Framework For Evaluating Wireless Technology Functionality In Transportation

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Connected Vehicle Workshop
July 20 2012
University of British Columbia

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AUTO21 Innovation Through Research Excellence / l'innovation par l'excellence en recherche

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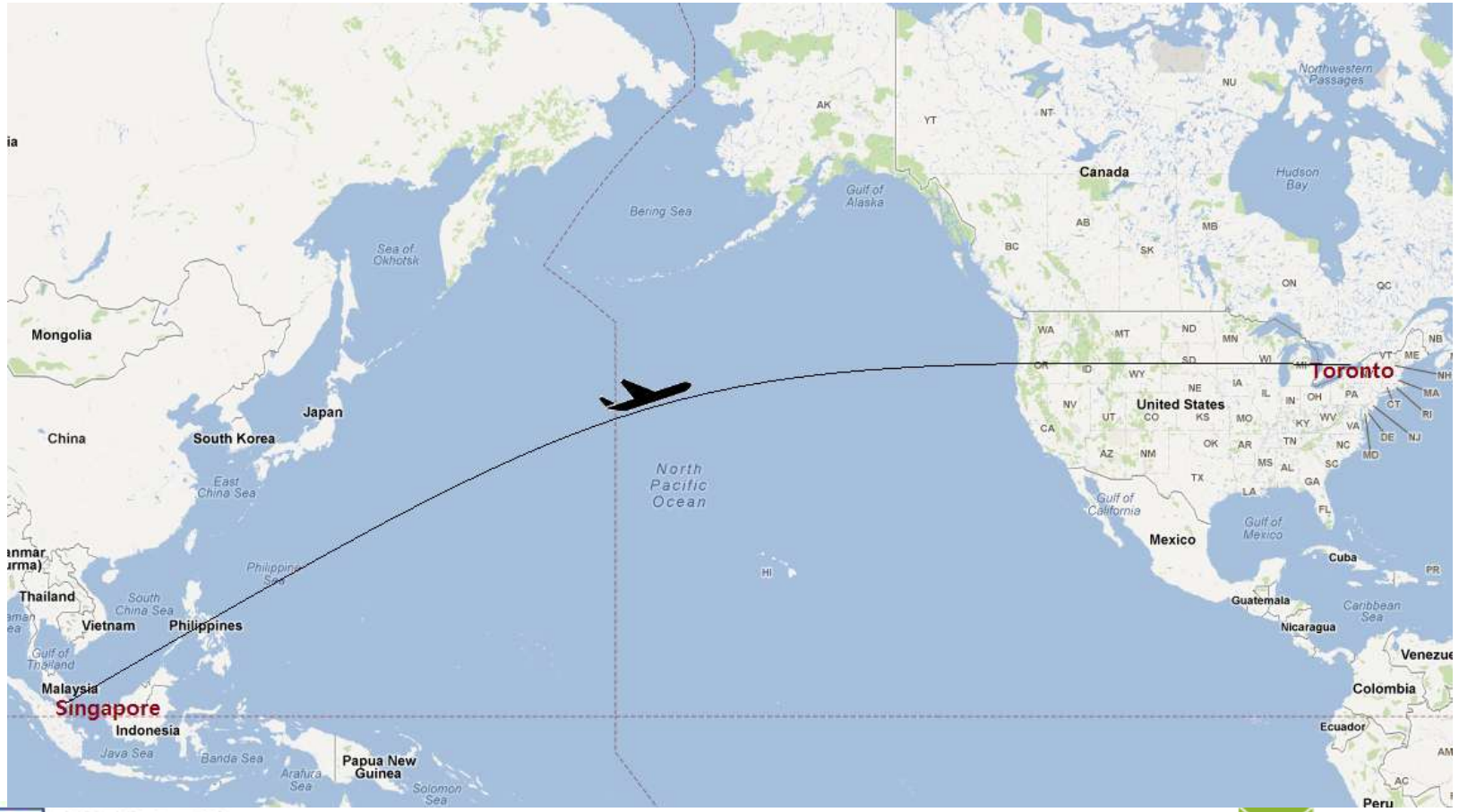
If you are flying from India, Hong Kong, Tokyo, Beijing or Sydney to Toronto, what is your flight plan (route)?

Direct Flight – Singapore to Toronto



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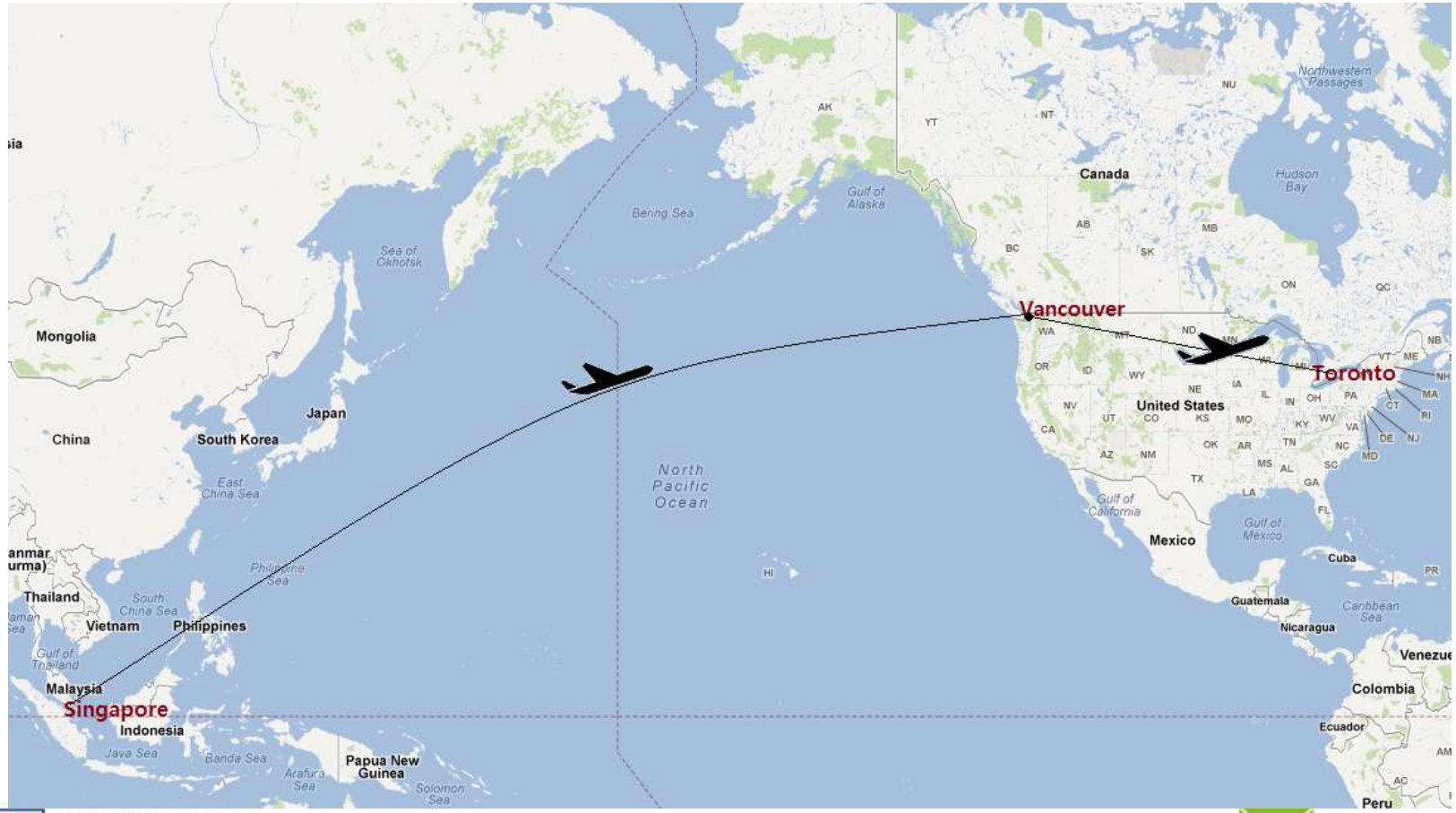
Indirect Flight
Singapore to Vancouver to Toronto



