

EXECUTIVE SUMMARY

Better, Faster, Stronger:

Maximizing the benefits of
automation for Ontario's
firms and people

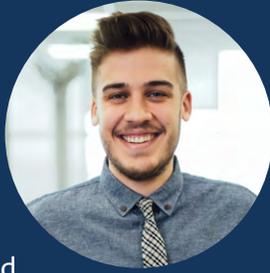
May 2018



AUTHORS

CREIG LAMB Senior Policy Analyst

Creig is a Senior Policy Analyst at the Brookfield Institute. Prior to joining BII+E, Creig held research roles with Toronto Artscape and Economic Development and Culture at the City of Toronto. Creig also worked for Public Works and Government Services Canada for several years, designing and implementing communications strategies and materials. Creig holds a Master of Public Policy from the University of Toronto and a Bachelor of Communications from the University of Ottawa.



creig.lamb@ryerson.ca

VIET VU Economist

Viet Vu is an Economist at the Brookfield Institute. Prior to joining BII+E Viet studied at the London School of Economics & Political Science where he taught Intermediate Microeconomics and worked on his thesis on the game theory of seller reputation. He holds a Master of Science in Economics from the London School of Economics & Political Science and a Bachelor of Arts in Economics from the University of British Columbia.



viet.vu@ryerson.ca

DR. DANIEL MUNRO Research Advisor

Dr. Daniel Munro is a Visiting Scholar in Innovation Studies and Director of Policy Projects in the Innovation Policy Lab at the Munk School of Global Affairs at the University of Toronto, and Researcher in Residence at Actua. Dan holds degrees in political science from the University of Toronto (B.A.), Western University (M.A.), and the Massachusetts Institute of Technology (Ph.D.).



dan.munro@utoronto.ca

The Brookfield Institute for Innovation + Entrepreneurship (BII+E) is a new, independent and nonpartisan institute, housed within Ryerson University, that is dedicated to making Canada the best country in the world to be an innovator or an entrepreneur.

BII+E supports this mission in three ways: insightful research and analysis; testing, piloting and prototyping projects; which informs BII+E's leadership and advocacy on behalf of innovation and entrepreneurship across the country.

ISBN: 978-1-926769-88-2

For more information, visit
brookfieldinstitute.ca

 /BrookfieldIIE

 @BrookfieldIIE

 The Brookfield Institute for
Innovation + Entrepreneurship

20 Dundas St. W, Suite 921
Toronto, ON
M5G 2C2



ACKNOWLEDGEMENTS

This report was supported by the Government of Ontario.

An expert advisory panel provided insights and guidance throughout this project. We are deeply grateful for their contribution.

Thank you to the many people who provided their time and insights to contribute to the development of this report.

SPECIAL THANKS

We would also like to thank Burning Glass Technologies who granted us access to their data.

CONTRIBUTORS

Sarah Doyle, Director of Policy + Research

Jane Farrow and the team at the Department of Words & Deeds

Annalise Huynh, Policy Analyst

Jon Medow, Project Advisor

Sean Mullin, Executive Director

Diana Rivera, Economist

Jessica Thornton, Senior Projects Designer

Sarah Villeneuve, Policy Assistant

EXPERT ADVISORY PANEL

Robert Carlyle, Senior Director, Strategic Workforce Management RBC

Rebecca Finlay, Vice President, Engagement and Public Policy, Canadian Institute for Advanced Research

Ryan Gariepy, Co-Founder and CTO, Clearpath Robotics

Avi Goldfarb, Professor, Rotman School of Management, University of Toronto

David Green, Professor and Director, Vancouver School of Economics, University of British Columbia

Sunil Johal, Director of Policy, The Mowat Centre

Krista Jones, Managing Director of Work and Learning, MaRS

Bob Magee, Chairman, Woodbridge Group

Colin McKay, Head of Public Policy and Government Relations, Google Canada

Bakhtiar Moazzami, Professor/Researcher, Department of Economics, Lakehead University

Jayson Myers, Former President, Canadian Manufacturers and Exporters

Graham Taylor, Co-Founder, Kindred.ai and Associate Professor, University of Guelph

Armine Yalnizyan, President, Canadian Association for Business Economics

Richard Zuroff, Director of Delivery and Customer Success, Element AI



For Ontario firms and workers to thrive in the age of automation, we need to find ways to increase firms' lagging adoption of automation technologies, while also equipping workers with skills and opportunities to adapt and thrive in a changing labour market.

Ontario faces a dual challenge: automation technologies have the potential to improve productivity and competitiveness, and to generate more jobs and prosperity over the long term, yet many Ontario firms have hesitated to invest. At the same time, when firms adopt automation technologies, the disruption to jobs and tasks—and thus to workers' income and well-being—can be significant. For Ontario firms and workers to thrive in the age of automation, we need to find ways to increase firms' lagging adoption of automation technologies, while also equipping workers with skills and opportunities to adapt and thrive in a changing labour market. This report provides a grounded and detailed picture of the extent and nature of automation trends in Ontario and identifies strategies to help public, private and non-profit sector actors navigate this dual challenge.

Rapid technological advances, particularly in artificial intelligence (AI), have heightened concerns about automation and the potential for job loss. These concerns have prompted a number of studies—each pointing to a large proportion of jobs or tasks that are susceptible to automation. While useful in highlighting an issue that deserves attention, the studies tend to overemphasize the risks of automation. First, most focus on whole economies, overlooking how impacts will vary by

region, sector, firm and worker. Second, they tend to focus narrowly on jobs and tasks that could be automated by existing and emerging technologies in theory, and do not analyze the many factors that affect firms' decisions to automate and thus the actual rate of automation in the economy. Finally, these approaches tend to focus more on the potential for automation to eliminate jobs or tasks, and less on the potential to augment or create jobs and enhance firm productivity and competitiveness.

To fill these gaps in understanding, this report offers a more granular and nuanced understanding of automation in the Ontario context, and of the dual challenge it presents. It closely examines two sectors that are broadly representative of Ontario-wide trends—manufacturing, and finance and insurance—and explores the experiences and perceptions of Ontarians from different communities. The analysis draws on relevant data, existing literature, interviews with over 50 stakeholders from the two sectors, and engagement of over 300 Ontarians through interviews, public consultations and an online survey. This report is also informed by the guidance offered by an Expert Advisory Panel of 14 individuals with academic, technological, and industry expertise.

