S&T Foresight & Geomatics: Enabling New Tools for Policy Futures

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Jack Smith, Director S&T Foresight
Office of the National Science Advisor,

Socio-economic Policy Drivers for Canada in the 21st Century

- **Our economic future – productivity, trade and innovation**
  - Canada is a small market, highly trade-dependent nation
- **Our new partners and competitors – Emergence of new economic powers – China, India**
  - Moving quickly from low-cost manufacturer to knowledge-based competition
- **Our natural resources**
  - Need to gain sustainable competitive edge through innovations in extraction and production to harness value-added benefits
- **Our environment – Global Warming: A fundamental effect on our economy, ecology and society**
  - North and coastal regions are particularly vulnerable to climate change
- **Our health and security**
  - Aging populations
  - Increasing virulence and rapidity of infectious diseases

What is Foresight?

A set of strategic tools for anticipating the future, to become more prepared for diverse challenges with adequate lead time

- **Anticipates multiple, plausible futures**
- **5 – 25 year time horizon**
- **A rehearsal for potential futures**
- **Accommodates uncertainty & diversity**
- **Highlights emerging opportunities & threats**

Becoming Knowledge Based

- **Speed, intangible assets and connectivity become your sources of value**
- **Increasing returns to scale from (intangible) products**
- **Products, services stay competitive by becoming smarter - "What do the vending machine, chairs, switches want to know?"**
- **When products, services become mass customized, interactive, remembering customers**
- **When relationships with customers start before the product arrives; remain after purchase**
- **When production processes have embedded in them the collective memory, intellect of the organization**

Macro Shaping Trends

- **Integration, Miniaturization of Technology**
- **Globalization of Capital, Terror , Disease**
- **Anti-globalization of Biodiversity, Culture, Sustainability**
- **De-Carbonization of Energy Economy**
- **Harmonization and Standardization for Trade**
- **Migration, Multi-Culturalism of Populations**
- **Intensification, Differentiation, of Wealth**
- **Bi-polarization of Religious Values and Secular Evolution**
- **Transformation, Integration of Infrastructure Systems**
- **Virtualization, Digitization of Communications, Entertainment, Education**
- **Automation, and Customization of Production**
- **Acceleration of Knowledge Services as Economic Driver**
- **Proliferation of Surveillance - Security**

Disruptive, Enabling, Converging S&T

- **Nanotechnology Devices:** in the body, in built environment, info systems
- **Geo-Strategic Pervasive Sensors :** embodied in smart networks
- **Customized Materials**: auto design, modelling engineered
- **Quantum Computing** :models that reach beyond Moore`s
- **Semantic Internet** (data rich & self navigable)
- **Cyber Agents** - sensors for networked intelligence
- **Autonomic Software** :self repair code generation
- **Stand Alone Power** : portable, sustainable energy systems :for sensors
- **Nanorobotics – Smart Dust**, linked in colonies
- **Smart Organics** :that upgrade life forms intelligence
- **Visualization, Human-Machine Interfaces** linking brain and machine

Converging Technologies
Example of a Domain Matrix

Contrib. Domain	Extended or Assisted Domain			
	Bio	**Nano**	**Info**	**Cogno**
Bio	–	*RNA-scaffolded nanostructures*	*DNA computing*	*cognitive enhancements*
Nano	*nano-biosensors*	–	*single molecule transistor*	*real-time brain nanosensors*
Info	*proteomics*	*nanophysics simulations*	–	*brain augmentation*
Cogno	*bio-data mining*	*nanodevice optimization*	*swarm intel. for network monitoring*	–

CT Tools: Example of a Table of +/- impacts on Prospective Domains of Application