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Your choices are:

- **Direct Flight – e.g. Singapore to Toronto**

- **Indirect Flight – e.g. Singapore to Vancouver (or other intermediate stop) to Toronto**

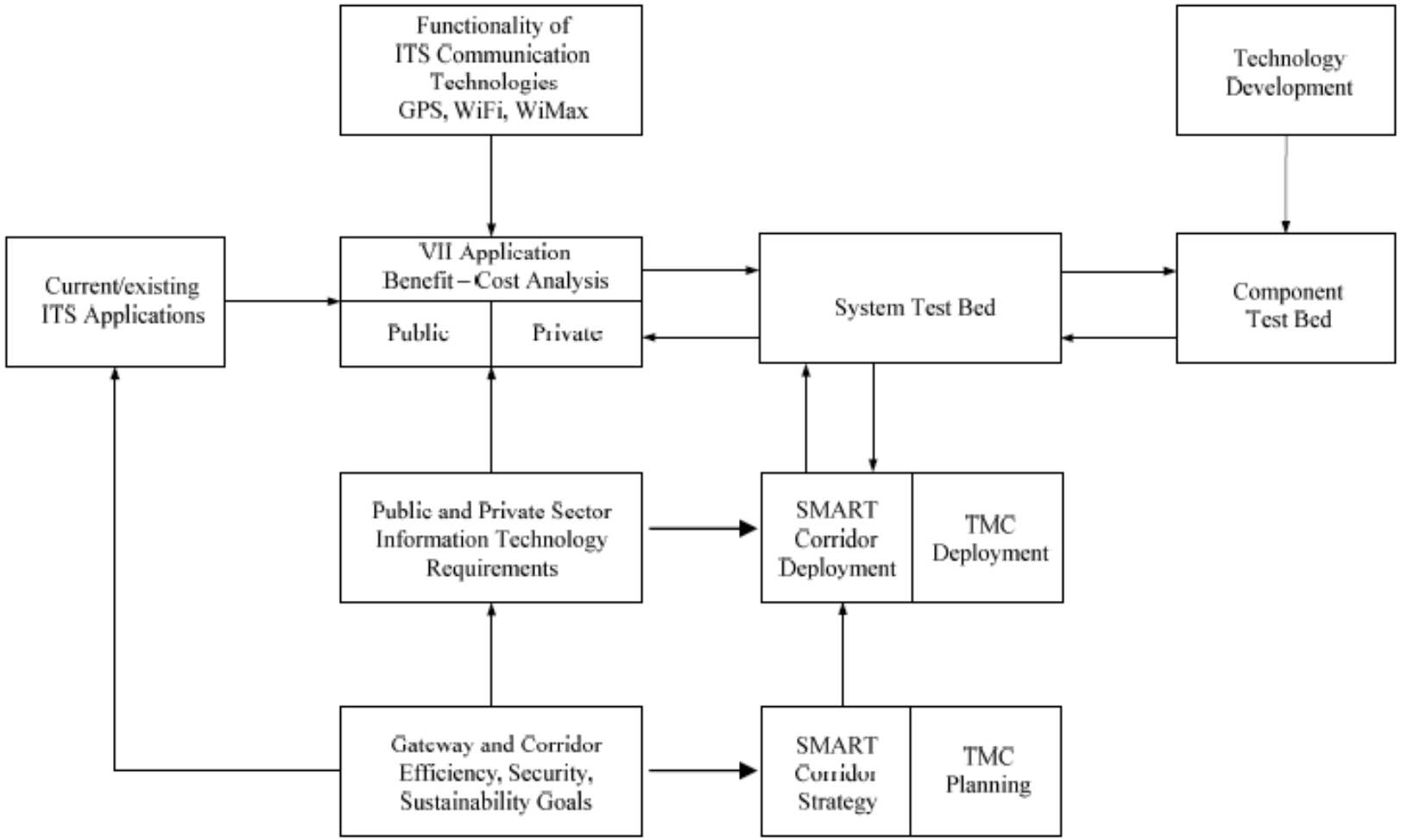
The industrial innovation process

- Customer demand → Market research
- Need for improvement in capabilities of aircraft → target functionality of aircraft and components
- Demand improved technology from suppliers → improved functionality
- Trade off with cost of improved functionality

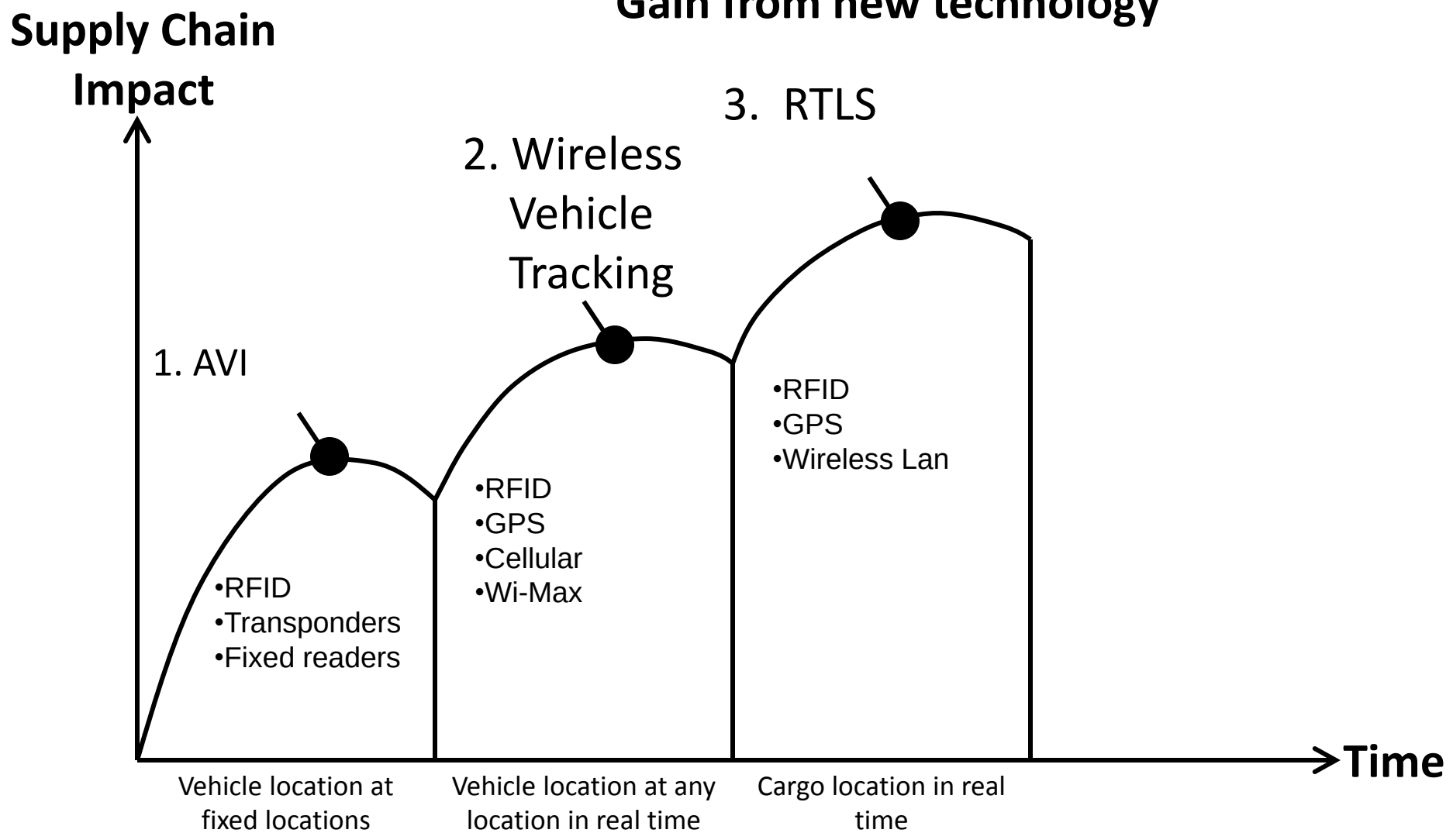
Research is driven by demand

- **Canadian Government Economic Action Plan 2012**
- Refocus the National Research Council on demand-driven business-oriented research that will help Canadian businesses develop innovative products and services.

