



National Defence / Défense nationale



# ENG Spring Forum 2024

7 June

9:00 – 12:00



National Defence / Défense nationale



# Forum ENG du printemps 2024

7 juin

9h00 – 12h00





# Welcome and Introduction

**Justine Dagenais**  
Master of Ceremonies



# Bienvenue et introduction

**Justine Dagenais**  
Maîtresse de cérémonie



# Opening Remarks Deputy



Deputy Eng Champion  
Zarina Intwala



# Discours Inaugural



Championne adjointe ENG  
Zarina Intwala





## Volunteer with the ENG Advisory Committee (AC)

Volunteering with the ENG AC is a great way to make new contacts within DND while supporting very worthy work to better the ENG community.

### **Current Openings:**

#### **ENG Advisory Committee:**

- Deputy Eng Champion Shadow
- Evaluator for a Process
- Divisionnel Rep.

#### **ENG Horizons**

- Vice Chair Shadow
- Join a working group:
  - WG1: Career Progression and Development
  - WG2: ODP Issues and Development
  - WG3: Lateral Progression Programs and ENG Promotion Process
  - WG4: Diversity and Inclusion
  - WG5: System Engineer (SE) Competency Development
  - WG6: Professional Qualifications and Certifications

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## Portez-vous volontaire au sein du Comité consultatif (CC) ENG

Le bénévolat au sein du CC ENG est un excellent moyen de créer des contacts au sein du MDN tout en soutenant un travail très utile pour améliorer la communauté ENG.

### **Emplois actuels:**

#### **Comité consultatif ENG:**

- Ombre de la championne adjointe ENG
- Évaluateur de procédure
- Représentant de division

#### **Horizons ENG**

- Ombre du Vice-président
- Rejoignez un groupe de travail :
  - GT1 : Progression et développement de carrière
  - GT2 : Questions et développement du PPO
  - GT3 : Programmes de progression latérale et processus de promotion ENG
  - GT4 : Diversité et inclusion
  - GT5 : Développement des compétences des ingénieurs de systèmes
  - GT6 : Qualifications et certifications professionnelles

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**QETE**

Quality Engineering  
Test Establishment

Science and engineering at your service

Presentation to Spring 2024 ENG Forum

**Leila Ahad**  
QETE Chief of Staff  
7 June 2024



**CETQ**

Centre d'essais techniques  
de la qualité

La science et l'ingénierie à votre service

Présentation au forum ENG, printemps 2024

**Leila Ahad**  
Chef d'état-major CETQ  
7 juin 2024





### Quality Engineering Test Establishment (QETE)

QETE provides DND and the CAF with **specialized, technology-based test and investigative services** required to support engineering decisions throughout all phases of Materiel Acquisition and Support.



### Centre d'essais techniques de la qualité (CETQ)

Le Centre d'essais techniques de la qualité (CETQ) fournit au MDN, aux FAC et à d'autres organisations fédérales une **vaste gamme de services spécialisés d'essais et d'enquêtes en génie et en sciences appliqués axés sur la technologie** pour appuyer les prises de décision à toutes les étapes de l'acquisition et du soutien du matériel.



## Quality Engineering Test Establishment (QETE)

Planning		Acquisition		Operating and Maintenance		Disposal
Identification	Options Analysis	Definition	Implementation	In-Service (Sustain and Operate)		Disposal
SOR Review	Req. definition Review	SOW /Spec Review	Tech Bid Eval. testing	Failure & accident investigation	Calibration of equip. & instruments	Provide expert advice, including disposal of hazardous materials
	Test plans & procedures dev.	Observing tests conducted at OEM facility	Provide technical support in cases of litigation	Testing for life extension and/ or retirement		
	Review testability provisions in contracts	Risk ID & Mitigation	Investigate in-service performance of systems, equipment, components, and materials			

