Defence Research and Development Canada
Recherche et développement pour la défense Canada

EMERGING TECHNOLOGIES FOR SUSTAINMENT FOR COMMAND OF FUTURE OPERATIONS

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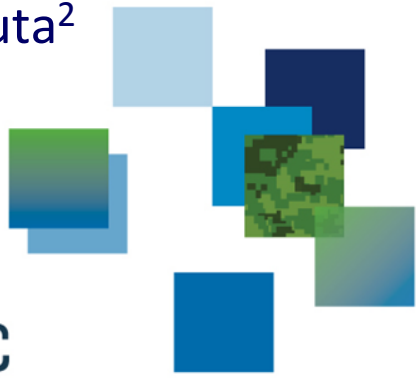
November 2018



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Introduction and Structure

This presentation summarizes technology development for combat service support, and considerations for evaluating emerging technologies.

Introduction

Focus: how emerging technologies can provide new capability for combat service support for the future force.

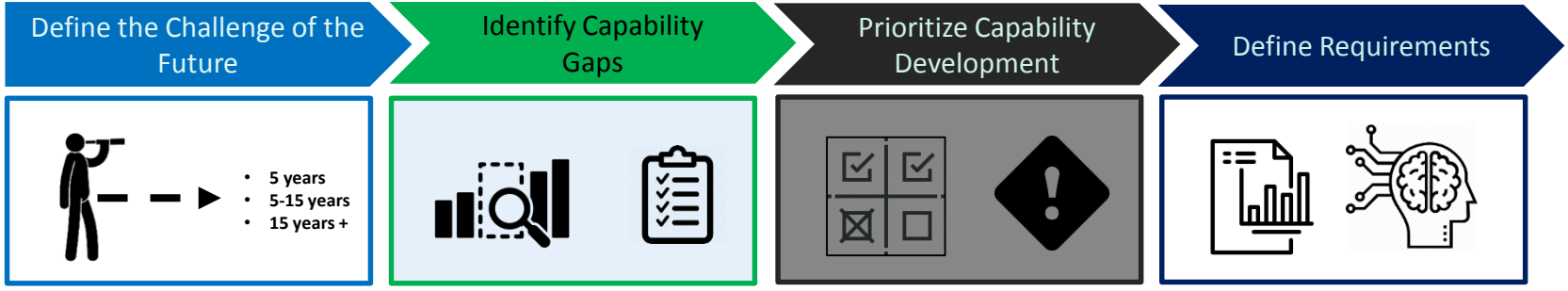
- Western militaries continuously consider the future of armed conflict in order to better prepare for the challenges of tomorrow (near-term threat monitoring, and future security forecasting)
- Defining the potential military missions for the future enables capability development toward a view of future challenges.
- ***To prepare for the future sustainment, emerging technologies should be carefully considered to give commanders and logisticians the necessary sustainment options.***

Structure

1. **Capability Development:** planning to meet the challenges of the future
2. **Strategic Policy Documents:** views of the future
3. **Technology Development for CSS:** Priority Areas
    - Autonomous Systems
    - Internet of Things (IoT) enabled systems / data analytics
4. **Measuring Expectations:** Trends and Technology Development
5. **Summary and Way Ahead**

1. Capability Development: planning to meet the challenges of the future

Capability development is a deliberate process, and requires an evaluation of what the future security environment might look like. From there, gaps in existing capabilities are identified to better inform where work is needed. Priorities are then established, with detailed requirement to follow. Changes in the expectations of the security environment requires capability gaps and requirements to be re-evaluated.



Future Security Environment

- Characterize the challenge
- Characterize the threat
- Provide an informed assessment of what the force of tomorrow, and future force are likely to need to meet the challenge

Capability Gaps

- Identify gaps limiting current operations
- Identify gaps limiting future development
- Identify enterprise, organizational, structural gaps (limits to realizing the future vision)

Prioritize Capabilities

- Key capabilities
- Key enablers
- IT transformation
- Cyber security
- Integration with allies

Define Requirements

- Clarity on what is needed
- Constraints / dependencies for capability development
- Approximate timeline
- Evaluation metrics

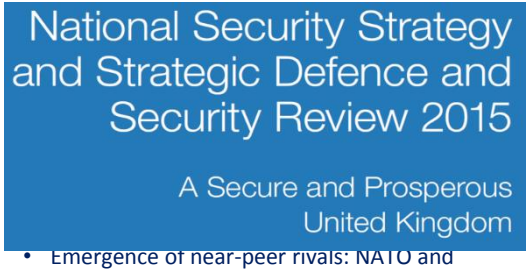
2. Strategic Policy Documents: views of the future

There is agreement between the United States, the United Kingdom and Canada that the future presents a wide range of threats. In the face of growing complexity there is agreement on need for technological innovation, cyber security, and cooperation with allies.