Technology Development Should be Sensitive to the Potential Needs of the Ultimate Users



Cargo Tracking Evolution – Transformational Gain from new technology



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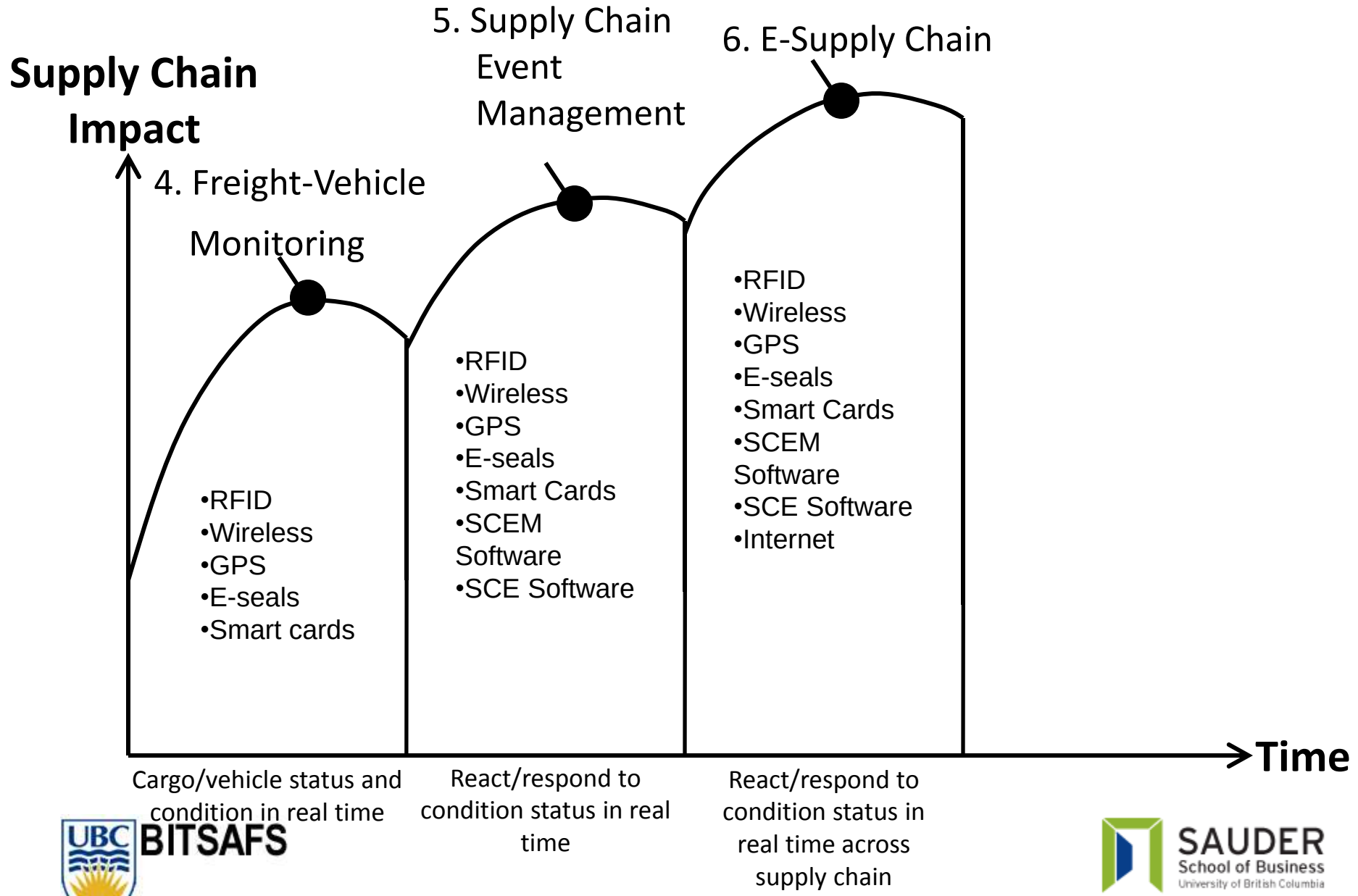
Enabling a Smart Supply Chain Evolution



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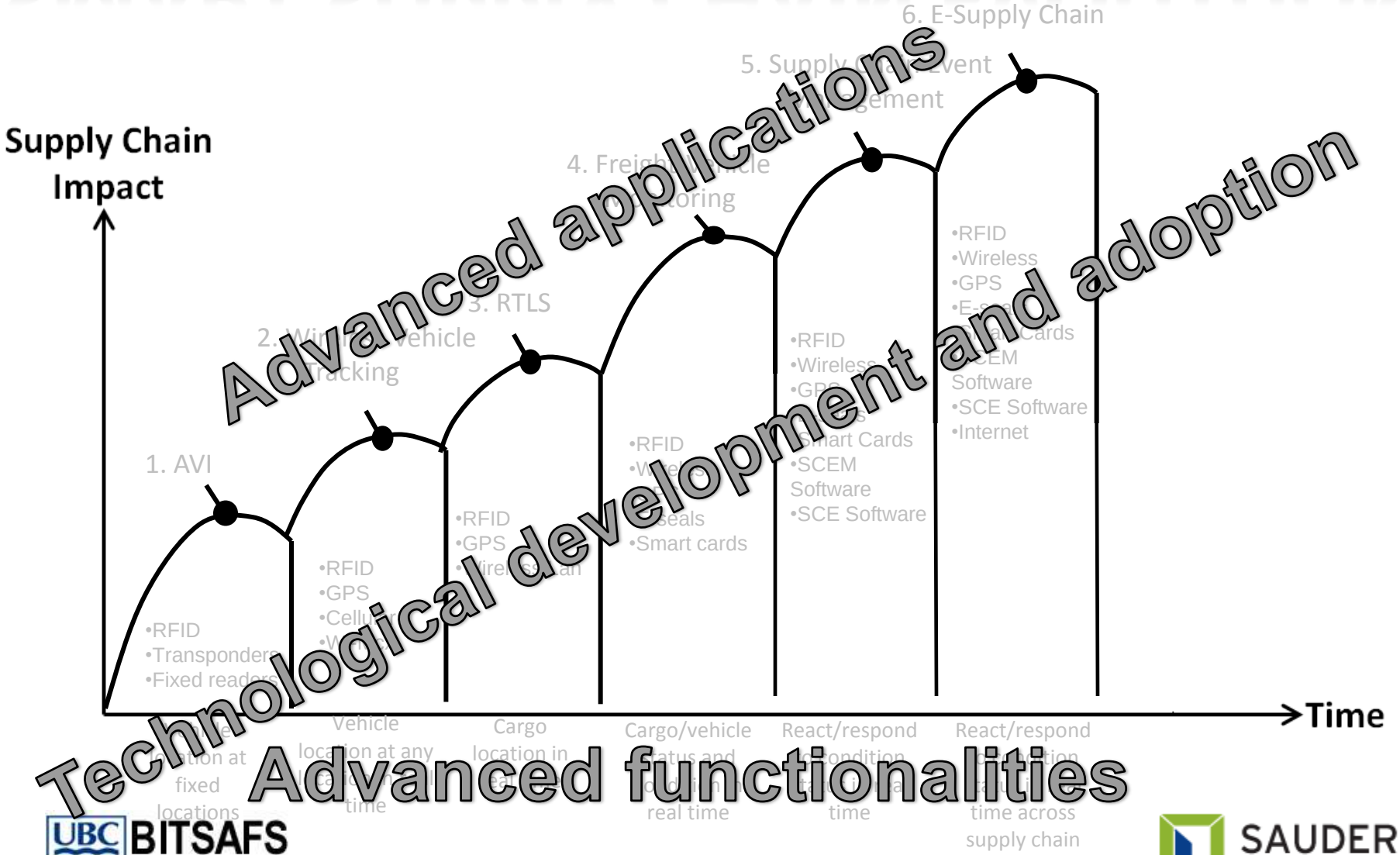
SMART SUPPLY CHAIN EVOLUTION



