

Summary of 3 December Workshop Measuring the Digital Economy – Reimagining a Digital and AI-Driven World

by Erik Bohlin and Romel Mostafa, Ivey Business School

The workshop on the theme “Measuring the Digital Economy – Reimagining a Digital and AI-Driven World” was convened on 3 December 2025, at the Ivey Donald K. Johnson Centre in Toronto. It attracted more than 70 in-person registrations and 15 webinar participants. It was the fifth Ivey Workshop on Telecommunications Policy, convened by the Ivey Chair in Telecommunications Economics, Policy and Regulation, *Erik Bohlin*, and the Director of Lawrence National Centre for Policy and Management, *Romel Mostafa*, Ivey Business School at Western University.

The workshop explored various aspects of measuring the digital economy, including challenges in capturing value from digital platforms and AI, with presentations on digital usage indices, China's digital economy, and the need for new measurement ecosystems. The discussion covered consumer welfare from digital technologies, broadband impact measurement, and AI adoption across different sectors, with particular focus on Canada's approach to measuring and developing sovereign AI capabilities. The conversation ended with conversations about the importance of balancing partnerships with major AI companies while maintaining Canadian sovereignty, along with discussions about digital adoption challenges and the need for new regulatory approaches.

In the opening address, Professor *Erik Bohlin* linked the Land Acknowledgement and its recognition of territories to both the importance of maps, and the need to update them, as some legacy maps have also been exclusionary and focused on economic extraction. Now, in the age of AI, new conceptual maps are needed, as the standard metrics such as GDP and price indices miss the mark for a digital age. While initial efforts to measure the information economy has been around for 50 years or more, there is a need to develop new thinking and analysis, together with new collaboration between stakeholders. And this workshop intends to facilitate this, through presentations and panels. Welcome to all!

Professor *Romel Mostafa*, Director of Lawrence National Centre for Policy and Management, welcomed the participants further, and elaborated upon the importance of economic measurement, reminding the audience of the 1987 Nobel Laureate Robert Solow. He emphasized the fundamental importance of technological change to explain economic growth. The recent laureates Aghion and Howitt stressed the creative destruction of new technologies as a driver of growth and transformation. All of this suggests the increasing importance of knowing where we are heading and taking account of the fundamental changes posed by AI. This workshop is one of many efforts to improve our knowledge and collaboration in this important mission.

Professor *Shane Greenstein*, Harvard Business School, presented some new research on the digital divide. His team has built and analyzed new measures of digital usage that leverage telemetry data collected by Microsoft during operating system updates across 40 million Windows devices in U.S. households. These measures of U.S. household digital usage are significantly more comprehensive than those provided by any existing commercial or government survey. We

construct representations of devices in ZIP codes and find evidence of significant variation in usage reflecting an urban-rural divide. We also show the existence of substantial disparities in usage even *within* narrowly defined Metropolitan Statistical Areas. Income and education correlate with these observed differences. These effects are large and suggest digital usage gaps that extend beyond the availability of essential IT infrastructure at the local level. These findings call for interventions beyond the traditional focus on infrastructure access and address usage and skills development. The indices are made publicly available to support future research.

Professor *Yu-li Liu*, Distinguished Professor at the School of Journalism and Communication, Shanghai University, provided insights into China's platform economy and livestreaming commerce. According to official estimates, in 2023, China's digital economy reached approximately 56.1 trillion RMB, accounting for 44.2% of GDP, driven by advances in digital infrastructure, industrial digitalization, and data governance. Major platforms such as Tencent, Alibaba, and Meituan illustrate how expansive user networks, data-driven algorithms, and integrated ecosystems generate economic value and influence consumer behavior. Livestreaming commerce, now exceeding 3.5 trillion RMB in gross merchandise value (GMV) based on industry estimates, exemplifies a rapidly growing sector that blends entertainment, social interaction, and real-time transactions. By analyzing metrics such as monthly active users (MAUs), GMV, and conversion rates, this talk illustrates how platforms and live streamers create a mutually reinforcing flywheel that drives China's digital growth, with implications for global measurement of the digital economy and the future of innovation, regulation, and user rights.

Dr. *Volker Stocker*, Research Group Head, Weizenbaum-Institute Berlin, examined emerging policy challenges in two interrelated areas: the growing complexity of technical and business relationships in AI-driven tech stacks and digital ecosystems and changing concerns about asymmetric information and transparency. With AI, we need a much better and more capable multi-stakeholder measurement ecosystem, and we need to strengthen policymakers' human multidisciplinary institutional capacity. Furthermore, agentic AI and agent-to-agent transactions could alter the economics of digital platforms by weakening attention-based platform business models, reshaping network effects, and redistributing bargaining power. The analysis concludes that as AI becomes increasingly distributed and personalized, meaningful governance requires a workable multi-stakeholder measurement ecosystem and building multidisciplinary institutional capacity to interact with this ecosystem to enable evidence-based decision-making.

Professor *Avinash Collis*, Professor, Heinz College of Information Systems and Public Policy, Carnegie-Mellon University, spoke on the topic of measuring consumer benefits of AI. He noted that AI is transforming daily life far faster than conventional economic statistics suggest. While productivity and GDP figures show only modest gains, measuring consumer welfare reveals that Americans already derived about \$97 billion in annual value from generative AI tools in 2024—more than ten times the industry's recorded revenues. In our work, we develop a new metric GDP-B (B for benefits), a complementary metric to GDP that captures the value of free and digital goods such as ChatGPT, Gemini, and Claude. Drawing on large-scale incentive compatible choice experiments across countries, we show how digital technologies and AI generate huge but largely invisible welfare gains that also reduce inequality. By augmenting production-based metrics with welfare metrics, we can gain a deeper understanding of how technological innovation truly enhances people's lives.

Professor *Elizabeth Mack*, Department of Geography, Environment and Spatial Sciences, Michigan State University, discussed challenges and opportunities on measuring broadband impact, covering both positive and negative effects. Professor Mack highlighted economic benefits, including increased productivity and GDP, while noting geographic disparities between urban and rural areas. She also discussed negative impacts such as environmental concerns from data centers and technostress, including digital addiction and mental health effects. She emphasized the challenges in measuring broadband impact, citing issues with data collection, privacy, and evolving technology. Finally, Professor Mack noted the increasing importance in measuring speed of broadband, digital skills, and challenges to understand use of broadband, when many seamless devices are being used. In the end, it is the actual use, which is of interest, but capturing the actual use can prove elusive. Data access for use is one future challenge for research, as is the many parties involved in data provision.

The first panel was moderated by *Jennifer Withington*, Acting Assistant Chief Statistician, Statistics Canada, together with *Viet Vu*, Researcher at the DAIS of TMU, *Patrick Gill*, Vice President, Business Data Lab, Canadian Chamber of Commerce, *Marie-Christine Tremblay*, Senior Policy Adviser, Bank of Canada and Chair of the G7 Finance Track's Digitalization Working Group. The panel discussed the state and measurement of AI adoption in Canada, highlighting both progress and challenges. During the panel, new initiatives such as the StatCan's Tech Stack program and upcoming surveys on AI adoption and use. The panel emphasized the need to measure AI's impact on the workforce. Concern was expressed about the uneven diffusion of AI across sectors and the need to measure both intentional and unintentional use. A new measurement framework for tracking AI related productivity developments across G7 countries, focusing on key dimensions such as infrastructure, investment, adoption and labour markets, was presented. The panelists agreed on the importance of developing a resilient measurement framework to support evidence-based policy decisions, while acknowledging the current challenges in measuring AI's intensity of use and its full impact on the economy and workforce.

The second panel was moderated by *Romel Mostafa*, Professor and Director, Lawrence National Centre for Policy and Management, with *Trina Alexson*, Head of Customer Success, Cisco, *Chris Madan*, Vice President, Customer Digital Solutions & Product, TELUS, *Costa Pantazopoulos*, Vice-President, Product, Bell Canada. The discussion focused on AI trends and infrastructure, with Trina Allison from Cisco highlighting their three-pronged approach to AI: systems for AI, AI for Cisco, and AI for customers. Chris Madan from TELUS shared their experience with AI adoption, including the development of an internal AI agent called IRIS and their approach to generative AI. Costa Pantazopoulos from Bell discussed their AI infrastructure initiatives, emphasizing productivity gains and the importance of networking infrastructure. The conversation concluded with a discussion on Canadian sovereignty in the context of AI, touching on issues like data location, regulation, and the U.S. Cloud Act. The panel members emphasized that sovereignty means complete operational control over hardware, software, networks, and staffing with Canadian teams, while also addressing sustainability through green computing and partnerships with First Nations communities. The panel concluded on the challenges and opportunities in developing sovereign AI capabilities in Canada and discussed the country's partnerships with major AI companies, emphasizing the need to balance these relationships with the goal of creating more sovereign AI solutions, and the need for strategic investments in data centers.

The workshop concluded with remarks by *Ian Scott*, former Chairperson and Chief Executive Officer, Canadian Radio-television and Telecommunications Commission (CRTC). He focused on the need to address digital adoption challenges, including affordability and digital literacy, as well as the importance of tracking who is *not* adopting AI technologies. He raised concerns about the lack of data on digital adoption and suggested that Canada needs a new approach to regulation that focuses on consumer protection and transparency rather than various forms of price control.

