Capacity Assessment of the IT-Related Research Infrastructure Available in Ontario to Support Precision Agri-Food Application Development

Precision Agri-Food Scoping Study and Assessment 1

KEYSTEP Growth & Finance

Presentation Outline

- Study Objectives
- Methodology and Organizations Interviewed
- Ontario Precision Agri-Food IT Baseline
- Data and Information Exchange Models
- IT Usage Models
- Scalability of Research and IT Infrastructure Needs
- Concluding Remarks in the Context of Opportunities

Authors

Dr. Kevin Lim – Lead Investigator
- Geospatial Data and Systems Design & Implementation Consultant
- Major geospatial projects in defence, forestry and agriculture in the past

Dennis Nazarenko – Project Manager and Technical Research
- Senior consultant focused on emerging technologies and their commercial adoption

Peter Kallai – Project Oversight and Results Analysis
- Expertise in strategic program development for emerging technologies

About KEYSTEP
- 20 years in emerging tech with over 200 studies in various Canadian sectors for leading R&D organizations, universities, industry groups and companies.
- Dozens of projects relevant here in agri-food, spatial data, biotech, big data and ICT infrastructure
- Major public R&D program financing successes $2-$20 million/year.

Study Objectives (1)

1. Analyze the hardware, software and network components, including connectivity and data sharing, currently in place at various OPAF member sites.
2. Assess the technical feasibility of pilot scale sample sizes of farm and/or other agri-food enterprises providing data for research purposes.
3. Assess the capacity, robustness, reliability and cost of utilizing existing research data networks for transmitting data in real-time.

Study Objectives (2)

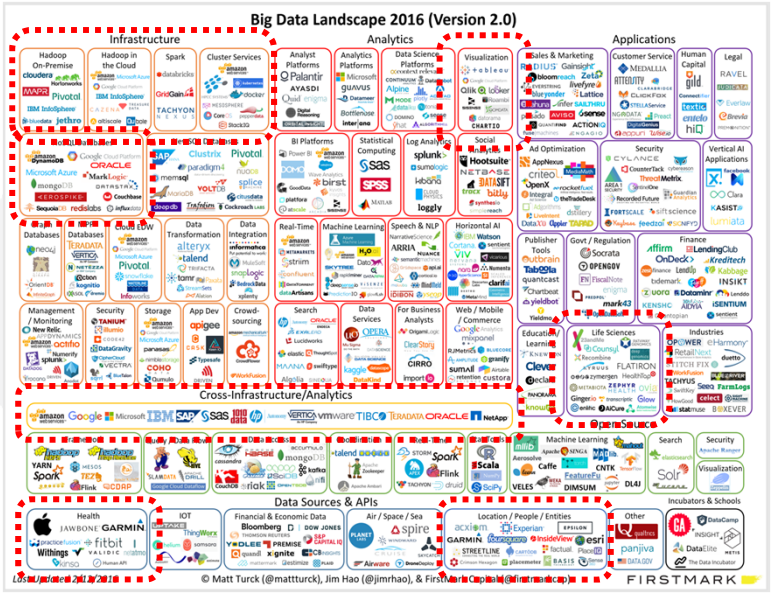
4. Assess the technical efficiency and cost/benefit of cloud-based supercomputing solutions.
5. Assess the software tools currently in use for data analysis.
6. Assess the methods, including formats and protocols, currently in use for data storage and security.
7. Assess the accessibility of current platforms and databases to commercial software firms in Ontario for development of decision support tools.

Disclaimers

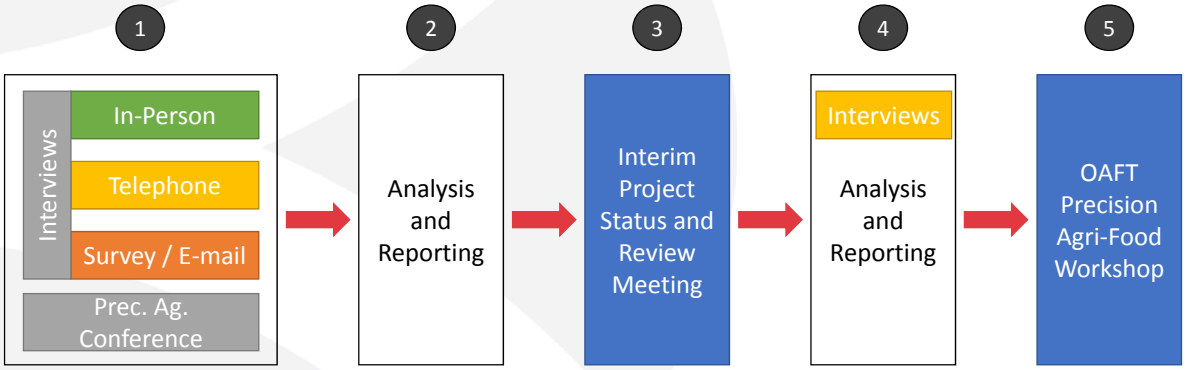
- The findings from this study are based on the input of those individuals that were interviewed for each organization.
- The organizations and individuals interviewed were determined in consultation with the OPAF Project Steering Committee.