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Where can we start to be more demand driven?

Where can we start to be more demand driven?

- Start with Service Packages or Users Services in the ITS Architecture to identify where wireless communication currently or potentially adds value to the process.

Canadian ITS Architecture

- Provides a unified framework for integration to guide the coordinated deployment of ITS programs within the public and private sectors. It offers a starting point from which stakeholders can work together to achieve compatibility among ITS elements to ensure unified ITS deployment for a given region.

Canadian ITS Architecture defines

- The functions (e.g., gather traffic information or request a route) that are required for ITS
- The physical entities or subsystems where these functions reside (e.g., the field or the vehicle).
- The information flows and data flows that connect these functions and physical subsystems together into an integrated system.

High Level View of Canadian ITS Architecture

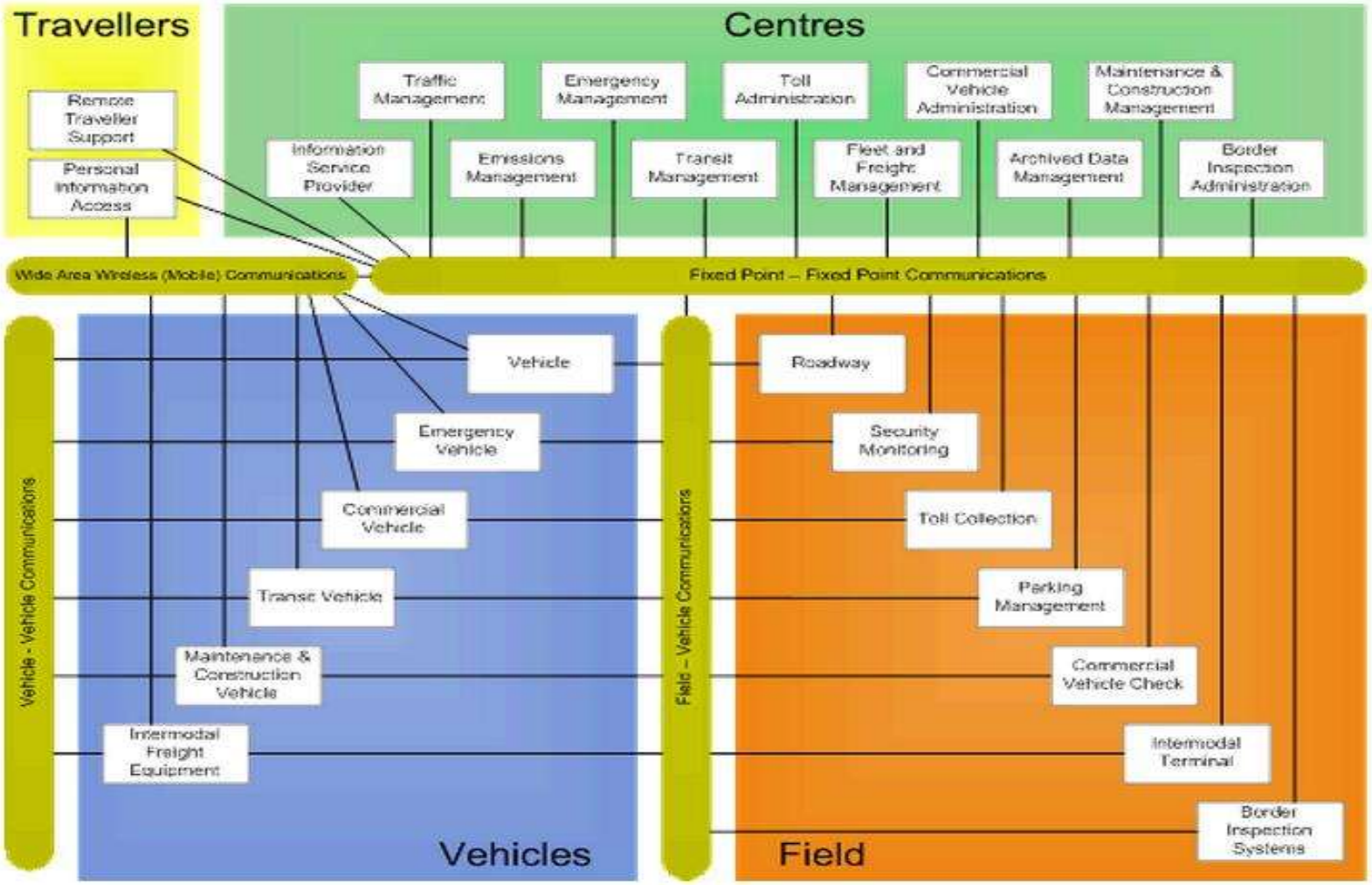


Figure 2. ITS Architecture for Canada Subsystems and Communications

User Services

- User services represent what the system will do from the perspective of the user. A user might be the public or a system operator.

- 37 user services which formed the basis for the ITS Architecture for Canada development effort, grouped into eight bundles for convenience.

8 User Service Bundles

1. Traveler Information
2. Traffic Management
3. Public Transportation Management
4. Electronic Payment
5. Commercial Vehicle Operations
6. Emergency Management
7. Advanced Vehicle Safety Systems
8. Information Management
9. Maintenance and Construction Management

User Service Bundle – Commercial Vehicle Operations (CVO) User Services

1. Commercial Vehicle Electronic Clearance
2. Automated Roadside Safety Inspection
3. On-Board Safety and Security Monitoring
4. Commercial Vehicle Administrative Processes
5. Hazardous Materials Planning and Incident Response
6. Freight Mobility
7. Intermodal Freight Management
8. International Border Transportation Management

Service Packages

- Identify the pieces of the ITS Architecture for Canada required to implement a service.
- Most Service Packages are made up of equipment packages in two or more subsystems. Service Packages are designed to address specific transportation problems and needs and can be related back to the user services and their more detailed requirements.