*and so much more...*



## Centre d'essais techniques de la qualité (CETQ)

Planification		Acquisition		Fonctionnement et entretien		Aliénation
Identification	Analyse d'options	Définition	Mise en œuvre	Soutien en service (soutien et fonctionnement)		Aliénation
Révision des EDB	Revue de la définition des besoins	EDT/révision des spécifications	Évaluations des soumissions techniques	Enquête sur les défaillances et les accidents	Étalonnage d'équip. et d'instruments	Fournir des conseils d'experts, y compris en ce qui concerne l'élimination des matières dangereuses
	Élaboration de plans et de procédures de test	Observer les tests effectués dans les installations de l'équipementier	Fournir une assistance technique en cas de litige	Essais de prolongation de la durée de vie et/ou disposition		
	Examiner les dispositions relatives à la testabilité dans les contrats	Identification et atténuation des risques	Étudier les performances en service des systèmes, des équipements, des composants et des matériaux			

*et encore plus...*



## Domaines de spécialités technologiques du CETQ



### Génie mécanique et des matériaux

- Génie climatique
- Enquêtes sur les défaillances
- Atelier de conception et de fabrication mécanique
- Rendement des matériaux
- Enquêtes sur les accidents
- Systèmes mécaniques et technologies de CAO
- Évaluation Non destructive
- Génie des vibrations
- Génie de la soudure



### Sciences appliquées

- Chimie analytique et sciences environnementales
- Prévention et atténuation de la corrosion
- Inflammabilité
- Matières textiles
- Matériaux en polymère
- Produits pétroliers



### Génie électrique

- Sécurité en matière d'émissions
- Sécurité des radiofréquences
- Dangers des rayonnements électromagnétiques pour la sécurité des matériaux
- Compatibilité électromagnétique
- Sécurité des lasers
- Systèmes d'optique et d'électro-optique
- Production, stockage et contrôle de l'énergie électrique
- Sécurité acoustique



### Science de la mesure et de l'imagerie

- Métrologie
- Imagerie technique



### CEEM - Centre d'essais et d'expérimentation en munitions

- Essais et évaluations spécialisés
- Enquête sur les défaillances
- Métrologie balistique
- Imagerie balistique
- Simulation du cycle de vie
- Conception et prototypages mécaniques
- Détoniques et instrumentation
- Radiographie (2D et 3D)
- Coordination et exécution des procès
- Soutien à l'ingénierie
- Analyse fonctionnelle



## QETE Technology Speciality Areas



### Mechanical & Materials Engineering

- Climatic Engineering
- Failure & Accident Investigation
- Mechanical Design and Manufacturing Workshop
- Material Performance
- Mechanical & Materials Failure Analysis
- Mechanical System & Design Verification
- Non-Destructive Evaluation
- Vibration Engineering
- Welding Engineering



### Applied Science

- Analytical Chemistry & Environmental Science
- Corrosion Prevention and Mitigation
- Flammability
- Textile Materials
- Polymer Materials
- Petroleum Products



### Electrical Engineering

- Emissions Security (EMSEC)
- Radio Frequency Safety
- Hazards of Electromagnetic Radiation to Ordnance Safety
- Electromagnetic Compatibility
- Laser Safety
- Optic & Electro-Optic Systems
- Electrical Power Generation, Storage, and Control
- Acoustic Safety



### Measurement Science & Imagery

- Measurement Science
- Technical Imagery



### METC – Munitions Experimental Test Centre

- Specialized Test and Evaluation
- Failure Investigation
- Ballistic Metrology
- Ballistic Imagery
- Life Cycle Simulation
- Mechanical Design and Prototyping
- Detonics and Instrumentation
- Radiography (2D & 3D)
- Trial Coordination / Execution
- Engineering Support
- Functional analysis