The workshop was adjourned shortly after 5PM.

Annex Agenda of the Day – 3 December 2025

Speaker Bios

Extensive Summary Report



MEASURING THE DIGITAL ECONOMY:

Reimagining a Digital and AI-Driven World

December 3, 2025 | Toronto, Ontario

Wednesday, December 3, 2025

12 – 6 p.m.

[Donald K. Johnson Centre, First Canadian Place / Exchange Tower](#)

130 King Street, Toronto, Ontario

Host

Ivey Business School, Western University, Ontario

Organizers

[Erik Bohlin](#), Ivey Chair in Telecommunication Economics, Regulation and Policy, and

[Romel Mostafa](#), Director, [Lawrence National Centre for Policy and Management](#), Ivey Business School

Schedule

Time	Location
12:00 – 1:00 p.m.	Welcome Buffet Lunch
1:00 – 1:10 p.m.	Welcome and Introduction Erik Bohlin, Professor and Chair in Telecommunication Economics, Policy and Regulation, Ivey Business School
1:10 – 1:30 p.m.	Opening Keynote: A New Measurement of Digital Divide Shane Greenstein, Professor, Harvard Business School
1:30 – 1:50 p.m.	Measuring the Digital Economy: Insights from China’s Platform Economy and Livestreaming Commerce Yu-li Liu, Distinguished Professor, School of Journalism and Communication, Shanghai University
1:50 – 2:10 p.m.	Measurement Challenges in the Age of AI Volker Stocker, Research Group Head, Weizenbaum-Institute Berlin
2:10 – 2:30 p.m.	Towards a New Proposal for Measuring Consumer Benefits in the Digital Economy Avinash Collis, Professor, Heinz College of Information Systems and Public Policy, Carnegie Mellon University
2:30 – 2:55 p.m.	Coffee Break
2:55 – 3:10 p.m.	Measuring Broadband: Impact: Challenges and Opportunities (virtual) Elizabeth Mack, Professor, Department of Geography, Environment and Spatial Sciences, Michigan State University
3:10 – 4:00 p.m.	Panel: Where Are We Now? Digital Metrics Today Moderated by Jennifer Withington, Acting Assistant Chief Statistician, Statistics Canada Patrick Gill, Vice President, Business Data Lab, Canadian Chamber of Commerce Marie-Christine Tremblay, Senior Policy Advisor and Chair of the G7 Central Banks’ Digitalization Working Group, Bank of Canada Viet Vu, Researcher at the DAIS of TMU

4:00 – 4:50 p.m.	<p>Panel: Reimagining Canada’s Digital Economy: Building the Infrastructure for AI-Driven Innovation and Adoption</p> <p>Moderated by Romel Mostafa, Professor and Director, Lawrence National Centre for Policy and Management, Ivey Business School</p> <p>Trina Alexson, Head of Customer Success, Cisco</p> <p>Chris Madan, Vice President, Customer Digital Solutions & Product, TELUS</p> <p>Costa Pantazopoulos, Vice-President, Product, Bell Canada</p>
4:50 – 5:05 p.m.	<p>Conclusions and Outlooks: Implications for Canada</p> <p>Ian Scott, former Chairperson and Chief Executive Officer, Canadian Radio-television and Telecommunications Commission</p>
5:05 – 6:00 p.m.	<p>Networking Reception with Cocktails and Hors d’oeuvres</p>

Speakers



Trina Alexson brings over three decades of experience in the information technology industry, including a tenure at Cisco since 1996. Trina is head of customer success for Cisco's North American service provider segment. Prior to her current role, she led software development teams, spearheading the creation of high-availability features for Cisco's leading routing platforms. A graduate of Memorial University of Newfoundland with a Bachelor of Engineering, she also holds an MBA from the Richard Ivey School of Business at the University of Western Ontario. Driven by her passion for fostering the inclusion of women in IT, Trina co-authored "Bit by Bit," a book designed to inspire young women aged 15 to 25 to pursue careers in technology.



Erik Bohlin is Professor and Chair in Telecommunication Economics, Policy and Regulation at the Ivey Business School. He is an expert in telecommunications policy, an inter-disciplinary topic concerned with the impact of digitalization in the economy and society. He is Editor-in-Chief of *Telecommunications Policy*, a premier journal in the field. He is on leave as Professor at Chalmers University of Technology, Sweden. His graduate degree is in Business Administration and Economics at the Stockholm School of Economics (1987) and his Ph.D. is from Chalmers University of Technology (1995). He is a Member of the Swedish Royal Academy of Engineering, and Past Chair of the International Telecommunications Society, an inter-disciplinary professional society convening conferences on the evolving digital society and policy needs.



Avinash (Avi) Collis is an Assistant Professor at the Heinz College of Information Systems and Public Policy at Carnegie Mellon University. He holds a Ph.D. in Management Science from MIT Sloan School of Management. His research interests include the economics of digitization, focusing on measuring the welfare gains from digital goods. His research has been covered in major media outlets and policy reports, including the New York Times, Wall Street Journal, Washington Post, The Economist, CNN, BBC, Financial Times, Bloomberg, and NPR, and reports by the US White House, Federal Reserve, Senate, and UK Treasury. He was a member of the Federal Economic Statistics Advisory Committee (FESAC), which advised the Department of Commerce, BEA, BLS, and U.S. Census.



As a career-long innovator and intrapreneur, **Patrick Gill** has founded five national initiatives aimed at helping Canadian businesses compete and prosper globally. Among these, he co-founded the Canadian Chamber's Business Data Lab (BDL), an initiative dedicated to democratizing data for decision-making and advancing the country's understanding of Canadian business conditions and trends. Patrick's work has established him as a recognized thought leader, frequently featured in the media and think tank publications. Most recently, he authored BDL reports on business adoption of generative artificial intelligence—"Prompting Productivity"—and on scaling small businesses—"Scaling Success." He holds a master's degree in public policy and an advanced certificate in public administration and governance from Toronto Metropolitan University.



Shane Greenstein is the Martin Marshall Professor of Business Administration. He teaches in the Technology, Operations, and Management Unit. Encompassing a wide array of questions about microelectronics, computing, communication, and internet markets, Professor Greenstein's research extends from economic measurement and analysis to broader issues. His most recent book, *How the Internet Became Commercial* (2015, Princeton University Press), won the 2016 Schumpeter Prize for best book. Many media outlets cover his work. Professor Greenstein previously taught at the Kellogg School of Management, Northwestern University, and at the University of Illinois, Urbana/Champaign. He received his Ph.D. from Stanford University and his BA from the University of California at Berkeley, both in economics. He continues to receive a daily education in life from his wife and children.



Dr. **Yu-li Liu** is a Distinguished Professor at the School of Journalism and Communication at Shanghai University (SHU). She joined SHU in July 2023 after serving as the Head and Professor of the Department of Media and Communication at City University of Hong Kong. Prior to that, she held the position of Distinguished Professor and Vice President for Research and Development at National Chengchi University in Taiwan. Currently, she serves as the Associate Editor of the *Journal of Telecommunications Policy* and is a member of the editorial boards of five other notable international journals. Her research interests encompass AI ethics and governance, telecommunications law and policy, and new media business strategies.



Elizabeth Mack is a Professor in the Department of Geography, the Environment, and Spatial Sciences at Michigan State University where she teaches courses in economic geography. Dr. Mack's research utilizes mixed methods to understand the evolution of the economy in the face of rapid technological change and climate change. Research on technological change evaluates the impact of information and communications technologies (ICTs) on the development trajectory of regional economies and everyday work. Her work on the environment and climate change evaluates household responses to changing environmental contexts, as well as uses and the ability to pay for water services. Dr. Mack's research has been funded by a variety of agencies including the National Science Foundation (NSF), the United States Department of Agriculture (USDA), the National Aeronautics and Space Administration (NASA) and the Kauffman Foundation for entrepreneurship research.



Chris Madan leads TELUS Digital with accountability for the digital client experience and commercial outcomes. Chris is best known for his visionary leadership focused on delivering large scale transformational change to meet the evolving consumer needs and his ability to drive business impact to succeed in a competitive market. A connector, educator and motivator of people and groups, Chris takes great pride in the top-performing teams he's built and championed over the years. As a successful visible minority leader Chris is committed to inclusion and has chaired a number of diversity groups with organizations he has worked for. Chris holds a number of professional designations in accounting and marketing, serves as a member of a not-for-profit board and audit committee in the medical field and holds a MBA from the Richard Ivey School of Business. Apart from work, Chris is a sought out industry expert and speaker at conferences across North America –and last but not the least -Chris is the proud father of 2 brilliant young ladies, NBA couch expert and an avid cricket player who spends most weekends at cricket pitches across the Greater Toronto Region.