US: National Defense Strategy (2018)

- Competitive advantage eroding
- Threats evolving, complex environment
- Peer rivals, rogue regimes
- Need for enhanced lethality, maintaining deterrence
- ***Acceleration of technology***
- ***Autonomous Systems***

UK: National Security Strategy (2015)



- Emergence of near-peer rivals: NATO and allies vital to future security
- Nuclear deterrence
- Serious and organized crime threatens security
- ***Cyber security is paramount***
- ***Innovation as a driver: partnerships with the private sector. Innovation initiative to be launched.***
- ***Cross government Emerging Technology and Innovation Analysis Cell.***

Canada: Strong, Secure, Engaged (2017)

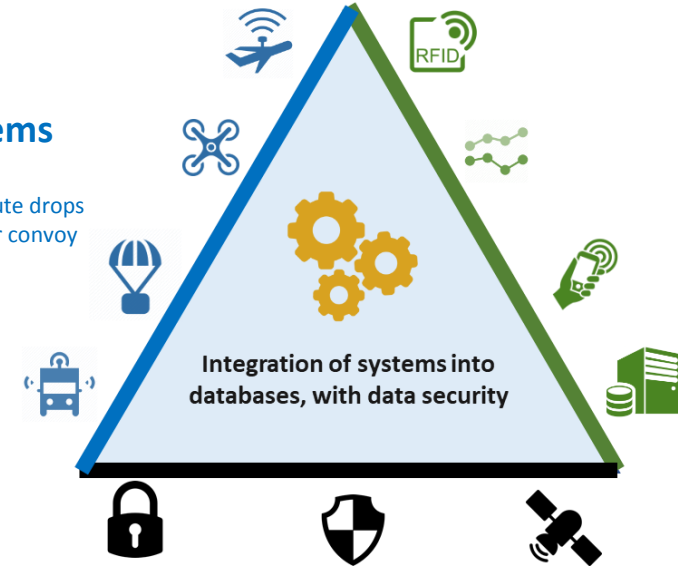
- Support for the military family
- Investment in full-spectrum capabilities (combat to peace support)
- Establish fixed defence funding
- ***Complexity in conflict***
- ***Technological evolution: cyber, space***
- Engagement with Allies

3. Technology Development for CSS: Priority Areas

Three priority areas for Combat Service Support (CSS) and Logistics, will be discussed further: autonomous systems, internet of things / data analytics, and cyber security.

Autonomous Systems

- Aerial vehicles
- Precision guided parachute drops
- Autonomous vehicles for convoy and supply operations.



Internet of Things (IoT) / Data Analytics

- Connecting devices to databases
- Visibility of supply chain
- Data analytics

Cyber Security

- Data integrity
- Secure connections and transmissions

3. Technology Development for CSS: Priority Areas
Autonomous Systems (1/2)

Autonomous aircraft and vehicles are being developed for commercial logistics management and the military supply chain. Large platforms are being developed for delivery to facilities and depots, and small / medium vehicles are being delivered to deliver supplies to units in the field.

	Large	Small / Medium
Aircraft 	**Large UAS** • **Converted helicopters:** these will be used as normal helicopters for delivering supplies. They can be converted from human piloted to autonomous, and back again. • **Autonomous aircraft:** these are intended to act like helicopters, though carrying smaller payloads per drop. These are purpose-designed without pilots, and will be capable of carrying modular payloads (supply, medical, transport, ISR). • **JPADS:** this system operates like a normal air-drop, but with GPS-enable precision drops from high altitude with significant stand-off distance.	**Small and Medium Autonomous Platforms** • **Converted helicopters:** similar to large UAS, some small and medium autonomous platforms are converted helicopters (Fire Scout series). • **Purpose-Designed:** the small and medium autonomous platforms are purpose designed platforms that are designed without a human pilot on-board. Their purpose is to deliver supplies forward, and generally have a small payload (hundreds of pounds).
Vehicles 	**Unmanned Ground Systems For Distribution** **Conversion of existing platforms:** this technology relies on existing medium and heavy cargo trucks, and converts them from being driven by humans to being controlled by autonomous systems. This includes sensors to determine the truck's location, the path ahead of it, and navigates the truck to its destination.	**Dismounted Load Carriage** • **Accompany the Section:** the systems are intended to accompany an infantry section and carry the necessary mission equipment. • **Resupply the Section:** systems are capable of leaving the section to collect resupply, using its autonomous guidance technology. • **Other missions:** these vehicles can be reconfigured for ISR, EW and CBRNE missions, and can be configured as direct fire platforms.