Canadian ITS Architecture V2.0
CVO Service Packages

Fleet Administration
Freight Administration
Electronic Clearance
CV Administrative Processes
International Border Electronic Clearance
Weigh-In-Motion
Roadside CVO Safety

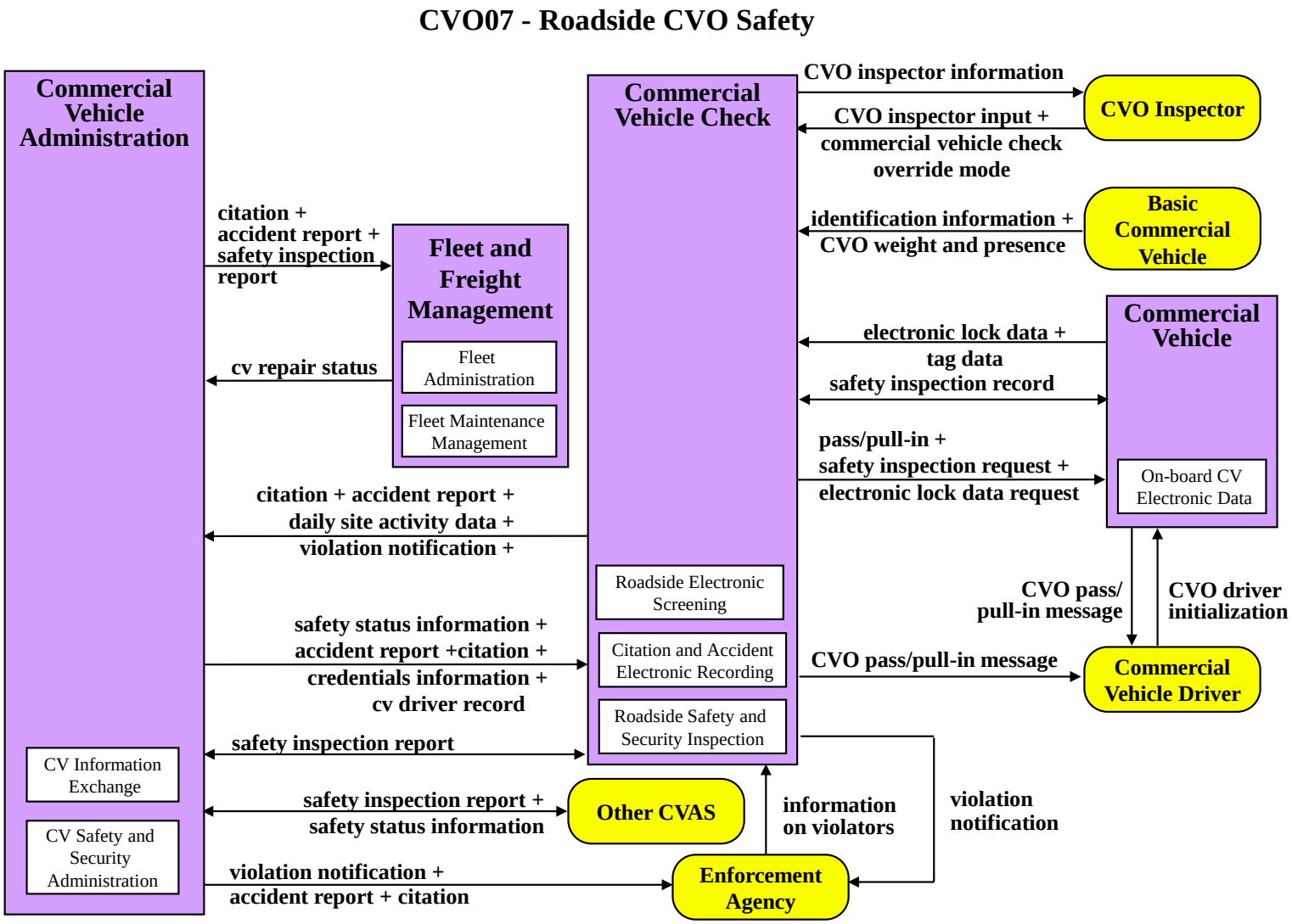
Canadian ITS Architecture V2.0
CVO Service Packages

Roadside CVO Safety
On-Board CVO and Freight Safety and Security
CVO Fleet Maintenance
Hazardous Material Planning and Incident Response
Roadside Hazardous Material Security Detection and Mitigation
CV Driver Security Authentication
Freight Assignment Tracking
Freight Terminal Management
International Border Registration
International Border Pre-Processing
International Border Inspection

CVO 007
Roadside CVO Safety

- This service package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at the roadside check locations. The capabilities for performing the safety inspection are shared between this service package and the CVO08: On-board CVO and Freight Safety & Security service package which enables a variety of implementation options. The basic option, directly supported by this service package, facilitates safety inspection of vehicles that have been pulled off the highway, perhaps as a result of the automated screening process provided by the CVO03: Electronic Clearance service package. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure which is used to support the safety inspection, and may also inform the pull-in decision if system timing requirements can be met. More advanced implementations, supported by the CVO08: On-board CVO and Freight Safety & Security service package, utilize additional on-board vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

CVO 007
Roadside CVO Safety



Map your research project against ITS Service Packages

Enabling Service Packages within the Canadian ITS Architecture (Version2.0)		Early Win Projects					
		DSRC 5.9 GHz New Technologies for Freight Security	Wireless Communications between Intermodal Truck Components (Cab, Container, Chassis)	Algorithm Development and Information Integration System to Support a Comprehensive Dangerous Goods Monitoring Capability	Intermodal Container Networking and Monitoring System	Applications for Intermodal Container Cargo Monitoring	Truck and Driver Automated ID Applications
ATIS09	In Vehicle Signing	●					
ATIS10	VII Traveller Information	●	●				
CVO01	Fleet Administration	●					●
CVO02	Freight Administration	●	●	●	●	●	●
CVO03	Electronic Clearance	●	●	●			●
CVO04	CV Administrative Processes						●
CVO05	International Border Electronic Clearance	●	●	●			●
CVO06	Weigh-In-Motion	●	●				
CVO07	Roadside CVO Safety	●	●	●			●
CVO08	On-board CVO and Freight Safety and Security	●	●	●			●
CVO09	CVO Fleet Maintenance						
CVO10	Hazardous Material Planning and Incident Response	●	●	●	●	●	
CVO101	Freight Terminal Management	●	●	●	●	●	
CVO102	International Border Registration						●
CVO103	International Border Pre-Processing	●	●	●			●
CVO104	International Border Inspection			●			●
CVO11	Roadside Hazardous Material Security Detection and Mitigation	●	●	●			
CVO12	CV Driver Security Authentication						●
CVO13	Freight Assignment Tracking	●	●	●		●	●

Example:Development of DSRC for ITS applications - **Vehicular Telematics over WiFi and WiMax Multihop Networks (ISS)**

- **Professors Involved:** Dr.Hossain and Dr. Leung
- **Technologies Involved:** DSRC and Mobile Wi-Max
- **Improvements/Additions to Current Technology:**
  - Enhanced Multi-channel MAC Protocol for DSRC to achieve performance standard
  - Optimize Transmission Range control for Multi-hop DSRC
  - Analyze Dynamic Spectrum Sharing between DSRC and Wi-MAX Radio

Example:Development of DSRC for ITS applications - **Vehicular Telematics over WiFi and WiMax Multihop Networks (ISS)**

- **Application of Technology:** Enable Reliable Vehicle to Vehicle and Vehicle to Roadside communication using DSRC
- **Increased Capabilities:**
  - Latency ?
  - Transfer rate ?
  - Range ?
  - Frequency (update rate) ?
  - Band width, packet size ?