Romel Mostafa is an Assistant Professor of Business, Economics and Public Policy at the Ivey Business School. Romel's areas of research and expertise include strategy & capability development in new firms, innovation & competitive dynamics, industrial evolution & policy, as well as behavioural decision-making. He has published in several leading academic journals, including Academy of Management Journal, Journal of Behavioral Decision Making, Journal of Risk & Uncertainty, Organization Science and Management Science. His research and commentaries have been featured in global media outlets such as CNN, NPR and the New York Times. Romel has taught both at graduate and undergraduate levels, and received

several teaching awards. He obtained his PhD and MSc from Carnegie Mellon University, and BA from Lawrence University. As the Director of Ivey's Lawrence National Centre for Policy and Management, Romel spearheads the Centre's research, outreach and teaching initiatives. The Centre advocates for sound policy and corporate action towards unlocking national competitive advantage, by focusing on critical challenges and opportunities around digital, trade and social infrastructural pillars.



Costa Pantazopoulos is Vice President of Enterprise Products for Bell Canada, helping lead innovation and growth for Canada's enterprise sector. With Bell since 2008, Costa is driving Bell's evolution through AI-powered solutions, positioning Bell as a trusted partner for digital modernization. He spearheads product strategy and partnerships with global technology leaders, enabling scalable, customer-centric offerings that differentiate Bell in a competitive

market. Known for his collaborative approach, Costa brings a pragmatic yet insightful perspective on AI adoption and enterprise transformation, making him a sought-after voice on intelligent connectivity and the future of telecom. Costa is based in Montreal and holds a bachelor's degree in computer engineering from McGill University and an MBA from the University of Vermont.



Ian Scott has over 25 years of policy and regulatory experience in broadcasting and telecommunications both in the public and private sectors. Most recently, Mr. Scott served as the Chairperson and Chief Executive Officer of the Canadian Radio-television and Telecommunications Commission. Mr. Scott was appointed by the Governor-in-Council on July 14, 2017 and led the organization from September 2017 to January 2023. Earlier in his career, Mr. Scott worked at the

Competition Bureau in both the Regulated Industries Branch and the Mergers Branch. After working at the Competition Bureau, he joined the CRTC from 1990 to 1994, where he collaborated on the development of a framework for long-distance telephone service competition in Canada. Between 2007 and 2008, as part of the Executive Interchange Program, he was Senior Policy Advisor to the Chairman at the CRTC. Before rejoining the CRTC in 2017, Mr. Scott held various executive positions in the communications industry, including at Telesat Canada, Telus and Call-Net Enterprises, one of the first companies to offer competition in the Canadian long-distance market. He also provided leadership on broadcasting policy and regulatory issues as an executive at the Canadian Cable Television Association. Mr. Scott has served on various boards, including Women in Communications and Technology, the International Institute of Communications, Canadian Aerospace Association and Ski Quebec Alpin, and holds a bachelor's degree in political science from McGill University.



Volker Stocker heads the multidisciplinary research group “Digital Economy, Internet Ecosystem, and Internet Policy” at the Weizenbaum Institute for the Networked Society (German Internet Institute) in Berlin. He is also a senior researcher in the Internet Architecture and Management Group at TU Berlin; an associated researcher at the Max Planck Institute for Informatics; a research fellow at the Quello Center at Michigan State University; and an affiliated scholar

with the Dynamic Competition Initiative (UC Berkeley & EUI). Additionally, he serves on the board of the International Telecommunications Society (ITS) and is Co-Chair of ITS Europe. An economist by background, Volker takes an interdisciplinary approach in his research, combining different areas of expertise and methods to investigate critical issues related to the digital economy at the intersection of technology, economics, and policy. His recent research focuses primarily on economics, evolution, and regulation of digital infrastructures, platforms, and technologies, as well as the Internet ecosystem.



Marie-Christine Tremblay is a Senior Policy Advisor in the Bank of Canada’s International Economic Analysis Department. In this capacity, she chairs the G7 Finance Track Digitalization Working Group, advancing G7 insights on the implications of AI for productivity and financial stability. Previously, Ms. Tremblay served as a Director in the Bank’s Financial Stability Department, where she led pioneering work on the macroeconomic and financial system impacts of climate

change. She played a key role in disseminating this work, notably by co-leading a related workstream at the Financial Stability Board. Ms. Tremblay has extensive experience in working on an array of global and economic analytical issues. Previously she held management positions at Finance Canada, Environment and Climate Change Canada, and the Treasury Board Secretariat of Canada. She served as a Head of Division at the OECD, leading and participating in several analytical initiatives, including through collaborations with international partners such as the International Energy Agency (IEA), the IMF and the World Bank. She recently served as guest editor for the journal of Energy Economics. Ms. Tremblay holds a BA in Economics from the University of Ottawa, an MA in Economics from Simon Fraser University, and a PhD in Economics from Université Laval.



Viet Vu (he/him) leads economics research at the Dais as Manager, Economic Research. Prior to the merger, at the Brookfield Institute, Viet has done extensive work on the impact of technology in the labour market in Canada, the technology sector and workers, digital skills, and scale-ups. His research has been cited widely in national media, and has impacted policies at all levels of government. He believes that research, when done

rigorously, can not only help shape policy, but also bring attention to issues that impact those who have been left out of conversations about Canada’s future. Viet holds a Masters of Science in

Economics from the London School of Economics & Political Science, and a Bachelor of Arts with Honours in Economics from the University of British Columbia. Being a queer immigrant to Canada, Viet also devotes significant attention to ensuring the field of economics is inclusive to all. He sits on the Canadian Economics Association's Diversity committee, and co-chairs the Affinity groups working group.



Jennifer Withington is the Assistant Chief Statistician responsible for Economic and Environmental Statistics at Statistics Canada. She has been working at Statistics Canada for over 25 years. As an executive since 2016, Jennifer has held various roles including Director General of the Macroeconomic Accounts, and Director of the International Accounts and Trade Division. She is responsible for key economic indicators such as the Consumer Price Index, Gross Domestic Product, and International Merchandise Trade. Jennifer represents Statistics Canada on several International Committees including the United Nations (UN) Advisory Expert Group on National Accounts and the Group of Experts on National Accounts. Jennifer holds a bachelor's degree in economics and political Science as well as a master's degree in economics from McGill University.

Draft annex to Summary Report 8 December Workshop Measuring the Digital Economy – Reimagining a Digital and AI-Driven World

Generated by AI tools, and edited by MSc Noor Us Sahar, Ivey Business School, with support by Erik Bohlin, Ivey Business School

Opening Addresses:

Speaker: Erik Bohlin, Professor and Chair in Telecommunication Economics, Policy and Regulation, Ivey Business School

Erik Bohlin opens with a land acknowledgment of Indigenous territories, emphasizing that maps are never neutral—they are assertions of what we value. Historically, Canada's economic maps measured resources like timber and fur but often erased Indigenous nations already present. Today, we must ensure new digital economy metrics capture the full reality of communities rather than repeating past exclusions.

Bohlin presents a striking metaphor: imagine understanding a modern megacity using a 1930s map. Similarly, traditional measures like GDP and price indices struggle to capture the AI-enabled economy where valuable tools have zero marginal costs, digital transformation is society's foundation, and AI's impact on work and welfare remains largely invisible. The old maps leave vast territory unmapped.

The workshop addresses critical questions: What is really present in the AI economy? How do we move from metrics to mandates for shaping the future? What are the research implications? Bohlin connects this quest to Canadian intellectual foundations, noting Marc Porat's 1977 seminal work on the information economy and the presence of Professor Heather Hudson, whose advisor Edwin B. Parker also advised Porat, creating direct links to the pioneers who first grappled with measuring information economies. The workshop aims to imagine new maps and address challenges with current ones, building on nearly 50 years of Canadian leadership in this critical endeavor.

Speaker: Romel Mostafa, Director, Lawrence National Centre for Policy and Management, Ivey Business School

Romel Mostafa builds on Erik's framing by grounding the measurement challenge in economic theory. He invokes Robert Solow, who famously identified that long-run growth comes from capital, labor, and a mysterious "residual" called technology—which turned out to be the biggest growth driver, opening vast research frontiers. This year's Nobel laureates, Aghion and Howitt, revived Schumpeter's creative destruction, making innovation endogenous—driven by R&D, skills, and competition rather than falling from the sky.

Their work reveals why measurement gaps persist: innovation improves quality, but GDP struggles to capture it; creative destruction reshuffles industries, but statistics lag behind

intangible businesses; and human capital matters, but we count degrees instead of digital fluency or ability to work alongside algorithms. If Solow showed we were missing technology's role, Aghion and Howitt explain why we keep missing it.

The digital economy challenged metrics even before AI—zero-price services, data as both input and asset, intangible capital invisible on balance sheets, and platform value from networks rather than production. GDP was designed for steel mills, not server farms. AI widens the gap: it's part labor, part capital, and partly a thinking system our statistical manuals lack categories for. It produces quality gains GDP rounds to zero and scales almost costlessly once trained.

This isn't academic. Policymakers rely on measurement like engineers rely on sensors. If sensors don't capture the right signals or are calibrated for a vanished world, the dashboard distorts reality. Our economic sensors were built for industrial economies, yet we're steering digital ones. This creates three major policy challenges: R&D incentives subsidizing traditional innovation while missing intangible investments; platform regulation risking regulating shadows instead of structures; and AI governance where poor measurement leads to misjudged labor transitions and widening digital divides.