THE RELATIONSHIP BETWEEN AUTOMATION + LABOUR

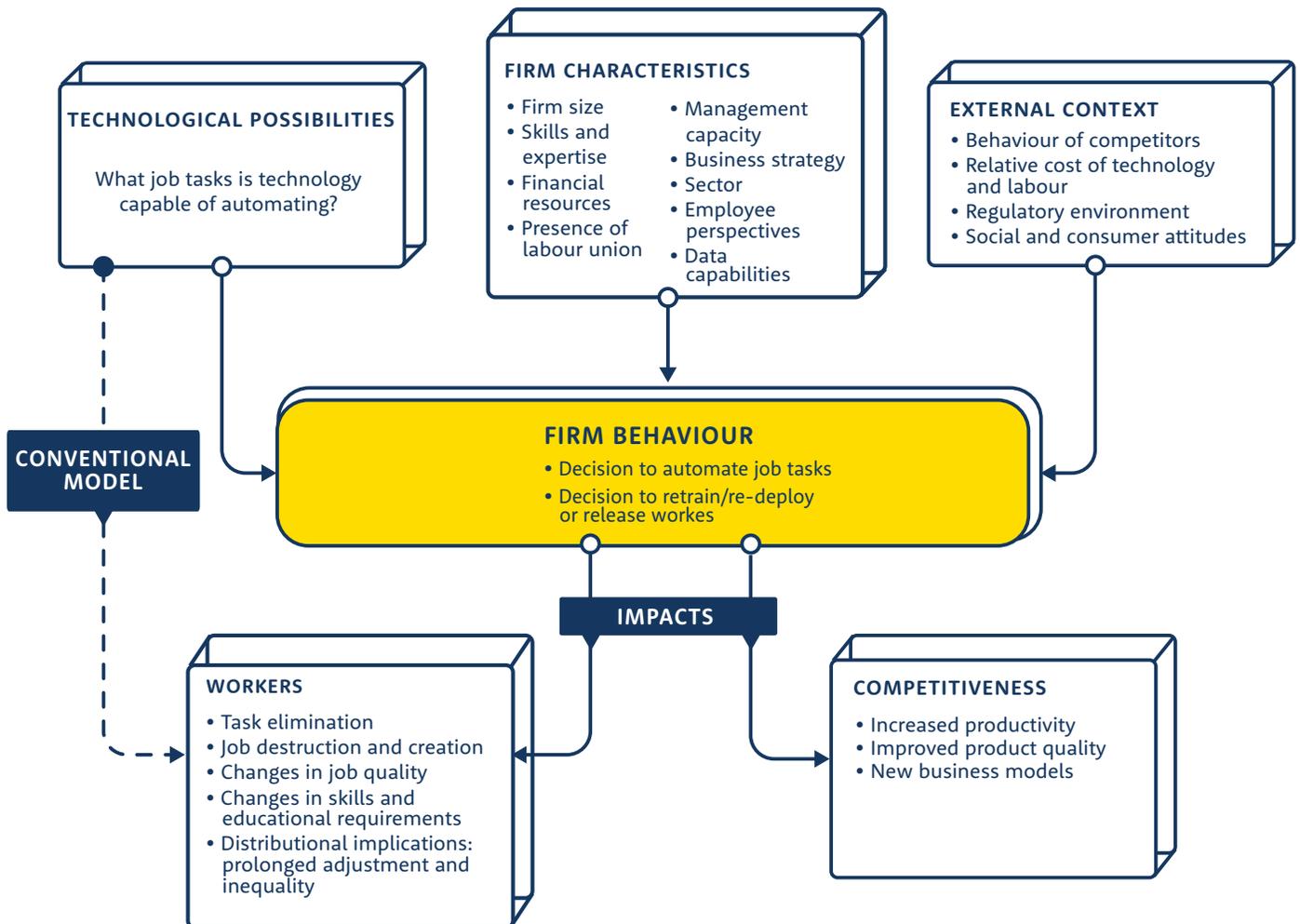
- + **A wide array of factors influence firms' decisions to automate.** As shown in Figure A, the *extent to which automation occurs* is a function of the characteristics of firms and the features of the external context in which they operate, as well as technological possibilities.
- + **Where automation does occur, the impact on workers and firms can vary significantly.** The *extent and nature of automation's effects* on workers and labour markets depends on a range of factors, including the fit between changing skills demand and the skills of

workers within local labour markets, the ability and willingness of workers to upskill or retrain, and the availability of training programs tailored to the needs of local firms and workers.

- + **Automation has the potential to reduce and generate employment.** Automation changes the kinds of job available and the skills they require. The distribution of job loss, change and creation is often uneven, affecting some regions, industries and workers more than others, which can exacerbate inequality and hurt some local labour markets, while benefitting others. Historically, however, automation has tended to create more jobs than it destroys over the long term.

Figure A:

Firm-level view of drivers and impacts of automation

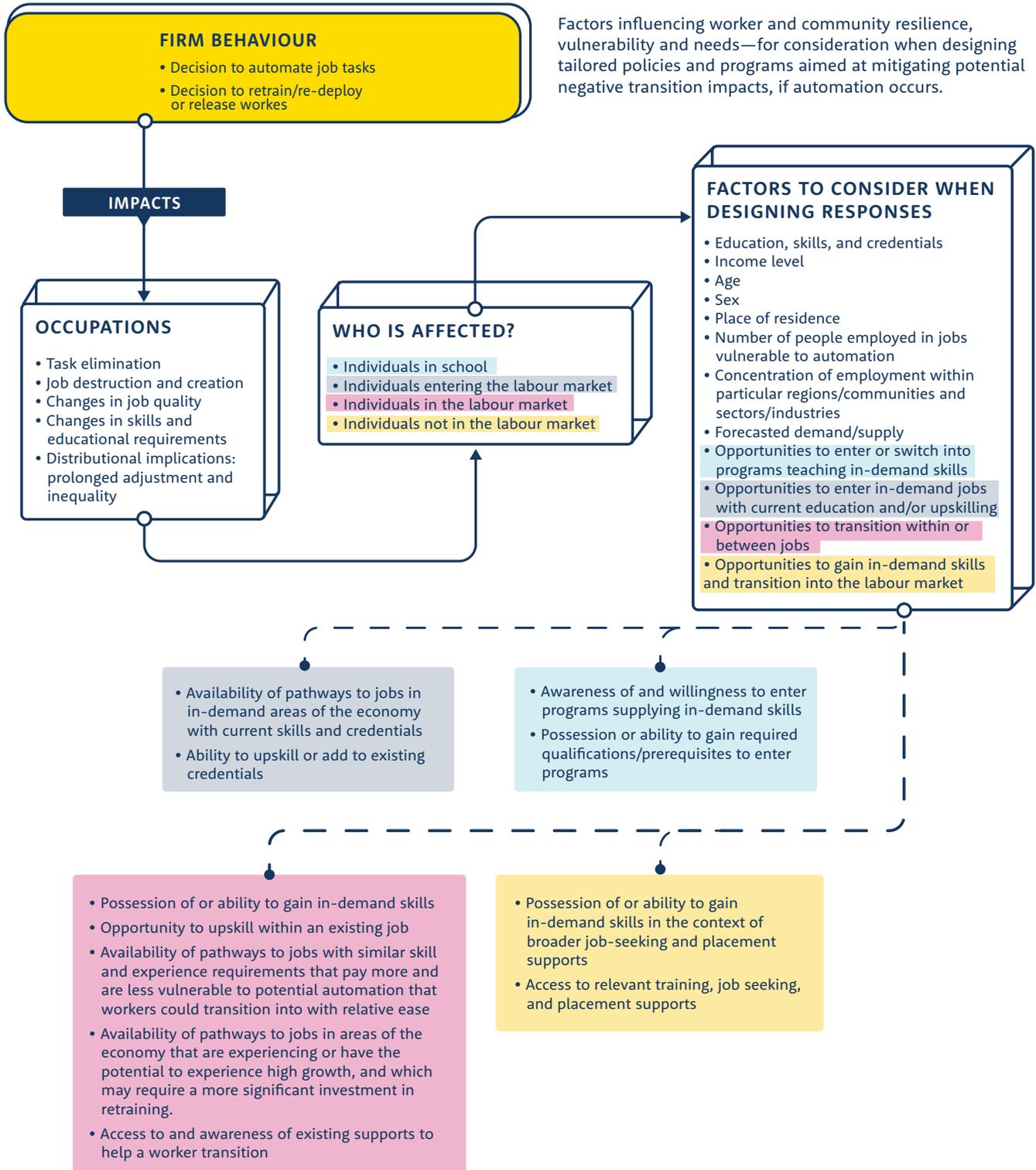


+ **When firms automate, the impact on workers is influenced by a number of factors.** As shown in Figure B, the vulnerability, resilience and needs of workers affected by automation are shaped by, for example, demographic characteristics, the concentration of job

disruption in a particular region or sector, and the opportunities available to transition to other jobs. These factors should be considered when designing initiatives to help workers and job seekers adjust to the changes brought about by automation.