3. Technology Development for CSS: Priority Areas

Autonomous Systems (2/2) – Strengths and Limitations

Autonomous aircraft and vehicles are being developed for commercial logistics management and the military supply chain. Large platforms are being developed for delivery to facilities and depots, and small / medium vehicles are being delivered to deliver supplies to units in the field.

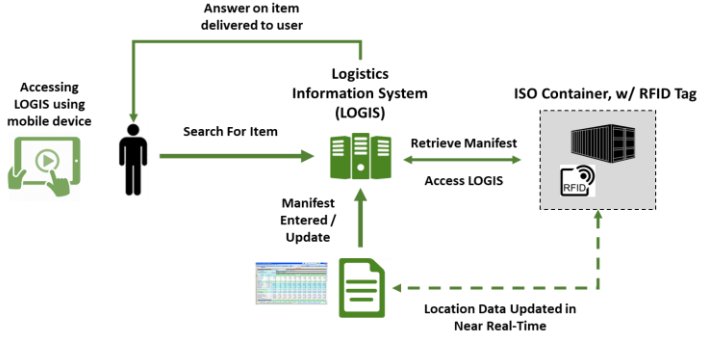
	Large	Small / Medium
Aircraft 	**Large UAS** **Strengths:** • Reduced risk to crews (fewer / no humans on board) • Increased endurance of platform (no crew fatigue) • Precision drops of goods (JPADS) **Limitations:** • Vulnerable in high-threat environments – autonomous flight not as responsive as human pilots • Questions about urban terrain – capable of operating? • GPS jamming (all systems, including JPADS0	**Small and Medium Autonomous Platforms** **Strengths:** • Reduced risk to crews (fewer / no humans on board) • Increased endurance of platform (no crew fatigue) **Limitations:** • ***Small payloads*** • Vulnerable in high-threat environments – autonomous flight not as responsive as human pilots • Questions about urban terrain – capable of operating?
Vehicles 	**Unmanned Ground Systems For Distribution** **Strengths:** • Reduced risk to crews (fewer / no humans on board) • Increased endurance of platform (no crew fatigue) **Limitations:** • Vulnerable in high-threat environments – autonomous driving not as responsive as human pilots • Questions about urban terrain – capable of operating?	**Dismounted Load Carriage** **Strengths:** • Increase range and endurance of dismounted section operations • Increase performance and decrease fatigue by taking loads off of soldiers' backs. **Limitations:** • Adding a vehicle to the section: maintenance, fuel requirements, and a solider to "drive" it.

3. Technology Development for CSS: Priority Areas
Internet of Things (IoT) / Data Analytics (1/2)

IoT technology will enable better tracking of deliveries through the supply chain. An IoT-enabled Logistics Information System (LOGIS) will enable near-real time tracking of supply movement. By connecting field units (soldiers, systems and vehicles) to an IoT-enabled LOGIS, orders can be demand-driven from the field unit based on need (ammunition, fuel, rations). With connectivity the overall health of mission systems can also be tracked.

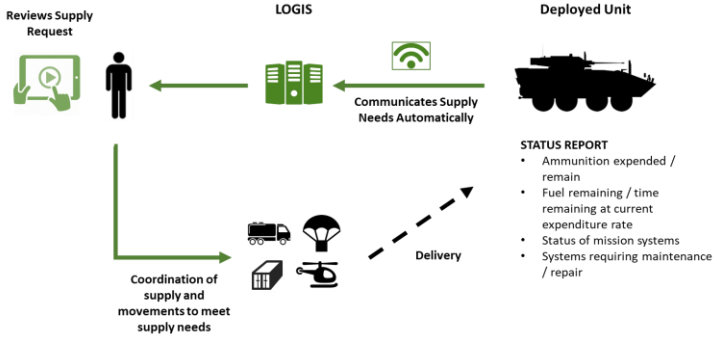
Track Deliveries through Supply Chain

A Logistics Information System (LOGIS) can enable users to determine the location of material and assets in the supply chain.



Automatically Generated Supply Requests

Using IoT solutions, 1st line units can automatically generate supply requests based on supplies expended, and enable automatic / semi-automatic delivery.