**QETE**

Quality Engineering  
Test Establishment

## Failure & Accident Investigation

**Patrick Thonon**

Group Leader - Failure and Accident Investigation

Science and engineering at your service



**CETQ**

Centre d'essais techniques  
de la qualité

## Enquêtes sur les accidents et les défaillances

**Patrick Thonon**

Chef de groupe - Enquêtes sur les défaillances et les accidents

La science et l'ingénierie à votre service

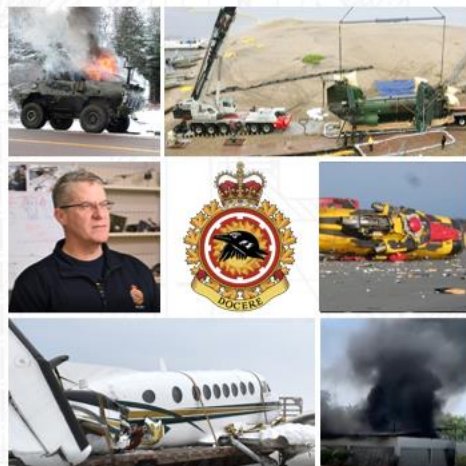


## Video – Failure and Accident Investigation



### QETE:

- Delivers independent, unbiased evaluations
- Ensures all military equipment and materiel withstand extreme operational environments
- Provides specialist technical services to clients to keep Canada's defence systems and equipment safe, available, and serviceable



*This video has not been approved by Global Affairs Canada.*



## Vidéo – Enquête sur les défaillances et les accidents



### CETQ:

- Fournit des évaluations indépendantes et impartiales
- Veille à ce que tous les équipements et matériels militaires résistent à des environnements opérationnels extrêmes
- Fournit des services techniques spécialisés à ses clients afin que les systèmes et équipements de défense du Canada restent sûrs, disponibles et en bon état de fonctionnement.



*Cette vidéo n'a pas été approuvée par Global Affairs Canada et le Commissaire des incendies des Forces canadiennes.*





## Innovation for Accident Investigation Use of MATLAB and Google Earth Pro

### Accident Event Description

On 29 Sept 2018, Tactical Armoured Patrol Vehicle (TAPV) CFR12157 was involved in a single vehicle accident while travelling on a paved civilian highway within Quebec city limits. The vehicle departed the highway, impacted and broke through a guardrail, and rolled multiple times before coming to rest inverted in the ditch.



## L'innovation dans les enquêtes sur les défaillances et les accidents avec MATLAB and Google Earth Pro

### Description de incident

Le 29 septembre 2018, le véhicule blindé tactique de patrouille (VBTP) CFR12157 a été impliqué dans un accident impliquant un seul véhicule alors qu'il circulait sur une route civile asphaltée dans les limites de la ville de Québec. Le véhicule a quitté l'autoroute, a heurté et brisé un garde-corps, et a effectué des tonneaux à plusieurs reprises avant de s'immobiliser à l'envers dans le fossé.





## MATLAB and Google Earth Pro

### MATLAB

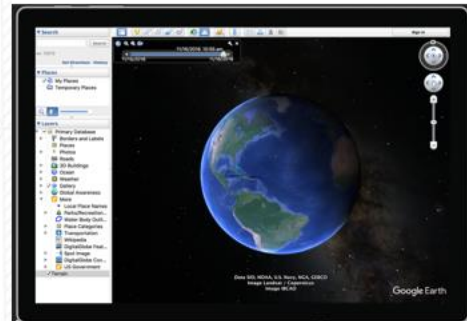
A programming and numeric computing platform used by millions of engineers and scientists to analyze data, develop algorithms, and create models.

### Google Earth Pro (Desktop)

Create maps with advanced tools

Import and export Geographic Information System (GIS) data and go back in time with historical imagery.

**Why now?**



## MATLAB et Google Earth Pro

### MATLAB

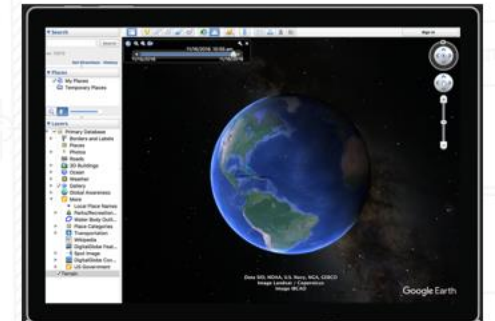
Une plateforme de programmation et de calcul numérique utilisée par des millions d'ingénieurs et de scientifiques pour analyser des données, développer des algorithmes et créer des modèles.