If we can't measure the digital economy, we struggle to govern it. The gap between reality and observation widens as transformation accelerates. The workshop matters but it won't solve everything today. Conversations like today help us see the economy as it is, enabling policy to respond to what it's becoming.

Concluding, in bringing these foundational perspectives together, Erik Bohlin and Romel Mostafa have effectively charted the intellectual and practical terrain of this pivotal workshop. From Bohlin's compelling call to recognize that maps—whether of land or data—are never neutral but reflections of power and value, to Mostafa's rigorous economic diagnosis of why our measurement tools are failing in an age of intangible assets and AI, a clear and urgent mandate emerges. We are navigating a new world with outdated instruments, risking policies that are misaligned, inequitable, and ineffective.

Yet, as both speakers underscored, this is not uncharted territory—it is a challenge with deep Canadian roots, stretching back nearly half a century to pioneers who first sought to measure the information economy. Today, we stand on that legacy, tasked with drawing new maps that are inclusive, dynamic, and capable of capturing the full spectrum of value in a digital society. This workshop is not about finding immediate answers, but about beginning the essential work of recalibrating our sensors—so we can see clearly, govern wisely, and ensure that the future economy reflects the realities and aspirations of all its people.

A New Measurement of Digital Divide

Speaker: Shane Greenstein, Professor, Harvard Business School (Technology Operations and Management)

Shane Greenstein presents groundbreaking research on measuring the digital divide through an unprecedented collaboration with Microsoft, focusing on actual usage patterns rather than simple access metrics. This joint work involves multiple co-authors, with Marianna Pira as the primary author, along with Rafael Sadun, Sonny Tombe, and several Microsoft statisticians. The research team gained access to Microsoft's telemetry data from approximately 40 million laptops with personal licenses across the United States, representing one of the most comprehensive datasets ever assembled for understanding digital engagement at the household level.

The research faced significant challenges due to the highly sensitive nature of the data. External researchers were never allowed to directly view the raw data, requiring all analysis to be conducted through Microsoft's internal statisticians with a six-week lag between questions and answers. The data captures system calls made by the operating system, measuring minutes of usage across different application categories at the zip code level. To protect privacy, the team applied differential privacy protections and excluded zip codes with fewer than 50 Microsoft-licensed laptops, ultimately covering 28,199 zip codes across the United States.

The methodology involves creating two distinct usage indices based on established digital literacy frameworks. The Media and Information Composite Index (MCI) measures basic digital skills, essentially capturing word processing and spreadsheet usage through seven categories of system calls. The Content Creation Index (CCI) measures advanced skills including tools like Adobe Creative Suite, developer tools, and cloud storage, built from five categories of system calls. The construction process involves calculating weighted averages using time spent in each category, with weights derived from principal component analysis of the entire population, then aggregating households within each zip code while adding noise for privacy protection.

The research produces several striking findings that challenge conventional wisdom. Most notably, broadband availability shows no correlation with PC usage, fundamentally contradicting the assumption that infrastructure access alone drives digital engagement. This suggests the digital divide is not primarily an access problem but reflects deeper patterns of engagement and capability. The data reveals an urban-rural divide, though Greenstein emphasizes it is subtle rather than stark. Urban areas show higher average usage on both indices, but distributions overlap significantly, with some rural areas showing high usage and some urban areas showing low usage. Geographic maps show rural and agricultural regions display lighter usage, while dense urban areas show higher usage. The two indices are positively correlated but not highly correlated, suggesting different skills are distributed differently across the population.

Examining metropolitan areas like Chicago reveals significant variation within cities, demonstrating that digital engagement is not uniform even in wealthy urban centers. This intra-urban variation suggests targeted interventions may be necessary even within traditionally well-connected cities. The statistical analysis examines correlations with various demographic variables including income, education, age, race, broadband availability, and population levels. Univariate correlations show many statistically significant relationships, but multivariate

regression reveals far fewer significant coefficients, indicating high multicollinearity among demographic features. This means simple pairwise correlations are misleading for policy purposes.

The regression results show that MCI usage is predicted by high income, high education, urban location, and high population density. However, CCI usage is predicted mostly by urban location alone, showing much weaker relationships with traditional socioeconomic factors. This divergence suggests basic usage and content creation skills have fundamentally different drivers, requiring distinct policy approaches.

The policy implications are profound. Infrastructure investment alone is insufficient since broadband availability does not correlate with usage. Policymakers must address deeper barriers beyond connectivity. The misleading nature of univariate correlations means simple demographic targeting may be ineffective, requiring nuanced, evidence-based interventions. Different skills need different approaches—programs for basic digital literacy require entirely different strategies than those developing advanced content creation skills. Finally, significant intra-urban inequality means even wealthy metropolitan areas need targeted attention.

This research represents a significant methodological innovation, creating the first-ever durable benchmark of this type with near-census level coverage. Most importantly, Greenstein emphasizes the team is releasing the data publicly and freely, encouraging other researchers to conduct additional analyses. He acknowledges they have "just scratched the surface" and want to enable more sophisticated policy evaluations.

Greenstein's core message fundamentally reframes understanding of the digital divide. The divide reflects deeper patterns of education, income, and urbanization that cannot be solved merely by deploying broadband networks. Understanding actual usage patterns, not just availability, is critical for effective policy intervention. The research reveals that basic digital skills and content creation skills have different geographic and demographic distributions requiring distinct policy approaches. By making this data freely available, the team hopes to enable evidence-based policymaking that addresses the true nature of digital inequality based on actual usage patterns rather than assumptions about infrastructure access.

Measuring the Digital Economy: Insights from China's Platform Economy and Livestreaming Commerce

Speaker: Yu-li Liu, Distinguished Professor, School of Journalism and Communication, Shanghai University

Professor Yu-li Liu brings a communication scholar's perspective to measuring China's digital economy, focusing on two interconnected engines: the platform economy and livestreaming commerce. She acknowledges being a communicator rather than an economist, hoping to stimulate discussion about measurement challenges in the world's second-largest digital economy.

China's digital economy accounts for approximately 43% of its GDP, representing a massive component of the national economy. However, traditional indices miss crucial aspects, including data, algorithms, trust, user interaction, and ecosystem effects. While some frameworks propose five dimensions for measuring the digital economy—infrastructure, industry scale, technological innovation, integration and application, and development environment and governance—these remain limited in capturing the full picture of digital value creation.

The fundamental problem is that traditional metrics like GDP are production-based and focus on priced market output, thereby missing digital value creation. AI-driven automation changes labor efficiency and transaction costs in ways that don't appear in conventional statistics. Digital value increasingly comes from free services, algorithmic efficiency, and productivity improvements not sold as goods. Platform activities generate intangible, data-driven outputs, while livestreaming commerce creates real-time behavioral value not captured in official statistics.

Liu frames her analysis around two "engines" that reinforce one another. The platform economy functions like the operating system of digital life—foundational infrastructure for economic activity. Livestreaming commerce represents the "show"—engagement, transactions, and community building. These engines create a powerful flywheel effect, driving innovation and consumption. China's platform economy has reached an extraordinary scale, with online retail sales exceeding 2 trillion USD, representing 30% of total retail.

Liu presents three detailed platform case studies. First, Tencent's WeChat ecosystem functions as a closed-loop, self-sustaining digital universe combining elements of Meta, Apple, Google, and Amazon. WeChat owns the primary social relationships, financial transactions, and digital routines of an entire nation. Without WeChat, many everyday activities in China would be highly inconvenient, as it functions as a core platform underpinning daily social and economic life.

Second, Alibaba owns digital real estate through platforms like Taobao (consumer-to-consumer) and Tmall (business-to-consumer). The ecosystem attracts merchants, monetizes matchmaking between buyers and sellers, and then reinvests to improve infrastructure. Alibaba has expanded well beyond e-commerce into cloud computing, digital finance, logistics, and smart services, illustrating the evolution of a diversified platform ecosystem.

Third, Meituan combines food delivery, local services, travel, mobility, and instant retail. It captures data on what sells, when, and where with every order, and has built a "last mile army"—an extremely fast delivery network. This integration of multiple service categories with logistics infrastructure exemplifies comprehensive digital ecosystems.

Livestreaming commerce represents the second major engine, providing real-time video broadcasts where hosts showcase products, interact with viewers, and drive immediate sales. Liu describes it as "the theater of shopping," combining entertainment, community, and instant gratification. The explosive growth has made it a massive component of digital China, though it complicates measurement because it spans multiple sectors simultaneously—retail, advertising,

services, and creator labor. Value is created through attention, trust, and recommendations rather than traditional production.

Liu presents two compelling livestreaming cases. First, a host sold 15,000 lipsticks in five minutes to millions of viewers, demonstrating the power of "trust capital." Even Liu herself felt the instinct to buy. Second, a knowledge-based approach in which the host teaches English while demonstrating products, providing educational value rather than competing solely on low prices. This creates a real-time learning experience that viewers enjoy while shopping.

The interaction between these engines creates a "dual engine flywheel." Platforms provide the stage, rules, traffic, and infrastructure. Livestreaming provides a dynamic, high-growth application layer. This symbiotic relationship creates a flywheel effect in which each engine reinforces the other, accelerating digital economic growth in ways that traditional metrics struggle to capture.