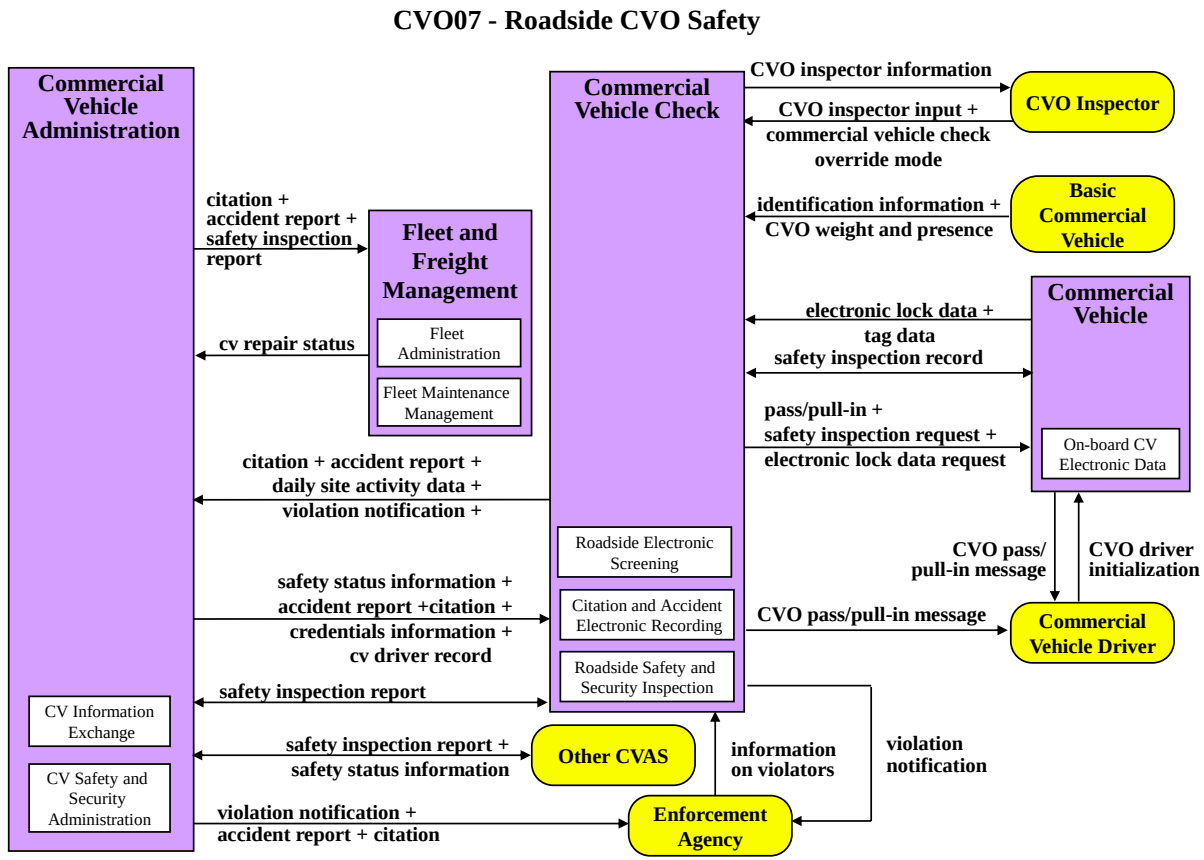
Example:Development of DSRC for ITS applications - **Vehicular Telematics over WiFi and WiMax Multihop Networks (ISS)**

- **Increased Capabilities:**
  - Failure probability ?
  - Reliability ?
  - Security ?
  - Interference Likelihood ?
  - Interoperatability?
  - Cost?

Map to appropriate ITS User Services or Service Packages

Fleet Administration
Freight Administration
Electronic Clearance
CV Administrative Processes
International Border Electronic Clearance
Weigh-In-Motion
Roadside CVO Safety
On-Board CVO and Freight Safety and Security
CVO Fleet Maintenance
Hazardous Material Planning and Incident Response
Roadside Hazardous Material Security Detection and Mitigation
CV Driver Security Authentication
Freight Assignment Tracking
Freight Terminal Management
International Border Registration
International Border Pre-Processing
International Border Inspection

Identify information flows, flow functionalities, and research outpout impacts process – e.g. CVO 007 Roadside CVO Safety



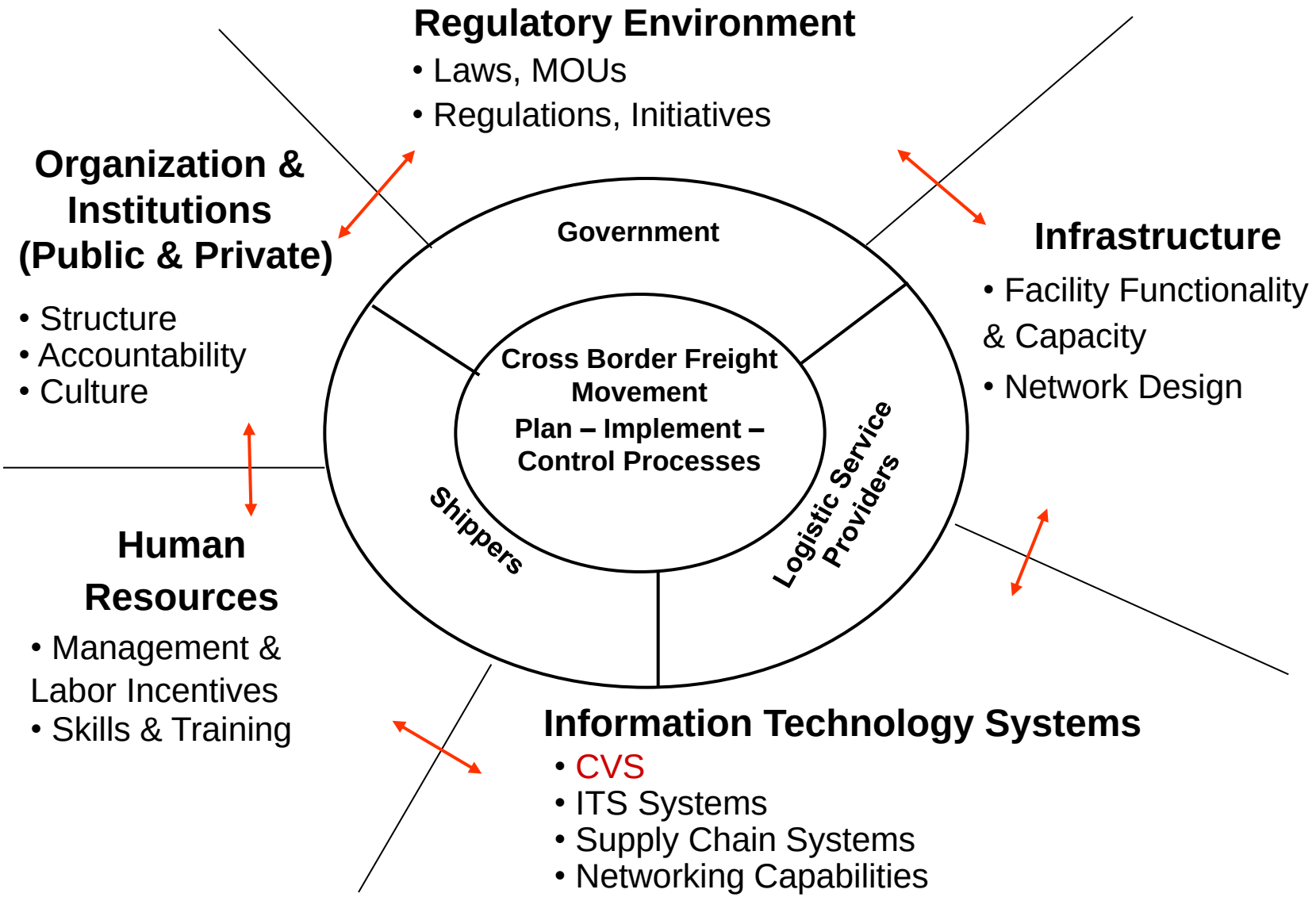
Evaluating Wireless Technology Functionality In Transportation

- Start with Service Packages or Users Services in the ITS Architecture to identify where wireless communication currently or potentially adds value to the process.
- Simulate/Estimate Benefit-cost

Many model types for evaluating benefits

- Write your own simulation
- Traffic Flow models – Vissim
- Routing and Scheduling
- Activity based
  - BITSAFS models for China – Canada – U.S. supply chain
  - US DOT Freight Technology Assessment Tool (FTAT)
- Consolidate into tool kit for assessing potential benefits of technology applications

