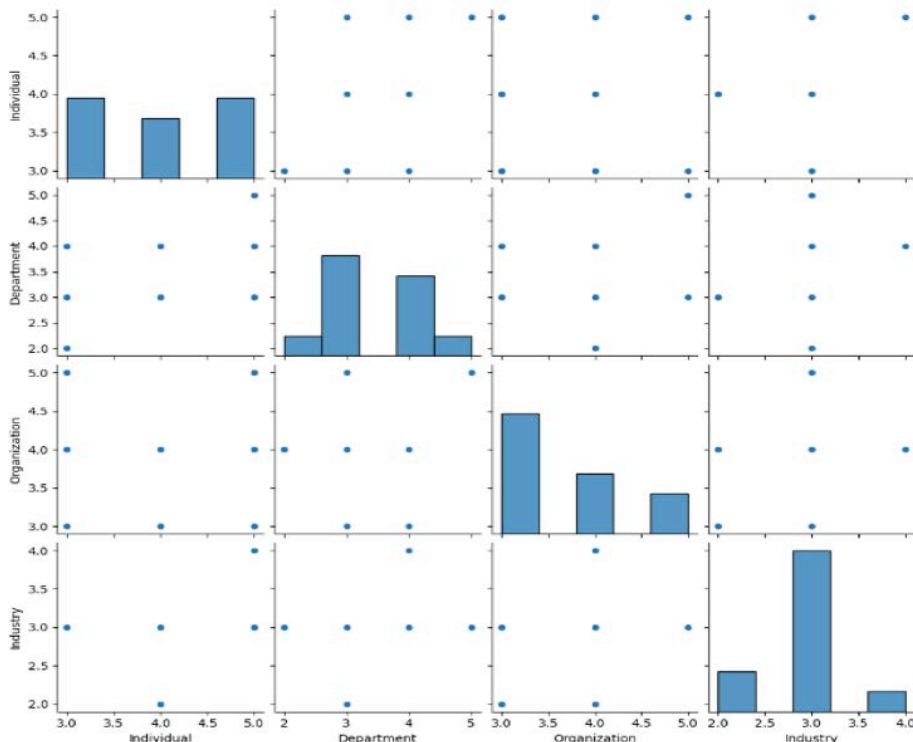**EXHIBIT 13** DIGITAL ADOPTION READINESS (ORGANIZATION)

	4
	3
	2

21.43%
64.29%
14.29%

EXHIBIT 14 DIGITAL ADOPTION READINESS (SECTOR)

Exhibit 15 shows the distribution and individual relationships for digital adoption readiness between the individual, department, organization, and industry. It is evident from the industry column that the department and individual responses demonstrate a greater digital adoption readiness.One of the reasons behind the low digital adoption level for the sector is that sector involves small, medium, and large-sized organizations. Mainly, small & medium-sized organizations will have resources, capital, & knowledge constraints. Also, supply chains are complex networks where upstream & downstream players may differ on current adoption levels, strategic objectives, and technology adoption priorities.

EXHIBIT 15 DIGITAL ADOPTION READINESS RESPONSES DISTRIBUTION

Further, digital adoption readiness correlation analysis (Exhibit 16) shows no significant correlation between the individual, organization, department, and sector. However, there is a moderate positive correlation (r = 0.55) between the individual and the department. There could be due to several known and unknown factors. It was highlighted during the interview that participants have a better view of the department. However, the technology readiness at the organizational level may be influenced by strategic directions and objectives. Also, from the industry perspective, companies deal with suppliers and customers with different strategic goals, constraints (resources & finances), growth pathways, etc. This means if few players are leading on technological innovations, this may not improve the overall sector. There need to be support mechanisms to support the small player or provide pathways for technology adoption.

EXHIBIT 16 DIGITAL ADOPTION READINESS CORRELATION

DIGITAL TECHNOLOGY ADOPTION PATHWAYS:

Technology adoption pathways were assessed as self-implementations, consultants, or mixed approaches. Appx. 93% of participants reported using mixed strategies (Exhibit 17), i.e., consultants and self-implementation. However, the projects are internally identified based on scope, cost, implementation time, alignment with the organization's strategic objectives/ priorities, NPV, ROI, etc. Most of the participants identified these projects are geared toward improving efficiency, effectiveness, productivity, quality of products/services, etc., by leveraging automation in the data collection, analysis and reporting process.

92.86%   7.14%

■ Mix
■ Self
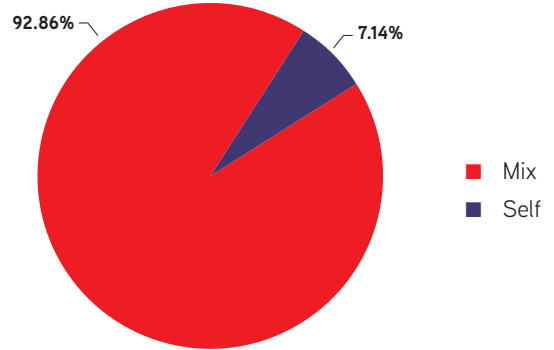
EXHIBIT 17 TECHNOLGY ADOPTION PATHWAYS

BUDGET ALLOCATION:

Approximately 86% of participants identified that the budget is allocated for digital technology-related projects (Exhibit 18). Proposals are selected through various approaches identified in the previous section, and the leadership teams decide on successful proposals based on established priorities. Return on Investment and immediate business needs seem to dominate the space as key reasons for the digitization of tasks and work. Yet, it seemed there is confusion in terms of how the budget is allocated, and where it is. The researchers sensed that there is a need for a more coherent and strategic approach to budget allocation. Some indications led the researchers to believe that it is the top leadership or active managers who decide which technology to be adopted based on their knowledge of the ecosystem and what they learn from their professional networks. There is a significant opportunity here for professional bodies like Supply Chain Canada to organize events and seminars about the latest tools, techniques and digital pathways for their memberships to consider. There is a high level of trust in (and expectation from) such non-partisan, industry associations to lead the way and help businesses understand their digitization paths. While a very limited number of respondents feel the governments have a role to play, a large number of them did not feel they had a high level of trust in what governments advise and suggest them to implement. This lack of trust too is an interesting find and merits further investigation.

85.71%   14.29%

■ Yes
■ No
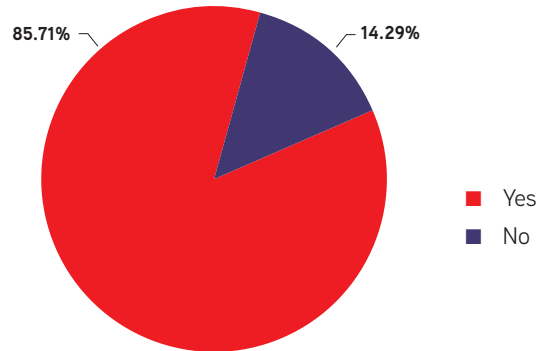
EXHIBIT 18 BUDGET ALLOCATION

BARRIERS TO DIGITAL ADOPTION:

Barriers to digital adoption readiness were accessed on a scale of 0 (not applicable) to 5 (strongly applicable). Seven barriers were identified based on the research literature. Exhibits 15 – 22 show participants' responses to each barrier coded as B1 – B7. The caption related to each figure shows the barrier name.

- Appx. 72% of the participants rated "Organizational, Managerial, and Attitudinal (OMA) (Exhibit 19 barrier three or above, with 7% identifying it as highly applicable for technology adoption.

- There was a mixed response towards the "Individual Commitment of the Employee to New Technologies" barrier (Exhibit 20), with approx. 50% responded by selecting it below level 3. Interestingly no participants identified it as a critical barrier (level 5 - no responses). It was identified through interviews that employees need to embrace those changes to improve the process once digital technology is adopted or the business process is digitized. However, there is always some resistance. Also, proper training is vital in ensuring employees are comfortable using new technologies.

B1
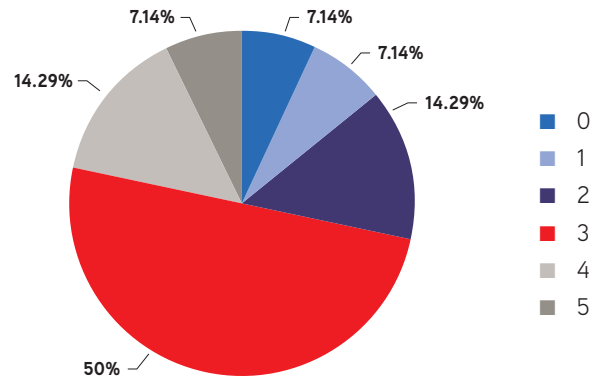
EXHIBIT 19 ORGANIZATIONAL, MANAGERIAL, AND ATTITUDINAL (OMA)

B2
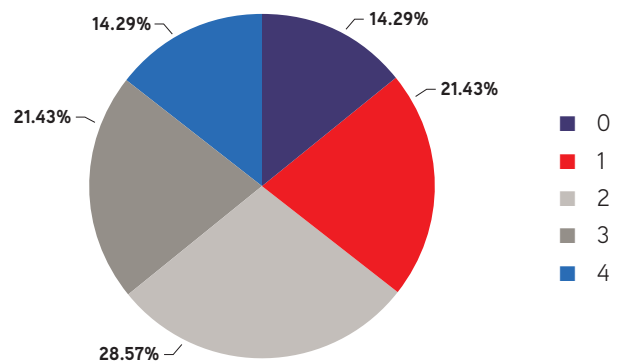
EXHIBIT 20 INDIVIDUAL COMMITMENT OF THE EMPLOYEE TO NEW TECHNOLOGIES

- Appx. 65% of the participants responded "Institutional/Governmental Support to Implement New Technologies" barrier (Exhibit 21) below level three, with appx. 36% indicating it is not a barrier to digital adoption. During the interviews, there was a mixed response to this barrier, as most organizations will allocate a budget for technology projects. However, institutional/government support can be in the form of training support funding, employee upskilling programs, sharing success stories of digital implementations, providing access to the knowledge base/subject matter experts, programs to enable PSE and industry partnerships, etc.