Liu concludes that China's digital economy is massive, structurally important, and uniquely powerful. Platforms function as foundational infrastructure while livestreaming provides dynamic consumer engagement. Future growth depends on balancing innovation and regulation. When questioned about regulatory oversight, Liu acknowledges that privacy is the biggest issue, noting challenges with data integrity and the spread of fake information. She points out that data privacy issues exist globally and asks whether audiences actually read privacy statements. Data has become an asset, with companies monetizing user characteristics for marketing purposes across all markets.

Liu's core message is that China's digital economy operates through fundamentally different mechanisms than traditional economies, requiring new measurement frameworks that can capture value created through platforms, data, algorithms, trust, and real-time engagement rather than conventional GDP metrics.

Measurement Challenges in the Age of AI

Speaker: Volker Stocker, Research Group Head, Weizenbaum Institute Berlin

Volker Stocker brings a multidisciplinary perspective from his work with computer scientists, engineers, and lawyers at the Weizenbaum Institute to address the fundamental measurement challenges posed by AI technologies. His central premise is that we often face a paradox of knowledge: "We don't know what we need to know, because we don't know that we don't know." Once we identify what needs measuring, we must obtain information and validate its accuracy, creating layers of complexity in understanding AI's true impact.

Generative AI has been deployed across all layers of the AI stack—from self-adjusting networks to consumer-facing applications—fundamentally changing how we produce and consume content. The critical challenge is that much of this diffusion occurs invisibly, blending online and offline worlds. People may unknowingly be influenced by AI-generated content in conversations,

making it extremely difficult to trace diffusion patterns and track the technology's true reach and impact.

The complexity of what Stocker calls the "fabric" of technical and business relationships in AI-driven technology stacks is unprecedented. He illustrates this with examples of foundation model development partnerships, where companies like Amazon and Google are simultaneously involved with Anthropic and other AI ventures in complicated, overlapping arrangements. This creates intricate dependency structures that defy traditional industry boundaries and market definitions. The conventional frameworks of competition and cooperation no longer adequately capture these dynamics, requiring new ecosystem and "co-opetition" lenses to understand how dependencies and interdependencies evolve—often only becoming visible when something goes wrong, similar to cybersecurity vulnerabilities or financial system failures.

Generative AI makes these complexities worse by changing power dynamics within ecosystems through numerous partnerships and vertical integrations. At the substrate level, clouds, data center networks, and algorithmic systems of large tech companies (hyperscalers) have become so central and capable that much innovation simply builds on top of these foundations, creating new dependency structures and concentrating control. Lines between private and public infrastructure blur, raising questions about what falls under which regulatory frameworks and what may be avoiding regulatory oversight entirely. Stocker emphasizes this trend has been developing for years, not appearing suddenly with generative AI.

The measurement challenges are substantial and multifaceted. First, AI systems based on deep neural networks are inherently opaque, creating fundamental transparency problems. Second, literacy gaps are emerging—while natural language interfaces make AI easy to use, understanding what it means to use these tools meaningfully remains difficult. Third, a "distinguishability conundrum" exists where people cannot determine what content is AI-generated versus human-created, making it nearly impossible to attribute value accurately. Fourth, an "alignment conundrum" arises when we use AI agents believing we are principals, but these systems have value judgments and objective functions shaped by others whose interests may not align with ours.

Stocker introduces the concept of "double agent problems" and "shadow principles"—hidden influences we cannot measure or detect. AI agents may not work in our best interests due to biased training data, selective information retrieval, or algorithmic manipulation, yet the more autonomous these agents become, the harder it is to verify and control their behavior. This creates dangerous co-evolution dynamics where humans shape AI, but AI simultaneously shapes us through feedback loops that may entrench biases, incompetencies, or manipulations we cannot detect. Users become more vulnerable the longer they rely on these tools.

From a platform economics perspective, if AI agents handle multi-step workflows without human attention and engagement, traditional metrics measuring impressions, clicks, and engagements become meaningless. Advertising budgets may shift to model providers and data

providers rather than websites. When agents negotiate with each other on our behalf, markets shift from transparent pricing to bilateral bargaining based on agent strength—computer science simulations already show those with stronger agents gain better outcomes, creating potential new divides.

Stocker's research team evaluated large language models for "sycophancy"—the tendency to flatter users even by deviating from truth—and discovered that while researchers measure this phenomenon, they conceptualize and measure it in completely different ways despite using the same terminology. Their experiments with German political alignment showed that lightweight prompting interventions can easily steer models toward different political positions, demonstrating both product differentiation potential and significant risks depending on who controls these steering mechanisms.

The solution requires building a multi-stakeholder measurement ecosystem that enables the capacity to detect problems, protect against harms, and act appropriately. Detection is critical—as Stocker emphasizes, solving the wrong problem statement yields meaningless results regardless of analytical sophistication. Policymakers must develop multidisciplinary institutional capacity to interact with measurement ecosystems, knowing which questions to ask and whether responses are valid and interpretable.

Stocker warns against binary framings and false dichotomies in AI discussions—such as "open versus closed" models, "biased versus unbiased," or "transparent versus opaque." These oversimplified categories are polarizing and unconstructive. Europe's AI Act provides exemptions for "open" models, but widespread "open washing" occurs where companies claim openness without substance. The measurement framework must acknowledge gradients and nuances rather than forcing complex realities into binary categories.

His core message is that AI measurement challenges fundamentally stem from the technology's opacity, our literacy gaps, distinguishability problems, alignment issues, and the distributed nature of AI interactions that create personalized experiences impossible to audit uniformly. Without robust measurement infrastructure involving cooperation between companies with data, regulators with authority, and researchers with expertise, we cannot properly detect problems, protect stakeholders, or act effectively to govern AI's societal impact.

Towards a New Proposal for Measuring Consumer Benefits in the Digital Economy

Speaker: Avinash Collis, Professor, Heinz College of Information Systems and Public Policy, Carnegie Mellon University

Avinash Collis addresses a fundamental paradox in measuring the digital economy: despite massive adoption of digital technologies like AI, traditional productivity statistics show minimal impact. His research directly tackles Robert Solow's famous 1980s observation that "we see the computer revolution all around us, except in productivity statistics." While some productivity benefits eventually materialized, the information sector's share of the U.S. economy has

remained relatively flat at 4-6% for over 40 years, with similar patterns in Canada. This disconnect exists because metrics like GDP and productivity measure the production side of the economy, not the consumer welfare gains that people actually experience when using digital technologies.

The gap between production metrics and consumer benefits is especially critical in the AI era. ChatGPT achieved the steepest adoption curve in history, reaching 100 million users within two months. Today, 10% of humanity uses ChatGPT weekly, with 150 million active users in just three years. In the U.S., approximately 40% of adults use generative AI tools regularly every week, with adoption curves steeper than those for the internet or computers themselves. Yet productivity impacts remain invisible because transformative technologies typically follow a J-curve pattern—initially, there's experimentation, learning, and business process changes that may even cause productivity declines before benefits emerge after a lag. Collis suggests we're still in the "dip phase" of AI adoption, experimenting and playing around, meaning productivity gains won't appear for 5-10 years.

However, consumer welfare benefits are already large and visible. When 40% of Americans use AI weekly and 10% of the world uses it actively, people are clearly deriving substantial value even before productivity gains materialize. Collis emphasizes this is not to say productivity and GDP are mismeasured—they're measured reasonably well for their intended purpose of capturing production. The problem is we lack complementary metrics measuring the consumer benefit side, which is where most value actually resides. According to estimates by Bill Nordhaus examining major 20th-century technological innovations, 97% of benefits went to consumers while only 3% went to producers. This pattern is especially important for generative AI, where according to OpenAI data, 70% of ChatGPT usage is non-work related—people planning trips, writing better emails and messages—representing pure consumer surplus not captured in productivity statistics.

Collis has spent several years developing methodology to directly measure consumer welfare rather than inferring it from production measures. His approach runs large-scale online choice experiments that function like surveys but with a crucial difference: since there are no market prices for digital goods like WhatsApp, Facebook, or Google Search, he asks people to make choices between keeping access to goods or giving them up in exchange for randomly varied cash amounts. By aggregating data across many people, researchers can estimate demand curves, creating price and quantity data even without market transactions. This can be done with real incentives, actually paying people cash and making them give up tools, which Collis has implemented in some studies.

Results from 2022 studies measuring consumer surplus from 10 popular digital goods—including Google Search, Google Maps, TikTok, Facebook, and WhatsApp—showed these tools generated approximately \$1.3 trillion in consumer welfare in the U.S. and \$125 billion in Canada. When examining welfare gains as percentages of overall economies, lower-income

countries in the sample like Mexico appeared to benefit disproportionately more relative to income compared to higher-income countries. The intuition is straightforward: in the physical world, higher-income countries have better homes and cars, but in the digital world, everyone gets the same Google search, WhatsApp, YouTube, and ChatGPT quality. Since prices are zero and quality is uniform regardless of income, people in lower-income countries get disproportionately more consumer surplus relative to their income. Once accounting for these gains, inequality across countries and within income levels appears lower than suggested by income data alone.