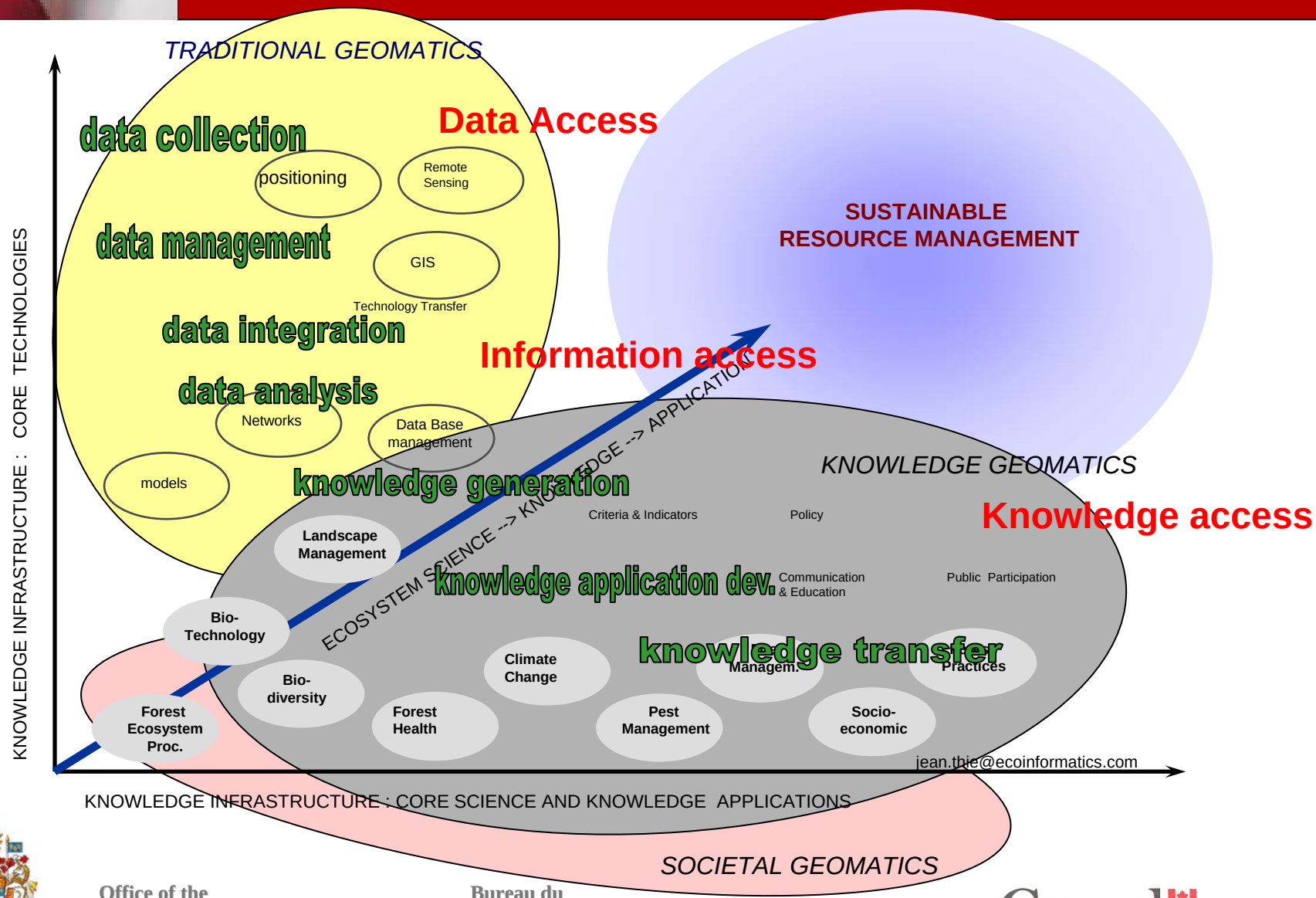
Impact on	Bio/Nano	Info/Cogno
Environment	+/-Nano-particle toxicity + Energy-efficiency +/- Synthetic life + CO2 scrubbers	+ Reality browsing + Sensor nets + Integrated landscape models
Economics	+/- Personal fabrication - High-cost interventions	-/+ IP as major repository of value -/+ IP easily violated thru invisible spying
Public Safety	- GMO hazards - On-line virus building - Grey goo	+ Disaster response nets - Information security, privacy
Health	+ Smart drug delivery - Incredible medicine for very rich only +/- Aging slowed down	+ Health informatics - Privacy of personal genomes - Genetic predeterminism

Geo-Strategics

The future horizons and applications of geo-spatial data and related knowledge management technologies for decision support, including pattern recognition software, wireless communications infrastructure futures, and links to major new capacities in surveillance, ecological monitoring and resource management technologies.

