ORION's Socioeconomic Impact 2020–21

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CANADIAN CENTRE FOR ECONOMIC ANALYSIS

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1.0 INTRODUCTION

1.1 BACKGROUND

ORION is a self-sustaining not-for-profit organization formed in 2001 to serve the unique connectivity and cybersecurity needs of Ontarians involved in research, education, and all kinds of innovation. As Ontario's only research and education network, ORION provides an on-ramp to others like it across Canada and around the world. Since its founding, ORION has provided critical digital infrastructure across the province, connecting students, teachers, researchers, and innovators via its high-speed, fibre optic network to each other and to their global colleagues. ORION is committed to keeping this digital community safe through providing security guidance, tools, and training to our constituents.

In connecting Ontario's universities, colleges, hospitals, and schools, as well as advanced research computing centres, ORION is not merely a pivotal component of the province's research, education, and innovation sectors, but of its economy. The work conducted on and supported by ORION's network contributes to Ontario's current and future prosperity while the cybersecurity services offered by ORION help safeguard this digital community.

Figure 1   ORION Network
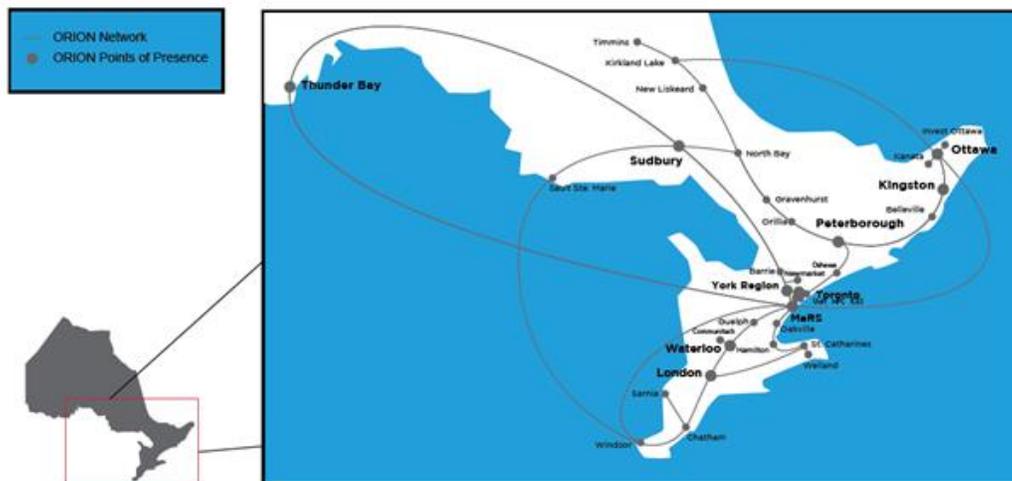
As ORION enters its 20th year and continues to work to expand access to affordable, high-speed connectivity across the province, this report examines its current socioeconomic impact.

1.1.1 ORION'S CONSTITUENTS

ORION directly supports over 100 constituents across Ontario including universities and colleges, hospitals, and school boards. Table 1 outlines the constituents, divided into 6 categories, with the estimated number of employees in each of the categories. Across all categories, the total number of employees exceeds 280,000. (Note that not all employees within each constituent use the ORION network.) Across Ontario, about 1 in 9 people (or over 1.7M individuals) rely on ORION.