- There was a mixed response toward the "Information Technology/Technical Support and Availability to Implement New Digital Tools" barrier (Exhibit 22). This also links back to the previous response, as companies want to have control over technology project implementations. There are either internal teams or consultants or a mixed approach. Also, organizations want to look into longer-term strategic objectives, ROI, and other factors when implementing these technologies.

B3
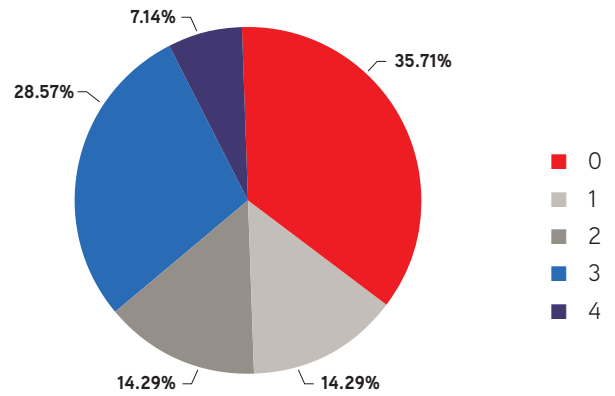
EXHIBIT 21 INSTITUTIONAL/GOVERNMENTAL SUPPORT TO IMPLEMENT NEW TECHNOLOGIES

B4
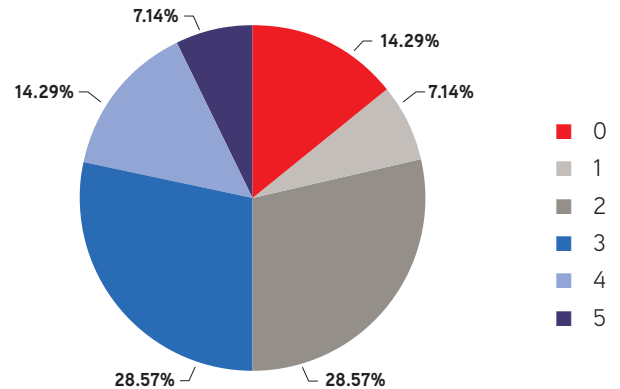
EXHIBIT 22 INFORMATION TECHNOLOGY/TECHNICAL SUPPORT AND AVAILABILITY TO IMPLEMENT NEW DIGITAL TOOLS

- Exhibit 23 shows the responses for "Financial Market and Business Context Drive the Implementation of Newer Technologies at Work" with appx. 57% of respondents rated it as three or above. There are three main reasons; First, it depends on the current level of digital adoption. If the organization is not mature with its digital journey or is at the early stages of digital technology adoption, it will work as a barrier. Second, some technologies will be implemented as part of continuous process improvement projects to manage known risks, to comply with customer/supplier/regulatory requirements. These type of projects needs to be implemented as part of the cycle. Financial and market conditions may slow down these projects. Third, technology adoption to respond to the unknown risks can promote technology adoption instead of acting as a barrier, given that there is access to the resources, knowledge and finances.

- Appx. 43% identified the "Availability of Training and skills development (TSD)" barrier (Exhibit 24) three or above, while appx. 14% identified it as not a barrier to digital technology adoption. Although organizations have internal training programs, however, it was identified a greater need for PSE, industry, and bodies like Supply Chain Canada to provide training and skill development opportunities geared toward advanced tools and technologies. It can be available for both organizations and future graduates.
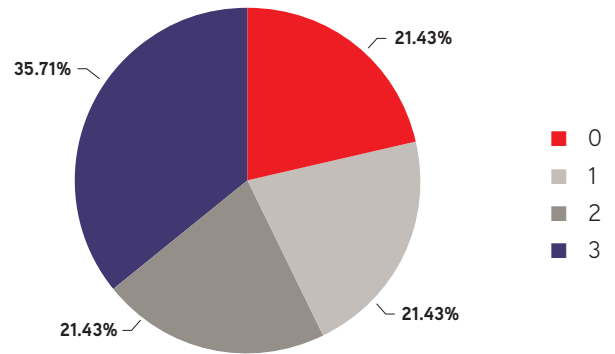
B5

EXHIBIT 23 FINANCIAL MARKET AND BUSINESS CONTEXT DRIVE THE IMPLEMENTATION OF NEWER TECHNOLOGIES AT WORK
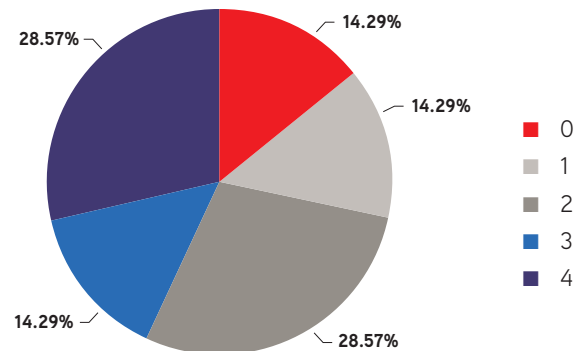
B6

EXHIBIT 24 AVAILABILITY OF TRAINING AND SKILLS DEVELOPMENT (TSD)

- Respondents demonstrated a very good awareness of "Legal/Privacy/Data Management" berries (Exhibit 25). Appx. 64% identified it as a barrier. As the data in supply chains has grown exponentially over the past few years, there is a greater need for individuals within the organization to understand data governance principles. Again, PSEs, Supply Chain Canada, the government or other third parties can support by providing the training specifically developed for the selected organization.
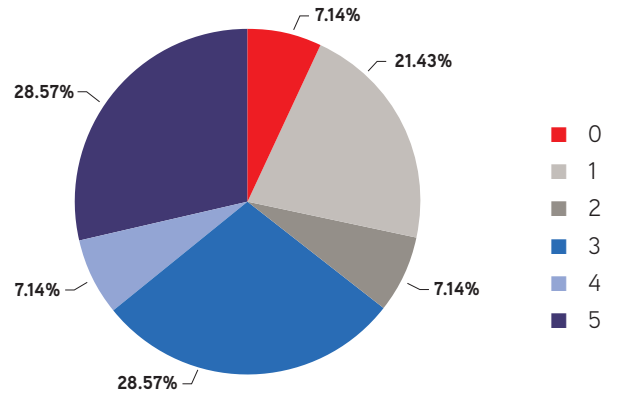
B7

7.14%
21.43%
28.57%
7.14%
7.14%
28.57%

0
1
2
3
4
5

EXHIBIT 25 LEGAL/PRIVACY/DATA MANAGEMENT BARRIERS

- Further correlation analysis of barriers (Exhibit 26) shows that there is a moderate positive correlation (r = 0.61) between B1 (Organizational, Managerial, and Attitudinal (OMA)) and B2 (Individual Commitment of the Employee to New Technologies). This means a lack of organizational & managerial support can lead to an individual's lack of commitment to new technologies. Similarly, B4 (Information Technology/Technical Support and Availability to Implement New Digital Tools) and B5 (Financial Market and Business Context Drive the Implementation of Newer Technologies at Work) show a moderate positive correlation (r = 0.65). Information Technology/Technical Support and Availability to Implement New Digital Tools can promote digital technology implementation by providing necessary information on the ROI, benefits, and support during the technology implementation and training process.
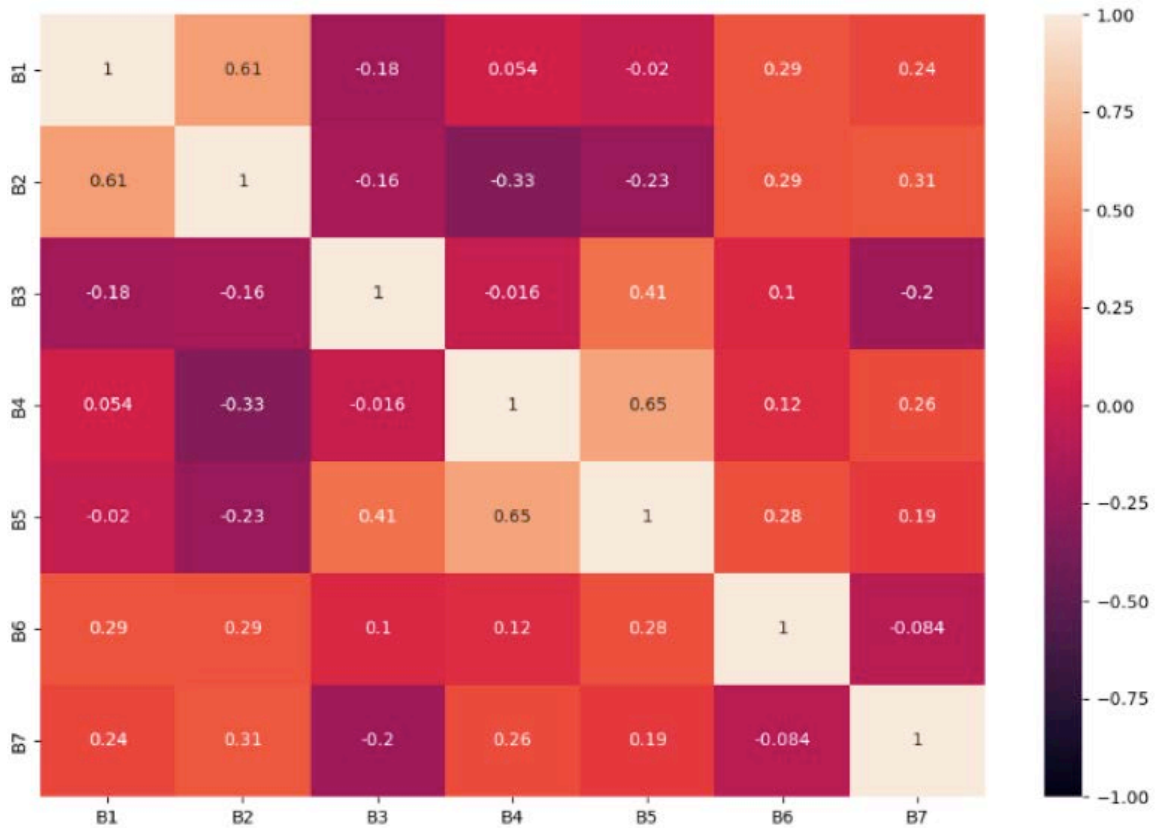
EXHIBIT 26 BARRIERS CORRELATION ANALYSIS