GeoStrategics Value System

MIGRATING FROM "TRADITIONAL" SPATIAL DATA TO KNOWLEDGE INFRASTRUCTURE



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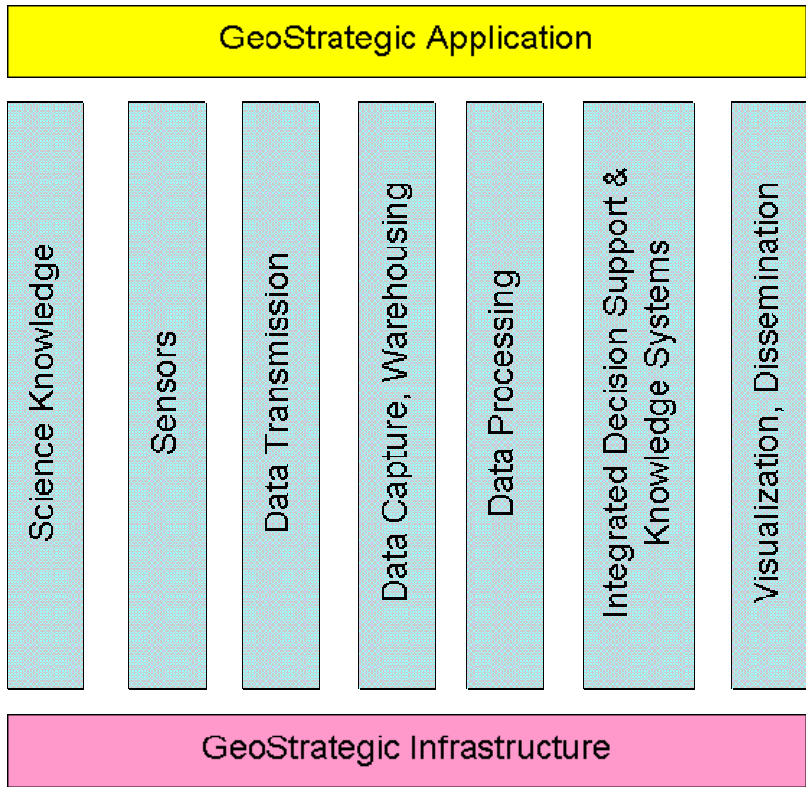
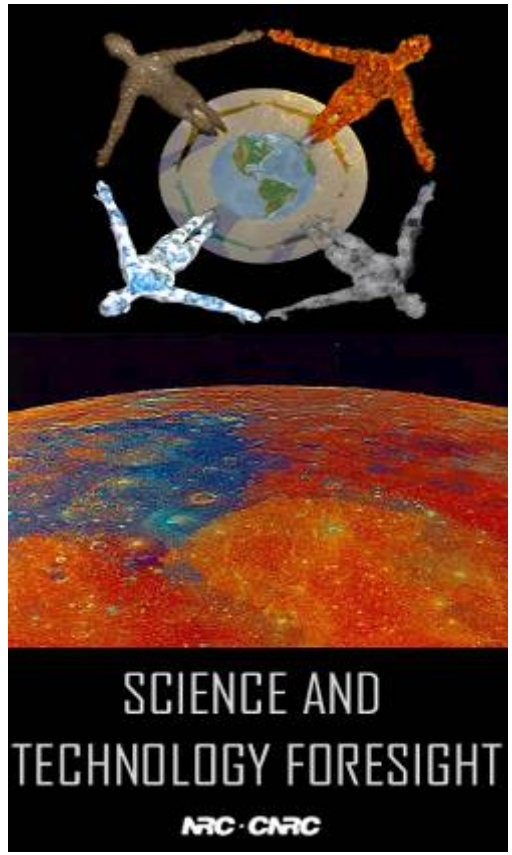
Strategic Reach :Geomatics +Foresight