Figure B:

Individual-level view of factors influencing the impacts of automation



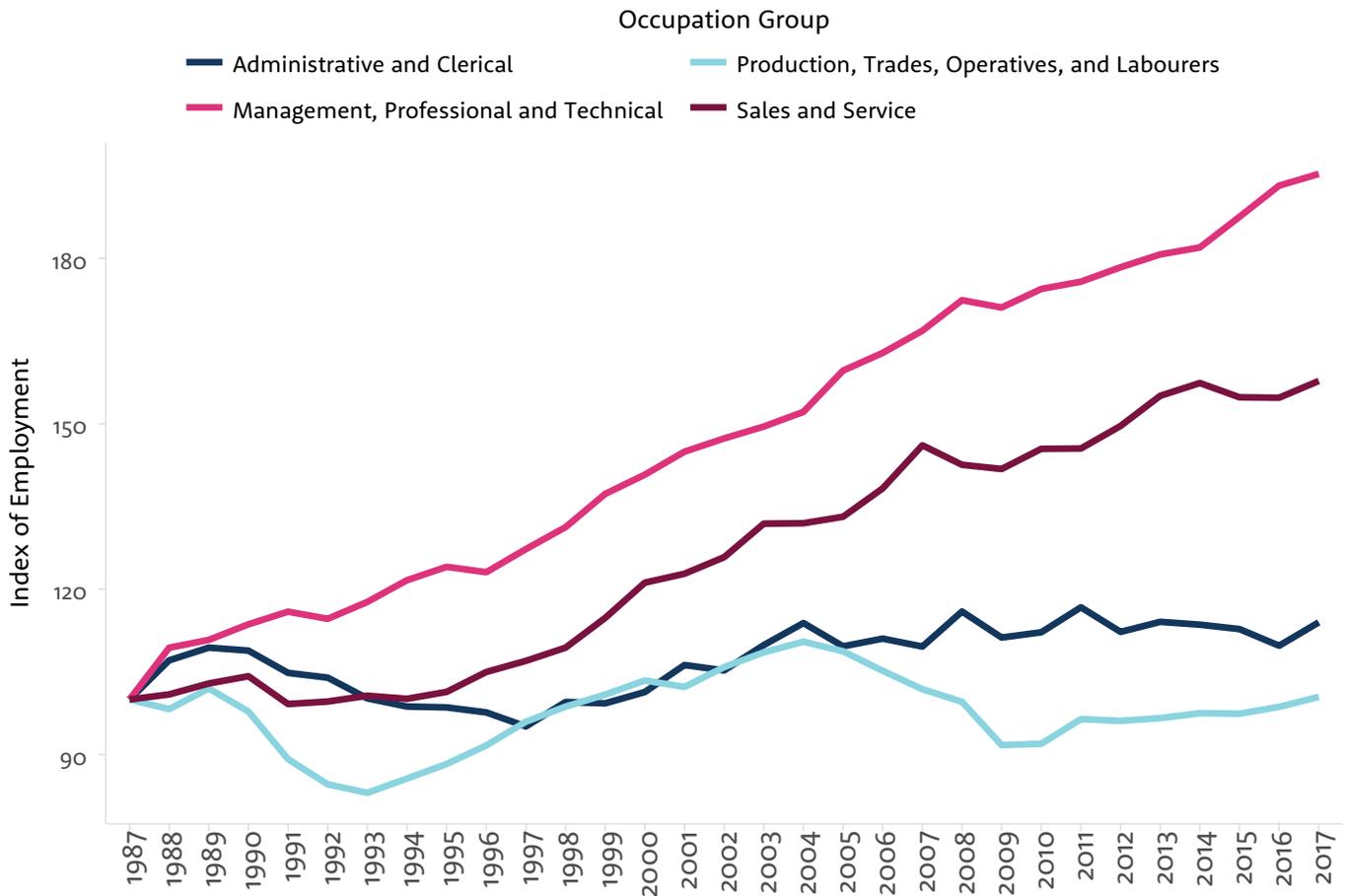
AUTOMATION TRENDS FOR ONTARIO AS A WHOLE

- + **Technology adoption in Ontario is low.** Compared to peer jurisdictions, Ontario firms lag on technology adoption, which is likely inhibiting productivity gains and growth, and putting both firms and workers at a long-term disadvantage.
- + **Skills demands are changing across the province.** Despite this lag, the automation that is occurring in Ontario is contributing to changes in the kinds and nature jobs available and the skills and knowledge that employers need. Job growth is largely in non-routine work that is either manual—such as cleaning services—or cognitively demanding—such

as management. More routine-oriented occupations, which are often easier to define and codify using technology, have experienced decline or stagnation. Figure C shows these shifts in employment over time.

- + **If technology investments grow, the impacts of automation on Ontario’s labour market could become more significant.** Automation has the potential to cause substantial short- to medium-term disruption in labour markets and employment, especially in Ontario towns and cities in the southwest that specialize in manufacturing, as shown in Figure D. While the relatively lower rates of automation in Ontario’s firms will likely delay or temper job disruption, they could negatively affect employment in the long-term, by inhibiting firm competitiveness and increasing risks of firm failure.

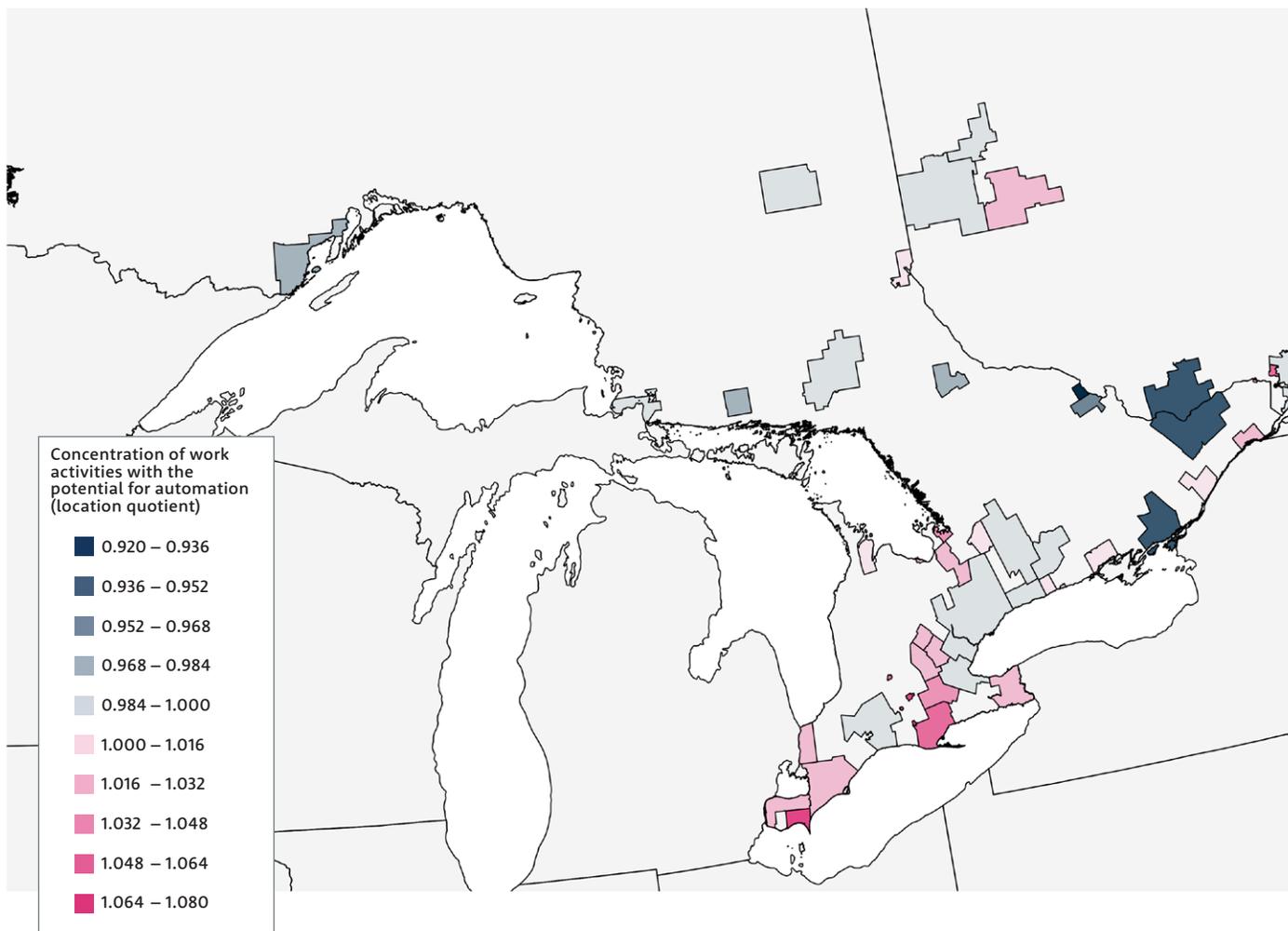
Figure C:
Employment Growth, Ontario, 1987–2017



Source: Statistics Canada CANSIM Table 282–0142, BII+E Analysis
Note: Index base year = 1987.