ENABLERS OF DIGITAL ADOPTION:

Enablers to digital adoption readiness were assessed on a scale of 0 (not applicable) to 5 (strongly applicable). Twenty enablers to adoption of digital technologies were identified from existing academic literature across various jurisdictions around the world and were tested during this study (Exhibit 27 – Exhibit 47). The key insights about enablers to digital adoption are:

- Public/Private Funding (Exhibit 27): Appx. 64% of the respondents rated it four or above, and appx. 21 % considered this not applicable to their organization. This could be due to the availability of the internal budget. At the same time, all organizations will not have a budget to implement projects related to emerging technologies.

- Provide Government Sponsored Platforms Supporting SMEs (Exhibit 28): Appx. 43% of the respondents considered this applicable or strongly applicable to their organization. Again, this can be linked to internal funding available to the organization and the ability to control the digital implementations based on the strategic objectives and organization needs by decoupling it from any government influence.

- Increased Awareness of the Economic Benefits (Past Implementations; User Cases) (Exhibit 29): Appx. 43% of the respondents rated it as four or above. Past implementation and user cases are helpful; however, the applications will vary for different industry sectors, strategic objectives, and companies within the industry based on the current state of digital adoption. Future investigations can focus on a specific industry or companies at the same level of the digital adoption journey.
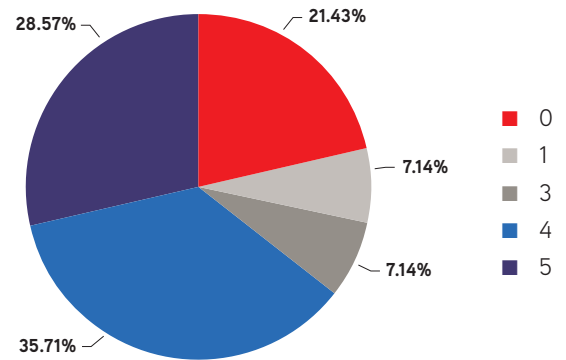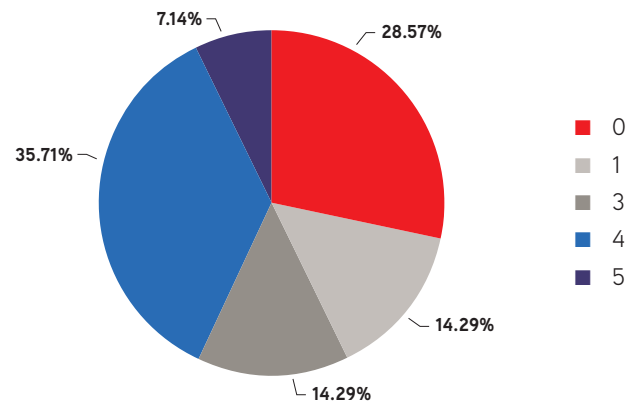

EXHIBIT 27 PUBLIC/PRIVATE FUNDING

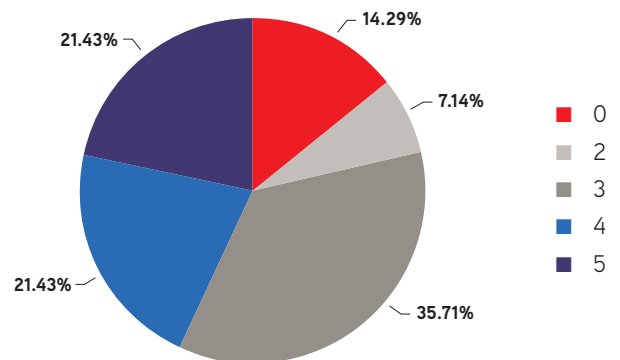**EXHIBIT 28** PROVIDE GOVERNMENT SPONSORED PLATFORMS SUPPORTING SMES

EXHIBIT 29 INCREASED AWARENESS OF THE ECONOMIC BENEFITS (PAST IMPLEMENTATIONS, USER CASES

- Government and Other Bodies Offer Information and Knowledge (Exhibit 30): Again, only 43% of respondents rated it as four or above. Bringing awareness to the industry is essential. However, it was identified that there is a lack of awareness in the industry about different support programs offered by the government. Supply Chain Canada or other bodies can play an essential role by providing this knowledge through a centralized portal enabling information dissemination based on the industry sector, digital adoption journey, etc.

- Financial Incentives to Adopt Innovative Technologies (Exhibit 31): Appx. 64% of the respondents reported that Financial Incentives to Adopt Innovative Technologies are strongly applicable (28.57%) or applicable (35.71%) — specifically, the financial incentives to offset the training costs.

- Government Award and Recognition Toward Technology Adoption (Exhibit 32): Only 14.29% of the respondents replied that "government award and recognition toward technology adoption" may be an enabler to promote technology adoption in the sector. Most participants felt it could be more beneficial if financial incentives could be provided in the form of offsetting costs.
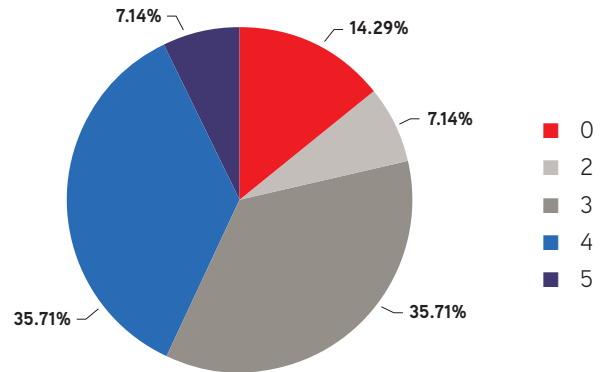
EXHIBIT 30 GOVERNMENT AND OTHER BODIES OFFER INFORMATION AND KNOWLEDGE
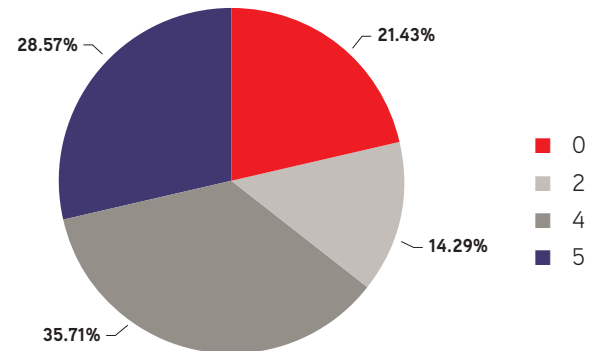
EXHIBIT 31 FINANCIAL INCENTIVES TO ADOPT INNOVATIVE TECHNOLOGIES
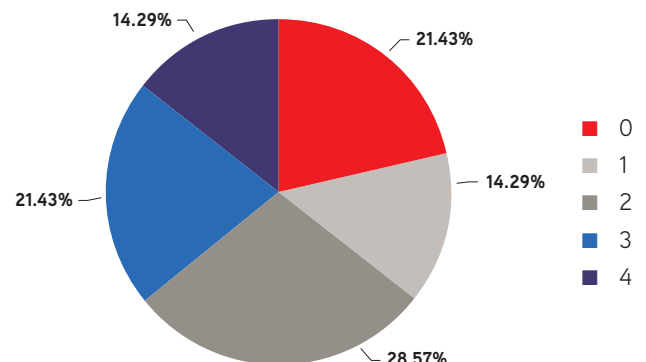
EXHIBIT 32 GOVERNMENT AWARD AND RECOGNITION TOWARD TECHNOLOGY ADOPTION

- Internal Capital (Exhibit 33): Participants considered internal capital as an essential enabler to the technology adoption projects. If a company has limited financial resources, it may not be able to invest in expensive hardware, software, or consulting services that are necessary for successful technology adoption.

- Market Potential (Exhibit 34): Participants also considered market potential as an import enabler to the technology adoption projects, with appx 93% choosing the applicability level three or above. If the market potential is low, the return on investment may not be sufficient to justify the investment.