1. **Environment & Resources**
2. **National Security & Emergency**
3. **Transportation Efficency**
4. **Sustainable Cities and Urban Development**
5. **Global Health Risks and Hazards to Canada**
6. **Ocean and Inland Water Resources – “oil for the future”**



Strategic Opportunity: Sensors

- 3D detectors & non-linear optics
- Sensor swarms surveilance, collection and data management
- Tuanble & micro Linar, advanced microwave, warm Focal Planes
- Next generation telescopes, antennas
- Multi-functional, autonomous and reconfiguable communications structures
- Automated calibration



Strategic Opportunity:Knowledge & Information Synthesis

- High reliability high -bandwidth info delivery
- Space – ground programming for patterns and eco change
- Geo-spatial data sets for human-machine futures
- Immersed telepresencec collaborations
- Pervasive GeoReference standards for public reliance

NATIONAL ISSUE MAP SERIES: SCIENCE-POLICY LINK CARTOGRAPHY

NATURAL CHANGE → SUSTAINABLE PRESSURES

LINK BETWEEN ENVIRONMENT AND SOCIETY

EVOLUTION OF ECONOMY

ALTERNATIVE FUTURES

ALTERNATIVE POLICIES

ADEQUACY OF POLICIES ← NEED FOR CHANGE ← SOURCES OF STRESS

ISSUE INTRODUCTION 1

THE NATURAL ECOSYSTEM 2

DESCRIPTION OF UNDISTURBED SYSTEMS, BEFORE SETTLEMENT, WITH FOCUS ON INTERRELATIONSHIPS BETWEEN AIR, WATER, LAND, LIVING ORGANISMS

QUALITY, QUANTITY
INTERACTIONS
CYCLES

GLOBAL
CONTINENTAL
REGIONAL
LOCAL

ABORIGINAL / PREHISTORIC PERSPECTIVE 3

DESCRIPTION OF ABORIGINAL LINKS WITH THE ECOSYSTEM OR
DESCRIPTION OF HISTORIC OR PREHISTORIC CHANGES TO THE ECOSYSTEM RELEVANT TO TODAYS ISSUE

FUTURE SCENARIOS

DESCRIPTION OF THE POTENTIAL

EFFECT OF VARIOUS POLICY

SCENARIOS

8

HISTORIC / CULTURAL PERSPECTIVE 4

ACTIONS & POLICIES TO DEAL WITH ISSUE 7

PRESENTATION OF POLICY RESPONSE AND EFFECTS;
DISCUSSION OF ALTERNATIVE POLICY SCENARIOS

EFFECTS ON SOCIETY ENVIRONMENT 6

PRESENTATION OF DISTRIBUTION, EXPOSURE AND EFFECTS OF STRESSORS ON ENVIRONMENT AND PEOPLE;
CUMULATIVE ENVIRONMENTAL IMPACTS;

STRESS - RESPONSE ANALYSIS PROVIDES PERSPECTIVE ON SUB-ISSUES FOR POLICY ACTIONS

ECONOMIC PERSPECTIVE 5

ECONOMIC DEVELOPMENTS
ECONOMIC PROJECTIONS
LINK WITH RESOURCES, POPULATION
INDUSTRIAL DEVELOPMENT AND
SOURCES OF ENVIRONMENTAL AND HEALTH STRESS

Jean Thie, Nov. 1992

Federal Science – A Vision to 2010

The Government of Canada will be recognized nationally and internationally for the quality and productivity of its science in support of the public good, that would have:

- Focused S&T programs aligned with mission critical goals
- A talented and committed workforce dedicated to government science
- State-of-the-art equipment and clusters of core infrastructure
- Commitment to partnerships and networks with others to lever resources and research capacity
- An enabling administrative and fiscal environment

Canada's International Legacy

"Our strategy for international commerce has moved well beyond simply looking for export markets, and marketing our natural resources . . . In today's economy, it is ever more important to promote strong international investment and scientific and research relationships around the world . . . The future belongs to knowledge-based economies, and steps are being taken now by government and the private and academic sectors to make sure Canada is equipped to benefit."

Prime Minister Paul Martin,

Foreword to Canada's International Policy Statement

April 2005

Canada

Office of the
National Science Advisor

Bureau du
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Canada