Collis has developed a new metric called "GDP-B" (where B stands for benefits) that measures benefits from free and new digital goods. Incorporating these estimates into the framework shows that from 2004-2017, Facebook alone contributed 0.05 to 0.11 percentage points of annual GDP-B growth in the U.S. Smartphone cameras produced significant gains—20-25 years ago only a few billion photos were taken globally; now trillions are taken with everyone having camera access. Similarly, WhatsApp, Google Maps, and other apps show significant welfare growth not captured in traditional GDP.

Applying this methodology to generative AI tools in late 2024, Collis found that among users, the average person needs approximately \$98 to give up these tools for one month—a proxy for consumer surplus. With 40% of Americans using AI weekly, this translates to approximately \$97 billion in consumer surplus generated in 2024. Meanwhile, all major Gen AI companies combined generated only about \$7 billion in revenue (mostly from API access, not consumer subscriptions). This means 93% of welfare gains went to consumers, with only 7% captured by firms—remarkably consistent with Nordhaus's historical 97-3 split.

Collis emphasizes the need for a dashboard of metrics rather than replacing GDP. Production metrics remain essential and well-measured, but we also need welfare metrics and well-being metrics (measuring happiness and life satisfaction from subjective perspectives). Looking only at production misses all welfare gains, but examining welfare alone misses important dimensions—the well-being side could be very different. For instance, while people derive substantial consumer surplus from social media and AI tools, research on youth mental health impacts from social media suggests potential negative well-being effects that wouldn't appear in economic welfare calculations.

When questioned about AI risks and whether productivity gains might be offset by cognitive impacts, Collis acknowledges this as unexplored territory. He references MIT Brain Lab research on how AI interaction might affect human cognitive capacity, potentially enabling firms with market power to extract welfare back. However, he notes we're in early stages—educators are adapting teaching methods, and just as society learned to integrate calculators productively, there's potential to reach a stage where AI complements rather than substitutes for human capabilities. The challenge is designing assignments and courses where AI enhances rather than

replaces learning, which requires navigating the J-curve dip phase before reaching optimal integration.

Regarding the lower consumer surplus findings in lower-income countries, Collis clarifies this reflects two factors: quality differences (search engines work poorly in Sub-Saharan Africa due to lack of local language content, though AI performs comparably) and the sample limitation—their lowest-income country was Portugal, not representing truly low-income populations. OpenAI data suggests middle and high-income countries show similar absolute ChatGPT usage levels, meaning relative benefits would indeed be higher for middle-income users. However, the pattern breaks down in very low-income countries lacking high-speed internet infrastructure and sufficient training data.

Collis's core message is that traditional economic measurement captures production well but systematically misses the consumer welfare side where most digital economy value resides. His research provides methodology and evidence for measuring these benefits directly, revealing that consumer surplus from digital technologies—especially AI—is already substantial and growing, even as productivity impacts remain years away. Policymakers need comprehensive dashboards including production, welfare, and well-being metrics to understand the full picture of digital technology's impact on society and make informed decisions about technology adoption, regulation, and investment priorities.

Measuring Broadband Impact: Challenges and Opportunities

Speakers: Elizabeth Mack, Professor, Department of Geography, Environment and Spatial Sciences, Michigan State University

Elizabeth Mack, joining the workshop virtually from Michigan State University, provides a comprehensive overview of broadband impact measurement, drawing from extensive interdisciplinary literature spanning economics, technology policy, and information technology communities. Her presentation balances documenting established positive economic impacts with highlighting negative consequences often overlooked in policy discussions, while identifying critical measurement gaps that must be addressed as technology continues evolving rapidly.

Established Economic Benefits of Broadband

Mack begins by acknowledging that while broadband's economic impacts were initially invisible in statistics (echoing Solow's famous paradox), recent studies have conclusively quantified positive effects. Research demonstrates broadband generates measurable impacts on productivity and gross domestic product, with the Trump et al. study providing OECD country-level analysis showing consistent patterns across developed nations. Studies document job creation resulting from enhanced broadband availability, and research establishes correlations between broadband access and higher incomes. The general consensus across vast literature confirms positive economic impacts.

However, important geographic disparities exist. While urban areas show consistent benefits, debate continues about whether broadband delivers equivalent benefits to the most remote and rural communities. This uncertainty stems from multiple interacting factors including digital literacy levels, basic access quality, skills availability, and policy implementation—all areas where measurement challenges persist and make definitive rural impact assessment difficult.

Negative Impacts: The Overlooked Dimension

Mack emphasizes that discussions focusing solely on connectivity benefits miss a critical dimension—broadband and digital technologies also generate negative impacts that merit measurement and policy attention. While she notes environmental impacts (water consumption for cooling servers, energy demands of data centers) as increasingly important for AI and data center research, she focuses primarily on social and health consequences.

Research documents willingness to pay to minimize exposure to fake news, indicating people recognize and value protection from misinformation enabled by connectivity. Techno-stress—a broad term for maladaptation to technological change—became prominent during the pandemic when people spent entire days online. Popular press extensively covered mental and physical health outcomes from constant technology attachment. Digital addiction research, particularly from psychology communities studying youth and video game addiction, examines time spent on devices daily and associated impacts.

Recent conversations focus intensely on youth social media exposure and its costs, prompting policy discussions about whether and how to mitigate negative mental health impacts of constant online presence. Physical health impacts include poor posture, wrist and finger issues from device use, and other manifestations of what Mack calls the "physical manifestation of techno stress." She mentions submitting a research proposal with health colleagues attempting to quantify techno-stress biomarkers in midlife adults, seeking to identify measurable physical indicators of prolonged device exposure and online activity.

Measurement Framework: Five Critical Dimensions

Building on Shane Greenstein's earlier presentation about the evolution of digital access measurement, Mack outlines five key measurement areas, noting that the first two are well-established while the latter three remain insufficiently measured:

1. Device Access (Well-Measured) Initial research focused on desktop computer access, now expanded to include mobile phones and other devices. This dimension has substantial data and established measurement approaches.

2. Internet Access (Well-Measured) Who has broadband connections at home? How do they connect—fiber, digital subscriber line, mobile phone? These questions have been systematically tracked, providing solid baseline data on connectivity availability.

3. Access Quality (Emerging Measurement) Moving beyond simple yes/no connectivity to examine speed and reliability. While Ookla provides speed test data posted on various repositories, several challenges remain. Available data often show advertised speeds rather than actual access speeds. Speed tests may be biased toward users experiencing problems who run tests specifically because of connectivity issues. More critically, dimensions like latency and connection reliability—increasingly important for modern applications—lack comprehensive public data. Mack emphasizes that as universal coverage becomes reality, the question shifts from "who is covered?" to "how fast are you accessing the internet and what's the quality of that access?"

4. Internet and Device Use (Major Gap) How much time do people spend online? What are they doing? Greenstein's Microsoft data research provided valuable insights into usage dimensions, and Pew Foundation releases reports on time spent online and mobile phone usage. The International Telecommunication Union provides some global information. However, achieving high-resolution measurement faces enormous challenges. Unless researchers access proprietary data like Microsoft's or data from private providers, or convince participants to install tracking devices across multiple devices (with serious privacy implications), comprehensive usage data remains elusive. Understanding what people actually do once online is critical for assessing economic benefits, but systematic, publicly available, regularly updated data on usage patterns doesn't exist at necessary scale and granularity.

5. Digital Skills (Critical Gap) Greenstein's work and many others have begun thinking about digital skills measurement, and the now-canceled U.S. Digital Equity Initiative had digital skills improvement as a major component. However, measuring digital skills systematically remains extremely challenging. What publicly available data can researchers access to examine connections between skills and outcomes? Many economic benefits documented in earlier literature are contingent upon people effectively leveraging online possibilities—without adequate skills, connectivity alone cannot deliver promised benefits. This represents perhaps the most significant measurement gap with direct policy implications.

The Challenge of Rapid Technological Change

Mack presents Moore's Law as emblematic of the fundamental measurement challenge: the relentless pace of technological change makes tracking these dimensions extraordinarily difficult. Device ownership changes constantly—she notes losing track of iPhone releases and their varying capabilities. The speed frontier shifts continuously, with definitions of adequate broadband evolving from narrowband versus dial-up debates to current discussions about necessary speeds for real-time communication and future applications. How information technology is used evolves constantly, making longitudinal tracking challenging even as it becomes increasingly exciting.

These measurement difficulties raise critical questions about data archiving and longitudinal analysis. How can we go back in time to examine evolution with solid data foundations when

technology changes so rapidly? Establishing consistent measurement frameworks that remain relevant as technology evolves represents a significant methodological challenge. We can certainly think of anecdotes about how usage has changed, but backing those observations with systematic data over time proves difficult.

Critical Considerations for Future Measurement

Mack concludes with several considerations the research and policy communities must address for effective impact measurement:

Data Variability Across Countries Substantial variation exists in data quality and availability internationally. The Dutch and Swedes are "notorious for their quality data access," while many countries including the U.S. lack comparable data infrastructure. This matters for reviewing research and tackling issues at global scale—conclusions drawn from high-quality data environments may not generalize to contexts with limited measurement capacity.

Declining Government Data Quality Government sources that historically collected and publicly provided data diligently have seen declining commitment, particularly in the U.S. over the last decade. The quality and regularity of government data provision has deteriorated, creating significant gaps in what was previously reliable information infrastructure.