Table 1   Constituents and number of employees

Universities	Colleges	Hospitals
Algoma University	Cambrian College	Ajax Pickering Hospital
Brock University	Canadore College	Oshawa Hospital
Carleton University	Canadian Forces College	Whitby Hospital
Lakehead University	Centennial College	Bowmanville Hospital
Laurentian University	Collège Boréal	Port Perry Hospital
McMaster University	Conestoga College	Baycrest Health Sciences
Nipissing University	Confederation College	CAMH
OCAD University	Durham College	Institute for Clinical Evaluative
Queen's University	Fanshawe College	Sciences
Royal Military College of	Fleming College	The Hospital for Sick Children
Canada	George Brown College	London Health Sciences Centre
Ryerson University	Georgian College	The Michener Institute of
Trent University	Humber College	Education at UHN
University of Guelph	La Cité Collégiale	McMaster Children's Hospital
University of Ontario Institute	Lambton College	Northern Ontario School of
of Technology	Loyalist College	Medicine
University of Ottawa	Mohawk College	Ontario Institute for Cancer
University of Waterloo	Niagara College	Research
University of Windsor	Northern College	Ontario Telemedicine Network
Western University	Sault College	Public Health Ontario
Wilfrid Laurier University	Seneca College	Southlake Regional Health Centre
York University	Sheridan College	St. Joseph's Health Care
University of Toronto	St. Clair College	Sunnybrook Health Sciences Centre
	St. Lawrence College	University Health Network
Total employment: 32,100	**Total employment: 28,800**	**Total employment: 172,000**
School Boards	**Regional Innovation Networks**	**Other Organizations**
Conseil scolaire catholique MonAvenir	Haltech Innovation Centre, Innovate Niagara	Agriculture and Agri-Food Canada
Conseil Scolaire Catholique Providence	Innovation Factory	Bureau of Food Surveillance and Science Integration
Greater Essex County District School Board	Innovation Guelph	Canadian Microsystems Corp.
Niagara Catholic District School Board	Innovation Initiatives Ontario North (IION)	Canadian Research Data Centre Network (CRDCN)
Provincial Schools Branch, Ministry of Education	MaRS Discovery District	Centre of Excellence in Next Generation Networks (CENGN)
Simcoe County District School Board	Northwestern Ontario Innovation Centre (NIOC)	City of Vaughan
Thames Valley District School Board	Productivity & Innovation RIC Centre	Contact North	Contact Nord
Waterloo Catholic District School Board	Sault Ste Marie Innovation Centre	DRDC
Waterloo Region District School Board	Spark Centre	Hamilton Public Library
Windsor-Essex Catholic District School Board	TechAlliance	Laboratory for Foodborne Zoonoses
York Region District School Board	ventureLab	National Research Council
		Natural Resources Canada
		Perimeter Institute
		Robarts Research Institute
		Royal Ontario Museum
		SNOLAB
		Vaughan Public Libraries, Groupe Média TFOTVO
Total Employment: 42,800	**Total employment: 2,800**	**Total employment: 3,600**

1.2 OBJECTIVE

The objective of this study is to measure ORION's social and economic impact resulting from its operations and capital expenditures, network contributions from its constituents, and its cybersecurity services. This research provides an update of ORION's impact previously reported in 2015. Metrics that will be used to understand ORION's contributions for the 2020 fiscal year include GDP, jobs, private investment, and government revenues.

1.3 APPROACH

ORION's impact is assessed in terms of its economic contributions and its other contributions, including the number of people who rely on its network, bandwidth utilization, and its role in supporting research, education, and innovation.

This study uses CANCEA's agent-based modelling platform to analyze ORION's economic contributions. Additional data provided by ORION included data regarding its operating and capital expenditures, constituent profiles, and statistics relating to distributed denial-of-service (DDoS) attacks.

ORION's economic contributions represent its economic footprint resulting from the use of its network by constituents, its own operations and capital investments, and the value of its cybersecurity services. These contributions can be classified into three main effects by economic convention, as follows:

- **Direct Effects:** Include all economic activity that can be directly attributed to the use of ORION's network, its operations and expenditures, and services. This includes the income and value of the production of contributing economic agents (i.e., workers and firms).
- **Indirect effects:** Include all economic activity that arises through business-to-business interactions within the supply chain. Indirect effects include input expenditures, as well as the follow-on expenditures that are generated further up and down the supply chain in all sectors of the economy.
- **Induced effects:** Include all economic activity generated through the spending of wages earned by workers whose employment is supported by ORION's network and activities. Induced effects also include expenditures on increased capacity or the replacement of depreciating capital stock that result from reinvesting business profits. These purchases or activities can lead to further hiring, resulting in income and tax revenues that reverberate throughout the economy.