- Existing Employees with Relevant Knowledge and Skills (Exhibit 35): Appx. 64% responded that this enabler is applicable at level three or above. Existing employees with relevant knowledge and skills are often the most valuable asset of an SME when it comes to digital adoption. They have the institutional knowledge and experience necessary to understand business processes and identify opportunities for improvement through digital technologies. At the same time, additional training and upskilling may be required to ensure that the employees have the necessary digital skills to leverage the new technology fully.
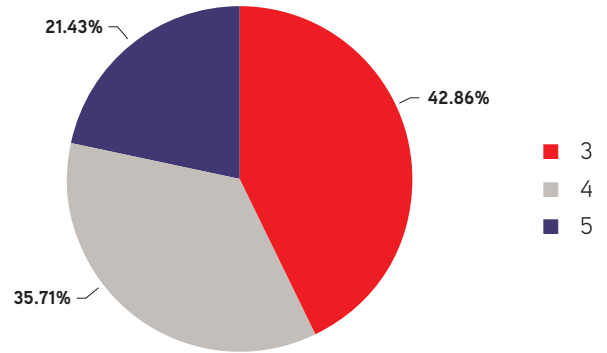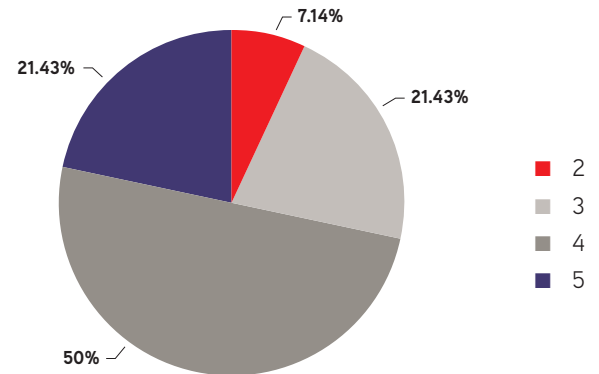

21.43%
42.86%
35.71%

3
4
5

EXHIBIT 33 INTERNAL CAPITAL

7.14%
21.43%
21.43%
50%

2
3
4
5

EXHIBIT 34 MARKET POTENTIAL
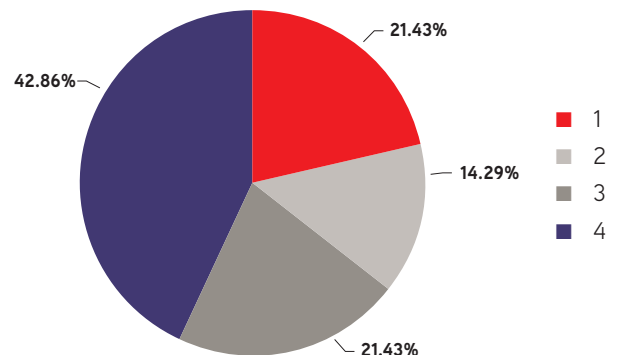

21.43%
42.86%
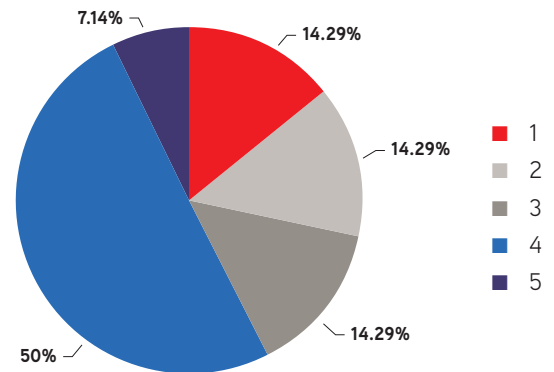14.29%
21.43%

1
2
3
4

**EXHIBIT 35** EXISTING EMPLOYEES WITH RELEVANT KNOWLEDGE AND SKILLS

- Hiring New Employees with Relevant Knowledge and Skills (Exhibit 36): Appx. 71% responded that this enabler is applicable at level three or above. New employees can bring in new skills and expertise not present in the existing workforce. This can help organizations develop and implement new technologies they might not have been able to do otherwise.

- Internal/External Collaboration (Exhibit 37): Appx. 71% of the respondents reported that this enabler is applicable at a level of three or above. Supply chain organizations often involve multiple stakeholders, including suppliers, vendors, logistics partners, and customers. Collaboration is crucial to ensure the smooth adoption of new technology solutions. Collaboration can help ensure that technology adoption is not hindered by communication barriers, competing interests, or other factors.

- Advisory Services/Practices to Support and Quick Adaption (Exhibit 38): Appx. 71% of the respondents reported that this enabler is applicable at a level of two or above, and none reported it as strongly applicable. Technology adoption projects often require specialized knowledge and expertise that may only be available in some places. Advisory services can help organizations gain access to the necessary knowledge and expertise to ensure successful technology adoption. These services can include consulting, training, and implementation support.

EXHIBIT 36 HIRING NEW EMPLOYEES WITH RELEVANT KNOWLEDGE AND SKILLS
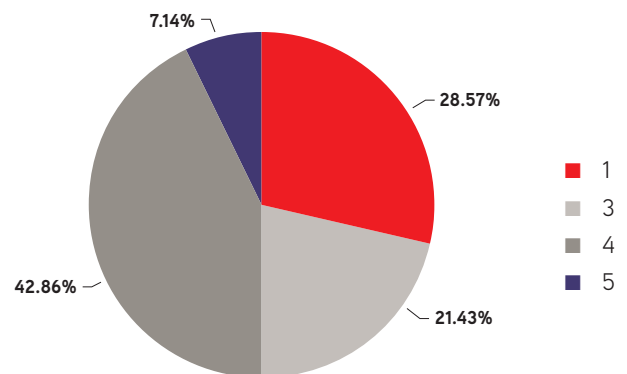
EXHIBIT 37 INTERNAL/EXTERNAL COLLABORATION
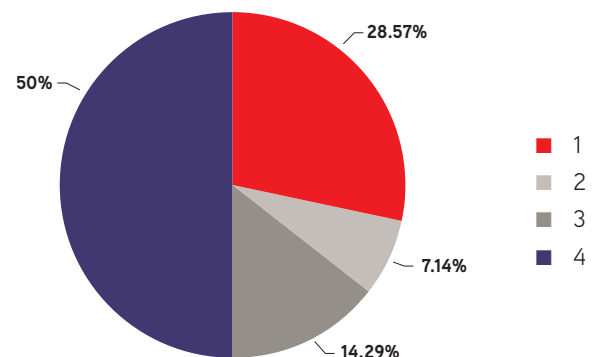
EXHIBIT 38 ADVISORY SERVICES/PRACTICES TO SUPPORT AND QUICK ADAPTION)

- Managerial Support and Leadership towards Technology Adoption & Innovation (Exhibit 39): Availability of Flexible and Innovative Human Resources (Exhibit 39): Every respondent agreed that "Managerial Support and Leadership towards Technology Adoption & Innovation" is an essential enabler for technology adoption projects. Managers and leaders can provide a strategic vision for the technology adoption project, aligning it with the broader organizational goals and mission. This ensures that the technology adoption project fits into the organization's long-term plans. Also, management/leadership support is important in the change management process and post-implementation challenges such as employee training, data management, etc.

- Longer Term Strategic Alignment and Prioritization to Adopt Newer Technologies (Exhibit 40): Appx. 86% of the organizations reported that this enabler is applicable at a level of three or above. It was also noticed that technologies were adopted recently to deal with supply chain shocks. The respondents felt that strategic alignment may not always be the case when it comes to project selection decisions to deal with unknown pressure from customers (especially in B2B environment, a customer/supplier may mandate using certain technologies). As technologies constantly evolve, supply chain organizations must stay up-to-date with the latest technological advancements. Organizations can future-proof their supply chain operations by prioritizing the adoption of newer technologies and aligning their strategies with these technologies.
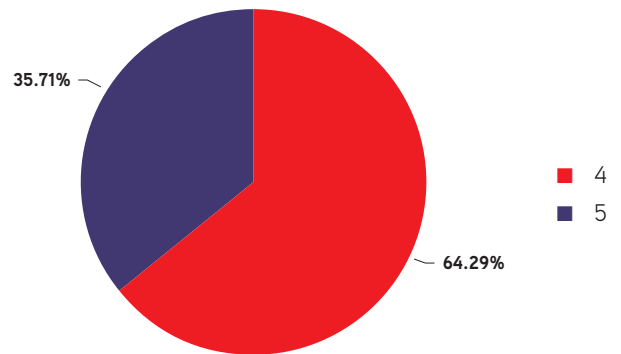

EXHIBIT 39 MANAGERIAL SUPPORT AND LEADERSHIP TOWARDS TECHNOLOGY ADOPTION & INNOVATION
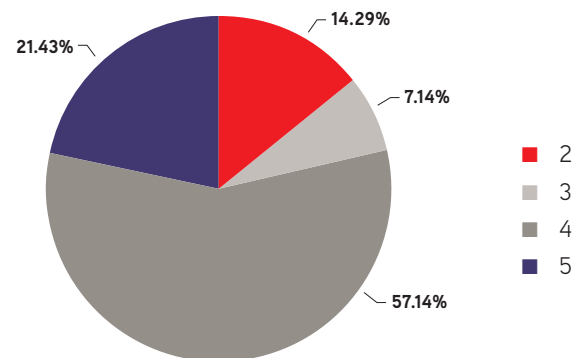
EXHIBIT 40 LONGER TERM STRATEGIC ALIGNMENT AND PRIORITIZATION TO ADOPT NEWER TECHNOLOGIES

- Use of Business Analysis and Mapping Tools to Identify & Prioritize (SWOT, Process Mapping, Etc.) (Exhibit 41): Appx. 93% of the organizations reported that this enabler is applicable at a level of three or above. Business mapping can help prioritize the technology projects and help to align those projects to the strategic objectives. However, this may not always be the case based on recent supply chain shocks. Once technology needs have been identified and priorities established, business analysis and mapping tools can help develop implementation strategies. This can include identifying potential roadblocks, developing implementation timelines, and determining how the technology will be integrated into existing processes.
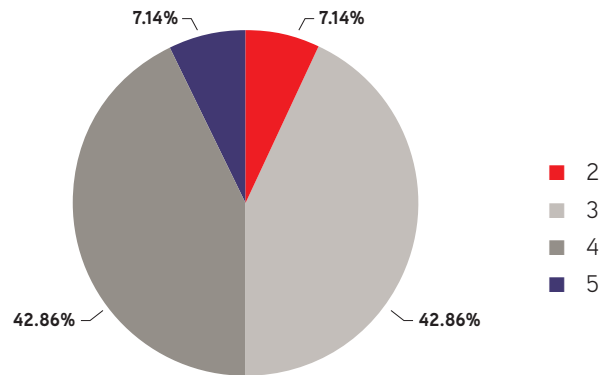
EXHIBIT 41 USE OF BUSINESS ANALYSIS AND MAPPING TOOLS TO IDENTIFY & PRIORITIZE (SWOT, PROCESS MAPPING, ETC.