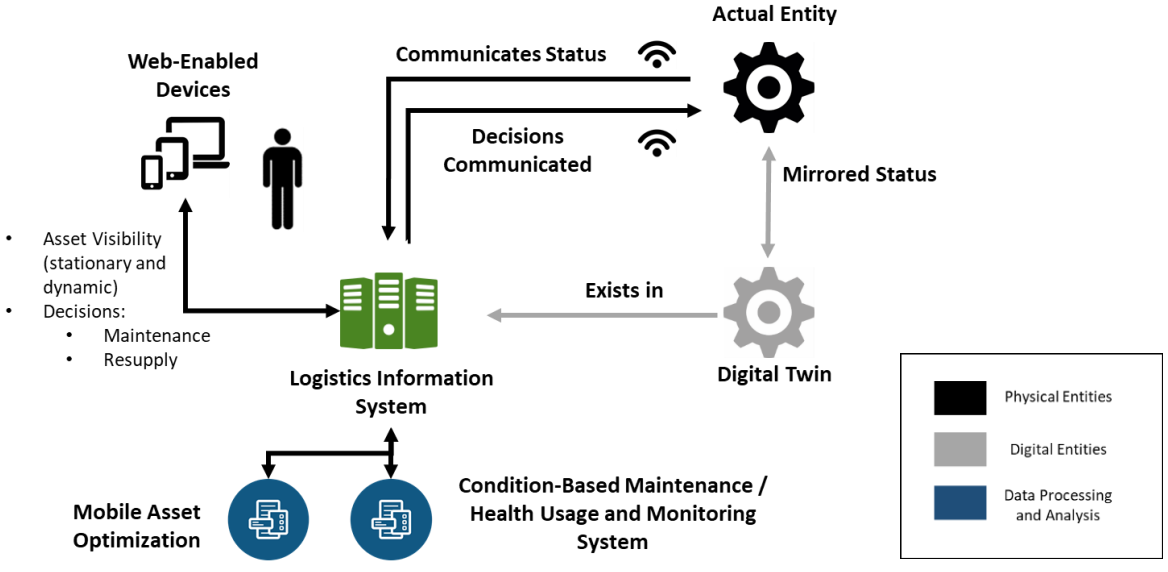
3. Technology Development for CSS: Priority Areas
Internet of Things (IoT) / Data Analytics (2/2)

IoT-enabled systems will connect things to databases, generate huge amounts of data, and therefore enable systems monitoring and data analytics. The graphic below shows a concept of the services that an IoT-enabled LOGIS could provide.

Mobile Asset Optimization: managing fleet allocation could be improved / optimized using IoT technology. This includes routes, dispatching, load and manifest development.

Conditions-Based Maintenance: planning preventative maintenance for vehicle fleets could results in a higher rate of total fleet availability. By planning preventative maintenance vehicle downtime can be staggered to meet needs.

Health Usage and Monitoring Systems: monitoring systems health in real-time allows for problems to be immediately diagnosed (even remotely) to begin taking corrective damage. This will reduce the risk of catastrophic failure, and may reduce overall risk to operators.



3. Technology Development for CSS: Priority Areas
Cyber Security

Cyber security is not only a question of maintaining the integrity of computer networks. It also includes the security of on-board systems in the field, the means of transmission, and all systems that support PNT.

Data Storage and Use

Protection against intrusion, disruption and maintaining data integrity is essential.

- **Databases and Enterprise systems:** these systems enable information exchange and data management for individual counties and for allies.
- **Vehicle Systems:** on-board battle management systems process large volumes of data.
- **Mobile Devices:** hey enable daily administration and connectivity for field operations.

Transmission

The scope of operations is effectively global. This means continuity of communications in theatres across a distributed area, and with domestic headquarters.

- **Beyond-line-of-sight (BLOS):** this is ensuring global continuity of communications, and across large theatres of operation.
- **Line-of-sight (LOS):** communications within a single theatre, where tactical communications systems connect command posts to deployed units.