The following section reports these economic contributions in Ontario and across the rest of the country, highlighting industries and sectors where ORION's economic contributions are most significant. Economic contributions are reported as changes in economic indicators, such as GDP, employment, private capital investment, and government revenues.

2.0 RESULTS

2.1 ECONOMIC CONTRIBUTIONS

ORION's overall economic contributions in the 2020 fiscal year are summarized in Table 2, below.

Table 2   ORION's Economic Contributions, 2020

$10.1 billion	Contributed to Canada's GDP with 94% remaining in Ontario
102,000 FTE jobs	Supported by ORION's network, measured in full-time equivalents (FTEs). Over 280,000 employees are direct users of the network.
$1.7 billion	Private capital investment contributed by $10.1B in economic activity
$2.8 billion	Federal and provincial tax revenue resulting from this economic activity

ORION contributed over $10.1 billion in economic activity in 2020. This includes $6.2 billion in direct economic effects, $1.5 billion in indirect effects, and $2.4 billion in induced effects. This economic contribution resulted largely from the use of ORION's network by its constituents. However, ORION's own operations, capital investments and cybersecurity services also contribute to the economic benefits and play a critical role in the realizing the contributions of its constituents.

ORION's contributions to economic activity are concentrated in two main industries: educational and academic services, and health care. Around 65% of ORION's total contributions to GDP are in these two industries, as shown in Table 3. More than 95% of ORION's direct contributions are in these two industries, which encompass its main constituents. However, the indirect and induced effects propagate across all sectors of the economy, as shown by the total contributions across industries in Table 3. The division between direct, indirect, and induced contributions are included in Appendix A.

Table 3   Industry Impact, Top 10 by Contribution to GDP

Industry	GDP Contributed (millions)	Share of Total Contribution
Educational and research sector	$3,522	35%
Health care & social assistance	$3,058	30%
Manufacturing	$472	4.7%
Retail trade	$450	4.4%
Prof., scientific, technical services	$348	3.4%
Finance and insurance	$313	3.1%
Wholesale trade	$240	2.4%
Information & cultural industries	$236	2.3%
Accommodation & food services	$221	2.2%
Transportation and warehousing	$170	1.7%
All Industries	**$10.1**	**100%**

The vast majority of ORION's contribution to economic activity is in Ontario, where its network supports research, education, and innovation, and where it is headquartered. Overall, ORION contributed $9.5 billion to Ontario's GDP in 2020—$6.2 billion in direct effects, $1.3 billion in indirect effects, and $2 billion in induced effects.

Nearly 60,000 FTE jobs are directly dependent upon the ORION network, with an additional 42,000 FTE jobs supported indirectly through the indirect and induced economic activity contributed by ORION. The jobs that depend directly on the network are all located in Ontario, with the vast majority of these in educational/academic services, and health care. However, the jobs supported through ORION's indirect and induced economic activity are spread across a range of industries, as shown in Table 4. If we restrict our focus to Ontario, nearly 36,000 jobs are supported by indirect and induced economic activity.

Table 4   Industry Impact, Top 10 Combined Indirect and Induced Jobs

Industry	FTEs Supported
Retail trade	8,640
Health care	7,440
Accommodation & food services	5,800
Other services	3,390
Manufacturing	3,060
Administrative & support	2,000
Transportation & warehousing	1,780
Finance & insurance	1,510
Wholesale trade	1,420
Educational services	1,200
All Industries	**42,590**

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Considering ORION has a staff of only 30, this means that for each ORION employee, another 3,400 jobs are supported directly by the network, or through the indirect or induced economic activity contributed by ORION. Unlike many traditional businesses where each direct employee only supports a few additional jobs throughout the economy, the fact that ORION provides critical infrastructure for many constituents results in a significantly greater contribution per employee than most other organizations.