Figure D:

Canada's industrial heartland has the greatest potential for automation



Source: Brookfield Institute for Innovation + Entrepreneurship, *Automation Across the Nation: Understanding the potential impacts of technological trends across Canada*, 2017

Note: A location quotient above one indicates a higher concentration of work activities with the potential to be automated, compared to the Canadian average.

WHAT WE HEARD FROM ONTARIANS

- + **“Adapt or perish”.** Among those interviewed, there is a general sense that automation is happening, that its scope is increasing, and that it will disrupt many sectors and change how Ontarians work.
- + **Some automated job tasks are ones that people don’t want to perform.** We heard that automation often replaces human labour when work is unsafe, when it involves repetitive or routine tasks, and when working conditions are such that jobs are hard to fill reliably.
- + **A range of perspectives.** Some workers feel that automation has reduced their jobs to “button-pushing” and devalued certain skills. For others, automation has made jobs safer, allowed them to focus on more interesting tasks and/or provided them with greater flexibility.
- + **There are growing gaps between the skills of existing workers and those employers are seeking.** While some workers are eager to learn new skills and adapt to changes in the workplace, others are not. This applies across all age groups, although mid-career workers who have not been working in offices and have few computer skills may have the hardest time adapting or finding new employment.

“People are equally scared, hopeful, don’t know, or don’t care. They are hopeful that with automation work can become more interesting, less physical, less dangerous. But they also fear their own ability to adapt—and if they will even be given the opportunity to adapt. It sparks a lot of emotional reactions.”
— *university researcher in Kingston*

“Some people are learners, and want a challenge. There are some 55-year-olds who are like that. Others say ‘I’m out of here, I can’t learn that’, and they leave. Then we lose process knowledge, product knowledge, and company knowledge.”
— *manufacturing sector stakeholder*

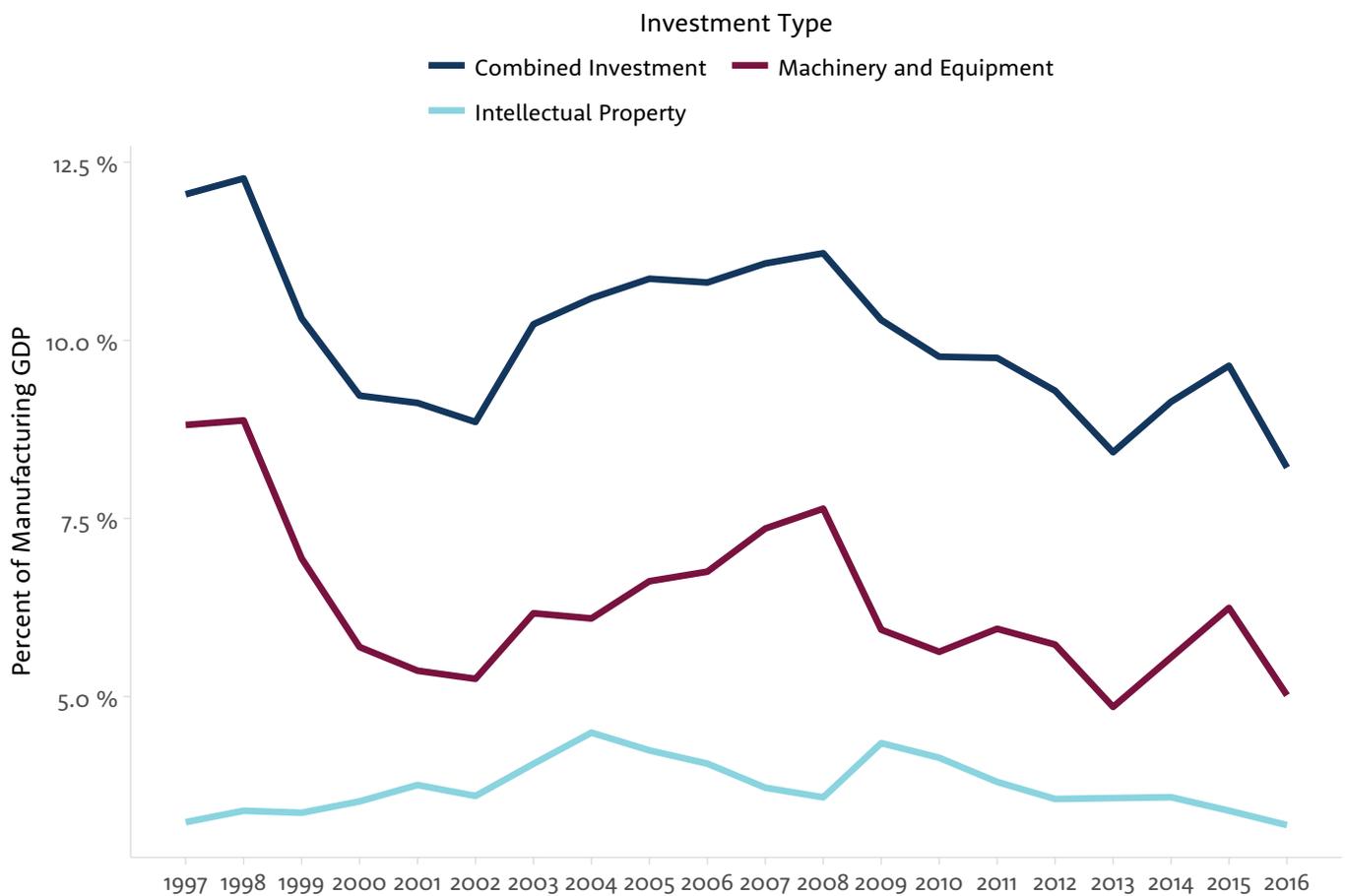
MANUFACTURING SECTOR INSIGHTS

+ **Low technology adoption is stifling competitiveness.** The Canadian manufacturing sector (to which Ontario manufacturers contributed roughly 47 percent of output in 2016) lags peer jurisdictions in terms of technology adoption. Total information and communication technology (ICT) investment per worker among Canadian manufacturers was 57 percent that of their US counterparts, as of 2013. In Ontario, between 1997 and 2016, the sector’s investment in intellectual property (IP), machinery, and equipment as a percent of GDP declined by 32 percent, as shown in Figure E.

+ **Declining employment over the past three decades cannot be attributed to automation alone.** Ontario experienced a 5.5 percent drop in manufacturing employment from 2001 to 2011, whereas the US and Germany—jurisdictions with higher rates of technology adoption—saw manufacturing employment drop by only 4.2 percent and 4 percent respectively. Automation likely played some role, alongside globalization, economic cycles, changing input costs, changing consumer demands and other factors. In fact, low technology adoption may have undermined Ontario firms’ competitiveness and put more workers at risk.