- Availability of Flexible and Innovative Human Resources (Exhibit 42): Appx. 79% of respondents responded to this enabler at a level three or above. With rapidly evolving technology, it is crucial to have an adaptable workforce that can quickly learn and implement new technologies. Innovative human resources can bring fresh perspectives and ideas, leading to the development of more efficient and effective supply chain processes.
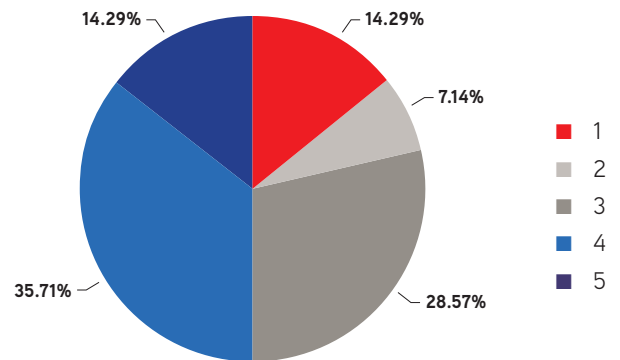
EXHIBIT 42 AVAILABILITY OF FLEXIBLE AND INNOVATIVE HUMAN RESOURCES

- Flat Management Structure and Employee Empowerment (Exhibit 43): Appx. 93% of the respondents responded to this enabler at a level three or above. A flat management structure allows for more direct employee communication and collaboration, fostering innovation and creativity. This can lead to new ideas and approaches to technology adoption that may not have been considered otherwise.
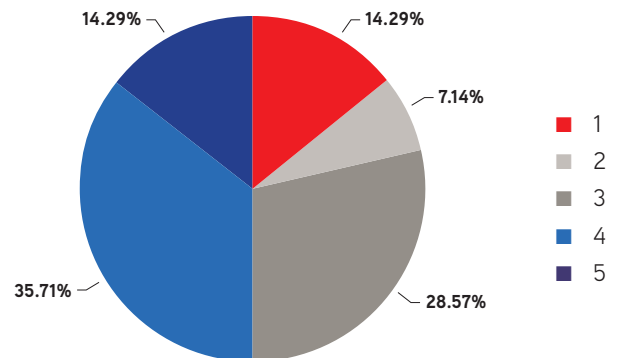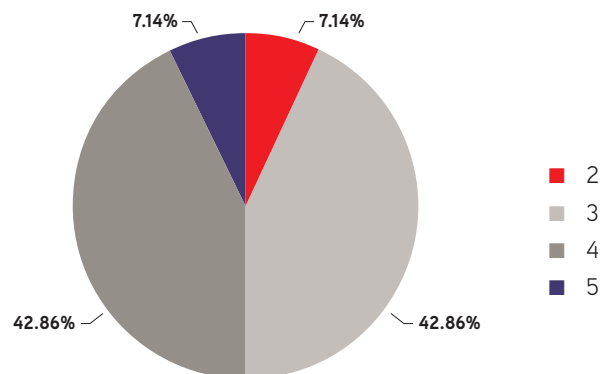
- Use Indicators and KPIs to Measure the Technology Adoption Success/Failure (Exhibit 44): Appx. 79% of the organizations reported that this enabler is applicable at a level of three or above. It helps to assess the impact of the technology on the supply chain operations and performance. Indicators and KPIs provide measurable and tangible evidence of the benefits and drawbacks of the technology on key supply chains metrics such as cost, quality, delivery, and customer satisfaction. It helps to communicate the value of the technology adoption project to stakeholders. Indicators and KPIs provide objective evidence of the value of the technology adoption project, which can help convince stakeholders of the project's benefits and secure their buy-in and support. However, some organizations may not have a formal process to measure the impact of technology on business and the supply chain.

- Informational Support (Guidance Regarding SOPs) from Technology Suppliers (Exhibit 45): Appx. 93% of the organizations reported that this enabler is applicable at a level of three or above. Technology suppliers can provide guidance and support regarding the new technology's standard operating procedures (SOPs), including best practices for use, maintenance, and troubleshooting. This support can help organizations avoid common pitfalls and ensure that the technology is used effectively and efficiently, leading to better supply chain performance and improved business outcomes. It can also improve the trust and transparency between technology providers and user organizations.

7.14% 7.14%
42.86% 42.86%

Legend: 2, 3, 4, 5
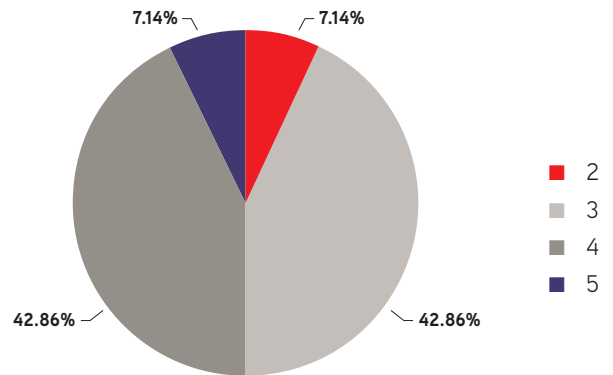
EXHIBIT 43 FLAT MANAGEMENT STRUCTURE AND EMPLOYEE EMPOWERMENT

14.29% 14.29% 7.14%
35.71% 28.57%

Legend: 1, 2, 3, 4, 5

EXHIBIT 44 USE INDICATORS AND KPIS TO MEASURE THE TECHNOLOGY ADOPTION SUCCESS/FAILURE

7.14% 7.14%
42.86% 42.86%

Legend: 2, 3, 4, 5

EXHIBIT 45 INFORMATIONAL SUPPORT (GUIDANCE REGARDING SOPS) FROM TECHNOLOGY SUPPLIERS.

- Collaboration with Industrial Associations and Technology Suppliers to Increase the Trustworthiness (Exhibit 46): Appx. 79% of the organizations reported that this enabler is applicable at a level of three or above. Collaborating with industrial associations and technology suppliers provides access to industry expertise and knowledge that can inform the technology adoption process. This can be particularly valuable for organizations that may need access to in-house expertise. This can be particularly important for organizations that may lack larger companies' brand recognition and reputation.
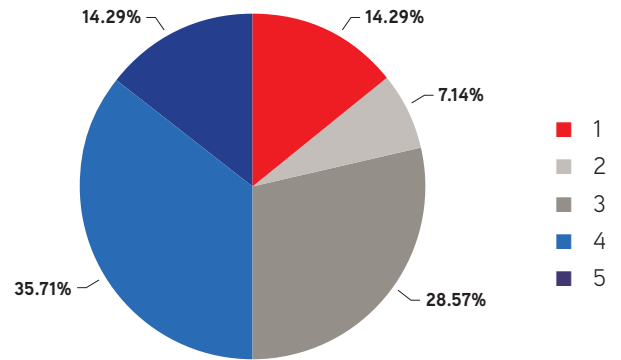
EXHIBIT 46 COLLABORATION WITH INDUSTRIAL ASSOCIATIONS AND TECHNOLOGY SUPPLIERS TO INCREASE THE TRUSTWORTHINESS

Enablers Correlation Anlysis (Exhibit 47):

- "Public/Private Funding" Exhibits a strong positive correlation with "Increased Awareness of the Economic Benefits (Past Implementations; User Cases)" (r=0.81), "Government and Other Bodies Offer Information and Knowledge" (r=0.71), and "Financial Incentives to Adopt Innovative Technologies" (r=0.86). There is a high correlation between increased awareness of the economic benefits of past technology implementations and user cases. This may be because funding often supports these initiatives and shares their results with others. Similarly, access to government and other bodies for information and knowledge may be more available to those with funding, as they may have more resources to devote to seeking these kinds of resources. Additionally, a strong correlation between funding and financial incentives for technology adoption, which makes sense, given that funding is a form of financial support that can be used to incentivize the adoption of new technologies. Overall, access to public and private funding can be important in supporting technology adoption in supply chain management. It may facilitate the development of resources, knowledge, and financial incentives that can help organizations implement new technologies more effectively.

- "Increased Awareness of the Economic Benefits (Past Implementations; User Cases)" Exhibits a strong positive correlation with "Financial Incentives to Adopt Innovative Technologies (r=0.7) " and "Internal Capital (r=0.74)". Increased awareness of the economic benefits of technology adoption may encourage companies to invest more internal capital in technology adoption projects. Similarly, financial incentives to adopt innovative technologies may increase awareness of the economic benefits of such technologies and encourage more companies to invest internal capital. This suggests that a comprehensive approach that includes all of these factors can be particularly effective in promoting technology adoption in supply chains.

