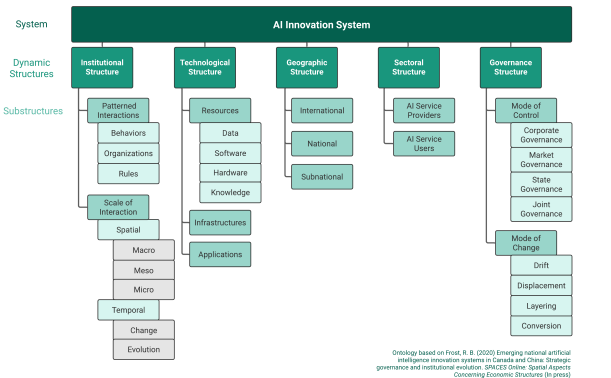# AI Governance Systems:
## Ontological Explorations in the Canadian Context

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## Ontology 1: AI Innovation Systems



System — **AI Innovation System**

Dynamic Structures: Institutional Structure · Technological Structure · Geographic Structure · Sectoral Structure · Governance Structure

Substructures:
- Institutional Structure: Patterned Interactions (Behaviors, Organizations, Rules), Scale of Interaction (Spatial — Macro, Meso, Micro; Temporal — Change, Evolution)
- Technological Structure: Resources (Data, Software, Hardware, Knowledge), Infrastructures, Applications
- Geographic Structure: International, National, Subnational
- Sectoral Structure: AI Service Providers, AI Service Users
- Governance Structure: Mode of Control (Corporate Governance, Market Governance, State Governance, Joint Governance), Mode of Change (Drift, Displacement, Layering, Conversion)
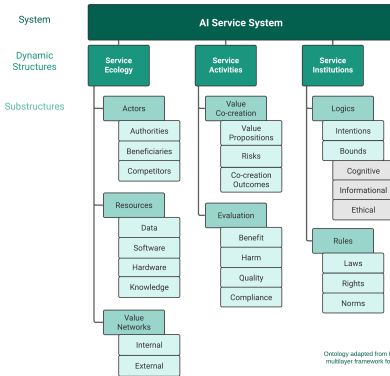
Ontology based on Frost, R. B. (2020) Emerging national artificial intelligence innovation systems in Canada and China: Strategic governance and institutional evolution. *SPACES Online: Spatial Aspects Concerning Economic Structures* (in press)

### Key features of the Canadian AI innovation system

| Institutional Structure | Technological Structure | Geographic Structure | Sectoral Structure | Governance Structure |
|---|---|---|---|---|
| - Macro scale: federal government policies, programs, and initiatives (e.g. ISED innovation superclusters, strategic innovation fund, data strategy roadmap)<br><br>- Meso scale: knowledge brokerage institutions and public-private sector interactive spaces (e.g. CIFAR Pan-Canadian AI strategy, Advisory Council on AI, Brookfield Institute)<br><br>- Micro scale: individual AI-providing and AI-using firms | - Strong early pool of AI expert knowledge, but AI industry now requires larger talent pool to remain competitive<br><br>- Existing infrastructures for IT/AI research and innovation in several regions (e.g. Toronto, Montreal, Kitchener-Waterloo, Vancouver, Ottawa)<br><br>- Industrial infrastructures in several sectors to be evolved through new AI applications (e.g. manufacturing, logistics, healthcare - targeted by ISED's innovation superclusters program)<br><br>- Significant focus on designing ethical AI applications | - International: Extensive research and work on AI ethics and regulation positioning Canada as a global leader on ethical AI innovation<br><br>- National: National AI strategy is jointly developed by many public and private institutions across multiple scales, strategic planning is pluralistic and transactive<br><br>- Subnational: Provincial governments coordinating federal AI innovation policy with needs of local firms (e.g. through Quebec's AI Cluster Steering Committee, Invest in Ontario, Invest in Alberta) | - Good environment for new AI-providing startups, but challenges with retaining companies and IP in Canada as startups grows<br><br>- Foreign (mostly American) AI service providers increasingly common in Canadian market<br><br>- High demand for AI services across many AI-using sectors with outdated infrastructures | - Joint governance: Legitimacy seeking approach to AI governance; co-creation of innovation, knowledge, and strategy through meso scale institutions<br><br>- Change through layering: New institutions such as Schwartz Reisman Institute and the Advisory Council on AI establish new interactive spaces through which to integrate strategic interests<br><br>- Change through conversion: existing government institutions offer new or modified programs to support AI innovation |