Figure E:

Investment in the Manufacturing Sector, Ontario, 1997–2016

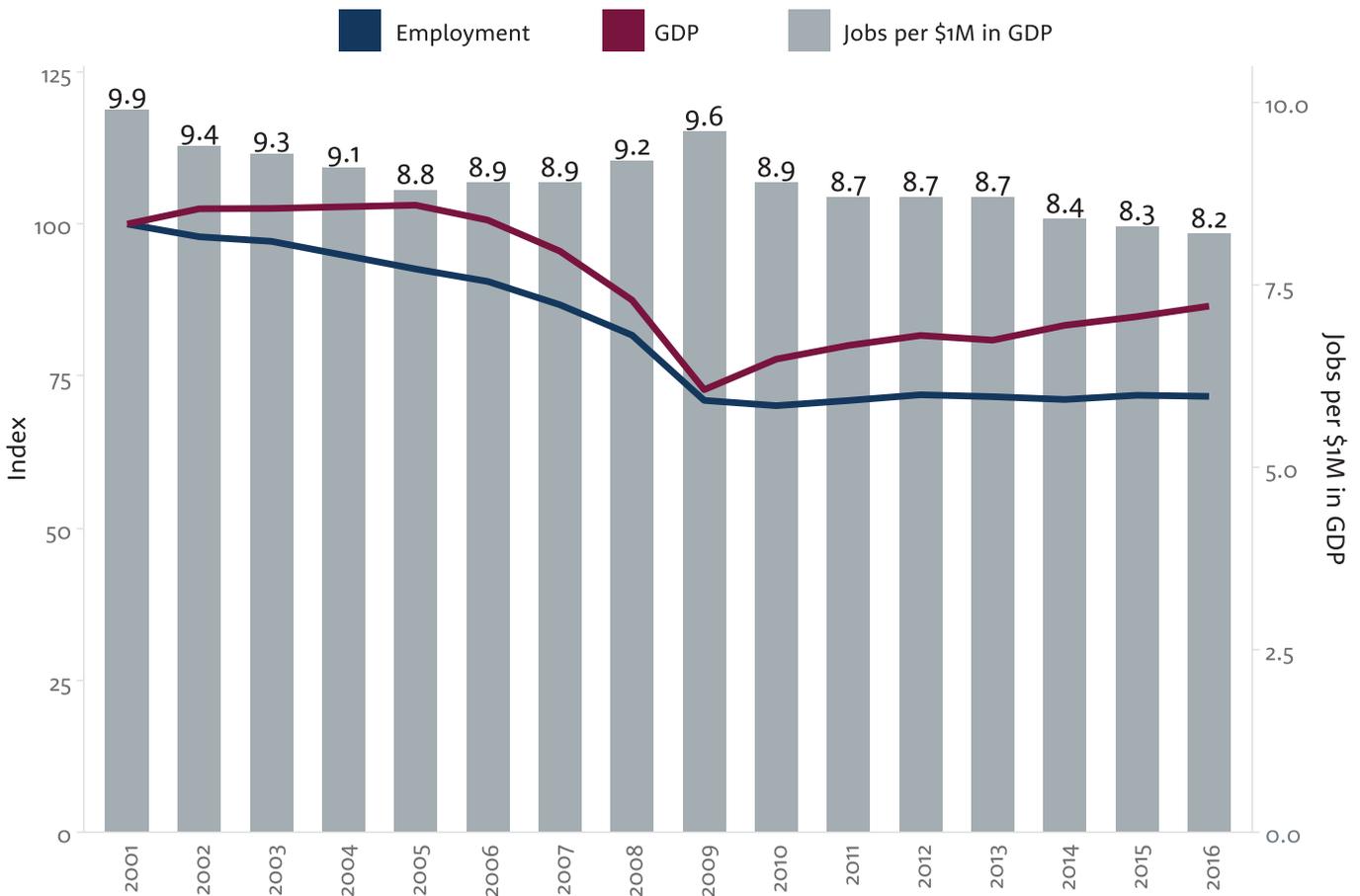


Source: Statistics Canada CANSIM 031-0005 & 379-0030, BII+E Analysis
 Note: Manufacturing includes NAICS 31-33.

+ **Manufacturing is getting leaner.** Despite lower levels of automation relative to international peers, Ontario manufacturers are in the automation game. Automation has likely contributed to a leaner manufacturing sector in Ontario, particularly following the 2008-09 recession. From 2001 to 2016, the number of employees required to generate \$1 million in revenue in Ontario's manufacturing sector declined from nearly 10 to just over 8, as shown in Figure F. During this time, employment in manufacturing fell by 28 percent or 261,390 workers, while output declined by 13 percent.

+ **Ontario manufacturers recognize the need to automate, but face a number of barriers to technology adoption.** With global competition rising and the workforce aging, Ontario firms recognize that technology is essential to improving productivity, product quality, and the expansion of existing business models. But adopting new technologies is hampered by a variety of factors, including cost and risk aversion (especially among smaller firms concerned about big investments in technologies that could soon become obsolete), as well as a limited supply of workers with the skills needed to implement, operate, and maintain new technologies. The looming retirement of many existing workers is an added challenge, which will lead to the loss of valuable institutional knowledge.

Figure F:
Manufacturing Employment and Revenue, Ontario, 2001–2016



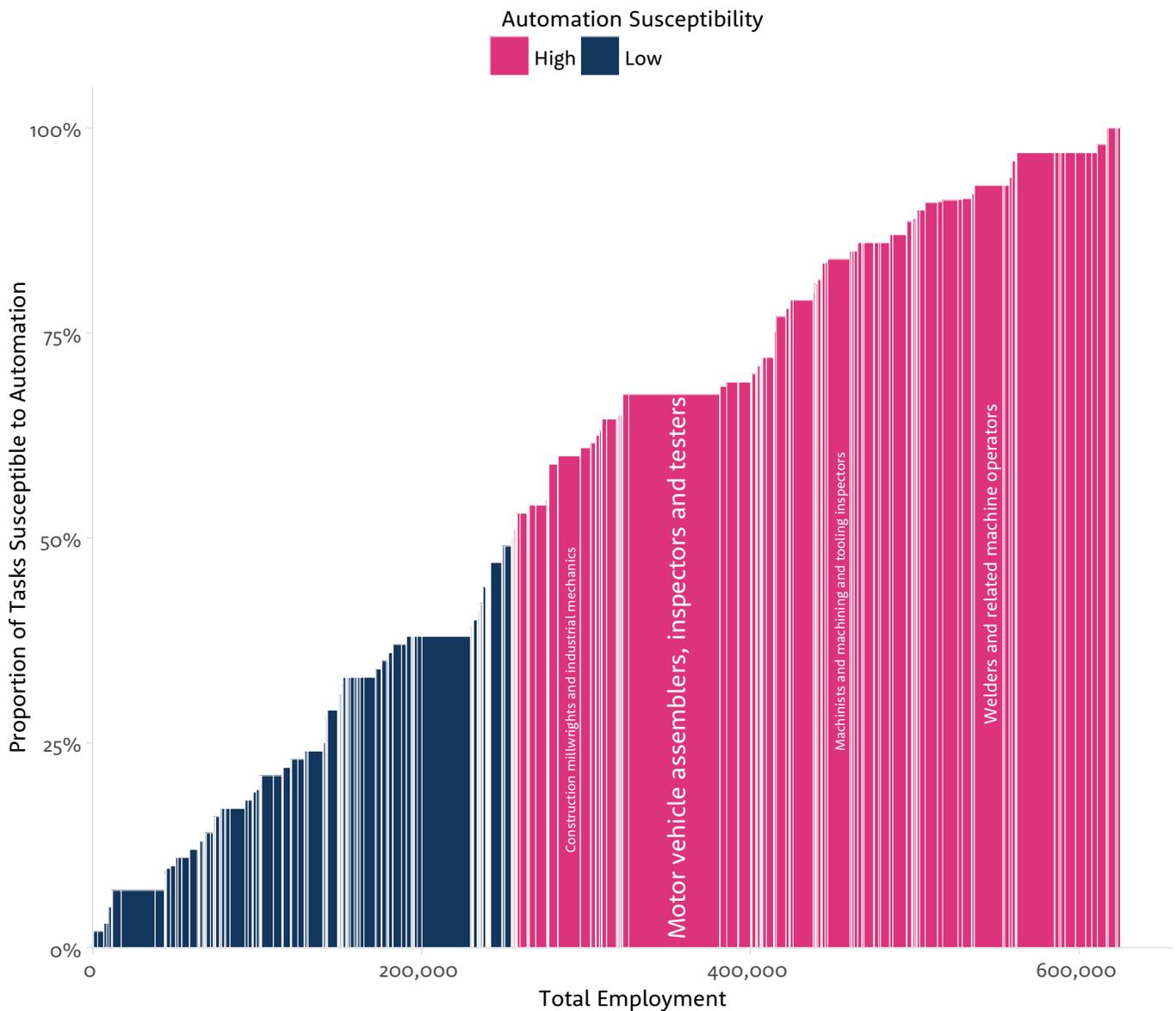
Source: Statistics Canada CANSIM Table 379-0030 and Table 281-0024, BII+E Analysis
 Note: For GDP and Employment, Index Base Year = 2001.