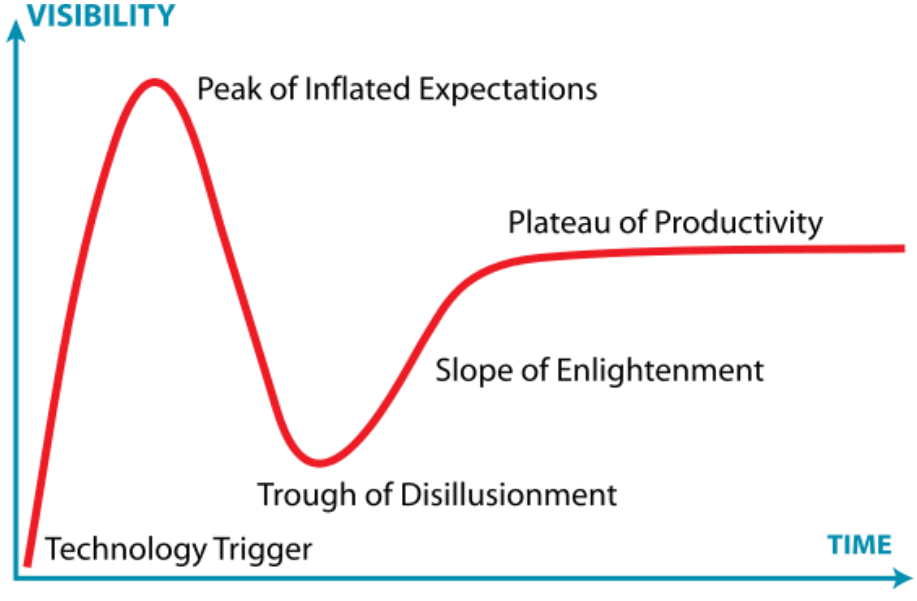
Positioning, Navigation, Timing (PNT)

PNT systems provide vital spatial awareness to multiple systems.

- **Autonomous Systems:** autonomous systems rely on PNT to move through their waypoints to destination. Without reliable PNT these systems will not be serviceable.
- **GPS-guided parachute drops:** the JPADS system relies on a GPS signal (a PNT function).

4. Measuring Expectations: Trends and Technology Development

The *Gartner Hype Curve* is illustrative in showing how expectations of what technology can provide evolves over the course of the development cycle. This curve is useful for evaluating the status of emerging technologies.



Gartner's Hype Curve

- **Concept vs. Capability:** initial concepts (technology trigger) promise to meet an existing need. However, those technologies often reach *the peak of inflated expectations* and cannot deliver the capability promise. The actual capability of emerging technologies needs to be carefully considered.
- **Military application**: many civilian-developed technologies were not conceptualized for military application. The rigours of military application means that some civilian technologies will not be suitable, or require significant modification for military service.
- **Maturity:** for technologies to be sustainable and fieldable, they likely need to cross the *trough of disillusionment* before they can be viable. The maturity of new technologies should be determined when evaluating them.

5. Summary and Way Forward

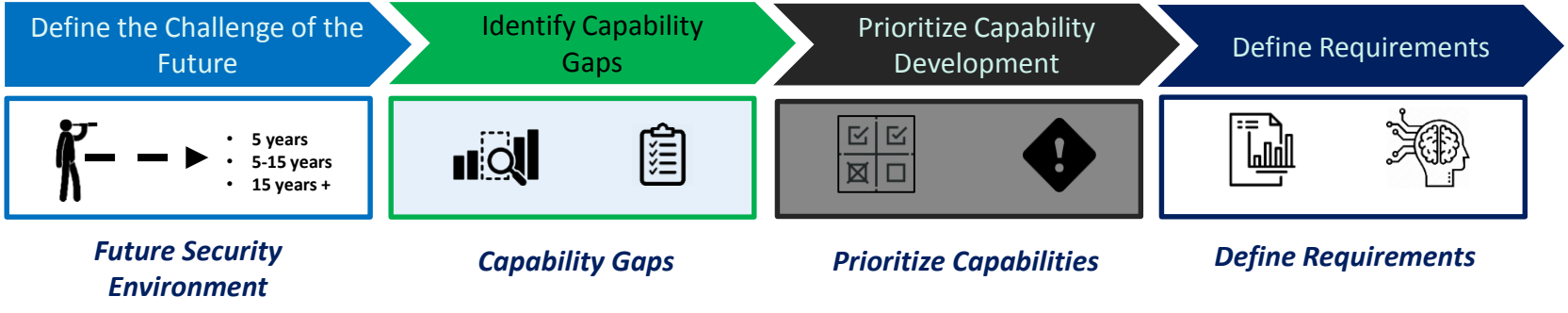
This slide summarizes the concepts in the work, and the challenge going forward.

Most militaries and national security agencies have a view of what the future threat will likely resemble.

Identifying capability gaps is a deliberate effort. Western militaries have done this for many missions and challenges.

For Combat Service Support development of new capabilities needs further prioritization. This should enable commanders to deliver the missions asked of national governments.

Once priority capability areas are defined, specific requirements should be defined. This will enable targets for systems, personnel and processes to proceed. ***This makes the capability plan real.***



Questions / Comments

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