### Google Earth Pro (Desktop)

Créez des cartes avec des outils avancés

Importez et exportez des données du système d'information géographique (SIG) et remontez le temps grâce à des images historiques.

**Pourquoi Maintenant?**





## Google Pro Earth – Image Superposition



Evidence: Autoroute 573 Traffic Camera Video

- Times references
- Position of vehicle over time



Google Earth Pro 3D view extraction

- Geospatial reference
- Fix in time



Overlay using Google Earth Pro  
Combine all the information



## Google Pro Earth – Superposition d'image



Preuve : Vidéo de la caméra de circulation de l'autoroute 573

- Références de temps
- Position du véhicule dans le temps



Extraction de vues 3D Google Earth Pro

- Référence géospatiale
- Statique dans le temps



Superposition à l'aide de Google Earth Pro

Combinez toutes les informations



## Analysis - MATLAB - Average Speed



Fix distance grid pattern using Google Earth Pro information  
Transpose in evidence video



Use of 1<sup>st</sup> known position in time.  
Reference markers



2<sup>nd</sup> known time and position  
  
Average Speed = Distance / Time



## Analyse - MATLAB - Vitesse moyenne



Insertion d'une grille de distance à l'aide des informations de Google Earth Pro transposer dans l'enregistrement vidéo



Utilisation d'une 1<sup>ère</sup> position connue dans le temps.  
Marqueurs de référence



2<sup>ème</sup> position connue avec différence de temps  
  
Vitesse moyenne = Distance / Temps



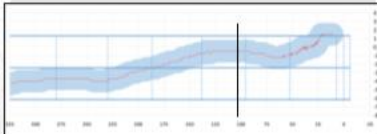


## Analysis - Combined - Trajectory/ Road Elevation



### Trajectory Estimate

- Front tire marker to plot a trace
- MATLAB + Google Earth Pro
- 3D => Difficult to analysis



### Top View Trajectory

- Compared to driver reported vehicle behavior
- Help deduct turning radius



### Side view - Road Elevation

- Elevation accuracy could not be confirmed. (Theoretical Analysis)
- Weightless effect
- Correlation

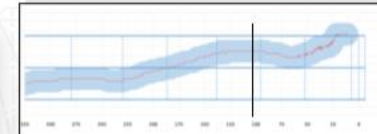


## Analyse - Combinée - Trajectoire/Élévation de la route



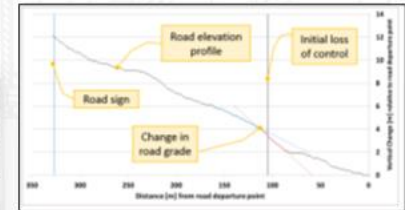
### Estimation de la trajectoire

- Marqueur sur le pneu avant pour tracer une trajectoire
- MATLAB + Google Earth Pro
- 3D => Difficile à analyser



### Trajectoire - vue de dessus

- Comparaison avec le comportement du véhicule signalé par le conducteur
- Aide à déduire le rayon de braquage



### Vue latérale - Élévation de la route

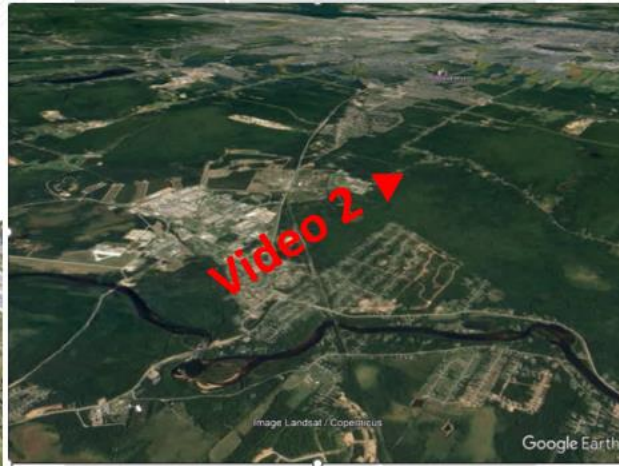
- La précision de l'altitude n'a pas pu être confirmée. (Analyse théorique)
- Effet « d'apesanteur »
- Corrélation