+ **A significant number of occupations in the sector are susceptible to automation.** Although the actual extent and nature of automation and its effects will depend on firms' behaviour, Ontario's manufacturing sector has 166 occupations, employing 370,850 people, that are highly vulnerable to automation in theory (i.e., jobs in which 50 percent or more tasks are technically automatable, based on McKinsey analysis). Susceptibility is correlated with lower education and income levels.

+ **Workers in certain occupations—such as motor vehicle assemblers, inspectors and testers—are particularly vulnerable.** This occupation employs over 62,000 Ontarians. Almost 70 percent of its tasks are technically automatable, and—based on an analysis of pathways between jobs that would require minimal retraining, which could be in the same or different sectors—workers in this occupation have no opportunities to move to jobs with similar skill, experience and credential requirements, lower automation susceptibility, and the same or higher pay.

Figure G:

Manufacturing Employment by Automation Susceptibility, Ontario



Source: 2016 Canadian Census, McKinsey & Company (2017), BII+E Analysis

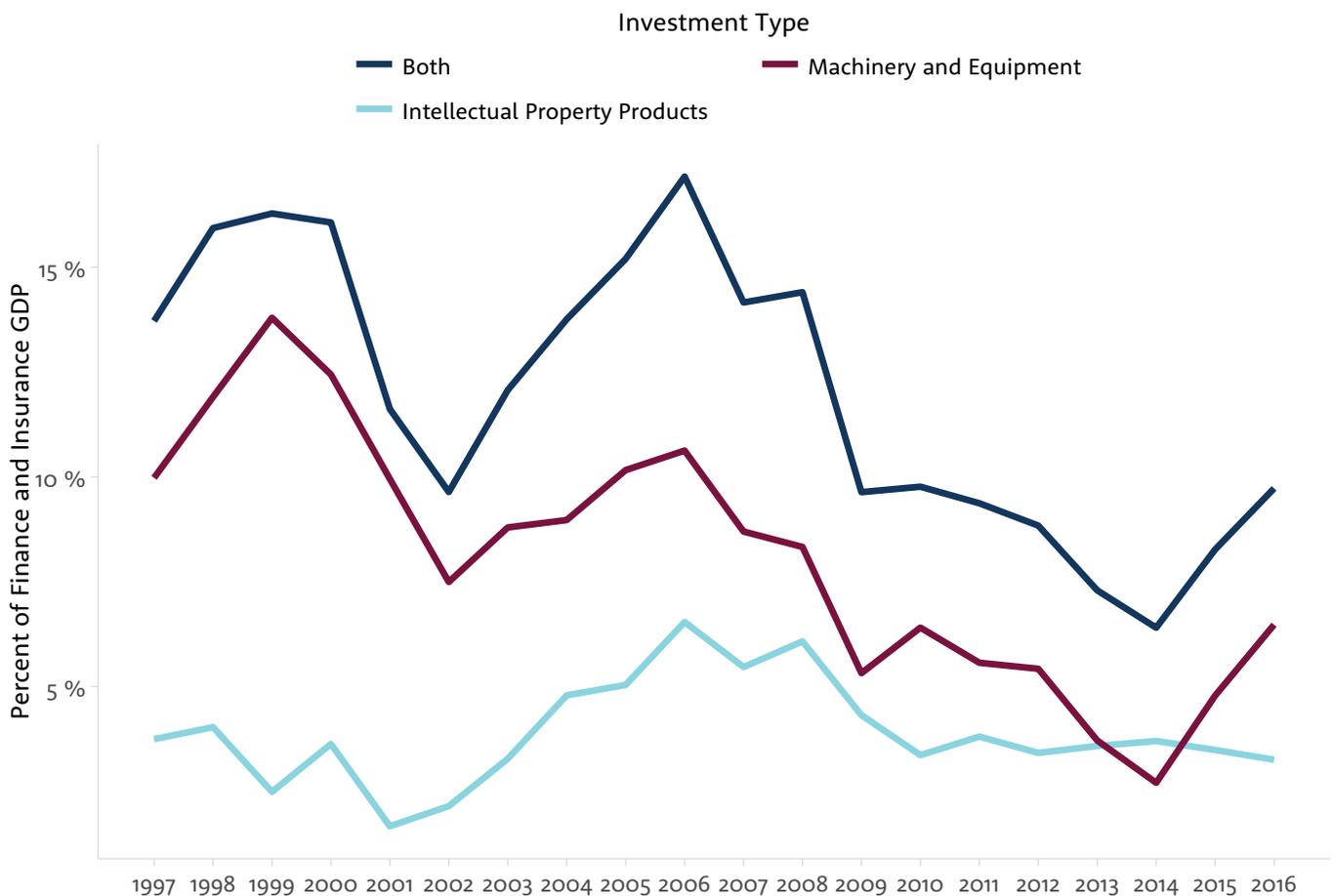
Note: Each bar represents an occupation; Bar width corresponds to employment within the manufacturing sector.

FINANCE AND INSURANCE SECTOR INSIGHTS

+ **Finance and insurance firms also lag in technology adoption, but this may be changing.** In 2013, total ICT investment per worker in the finance and insurance sector in Canada—of which Ontario makes up roughly 52 percent—amounted to only 79 percent that of the US. In Ontario, combined investment in IP and machinery and equipment declined by roughly 4 percent between 1997 and 2016, although there has been an uptick in the last few years, as shown in Figure H.

+ **A number of barriers have hindered automation in the sector, but the pressure to automate is growing.** Automation in Ontario’s finance and insurance sector has been hampered by regulatory hurdles, a limited supply of skills required to effectively implement, operate and maintain new technologies, and the incompatibility of some new technologies with existing legacy systems. At the same time, changing consumer demands, increasing competition from FinTechs and other global competitors, and the opportunity to develop new business models that exploit existing consumer data are increasing pressure on Ontario firms to accelerate their uptake of automation technologies.