The economic activity driven by ORION contributes $1.7 billion in private capital investment annually, helping to fuel additional innovation in Ontario, while also giving rise to almost $2.8 billion in federal and provincial tax revenue.

2.2 OTHER CONTRIBUTIONS

ORION enables researchers, students, teachers, and innovators to conduct collaborative research and blended learning, as well as access essential tools such as shared databases and advanced research computing facilities across Ontario. Its network supports data-intensive work and provides high-speed service and cybersecurity to institutions like universities and colleges, hospitals, school boards, and libraries and other community hubs. Nearly 1.7 million people use ORION's network, or around one in nine Ontarians including over 1.4 million students rely on the network.

Figure 2   Advanced Research Computing Facilities Linked over ORION
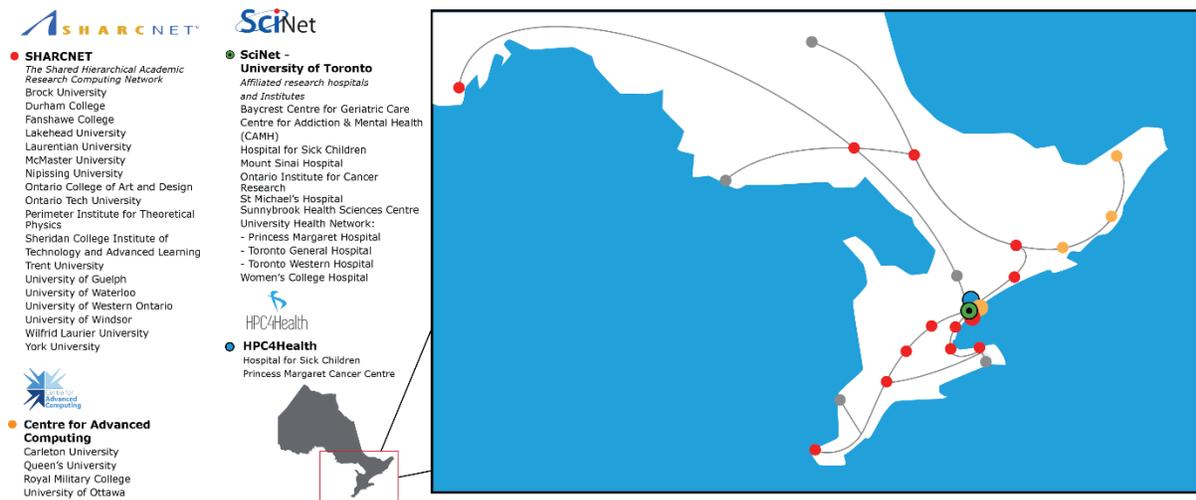
As research and innovation in technology, data, and health continue to grow in importance, ORION's role in Ontario grows as well. From the first quarter of 2013 to the last quarter of 2019 total bandwidth utilization on ORION's network grew by 430% highlighting the increasing importance of reliable connections among ORION's constituents.

As noted, ORION does not merely provide a high-speed network, but offers cybersecurity services to its constituents. Through DDoS detection and mitigation, cybersecurity professional development and

awareness training, as well as shared cybersecurity programs and services, ORION helps ensure its constituents can maintain productivity and safely conduct their research, education, and other work. Protecting its digital community is vital and offers economic upside. For example, a single cybersecurity breach can cost an institution $5M, a loss which ORION helps prevent[1]. More specifically, a DDoS attack can cost a large organization (1,000+ employees) over $2M, while the cost to small or mid-sized organizations can still exceed $100,000[2]. With over 10 million DDoS attacks globally in 2020 and more than 375,000 of them occurring in Canada, protection against this kind of threat is essential. ORION's DDoS threat protection services detected and responded to attacks against network constituents in 2020-21, successfully mitigating 42 attacks and saving constituents over $30M. DDoS attack responses can include improvements in constituents' cybersecurity settings, which can help mitigate future threats.