### MATLAB Simulation

- Help to confirm video
- Allow multiple view angle
- "Cleaner" view

Care should be taken – it is a simulation



### Simulation MATLAB

- Aide pour confirmer la vidéo
- Permet plusieurs angles de vue
- Vue « propre »

Il faut être prudent – c'est une simulation







## Final Analysis / Conclusion

Frame by frame timeline

More than just MATLAB and Goggle Earth Pro – One of many tools

Other elements:

- Vehicle dynamic / characteristics
- Ambient condition
- Other

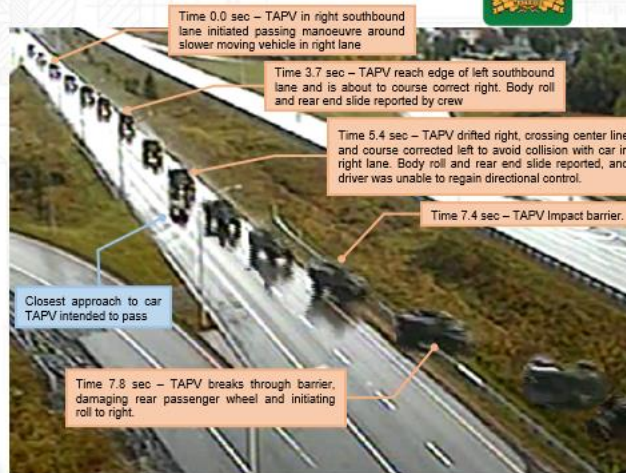
Root Cause

Recommendations

Changes

Training

Special thanks to **Vince Horne** for the fantastic work, dedication and countless hours spent to develop this capability and complete this analysis.



## Analyse finale / Conclusion

Chronologie image par image

Il y a bien plus que MATLAB et Google Earth Pro : un outil parmi tant d'autres

Autres éléments :

- Dynamique / caractéristiques du véhicule
- Conditions ambiantes
- Autre

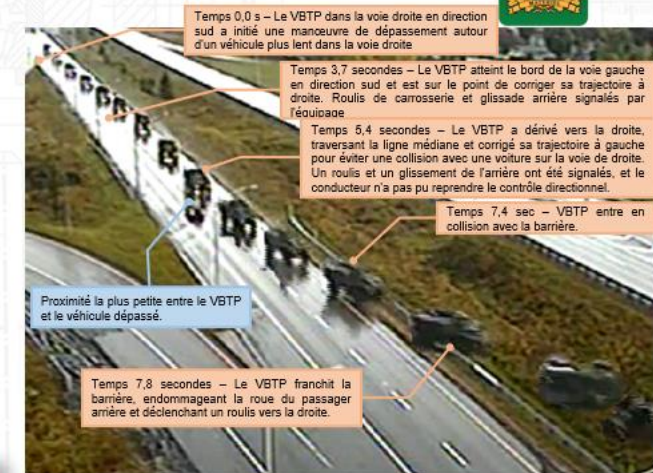
Cause Principale

Recommandations

Changements

Formation

Un merci spécial à **Vince Horne** pour le travail fantastique, le dévouement et les innombrables heures consacrées au développement de cette capacité et à la réalisation de cette analyse.





### Others Examples

Video Stabilization (MATLAB)



### Autres exemples

Stabilization video (MATLAB)