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## Ontology 2: AI Service Systems



System — **AI Service System**

Dynamic Structures: Service Ecology · Service Activities · Service Institutions

Substructures:
- Service Ecology: Actors (Authorities, Beneficiaries, Competitors), Resources (Data, Software, Hardware, Knowledge), Value Networks (Internal, External)
- Service Activities: Value Co-creation (Value Propositions, Risks, Co-creation Outcomes), Evaluation (Benefit, Harm, Quality, Compliance)
- Service Institutions: Logics (Intentions, Bounds — Cognitive, Informational, Ethical), Rules (Laws, Rights, Norms)

Ontology adapted from Frost, R. B. Cheng, M., Lyons, K. (2019) A multilayer framework for service system analysis. In *Handbook of Service Science, Volume II*, Springer.

### Key features of the Canadian AI service system

| Service Ecology | Service Activities | Service Institutions |
|---|---|---|
| - Authorities: Governments regulating and seeking to regulate data and AI software; private sector firms contribute their knowledge to advise government and authorize regulations.<br><br>- Beneficiaries: Private sector firms, people of Canada through decreased AI risks and increased tax revenues from growth of Canadian AI market, development of new Canadian AI resources, and growth of Canadian talent/knowledge pool<br><br>- Competitors: Inter-firm economic competition; inter-governmental competition over AI resources and regulation; public-private competition over design and implementation of AI regulation; public-private competition over flow of new tax revenues to Canadian public from private AI firms. | - Public and private sector initiatives for ethical AI systems and standardization seek to improve value proposition of Canadian AI by minimizing risks and harms and co-creating new compliance-focused value networks (e.g. Directive on Automated Decision-making, CIO Strategy Council standard for automated decision systems)<br><br>- Emphasis on developing a system of ethical/standardized/regulated AI services adds a unique value proposition to Canadian AI, integrates ethics into quality measures. | - Quality of AI services limited by cognitive bounds of ML developers and informational bounds of available data - bounds must be advanced by recruiting and training new talent and making more data available while minimizing potential risks and harms of increased data availability<br><br>- Emphasis on organizing large multi-actor value networks to identify ethical bounds of AI services and develop appropriate laws and rights for AI<br><br>- Ethical bounding and institutionalization of laws/rights for AI services could be undermined by harmful norms or actors with malintent - not enough attention to political-economic norms and business intentions in AI ethics initiatives |

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## Comparison of Ontologies 1 & 2

| AI Innovation Systems | AI Service Systems |
|---|---|
| - Disciplinary background: **economic geography** | - Disciplinary background: **service science** |
| - Generative mechanism: **production & consumption structures** | - Generative mechanism: **networks of value exchange** |
| - Emphasizes place and time: **situated knowledge** | - Emphasizes values and evaluation: **organizational knowledge** |
| - For broad overviews of political economies of AI: maps out AI innovation activities across several structures and scales | - For deep dives into political economies of AI: traces strategic relationships and value flows across several places and times |
| - Descriptive + prescriptive analysis of AI governance systems | - Evaluative + critical analysis of AI governance systems |

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## Next Steps

- Explore approaches to synthesizing these ontologies: **AI Service & Innovation Systems**
- Apply these ontologies to challenges in the **political economy of AI** (e.g. resource disparities, public-private value conflicts, ethical business models)
- More detailed **case studies** of the AI governance systems of Canada and other nations

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## Questions? Comments?

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