Terminology

- Big Data
- Data Centres and Clouds
- IaaS, PaaS and SaaS



Methodology



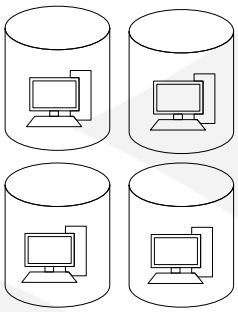
Organizations Interviewed

Ontario Precision Agri-Food IT Baseline

Type of research	How much research data produced?	Data storage capacity	Use of data standards?	External network bandwidth
Data producer?	Data consumer?	Data storage availability	Data backup plan?	Internal network bandwidth
QA/QC process for data?	Types of data used?	Host data for others?	Disaster recovery plan?	Software tools for Big Data analysis
Metadata produced for data?	How much data acquired?	Data privacy and confidentiality	Server infrastructure	Uses public cloud computing
Metadata standard used?	Data storage type	Data ownership	IT service provider	Accessibility of information systems

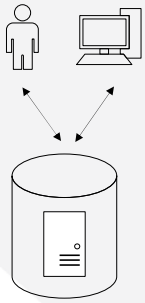
Data and Information Exchange Models

Model 1: Siloed



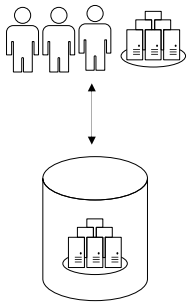
Example: Most Organizations Fall Under this Model

Model 2: Client-Server



Example: U. of Guelph – Laboratory Services

Model 3: Cloud



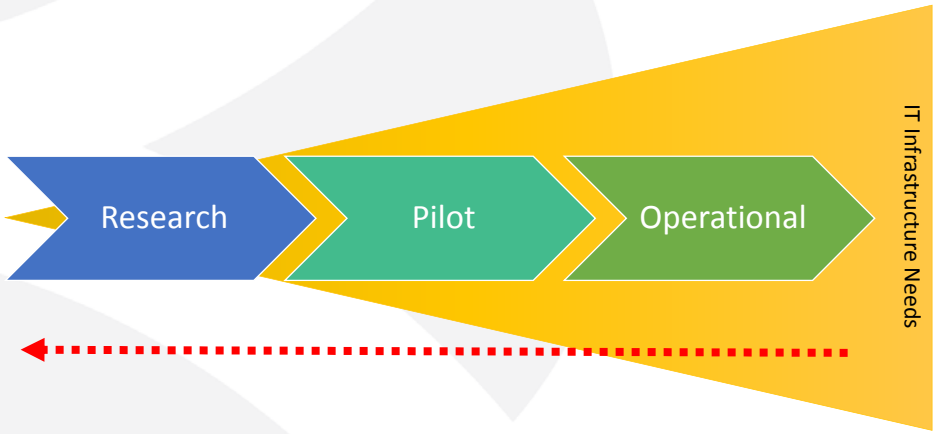
Example: U. of Guelph – Centre for Biodiversity and Niagara College

IT Usage Models

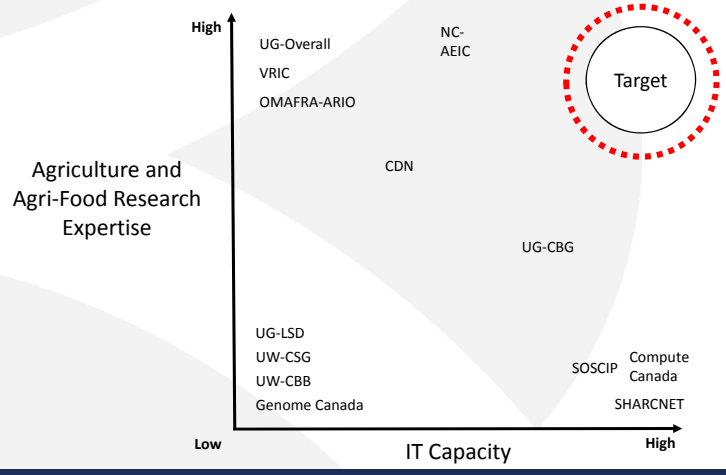
A	B	C	D	E	F
1	2	3	1	1	2
Organization	Organization	Organization	Organization	Organization	Organization
	Commercial – IT Service Provider	University / College – IT Service Provider	Organization – IT Service Provider	Organization – IT Service Provider	Organization – IT Service Provider
		Commercial – IT Service Provider	University / College – IT Service Provider	University / College – IT Service Provider	University / College – IT Service Provider
			Commercial – IT Service Provider	Specialized Research Data Network	Specialized Research Cloud Computing
				Specialized Research Cloud Computing	