Finally, ORION also connects to other members of Canada's National Research and Education Network (NREN), allowing its constituents to efficiently collaborate with other research, education, and innovation hubs across the country. It provides the ability for over 725 universities, colleges, hospitals, research labs, and businesses to work together in ways not possible over traditional commercial networks.[3]

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[1] Cost of a Data Breach 2020, IBM Security, 2020

[2] https://usa.kaspersky.com/about/press-releases/2018_ddos-breach-costs-rise-to-over-2m-for-enterprises-finds-kaspersky-lab-report

[3] https://www.canarie.ca/network/nren/

3.0 CONCLUSION

ORION plays a pivotal role in Ontario's research, education, and innovation ecosystem by providing network and cybersecurity services to institutions across the province. In 2020, ORION contributed over $10.1 billion in economic activity, largely from the use of its network by its constituents. Most of this economic activity, $9.5 billion, was in Ontario. Meanwhile, nearly 60,000 FTE jobs are directly dependent upon the ORION network, with over 42,000 FTE jobs supported through the indirect and induced economic activity contributed by ORION. Cybersecurity education, training, and monitoring help to ensure the network reliability of its constituents, and connection to larger national and international research networks that enable research not possible over traditional commercial networks.

Over the past several years, utilization of ORION's network and services has been increasing. As research and innovation continues to drive Ontario's prosperity, we can expect ORION's importance to the province and its economy to continue to grow.

A. ECONOMIC CONTRIBUTION

The following tables provide the GDP and jobs by direct, indirect, and induced contributions. Industries contributing less than 0.5% of the total GDP are grouped into the 'Other Industries' category.

Table 5   Detailed GDP Contributions

Industry Sector	Direct	Indirect	Induced	Total
Educational and research sector	$3,426.3	$23.7	$71.7	$3,521.7
Health care and social assistance	$2,543.9	$373.7	$140.4	$3,058.0
Manufacturing	$2.5	$175.1	$294.6	$472.3
Retail trade	$0.0	$40.9	$408.9	$449.9
Professional, scientific and tech. services	$204.7	$119.1	$23.8	$347.6
Finance and insurance	$0.0	$15.6	$297.3	$312.9
Wholesale trade	$0.0	$102.8	$136.8	$239.5
Information and cultural industries	$38.7	$80.9	$116.0	$235.6
Accommodation and food services	$0.0	$43.0	$177.7	$220.7
Transportation and warehousing	$0.0	$79.5	$90.0	$169.5
Admin and support, waste mgmt services	$0.0	$136.6	$20.8	$157.5
Other services (except public admin.)	$0.0	$54.9	$88.1	$143.0
Utilities	$0.0	$49.7	$64.2	$113.8
Other municipal government services	$1.2	$44.6	$41.6	$87.4
Engineering construction	$0.0	$70.4	$1.4	$71.8
Arts, entertainment, and recreation	$2.4	$5.0	$49.9	$57.2
Other Industries	$0.0	$79.3	$371.8	$451.1
Total	**$6,219.7**	**$1,494.8**	**$2,395.0**	**$10,109.4**

Table 6   Detailed Job (FTE) Contributions

Industry Sector	Direct	Indirect	Induced	Total
Educational and research sector	31,813	301	896	33,009
Health care and social assistance	25,855	5,425	2,017	33,298
Manufacturing	25	1,139	1,916	3,080
Retail trade	0	786	7,851	8,637
Professional, scientific and tech. services	1,875	983	197	3,055
Finance and insurance	0	75	1,433	1,509
Wholesale trade	0	607	809	1,416
Information and cultural industries	263	359	515	1,136
Accommodation and food services	0	1,129	4,669	5,797
Transportation and warehousing	0	834	943	1,778
Admin and support, waste mgmt services	0	1,735	265	1,999
Other services (except public admin.)	0	1,303	2,091	3,394
Utilities	0	154	199	354
Other municipal government services	10	393	366	768
Engineering construction	0	541	11	551
Arts, entertainment, and recreation	50	92	921	1,064
Other Industries	0	320	1,313	1,633
Total	59,891	16,176	26,410	102,477