Achieving an Efficient, Safe, Secure and Sustainable (ES^3) Supply Chain



Multiple Layers of the Supply Chain

Layer No. 6
Regulatory Oversight

Trade and Security – Competition Policy, CBSA
Safety – TC, Provincial MOT, municipal and metro transport, police
Labour standards – provincial and federal labour boards

Layer No. 5
Supply Chain
Transaction

Supplier – Logistics Service Provider – Manufacturer – Logistics Service Provider – Distributor - Logistics Service Provider – Retailer – Logistics Service Provider - Consumer

Layer No. 4 Logistics
Flow

Plant – Transportation Operations – DC – Transportation Operations – DC – Transportation Operations – Plant – Transportation Operations - Stores

Layer No. 3
Transport Operators

Trucking – rail – water – port consolidation – port terminals – marine – port terminals – truck – rail – water - intermodal

Layer No. 2
Traffic

Roadways – Bridges – Tunnels – Grade crossings – Border Crossings - Tracks

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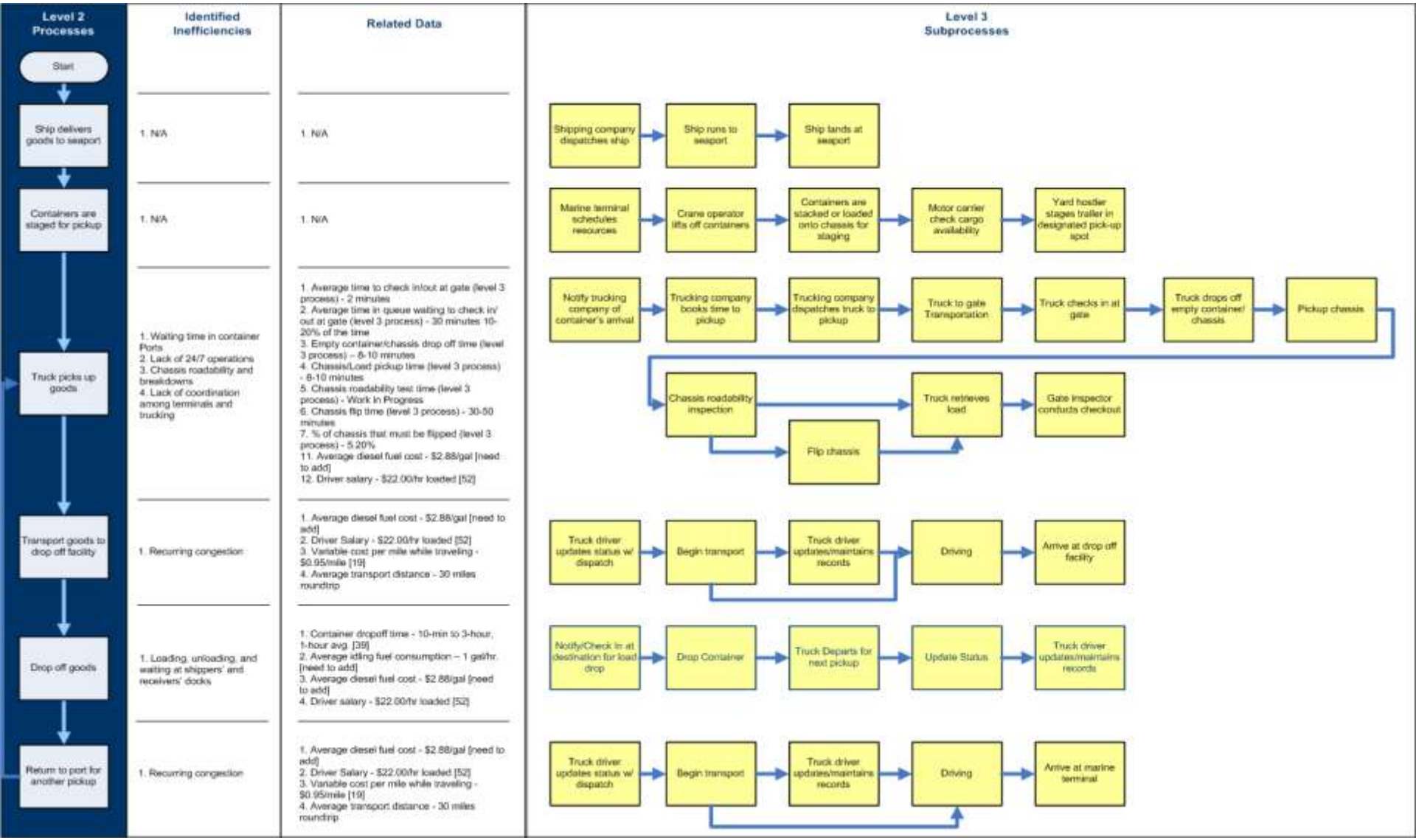
Layer No. 1
Transport
Infrastructures

Roadways – Bridges – Tunnels – Grade crossings – Border Crossings - Tracks

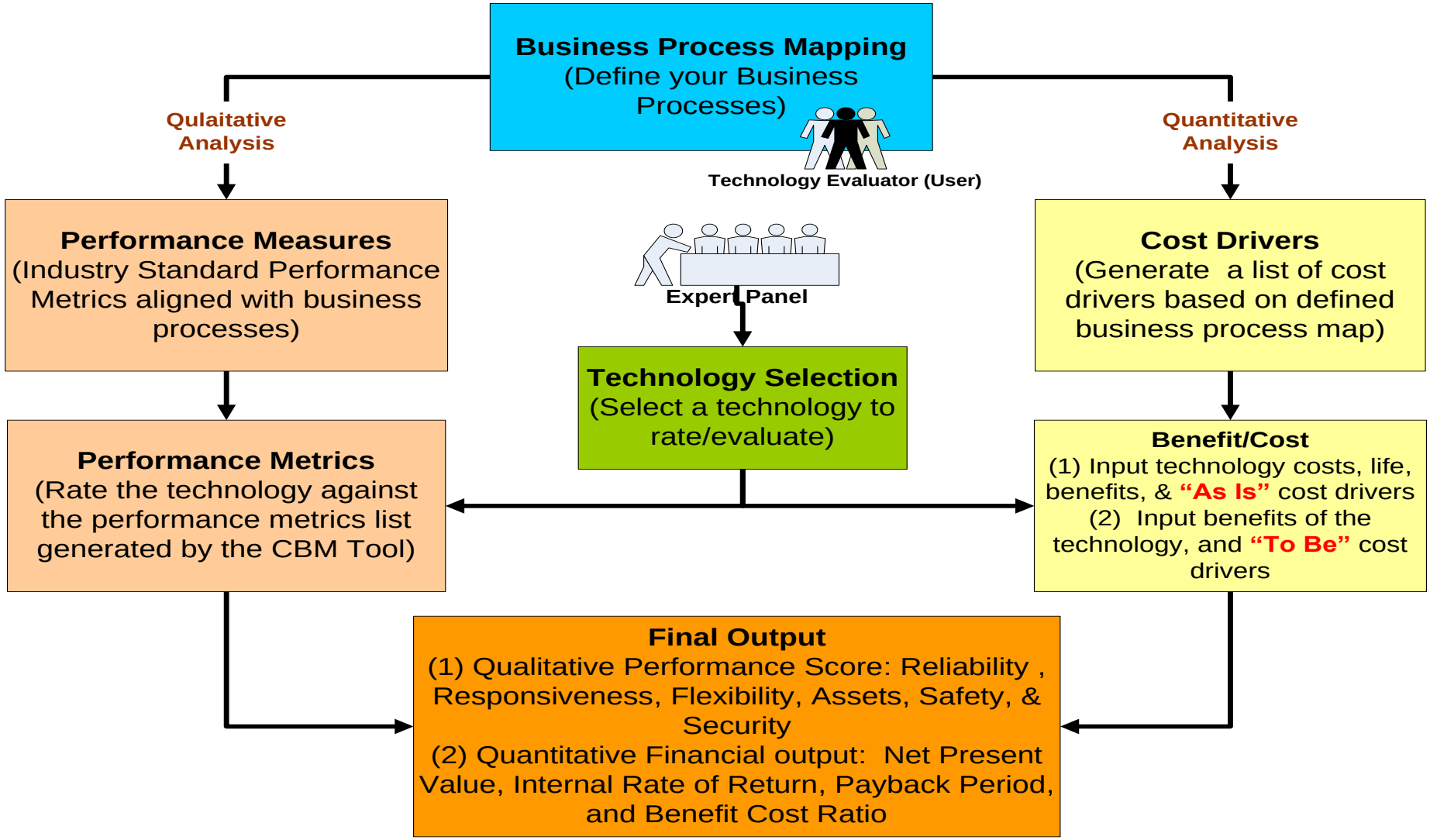
Applying FTAT
Motor Carrier Efficiency Study