Data Archiving and Accessibility How do we archive measurement data over time? Who will be responsible for long-term data stewardship? These questions become critical for longitudinal research and understanding technological evolution.

Private Sector Data Provision While it's exciting that researchers can access Microsoft data and share it with the community, concerning questions arise about the move to privatize data necessary for quality research on these topics. If essential data for understanding technology's societal impact increasingly resides with private companies rather than public institutions, what are the implications for research independence, public accountability, and equitable access to information needed for informed policymaking?

Core Message

Mack's presentation emphasizes that while broadband delivers documented positive economic impacts, comprehensive understanding requires measuring both benefits and costs—including negative health, social, and environmental consequences. The measurement framework she outlines reveals that while we've made progress on basic access metrics, critical gaps remain in understanding usage patterns, access quality dimensions, and digital skills. The rapid pace of technological change compounds these challenges, making consistent longitudinal measurement extremely difficult. Most concerning, declining government data provision combined with increasing privatization of essential data creates fundamental questions about whether the research and policy communities will have the information infrastructure necessary to understand, govern, and optimize the digital economy's impact on society. Addressing these

measurement gaps isn't just an academic exercise—it's essential for evidence-based policymaking that can maximize benefits while mitigating harms as broadband, AI, and other technologies continue transforming economic and social life.

Panel Discussion - "Where Are We Now? Digital Metrics Today"

Moderator: Jennifer Withington, Acting Assistant Chief Statistician, Statistics Canada

Panelists: Patrick Gill (Vice President, Business Data Lab, Canadian Chamber of Commerce), Marie-Christine Tremblay (Senior Policy Advisor and Chair of the G7 Central Banks' Digitalization Working Group, Bank of Canada), Viet Vu (Researcher, DAIS Lab, Toronto Metropolitan University)

Statistics Canada's New Measurement Infrastructure

Jennifer Withington opens by highlighting Statistics Canada's extensive history measuring the digital economy since hosting the OECD in 1998 to discuss e-commerce. Measurement priorities have evolved from connectivity to cloud computing, cybersecurity, and advanced technologies, with many Canadian standards adopted internationally. With AI's emergence, Statistics Canada is launching a comprehensive TechStat Program collecting crucial data across multiple dimensions.

Key initiatives include an AI Adoption and Use Module reaching nearly 13,000 firms starting next month, a TechStat Survey covering businesses and households with content finalized by February 2026, and a Labor Force Survey AI Supplement launching April 2026 asking about AI familiarity, tool usage, and adoption obstacles. The data already reveals compelling patterns: 60% of Canadian employees will be impacted by AI-related job transformations, and AI usage among firms doubled from 6% to 12% between 2024 and 2025, though this remains below the OECD average of 42%. Historical e-commerce adoption, which took from 2012 to 2021 to triple from 11% to 33% of enterprises, suggests technology diffusion requires extended timelines. Withington emphasizes the fundamental principle: we can't manage what we don't measure.

Business Perspective: The Challenge of Hidden AI Usage

Patrick Gill characterizes Canada's AI position as "strong on potential, weak on diffusion." While research and experimentation impress, actual adoption remains uneven and concentrated in specific sectors. Gill raises a critical measurement challenge: unaware usage. Many small businesses using Salesforce, HubSpot, or Shopify are actually using AI without realizing it. Current surveys capture deliberate, intentional AI adoption, but capturing embedded usage becomes crucial for accuracy. The TechStat program's ability to distinguish between explicit adoption and AI embedded in everyday business tools represents significant progress, as without this nuance, statistics could dramatically understate actual AI penetration throughout the economy.

International Coordination: The G7 AI Monitor

Marie-Christine Tremblay explains that the G7 Central Banks' Digitalization Working Group has evolved from examining AI governance toward real economic implications and financial stability. Under Canada's 2025 presidency, they developed a comprehensive measurement framework and monitoring tool called the "AI Monitor" tracking key indicators with principles emphasizing comparability across countries and consistency over time.

The framework includes global indices measuring vibrancy, innovation, intellectual dynamism, preparedness, and public sector involvement, plus targeted metrics across four buckets: AI infrastructure, investment, adoption, and labor market impacts. Canada doesn't rank in the top 10 on most global indices except patent-focused measures, while the U.S. dominates with striking margins. However, within high-intensity adoption sectors, Canada performs quite well, including in financial institutions. The monitor will be updated annually, establishing baselines to track narrative evolution across countries. Transparency challenges exist as some countries resist unfavorable public comparisons, but efforts continue toward public disclosure, potentially through a G7 finance track website.

Beyond measurement, central banks actively engage with financial institutions on adoption patterns and systemic implications given financial stability mandates. Looking to France's 2026 presidency, AI will continue as a priority informed by this measurement infrastructure.

Academic Research Perspective: Progress and Concerns

Viet Vu notes his assessment would differ dramatically from a year earlier. Recent progress includes the October 2024 Council of Canadian Academies comprehensive innovation review, the newly launched National Partnership on AI and Work Quality with 70 national partners, Statistics Canada's TechStat program, and expected renewal of the 2017 pan-Canadian AI strategy. Despite genuine excitement about this progress, Vu worries too much discussion focuses on short-term considerations like compute capacity investment or measuring specifically generative AI, when measurement infrastructure needs viability for five to seven years as technology evolves. He advocates resisting hype cycle pressures to build frameworks surviving until the next major innovation review potentially 10 to 15 years hence.

Vu structures his substantive assessment around three factors. First, regarding technology development, large language models with deep reinforcement learning represent a particular implementation, with frontier questions now asking what comes beyond LLMs. Second, concerning productivity, his research using firm-level TFP growth estimation required extensive statistical manipulation to find any significant results even one to two years post-adoption, concluding that productivity gains wash out in the short run—experimentation occurs but realizing benefits proves harder than marketing suggests. Third, technology sovereignty emerges at a different scale, as geopolitical tensions mean ownership and negotiating power over AI become sovereignty and defense questions, raising strategic choices about whether Canada should build its own models or secure specific positions in the AI supply chain.

Measurement Harmonization and Best Practices

Tremblay emphasizes the critical need for aligned definitions ensuring that when different jurisdictions report adoption percentages, everyone understands what those figures represent. The G7 central banks are harmonizing business outlook survey questions, creating communities of practice among survey professionals. She stresses thinking outside traditional boxes to develop new metrics, noting they deliberately labeled their framework as tracking "AI-related productivity developments" rather than claiming direct measurement, recognizing exploratory early-stage efforts. Novel approaches like welfare measurement, better diffusion metrics, and labor market micro-analysis examining tasks and exposure represent critical frontiers where current capabilities fall short.

Gill adds that while Canada is well-positioned after recent progress, substantial movement on standard measurements and definitions within the next year would constitute a major win. The challenge involves not just collecting data but ensuring it's comparable, interpretable, and actionable across contexts and stakeholders.

Critical Partnerships and Data Governance

The discussion emphasizes that no single organization can comprehensively measure the digital economy alone. Statistics Canada works with the Business Data Lab and other partners to generate insights beyond single-institution capabilities. G7 coordination creates international comparability no country could achieve independently. Academic researchers contribute methodological innovations informing official approaches. This collaborative ecosystem, while complex, represents the only viable path toward comprehensive measurement given the scale and rapid evolution of phenomena being measured.

On data governance, Withington emphasizes Statistics Canada treats respondent confidentiality as fundamental to maintaining public trust, developing AI capabilities in-house to ensure protection. Regarding employee usage, staff want AI tools but require clear blueprints for appropriate use, recognizing that startup investment doesn't always show immediate payoffs but creates capabilities usable throughout organizations requiring long-term perspective.

Looking Forward: Priorities and Challenges

The panel identifies several critical priorities: harmonizing measurements internationally while respecting national contexts, developing metrics capturing both intended and embedded AI usage, understanding not just adoption but intensity and quality of use, tracking labor market transformation at granular levels, and maintaining measurement infrastructure resilience as technology evolves. The progress made in 2024-2025 creates genuine optimism, but maintaining momentum, securing continued funding, and resisting short-term narrow metric pressures will be essential for building infrastructure serving policymakers, businesses, and citizens through future technological transformations.

The fundamental insight is that measuring the digital economy requires not just better data collection but rethinking what gets measured, how measurement happens, and how infrastructure adapts to technological change while maintaining consistency enabling meaningful longitudinal analysis. The measurement challenge isn't knowing all answers—it's figuring out what we don't know and building frameworks flexible enough to evolve with technology and markets.

Panel Discussion - Reimagining Canada's Digital Economy: Building the Infrastructure for AI-Driven Innovation and Adoption

Moderator: Romel Mostafa, Professor and Director, Lawrence National Centre for Policy and Management, Ivey Business School

Panelists: Trina Alexson (Head of Customer Success, Cisco), Chris Madan (Vice President, Customer Digital Solutions & Product, TELUS), Costa Pantazopoulos (Vice President, Product, Bell Canada)

Infrastructure Scale and AI Implementation

Trina Alexson frames Cisco's AI approach through three lenses: "Cisco for AI" (supplying infrastructure equipment for data centers and networks), "AI for Cisco" (internal productivity improvements showing quality gains rather than immediate time savings), and "AI for customers" (embedding AI in products like their new Cisco IQ self-support platform). She emphasizes the massive complexity behind consumer simplicity—deploying one U.S. carrier's virtualized packet core required 250,000 Cisco parts in the first wave alone. Comparing markets, Canadian service providers demonstrate equivalent engineering capability and technology adoption to their larger U.S. counterparts despite a more concentrated market structure.