- "Government and Other Bodies Offer Information and Knowledge" Exhibits a strong positive correlation with "Financial Incentives to Adopt Innovative Technologies (r=0.7). This can be particularly relevant in supply chain management, where adopting new technologies can require significant investment. When government or other bodies offer information and knowledge about these technologies and provide financial incentives to adopt them, it can increase the likelihood that supply chain organizations will adopt the technologies and realize their benefits.

- "Financial Incentives to Adopt Innovative Technologies" Exhibits a strong positive correlation with "Government Award and Recognition Toward Technology Adoption (r=0.74)". When organizations see that they can be recognized and rewarded for their technology adoption efforts, they may be more likely to invest in new technologies. Additionally, financial incentives can help offset the costs of implementing new technologies, making them more feasible for smaller organizations with limited resources.

- "Government Award and Recognition Toward Technology Adoption" Exhibits a strong positive correlation with "Advisory Services/Practices to Support and Quick Adaption (r=0.73)". It suggests that when governments offer awards and recognition for technology adoption, it incentivizes organizations to seek out advisory services and practices that can help them quickly and effectively adopt new technologies. This may be because organizations are more motivated to adopt new technologies when they receive public recognition for doing so and are, therefore, more likely to seek out expert advice and guidance to help them achieve their goals.

- "Internal Capital" Exhibits a strong positive correlation with "Market Potential (r=0.84). This can be attributed to SMEs with greater internal capital resources having more financial flexibility to invest in new technologies and adapt to market demand changes. The correlation indicates that organizations should assess their internal capital resources and the market potential for their products and services when considering technology adoption projects.

- "Existing Employees with Relevant Knowledge and Skills" Exhibits a strong positive correlation with:

  - "Hiring New Employees with Relevant Knowledge and Skills (r=0.82)". This suggests that SMEs should consider both strategies to ensure that they have the necessary knowledge and skills to support technology adoption projects. Existing employees can provide valuable experience and knowledge, while new employees can bring fresh ideas and skills to the organization.

  - "Internal/External Collaboration (r=0.75)". This suggests having employees with relevant knowledge and skills can contribute to the success of technology adoption projects by facilitating collaboration both within and outside the organization. When employees have the necessary skills and knowledge to work with new technologies, they are better equipped to engage in productive collaborations with other stakeholders, such as external partners and suppliers. This can lead to improved communication, knowledge-sharing, and problem-solving, ultimately improving the success rate of technology adoption projects in supply chain management.

  - "Advisory Services/Practices to Support and Quick Adaption (r=0.73)". This suggests that having employees with relevant knowledge and skills is important for technology adoption projects in supply chains and can lead to better collaboration with both internal and external stakeholders, as well as more effective use of advisory services and practices to support quick adaptation.

  - "Availability of Flexible and Innovative Human Resources (r=0.72)": This suggests that having employees with the right skills and knowledge can facilitate the development of flexible and innovative human resources. These resources can then be deployed to support technology adoption projects in supply chains, leading to greater success and better outcomes.

  - "Informational Support (Guidance Regarding SOPs) from Technology Suppliers (r=0.71)". This suggests that having employees with the right skills and knowledge can facilitate the development of flexible and innovative human resources. These resources can then be deployed to support technology adoption projects in supply chains, leading to greater success and better outcomes.

- "Internal/External Collaboration" Exhibits:

  - a very strong positive correlation with "Advisory Services/Practices to Support and Quick Adaption (r=0.93)". This means that effective collaboration between internal and external stakeholders, such as partners and suppliers, is crucial for implementing successful technology adoption projects in supply chains. At the same time, access to advisory services and practices that can support and facilitate quick adaptation to new technologies can help to improve collaboration and increase the chances of success.

- strong positive correlation with "Longer Term Strategic Alignment and Prioritization to Adopt Newer Technologies (r=0.74)". This suggests that stakeholders can prioritize and plan to adopt newer technologies that align with the organization's long-term goals by working together and communicating effectively. This can help ensure that the technology adoption process is integrated with the organization's overall strategic direction rather than being implemented in isolation.

- strong positive correlation with "Availability of Flexible and Innovative Human Resources (r=0.73)". This indicates that collaboration between employees within an organization and with external partners can foster a culture of innovation and adaptability, leading to a more agile and dynamic workforce that can better embrace and adopt new technologies. By working together and sharing ideas and knowledge, employees can develop new skills and insights that allow them to leverage new technologies better and work more efficiently, leading to greater success in technology adoption projects.

- strong positive correlation with "Flat Management Structure and Employee Empowerment (r=0.78)". This implies that organizations should encourage collaboration between internal departments as well as with external partners such as technology suppliers, industrial associations, and government bodies to increase the chances of success in technology adoption projects.

- strong positive correlation with "Use Indicators and KPIs to Measure the Technology Adoption Success/Failure (r=0.74)". This suggests that effective collaboration between internal and external stakeholders is important for defining, tracking, and measuring the success of technology adoption projects in supply chain management. By working together, stakeholders can establish clear goals, identify relevant metrics and key performance indicators (KPIs), and monitor progress toward achieving these goals.

- "Informational Support (Guidance Regarding SOPs) from Technology Suppliers (r=0.94)". This suggests that collaboration between internal and external stakeholders in the supply chain, including technology suppliers, is crucial to successfully adopting new technologies. This collaboration ensures that employees have the necessary guidance and support to effectively utilize new technologies, which can ultimately lead to improved performance and efficiency in the supply chain.

- "Collaboration with Industrial Associations and Technology Suppliers to Increase the Trustworthiness (r=0.74)". This suggests that collaboration between different organizations can improve the trustworthiness of technology suppliers, which can facilitate the adoption of new technologies in the supply chain. By working together, different organizations can share knowledge, expertise, and resources to collectively improve their technological capabilities and develop new solutions that benefit the entire supply chain.

- ■ "Advisory Services/Practices to Support and Quick Adaption" shows a:

- strong positive correlation with "Longer-Term Strategic Alignment and Prioritization to Adopt Newer Technologies (r=0.76)". Having advisory services and practices that support and facilitate quick adaptation can better align the organization's long-term goals with adopting new technologies. This can help ensure that the organization's technology adoption efforts are focused on strategically important areas and can potentially provide significant benefits in the long run.

SUPPLY
CHAIN
TRENDS

- strong positive correlation with "Availability of Flexible and Innovative Human Resources (r=0.84)". This could suggest that such resources may be better equipped to quickly learn and adapt to new technologies and be more open to new ideas and approaches. Additionally, these resources may be more likely to provide valuable insights and feedback that can help to optimize the adoption process and increase the likelihood of success.

- strong positive correlation with "Flat Management Structure and Employee Empowerment (r=0.74)". This could mean that organizations with flatter management structures and more empowered employees are more likely to seek out and utilize advisory services and practices to support the quick adoption of new technologies. This may be because employees are more willing to adapt to changes and seek out new knowledge and skills when they feel empowered and supported.

- very strong positive correlation with "Informational Support (Guidance Regarding SOPs) from Technology Suppliers (r=0.97)". This indicates that having guidance and support from technology suppliers can significantly increase the effectiveness of advisory services and practices in supporting quick technology adoption. This suggests that when implementing technology adoption projects in supply chains, it is crucial to collaborate closely with technology suppliers to ensure adequate support and guidance are available to help employees quickly adapt to new technologies.

- strong positive correlation with "Collaboration with Industrial Associations and Technology Suppliers to Increase the Trustworthiness (r=0.78)". This suggests that organizations that receive advisory services and practices to support and quickly adapt to new technologies are also more likely to collaborate with external parties to increase trust in the technology suppliers and industrial associations.

- ■ "Longer Term Strategic Alignment and Prioritization to Adopt Newer Technologies" Exhibit a:

- strong positive correlation with "Flat Management Structure and Employee Empowerment (r=0.70)". This suggests that organizations that prioritize and plan to adopt newer technologies over the longer term are more likely to have a flatter management structure and to empower their employees. This may be because a longer-term strategic perspective requires a more collaborative and inclusive decision-making process, which can be facilitated by a flatter management structure and increased employee empowerment. Additionally, a flatter management structure and employee empowerment may allow for greater agility and flexibility in responding to the challenges and opportunities presented by adopting new technologies.

- strong positive correlation with "Use Indicators and KPIs to Measure the Technology Adoption Success/Failure (r=0.76)". This indicates that companies that prioritize technology adoption and have a strategic plan in place are more likely to use indicators and KPIs to measure the success or failure of technology adoption projects. This can help companies to identify areas for improvement, track progress toward goals, and make informed decisions about future investments in technology.

- strong positive correlation with "Informational Support (Guidance Regarding SOPs) from Technology Suppliers (r=0.83)". This suggests that a well-aligned strategy and prioritization approach, coupled with the right support and guidance from technology suppliers regarding standard operating procedures (SOPs), is critical for successful technology adoption projects in supply chains. This highlights the importance of technology suppliers being involved in the early stages of the adoption process and providing ongoing support to ensure the technology is used effectively and efficiently.

- strong positive correlation with "Collaboration with Industrial Associations and Technology Suppliers to Increase the Trustworthiness (r=0.85)". This indicates that having a clear strategy and prioritization for technology adoption is essential for building trust and collaboration with external partners in the supply chain. This can lead to better communication, more open sharing of information, and a more collaborative approach to technology adoption.

- "Flat Management Structure and Employee Empowerment" Exhibit a:

  - strong positive correlation with "Use Indicators and KPIs to Measure the Technology Adoption Success/Failure (r=0.77)". Organizations that empower their employees and have a flat management structure are more likely to use objective measures such as KPIs to evaluate the success or failure of their technology adoption projects. This can be particularly beneficial in supply chain technology adoption projects, where multiple stakeholders and moving parts are often involved. By setting clear KPIs and empowering employees to make decisions, organizations can ensure that everyone is working towards the same goals and that progress can be objectively tracked and evaluated.