Figure H:
Investment in the Finance and Insurance Sector, Ontario, 1997–2016

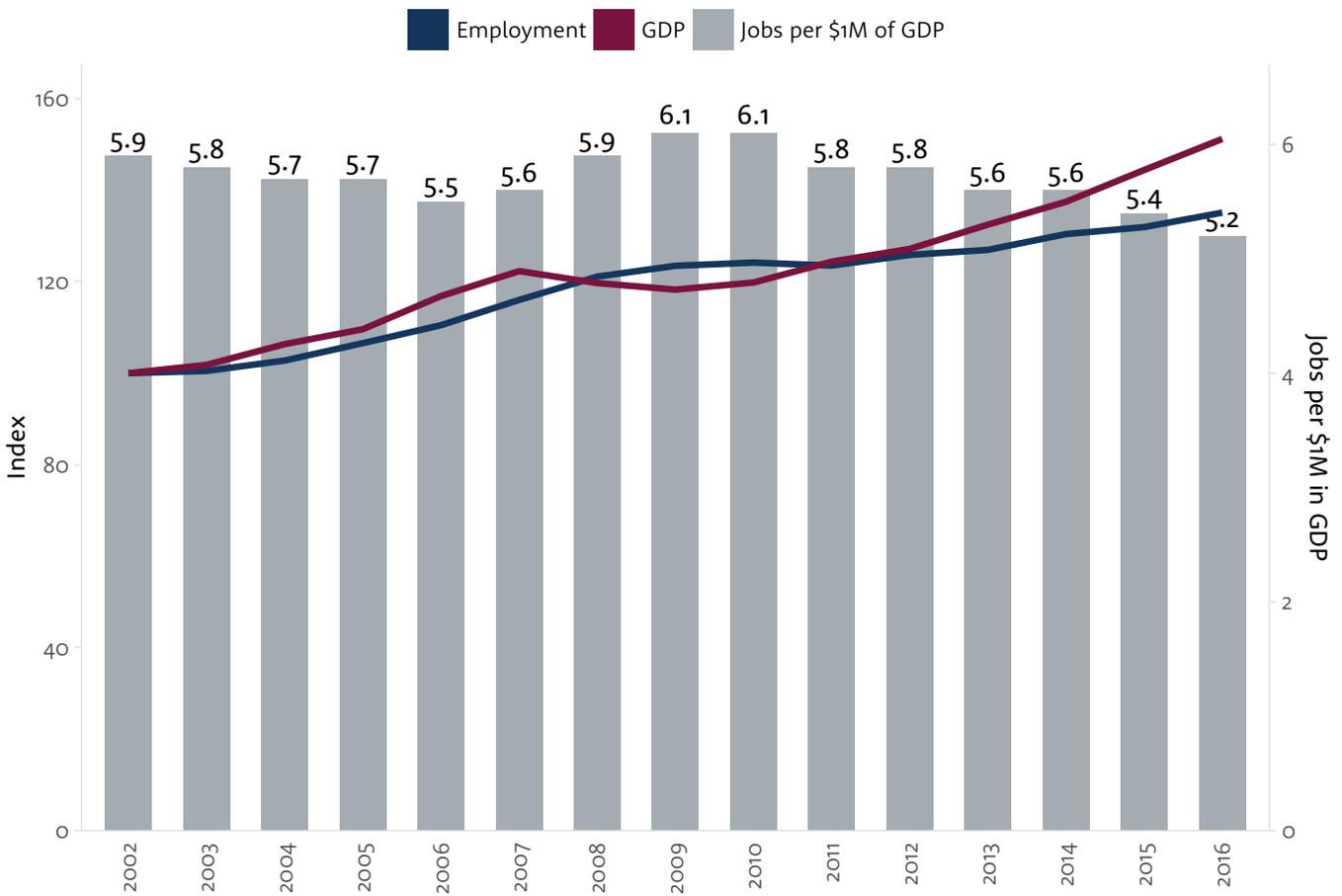


Source: Statistics Canada CANSIM 031-0005 & 379-0030, BII+E Analysis
Note: Finance and Insurance includes NAICS 52.

+ **Automation has not reduced the number of jobs in the sector.** Employment grew by 35 percent, or 85,350 workers, between 2002 and 2016, in Ontario's finance and insurance sector. During the same timeframe, productivity

improved, with the number of employees it took to generate \$1 million in revenue declining very slightly from 5.9 to 5.2, as shown in Figure 1.

Figure 1:
Finance and Insurance Employment and Revenue, Ontario, 2002–2016



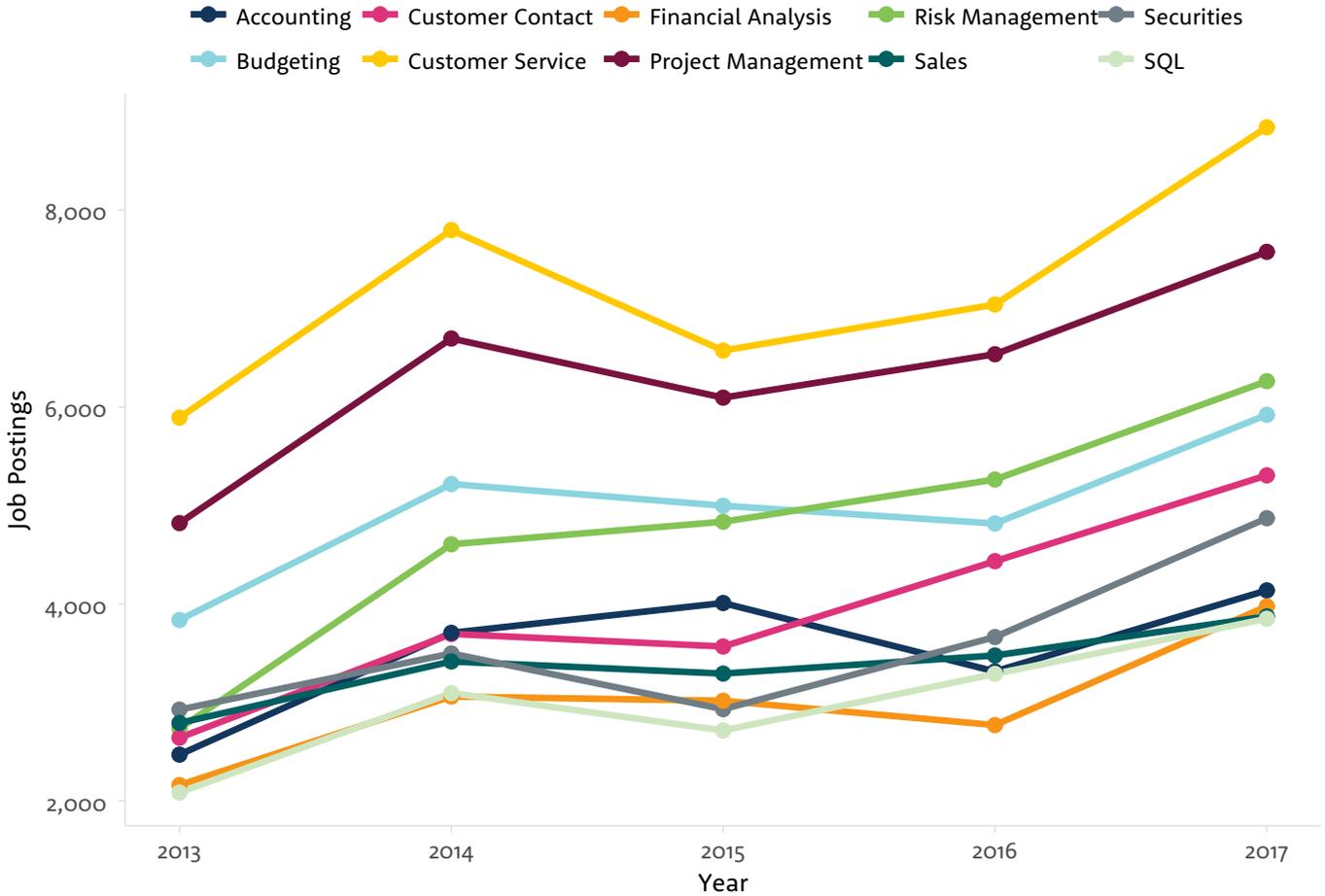
Source: Statistics Canada CANSIM Table 379-0030 and Table 281-0024, BII+E Analysis
 Note: For GDP and employment, index base year = 2002.

+ **Automation has contributed to changing skills demands**, lowering the need for transactional tasks and increasing demand for both soft and technical skills, including those related

to client experience, sales, project and risk management, as well as software development and data analysis. Figure J shows the most in-demand skills in the sector.

Figure J:

Most In-Demand Skills in Finance and Insurance, Ontario, 2013–2017



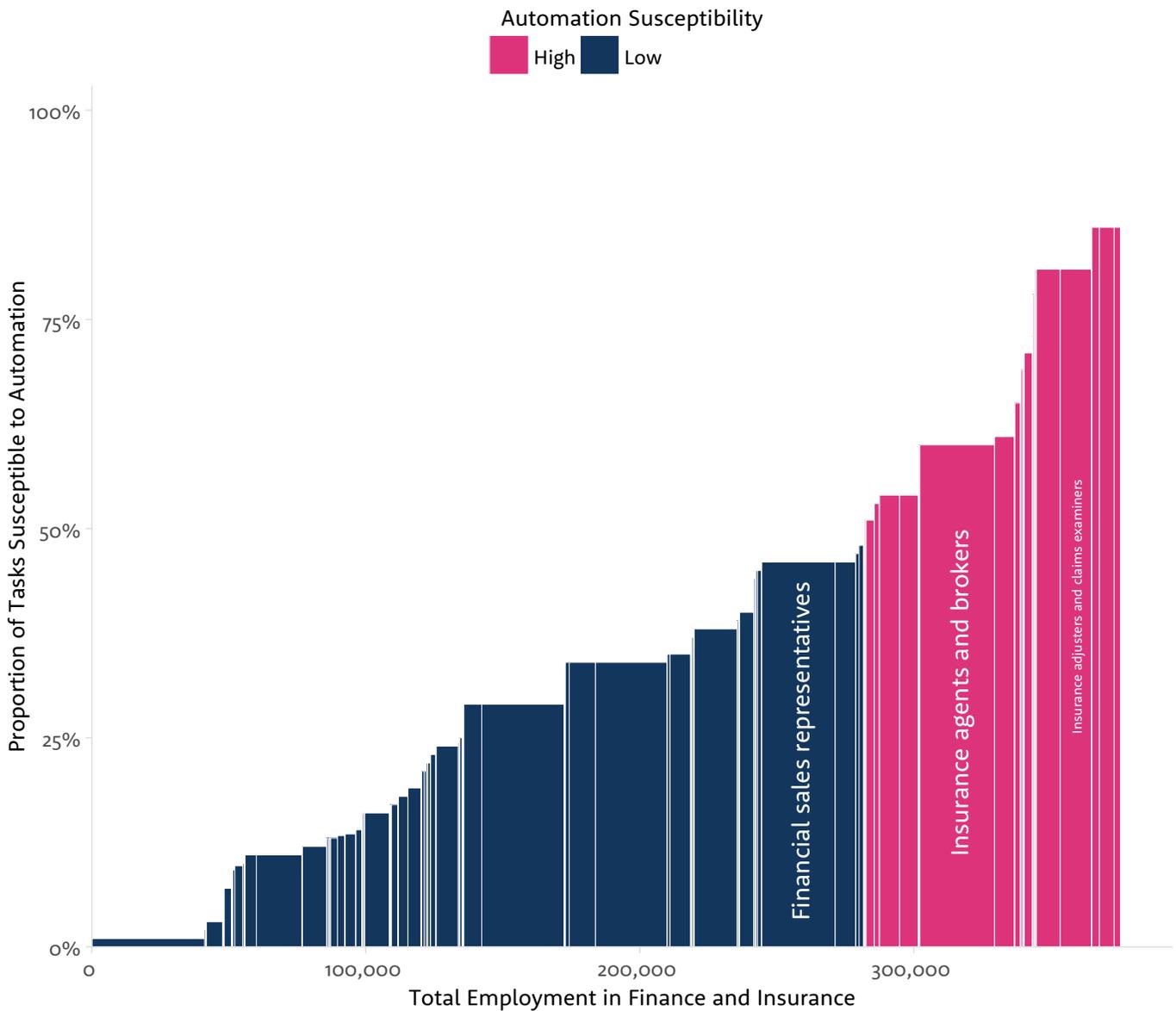
Source: Burning Glass Technologies, BII+E Analysis

+ **While fewer tasks in the sector can be automated, some occupations are especially susceptible.** As shown in Figure K, the sector is home to only 68 occupations considered highly susceptible to automation, but they employ 93,515 people within the sector. Susceptibility is correlated with lower education and with the proportion of female employees in the occupation.

+ **Some occupations are more susceptible to potential automation**—including insurance agents and brokers, insurance adjusters and claims examiners, and banking, insurance and other financial clerks. These occupations are notable because of their high employment numbers and high concentration within the sector. For these occupations, however, there are a number of opportunities to transition to jobs with similar skill, experience and credential requirements that pay the same or more, and are less susceptible to automation.

Figure K:

Finance and Insurance Employment by Automation Susceptibility, Ontario



Source: 2016 Canadian Census, McKinsey & Company (2017), and BII+E Analysis
 Note: Each bar represents an occupation; Bar width corresponds to employment within Finance and Insurance.

ONTARIO'S DUAL CHALLENGE

- + **To date, efforts to promote innovation and technology adoption, and efforts to train workers, have existed largely in parallel.** Yet Ontario faces a dual challenge: to stimulate technology adoption among businesses to improve competitiveness, while simultaneously ensuring that workers have the skills to adapt to—and even drive—this change.

A HIGH-LEVEL STRATEGY

- + **Responding to this dual challenge in a way that benefits both firms and workers demands more than incremental change.** It requires a strong vision and leadership, better collaboration among the public, private and non-profit sectors, and fundamental changes to education and training models, firm behaviour, and established labour market tools. Specifically, it will require:

1. **Investment in tech R&D and adoption.**

Achieving the productivity and competitiveness benefits of automation—and long-term job creation—requires the development, adoption, and effective use of relevant technologies. The governments of Ontario and Canada have already made substantial investments to support the development and adoption of automation technologies. These investments should be monitored, to determine whether they are having their intended effects or require augmentation.

2. **A system for lifelong education that offers a wide array of relevant and accessible retraining and upskilling programs.**

While our education system has continued to evolve to meet changing needs, it has not kept pace with technological change. Ontarians require a robust system for lifelong education that matches the scale of earlier efforts to support the shift from farm to factory and office. This modernized system requires:

- *Modular, stackable training programs* that are more tailored to tasks and skills than occupations, and that could be combined in different ways.
 - *Flexible programs* that can accommodate a variety of schedules and allow for working while training, reflecting the fact that, for many, it is neither practical nor desirable to go back to school for months or years.
 - *Task-based skills recognition models*, such as micro-credentials.
 - *A review of regulatory frameworks and public funding mechanisms* to ensure they do not inadvertently inhibit lifelong education. Ultimately, the shift to a system of lifelong education may require *dedicated funding that reflects the size of this ambition.*
 - *Participation and input from all stakeholders*—including students and workers, employers, colleges, universities, private and non-profit training organizations, unions, and governments.
- ### 3. **A coordinated, cooperative approach to firm and worker success.**
- Firm and worker success are closely intertwined. Firms succeed when they have workers with skills that meet their needs, support innovation, and enable and complement specific technology changes. Workers succeed when their skill sets meet employer needs, provide a foundation for lifelong learning, and contribute to their resilience in the face of technological and labour market change. Responding to firm and worker needs requires collaboration between businesses, post-secondary institutions and other training organizations and, in some cases, unions. Governments have an important role to play in fostering this collaboration. This can take a few forms, notably:
- *Consortia models*, specific to an industry and region, can help to pool the costs and risks of training among multiple employers,

deliver training that is employer-informed and responsive to particular industry needs, and help workers adapt with changing skills demands. Firms may also collaborate on some aspects of R&D and tech adoption. There are promising consortia models that could be expanded or learned from, such as the Hamilton Skilled Trades and Apprenticeship Consortium, which brings together several manufacturing employers, Mohawk college and the steelworkers union. Ontario's federally-supported advanced manufacturing "supercluster" also presents an opportunity to embed a collaborative approach to training within a broader innovation agenda.

4. **A user-friendly job pathways tool to empower workers and job seekers to make informed decisions about work and learning.**

Ontarians are largely in the dark when it comes to understanding how automation is changing skills demand. This makes it challenging to effectively navigate a changing labour market, which will become even more difficult if the pace of automation accelerates. Ontarians would benefit from a job-pathways tool to help them make informed decisions about what education and employment opportunities to pursue and what risks to avoid. This tool could:

- *Provide information on job risks, opportunities, and training pathways suited to an individual's particular abilities, interests, needs and geographic location.*
- Draw on *data from multiple sources* including traditional government collected and published statistics, as well as private sources and employer surveys. It could be designed to learn what works over time.

- *Be designed, owned, and operated outside of government* to ensure agility and responsiveness to user needs, but with government support and oversight to ensure that it is developed as a public asset.
- Be developed *in collaboration with the forthcoming federal Future Skills initiative and the Labour Market Information Council.*

RISING TO ONTARIO'S DUAL CHALLENGE

In this era of automation, Ontario faces a dual challenge. Automation is essential to maintain the competitiveness of Ontario firms, particularly in the face of increased international competition and changing consumer demands. Yet Ontario businesses lag the competition in adopting and implementing technology, which puts them at a competitive disadvantage and may pose just as large a risk for workers. At the same time, automation is already disrupting some jobs and, if the pace of adoption increases as seems likely, a larger number of workers will struggle with changing skills demands and possible job loss.

The dual challenge requires a dual response—one that moves beyond incremental changes. The province needs big ideas and a coordinated, multi-sector strategy to realize them. Decision-makers in the public, private, and non-profit sectors will need to collaborate to advance technological adoption, while ensuring that workers have the skills, knowledge, and tools to adapt in the face of change and to realize their potential role in driving innovation and prosperity in the province.