The panelists emphasize that current AI implementation focuses on quality improvements rather than speed. AI enables networks to become more self-healing through enhanced telemetry, ultimately reducing operational costs. Chris Madan provides concrete examples: TELUS uses AI to analyze network configuration scripts, identifying potential errors before deployment. Their internal agent "IRIS" provided complete observability across all systems during Black Friday and Cyber Monday, running diagnostics and now generating post-incident reviews. With 57,000 active users internally—including marketers, legal teams, and field technicians—TELUS demonstrates mass adoption across diverse functions, leading to their customer-facing product "Fuel iX" now sold globally.

The Cybersecurity Imperative

Alexson stresses that AI adoption for cybersecurity isn't optional—it's imperative. Bad actors monetize security exploits, creating an arms race where defensive capabilities must evolve alongside offensive threats. If legitimate organizations don't adopt AI for security, malicious actors will exploit innovations. However, this dynamic isn't fundamentally new; coding and

development techniques have always been dual-use technologies. AI represents a leap forward but follows familiar competitive security patterns requiring constant vigilance and adaptation.

Building Sovereign AI Infrastructure

Costa Pantazopoulos explains Bell's AI Fabric initiative emerged from converging factors: productivity pressures, national fiber network advantages, access to hundreds of megawatts of power, established partnerships with vendors like Cisco, strong public sector relationships, and dramatically shifting geopolitical realities that made sovereignty central to customer conversations starting in late 2024. Bell recognized they could become a significant AI infrastructure ecosystem player, though explicitly not alone—success requires collaborative effort across multiple partners and sectors.

Madan traces TELUS's journey from over a decade of AI work through their pivotal spring 2023 Stanford executive visit examining ChatGPT's emergence. They created internal sandboxes allowing experimentation with open-source models without betting on specific technologies, implementing privacy-by-design frameworks. The result: 57,000 active users within 24 months using AI for everything from translation to wildfire incident response. The sovereignty conversation began about a year ago when researchers noted Canadian compute capacity typically lags 2-3 generations behind, with even Shopify needing U.S. capacity. TELUS now operates a sovereign AI factory in Rimouski, Quebec, with Kamloops, BC opening next.

Defining Digital Sovereignty

The sovereignty discussion reveals both opportunities and constraints. Pantazopoulos acknowledges complete technological sovereignty is impossible—there's no Canadian competitor to NVIDIA GPUs. Sovereignty instead centers on location (data in Canadian data centers), operators (Canadian entities running infrastructure), and regulation defining sovereignty parameters, especially for public sectors. The core principle is controlling national destiny and minimizing foreign interference risks.

The U.S. Cloud Act creates major sovereignty challenges. Under this Act, the U.S. government can access data through any U.S.-headquartered company regardless of physical data center location. Many partners claim sovereign solutions, but U.S.-based entities remain subject to Cloud Act requirements. True sovereignty requires Canadian ownership and headquarters, not just physical infrastructure location. For TELUS, sovereignty means complete operational control: owning land, data centers, chips, software, networks, with all Canadian operators. This stringent definition directly addresses Cloud Act concerns.

Canada's Competitive Advantages

Madan articulates three pillars positioning Canada advantageously: sovereignty by design through complete operational control, trust (both in ethical AI use and geopolitical stability), and sustainability given AI infrastructure's environmental demands. Across these dimensions, Canada

possesses natural advantages to become a global force. Alexson adds Canada's talent advantage through universities and technical skills as another critical differentiator.

Energy emerges as perhaps Canada's most significant structural advantage. Pantazopoulos emphasizes abundant clean hydroelectricity—all Bell's AI power is 100% hydro with capacity for expansion. This sustainability advantage over the U.S. and most countries makes Eric Schmidt's statement that "the solution is Canada" particularly apt. Beyond raw power, both companies incorporate heat reclamation through district energy systems and sustainable design practices. Bell partners with First Nations communities for their first three data centers, ensuring AI benefits all Canadians.

Madan provides striking operational data: Rimouski achieves 99% free cooling with fewer than 40 hours annually requiring active climate control due to northern location. Power Usage Effectiveness metrics show TELUS facilities performing 2-3 times more sustainably than best global data centers. Their LEED3 facilities leverage natural water resources, with all green power. Green compute could become Canada's exportable competitive advantage.

Partnership Ecosystem

Both Bell and TELUS emphasize partnerships as essential. Pantazopoulos stresses Bell lacks expertise to build LLMs or high-density compute centers alone—success requires bringing together best talent and companies. They partnered with Cohere, deploying it internally while offering commercially. Their agent "Alex" uses LLMs with next-generation agentic AI development underway.

Madan highlights how AI manifests across TELUS business units. In telehealth, where they're among Canada's largest EMR providers, they've partnered with Leap and deployed systems addressing productivity challenges. AI Scribe uses natural language processing to document doctor-patient conversations automatically, addressing four hours daily doctors spend on paperwork. They're digitizing farm-to-food systems to reduce manual processing. These examples demonstrate AI driving efficiency through comprehensive partnerships.

Five-Year Vision

Looking ahead, Alexson predicts shifts from specialists toward generalists working across functions, enabling faster movement and adoption. Madan envisions Canada as a world-class AI powerhouse operating globally, stopping brain drain by creating "Silicon North," closing the productivity gap, and capturing substantial AI market share. Pantazopoulos emphasizes promoting Canadian startups to scale successfully, with benefits distributed nationwide. A colleague's insight captures the transformation: "AI will not replace people; AI will replace people who don't use AI." The vision is thriving ecosystems where Canadian talent, infrastructure, partnerships, and natural advantages combine to establish global AI leadership while ensuring broad domestic benefit distribution.

Conclusions and Outlooks - Implications for Canada

Speaker: Ian Scott, Former Chairperson and Chief Executive Officer, Canadian Radio-television and Telecommunications Commission (CRTC)

Ian Scott delivers closing remarks synthesizing the workshop's themes while offering regulatory and policy perspectives on Canada's digital economy challenges. He begins by confessing his biggest conclusion: "I don't know what I don't know," which he identifies as likely the Canadian government's greatest fear regarding AI and the digital economy. He organizes his observations around three critical building blocks: broadband access and adoption, data gathering, and future regulatory approaches.

Scott emphasizes that Canada's broadband access problem is largely resolved. When he and Deputy Minister John Loey testified before Parliament in 2019, they estimated universal broadband would require \$8-10 billion—now exceeded by combined federal, provincial, and territorial investments. The results are dramatic: 96% of Canadians have access to 50 megabits per second, rural access increased from 54% to 80%, and Indigenous communities rose from 24-25% to 61%. With low Earth orbit satellites and projects like fiber to Iqaluit, the remaining access gaps will be addressed. The real challenges are adoption, affordability, and digital literacy—areas where government has failed to track who isn't adopting and why. This knowledge gap is critical as government pursues digital services and AI-driven efficiency improvements while significant portions of Canadians remain digitally illiterate or cannot afford access.

Scott highlights the U.S. "Broadband for All" initiative's success, particularly its \$70 subsidy for tribal lands. Since the most expensive Canadian broadband is in territories at \$129-130 monthly, a similar subsidy would bring costs below national averages. He argues Canada should focus subsidies on those who need them rather than pursuing universally lower rates, ensuring industry has sufficient capital for continued infrastructure deployment and AI adoption.

On data gathering, Scott praises Statistics Canada's TechStat initiative but emphasizes Canada remains "almost nowhere" on measuring device use and digital skills despite performing well on device access, internet access, and improving on access quality measurement. Without knowing who isn't adopting and why, government cannot design effective interventions or successfully transition services online.

Scott's most provocative argument concerns regulatory reform. Just as GDP proves insufficient for measuring the information economy, current telecommunications regulation focused on industry structure and competition proves inadequate for the digital economy. He doubts Canada will develop comprehensive digital strategy quickly and questions government's capability to adopt AI efficiently given structural barriers like employee classifications and unions.

He proposes bifurcating regulation into two functions: first, a digital information regulator focused not on prescription but transparently providing necessary data to Canadians, industry,

and government about digital technology impacts; second, replacing economic regulation with consumer protection models focused on informed choice rather than prescriptive rate regulation. This represents moving away from facilities-based competition frameworks—a position that previously got him "vilified and attacked" as CRTC chair—toward models recognizing that digital economy dynamics differ fundamentally because without controlling input costs, wholesale rate arbitrage creates unsustainable cycles beneficial temporarily but not for long-term investment.

Scott's core message: Canada has made extraordinary infrastructure progress but must urgently pivot to adoption, affordability, and digital literacy while fundamentally reconceiving regulatory frameworks. The challenge isn't knowing all answers—it's figuring out what we don't know and building flexible frameworks capable of adapting as technology evolves while maintaining policy consistency.