  - strong positive correlation with "Informational Support (Guidance Regarding SOPs) from Technology Suppliers (r=0.81)". It suggests that having a flat management structure and empowered employees can improve communication and collaboration with technology suppliers, which in turn can lead to better support and guidance on standard operating procedures (SOPs) for technology adoption projects. Empowered employees may be more proactive in seeking the necessary information and working closely with technology suppliers to identify and address any challenges arising during the adoption process.

- "Use Indicators and KPIs to Measure the Technology Adoption Success/Failure" Exhibit a:

  - strong positive correlation with "Informational Support (Guidance Regarding SOPs) from Technology Suppliers (r=0.76)". This suggests that having clear metrics to measure the success or failure of technology adoption projects is important and that technology suppliers can be essential in providing guidance and support in this area. This can be particularly relevant in supply chain contexts, where technology adoption's success can significantly impact efficiency, productivity, and profitability. By working closely with technology suppliers to establish clear indicators and KPIs for measuring success, supply chain organizations can better align their technology adoption efforts with their strategic goals and ensure that they make informed decisions based on accurate data.

  - strong positive correlation with "Collaboration with Industrial Associations and Technology Suppliers to Increase the Trustworthiness (r=0.75)". This suggests that using metrics and involving industry associations and technology suppliers in the technology adoption process can help increase the trustworthiness of the new technology. This can be especially important in supply chain projects where multiple stakeholders and partners are involved. By collaborating with technology suppliers and industry associations, supply chain managers can gain valuable insights into the technology adoption process and ensure that KPIs and indicators are being used to measure the success and effectiveness of the new technology.

■ "Informational Support (Guidance Regarding SOPs) from Technology Suppliers " Exhibit a strong positive correlation with "Collaboration with Industrial Associations and Technology Suppliers to Increase the Trustworthiness (r=0.83)". The availability of guidance and support from technology suppliers is crucial in helping supply chain organizations understand and adopt new technologies effectively. When such support is combined with collaboration with industrial associations and technology suppliers to build trust and credibility, it can increase the likelihood of successful adoption and implementation of new technologies in supply chains. This highlights the importance of supply chain organizations working closely with their technology suppliers and other partners in the ecosystem to establish strong relationships and develop a collaborative approach to technology adoption.
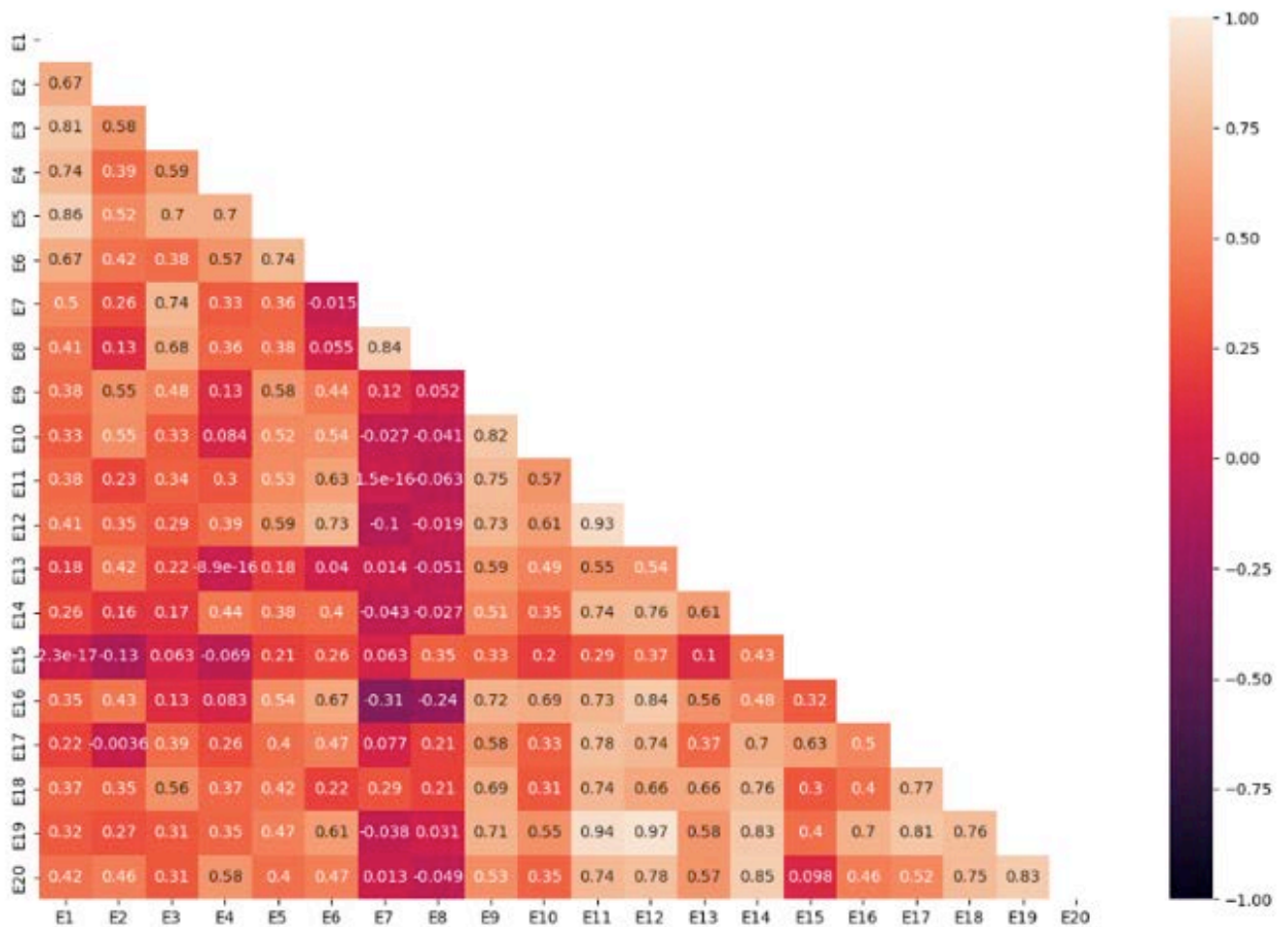

EXHIBIT 47 ENABLERS AND CORELATION ANALYSIS

SKILLS AND COMPETENCIES:

Participants were asked about the expected skills and competencies from future graduates/employees as part of accelerated digital adoption. Participants' responses divide expected skills and competencies into two main categories: technical and soft skills. Technical skills mainly around understanding digital technologies, technology interaction with business processes, applied data analytics tools & techniques, and artificial intelligence & machine learning applications important for leveraging the potential of digital technologies. On the other hand, soft skills, such as problem-solving, critical thinking, organization, and teamwork, are equally important for successful digital adoption. These skills enable individuals and teams to address complex challenges, identify opportunities, and collaborate effectively to implement and utilize digital technologies in a meaningful way.

To further understand the roles, Participants were asked to comment on the implications for supply chain management roles in the key sectors. The responses included following key insights:

- Transportation is a crucial aspect of the supply chain, and with the adoption of technology, it is expected to become more efficient, leading to supply chain efficiencies. The supply chain will play a key role in the organization as it touches each department in the organization. Especially during the COVID-19 pandemic, the supply chain came to the forefront and should be aligned with the organization's goals and objectives as part of the strategic planning process.

- Both new roles will emerge, and existing roles will change, with some being eliminated. There will be more demand for understanding, creative solutions, being open to innovative ideas, and pushing management roles to be more of these characteristics.

- Supply chain executives will have a significant say in the decision-making processes due to cost implications, profitability, etc.

- People in SCM roles need to be technically independent, learn new system functionalities every year, be skilled in each area of the existing SCM systems, understand how SCM systems integrations work, and understand data analytics-driven from data pulled from multiple SCM systems.

- Simplicity and harmonized flow of information are essential for better decision-making, and future decision-making should be based on real-time data, making the supply chain more proactive. Being comfortable with data, especially from a visual perspective, is crucial for future SCM roles.

- Participants were also asked what new roles would emerge, potentially creating new career pathways. The key insights based on responses include the following:

- The digital transformation of supply chains is expected to create new roles and potentially new career pathways. The responses suggest that there will be an increasing demand for people who can connect different aspects of supply chains and generate meaningful insights. Technical skills such as programming, data management, analysis, visualization and reporting will be crucial. Existing roles in data analytics, visualization, and risk analysis using data will also become more important. With the adoption of advanced digital solutions such as AI and ML, new roles associated with these technologies are expected to emerge.

- Other potential areas of growth include international trade-related digital roles, data-oriented jobs, and roles related to operating and maintaining advanced digital solutions. Traditional roles, such as operators, will require more skill sets, including effective writing, communication, and negotiation. A broader understanding of overall economic factors and the impact on supply chains will also be important.

- There will be a greater emphasis on data-oriented roles and IT governance roles for managing data input, analysis, and presentation. The responses also suggest that new roles could emerge around decision-making, building solutions out of data analytics, costing, freight modelling, and inventory management. While some jobs may become automated, the ability to use data from such automated processes to make decisions will be important. Overall, the transformation is expected to make the supply chain more data-oriented, leading to new career opportunities in this field.

Further, participants were asked where the talent with these skills and competencies would come from. It is important to note that business wants to explore both internal and external options based on their availability and as they fit with the organization's needs. PSEs seem to be the main avenue to provide high-calibre future graduates equipped with both technical and soft skills. Also, PSEs can play an important role in micro-credentials and certifications to upskill professionals. Along with this, internal training programs are important to fulfil the needs of organizations by upskilling employees in technology-focused areas.