Public Cloud Computing

Relationship Between Scaling of Research and IT Infrastructure Needs

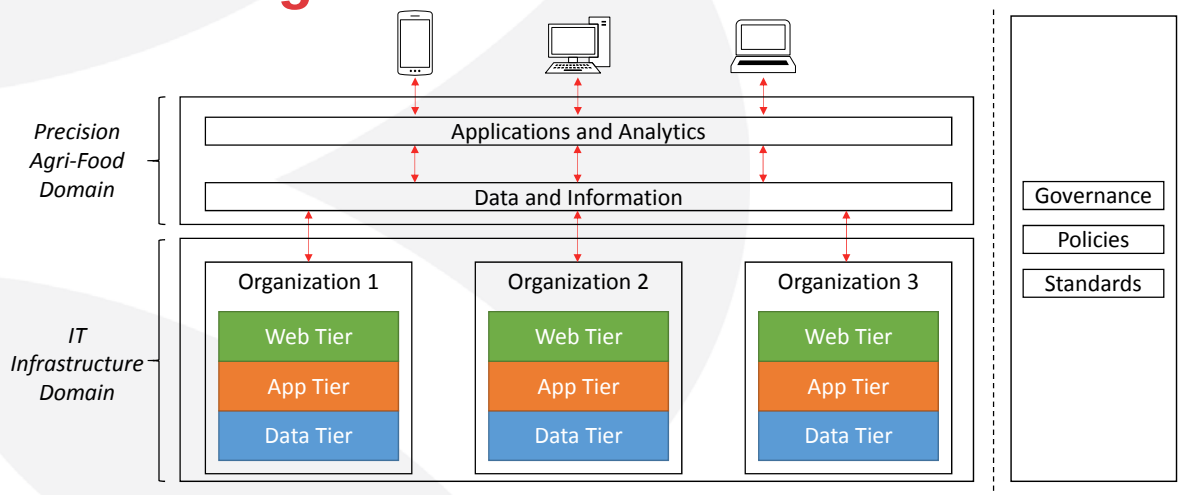


Precision Agri-Food Research Expertise and IT Capacity



UG – SCS = University of Guelph – School of Computer Science
UG – LSD = University of Guelph - Laboratory Services Division
UG – CBG = University of Guelph – Centre for Biodiversity Genomics
VRIC = Vineland Research and Innovation Centre
NC – AEIC – Niagara College – Agriculture and Environment Innovation Centre
UW – CBB = University of Waterloo – Centre for Bioengineering and Biotechnology
UW – CSG – University of Waterloo – Computer Systems Group
OMAFRA – ARIO = Ontario Ministry of Agriculture, Food and Rural Affairs - The Agricultural Research Institute of Ontario
CDN – Canadian Dairy Network

Target State for Data and Information Exchange: Data Networks & Clouds



Current Issues & Challenges (1)

- Need for a Community to Shape Big Data Precision Agri-food Research
- Effective Collaboration Models Between Precision Agri-food Research Groups and Sector Stakeholders for Data Management and Sharing are not Robust
- Need for a Precision Agri-Food Domain-specific Data Governance Policy
- Lack of Standards

Current Issues & Challenges (2)

- Insufficient IT Compute Resources to Support Precision Agri-food Research
- Insufficient Storage Infrastructure
- Lack of Communications Infrastructure on Farms
- Cybersecurity
- Developing Big Data Analytical Software Tools and Frameworks
- Scaling Research from the Lab to Operational and Commercial Trials

Concluding Remarks – Opportunities (1)

- Define what data should be acquired for genomics, environmental, and Big Data research.
- Break down data silos through collaboration models.
- Develop a data governance policy for Big Data in precision agri-food.
- Establish standards for data collections and exchange to ensure that data collected can be used today and tomorrow.
- Not all data collected is associated with location. Leverage GIS expertise in Ontario to ensure geospatial Big Data are collected.

Concluding Remarks – Opportunities (2)

- Articulate, implement and manage a scalable IT framework (in collaboration with IT experts) that is driven by sector expertise.
- Accelerate IT infrastructure (i.e., server, storage, compute, communications, etc.) development in Ontario.
- Partner with existing research high performance computing organizations to develop precision agri-food specific IT infrastructure in Ontario.
- Partner with industry IT powerhouses to expand high performance computing available to Ontario research organizations.

Concluding Remarks – Opportunities (3)

- Leverage existing IM/IT best practices and available standards, and tailor to precision agri-food.
- Develop the analytics and tools required for Big Data in precision agri-food.
- Opportunity for an organization to bridge research to operational use and commercialization.
- Opportunities to fund data science research that would benefit not only precision agri-food research, but general Big Data research.

Acknowledgements

Thank you to these organizations and their researchers and staff for input and advice.

Acknowledgements

This project was funded in part through *Growing Forward 2 (GF2),* a federal-provincial-territorial initiative. The Agricultural Adaptation Council assists in the delivery of *GF2* in Ontario.