Freight Technology Assessment Tool

FTAT

FTAT Methodology



FTAT Output

C-TIP Assessment		Wireless centralized dispatch	Ramp Scanner and RFID on containers	Shared intermodal container availability database	Appointment system for pick up and delivery	Chassis management system capability
Qualitative Summary	Reliability Score	1	0	1	0	0
	Responsivness Score	8	2	6	4	4
	Flexibility Score	0	0	0	0	0
	Cost Score	2	0	2	3	0
	Asset Management Score	5	0	4	9	5
	Safety Score	0	0	0	0	0
	Security Score	0	0	0	0	0
	Total Score	32	4	26	32	18
Quantitative Summary	Initial Investment	$110,200.00	$21,000.00	$105,700.00	$206,200.00	$22,000.00
	Net Annual Cash Flow	$21,420.21	($9,741.65)	$28,117.89	$28,212.86	$5,735.60
	NPV	$131,617.91	($59,858.24)	$172,772.24	$173,355.81	$35,242.79
	IRR	32.96%	0%	40.92%	26.29%	40.34%
	Payback	2.8	-3.32	2.33	3.34	2.36
	Discounted Payback	3.45	-3.01	2.79	4.26	2.83
	Benefit/Cost	2.19	-1.85	2.63	1.84	2.6

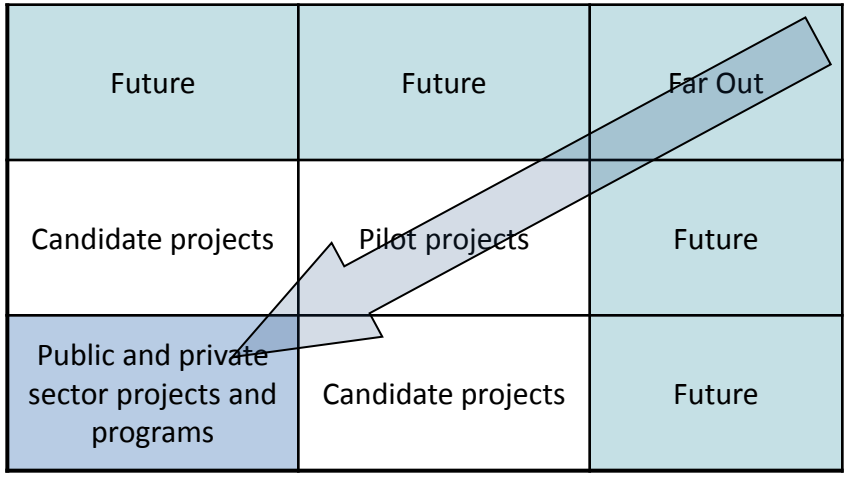
Take away #1
Canadian ITS Architecture

- This purpose of the Canadian ITS Achitecture *should* be extended to:

- The Canadian ITS Architecture provides a unified framework for the academic research community to identify and conduct value added research supporting ITS innovation and adoption in the public and private sectors. It offers a starting point from which the research community can identify the relevance of their research improving transportation efficiency, safety, security and sustainability in Canada.

Take away #2 - Benefits of Wireless and Connected Vehicle Research is creation of new opportunities

Technologies



Systems and Applications

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Take away #2 - Benefits of Wireless and Connected Vehicle Research

- Reduce cost of existing ITS applications
- Expand participation of existing ITS applictions
- Increase or create new functionalities to expand benefits of existing ITS applications
- Create new ITS applications, expand to logistics and supply chain
- Speed up adoption, guide research and development directions

Questions?

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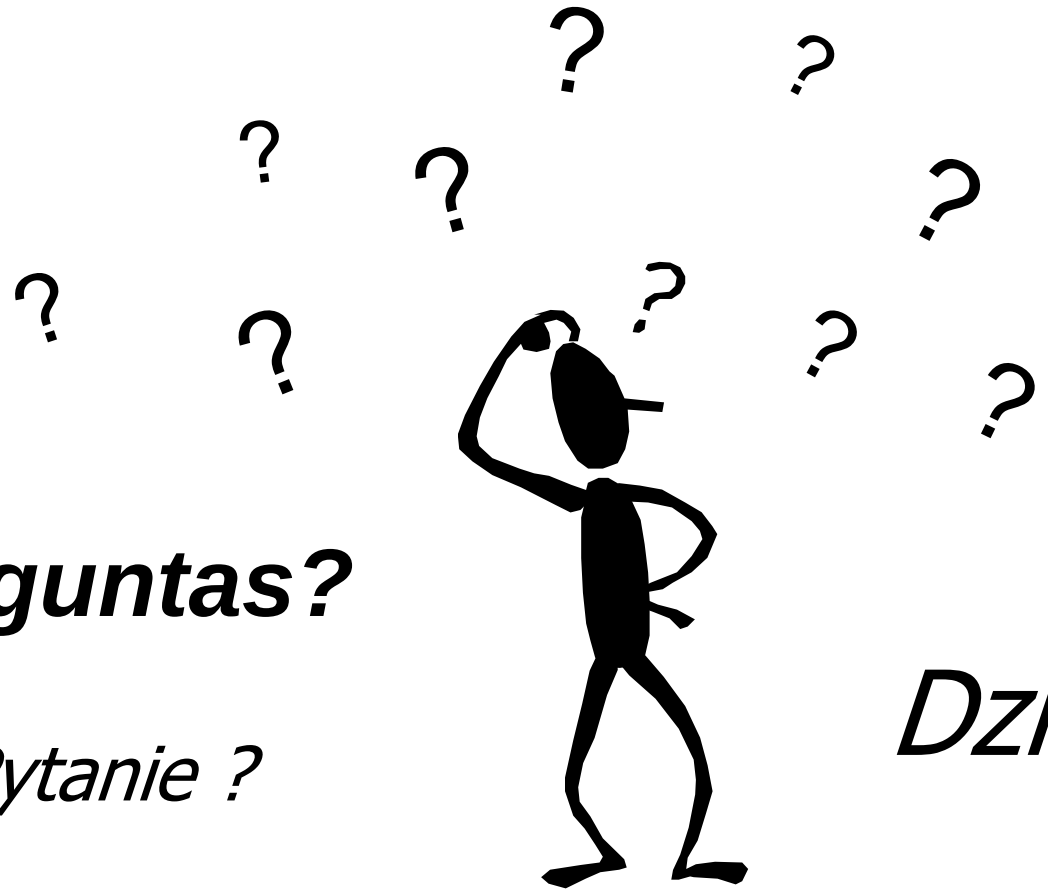

Preguntas?

Pytanie ?

Dziękuję!

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