GOVERNMENT SUPPORT

Participants were asked how the government can support the digital adoption journey for the organizations. Three areas were identified access to the latest technologies, training & education, and government policies. Participants were asked to respond on sale (0) not applicable at all and (5) strongly applicable.

- Providing access to latest technologies (Exhibit 48): Appx. 50% of the participants responded that providing access to the latest technologies is applicable at level four or above. However, organizations still want to have autonomy when it comes to technology selection and implementation.

- Government policies supporting businesses adopting new digital technologies (like providing some tax relief, subsidy etc. if businesses adopt a certain novel tech) (Exhibit 49): Appx. 79% of the participants responded at level 3 or above regarding policies from the government supporting businesses adopting new digital technologies. The support could be through monetary support or offsetting the training cost through grants.

- Training and Education (Exhibit 50): Appx. 86% of the participants responded at level 3 or above for training and education support. Training and education must be tailored to the specific needs of the industry/organization and complement the internal training programs.
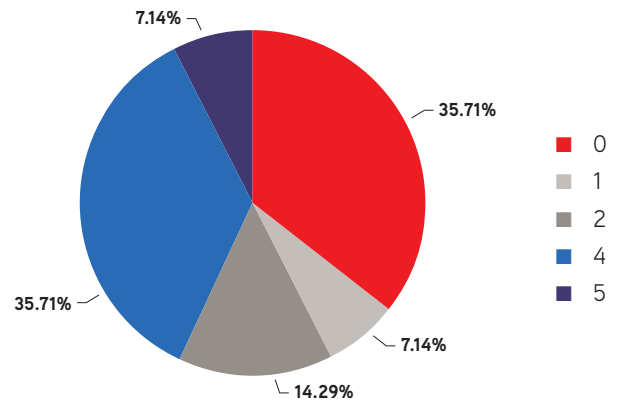

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EXHIBIT 48 PROVIDING ACCESS TO LATEST TECHNOLOGIES

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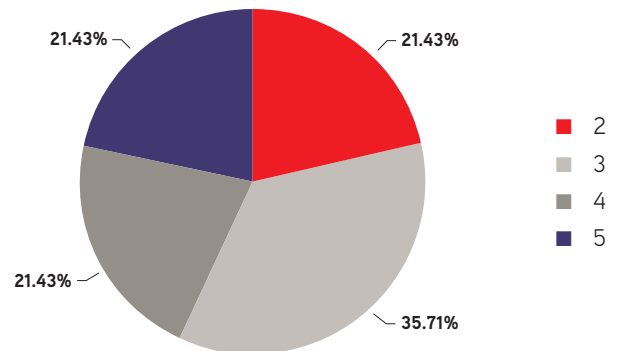
EXHIBIT 49 GOVERNMENT POLICIES SUPPORTING BUSINESSES ADOPTING NEW DIGITAL TECHNOLOGIES
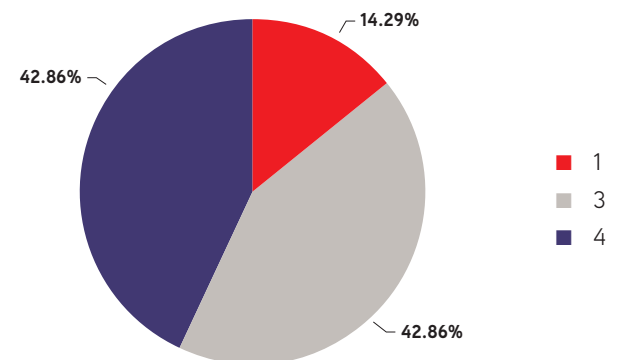

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EXHIBIT 50 TRAINING AND EDUCATION

Critical Insights

DIGITAL ADOPTION READINESS:

- Understanding the readiness level: organizations must understand the readiness level of individuals, departments, organizations, and sectors to facilitate digital transformation. A lack of understanding and experience with digital technologies and tools can hinder new adoption.

- Importance of organizational readiness: Even if individuals and departments are ready to adopt digitization, there is much that can be done at the enterprise level. The low percentage of organizations reporting readiness at level 5 indicates room for improvement in organizational readiness for digital adoption.

- Small and medium-sized organizations face challenges: The supply chain sector involves small, medium, and large-sized organizations, and small and medium-sized organizations may face resource, capital, and knowledge constraints.

- Support mechanisms for small players: There must be support mechanisms to assist small players in the industry or provide pathways for technology adoption to improve the overall sector's technological innovation.

- Lack of correlation between sectors and individual readiness: The moderate positive correlation between the individual and the department but no significant correlation between the individual, organization, department, and sector suggests that strategic directions and objectives may influence technology readiness at the organizational level and supply chains are complex networks where upstream and downstream players may differ on current adoption levels, strategic objectives, and technology adoption priorities.

  - Room for improvement: The fact that no participant reported readiness at level 5 at the sector level is a serious and damning indictment of how 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. There is room for improvement in the sector's digital adoption readiness.

BARRIERS TO DIGITAL ADOPTION:

- Organizational, Managerial, and Attitudinal (OMA) barriers are the most significant barriers to digital adoption readiness, with approximately 72% of participants rating it as a barrier three or above. Organizations should address these barriers by providing support and training to organizations to improve their organizational and attitudinal readiness for digital adoption. Also, providing information on the benefits and ROI of digital technology, incentivizing managers, and employees to embrace the changes, and training them on the use of new technologies.

- Individual Commitment of the Employee to New Technologies is also an essential factor for successful digital adoption.

Although it was not identified as a critical barrier, approximately 50% of participants responded by selecting it below level 3. Organizations should focus on adequately training employees to ensure they are comfortable using new technologies, incentivize them to embrace the changes, and creating a culture that values digital literacy

- Institutional/Governmental Support to Implement New Technologies was rated below level three by approximately 65% of participants, with approximately 36% indicating it is not a barrier to digital adoption. Organizations should provide institutional and government support through training, funding, and employee upskilling programs to improve organizations' readiness for digital adoption.

- Financial Market and Business Context Drive the Implementation of Newer Technologies at Work is another factor that affects digital adoption. Approximately 57% of respondents rated it as three or above. Organizations should know that financial and market conditions may slow digital technology adoption, especially for organizations at the early stages of the digital journey or with limited access to resources, knowledge, and finances.

- Availability of Training and skills development (TSD) is identified as a moderate barrier to digital adoption by approximately 43% of participants. Organizations should focus on providing training and skill development opportunities geared toward advanced tools and technologies, which can be available for both organizations and future graduates.

- Legal/Privacy/Data Management barriers are significant, with approximately 64% identifying it as a barrier. Organizations should focus on providing training specifically developed for the selected organization on data governance principles, which PSEs, Supply Chain Canada, the government or other third parties can provide.

- There is a moderate positive correlation between Organizational, Managerial, and Attitudinal (OMA) barriers and the Individual Commitment of the Employee to New Technologies. Policymakers should focus on addressing these factors together to ensure successful digital adoption.

- There is also a moderate positive correlation between Information Technology/Technical Support and Availability to Implement New Digital Tools and Financial Market and Business Context Drive the Implementation of Newer Technologies at Work. Organizations should provide necessary information on the ROI, benefits, and support during the technology implementation and training process to promote digital technology implementation.

DIGITAL ADOPTION ENABLERS:

- Public/Private Funding (Exhibit 27) and Financial Incentives to Adopt Innovative Technologies (Exhibit 31) are essential enablers for organizations to implement projects related to emerging technologies

- Providing Government Sponsored Platforms Supporting SMEs (Exhibit 28) is a critical enabler. However, organizations may prefer to be independent of government platforms. This can be linked to internal funding available to the organization and the ability to control the digital implementations based on the strategic objectives and organization needs by decoupling it from any government influence.

- There is a need to increase awareness of the economic benefits of past implementations and user cases (Exhibit 29), and the government and other bodies need to offer information and knowledge (Exhibit 30) about different support programs offered by the government to enable information dissemination based on the industry sector, digital adoption journey, etc.

- Internal capital (Exhibit 33) and market potential (Exhibit 34) are essential for technology adoption projects. Organizations must evaluate these factors before investing in expensive hardware, software, or consulting services necessary for successful technology adoption.

- Internal/External Collaboration (Exhibit 37) is a critical enabler, and organizations must collaborate with multiple stakeholders to leverage digital technologies' full potential.

- Technical Infrastructure (Exhibit 38), Digital Strategic Plan (Exhibit 39), Integration with Existing Systems (Exhibit 40), and Appropriate Consulting Services (Exhibit 41) are also essential enablers for technology adoption projects. Policymakers can support organizations by developing guidelines or policies to ensure these enablers are available.

- The regulatory Environment (Exhibit 42) and Intellectual Property Protection (Exhibit 43) are critical enablers, and policymakers can develop policies and regulations to support technology adoption while protecting intellectual property rights.

- Technological Infrastructure Development (Exhibit 44) and Investment in Research and Development (Exhibit 45) are essential enablers, and policymakers can support organizations by investing in infrastructure development and research and development.

- Finally, digital adoption readiness assessment tools (Exhibit 46) can help organizations identify their digital adoption journey and the enablers they must focus on to succeed in their digital transformation journey. Policymakers can promote such tools and develop customized tools for specific industry sectors.

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. They can also invest in infrastructure development and research and development to support organizations in their digital transformation journey. Additionally, policymakers can promote digital adoption readiness assessment tools to help organizations identify the enablers they must focus on to succeed in their digital transformation journey.

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