**QETE**

Quality Engineering  
Test Establishment



**Technical Imagery  
&  
Measurement Sciences**

**Jean-Francois Lauzé**  
Group Leader - Technical Imagery

**Lance Peters**  
Group Leader - Measurement Sciences

Science and engineering at your service



**CETQ**

Centre d'essais techniques  
de la qualité



**Imagerie technique  
&  
Science des mesures**

**Jean-Francois Lauzé**  
Chef de groupe - Laboratoire d'imagerie technique

**Lance Peters**  
Chef de groupe - Science des mesures

La science et l'ingénierie à votre service

# QETE Technical Imagery Laboratory



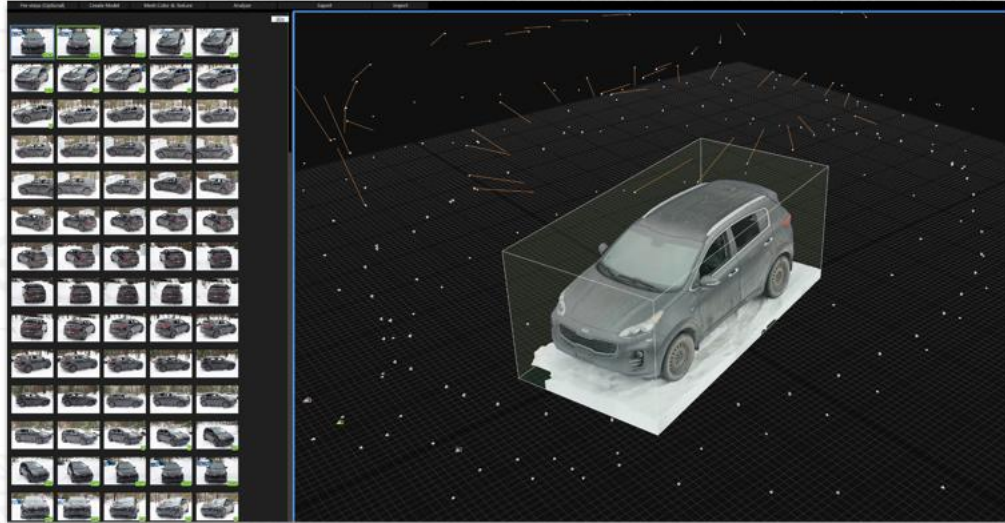
# Laboratoire d'imagerie technique du CETQ





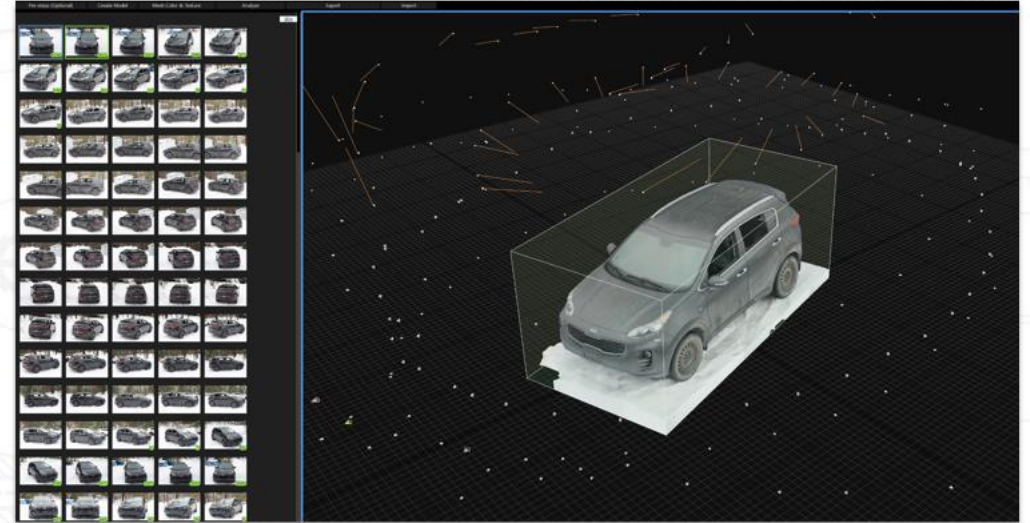
## Photogrammetry

The art and science of extracting 3D information from photographs.



## Photogramm trie

L'art et la science d'extraire des informations 3D   partir de photographies.



## Photogrammetry



## Photogrammétrie





## Close-range photogrammetry

Accurate 3D models of objects  
Provides colors, textures and details.



Evolved Sea Sparrow Missile (ESSM) support hook



## Photogrammétrie rapprochée

Modèles 3D précis d'objets  
Fournit couleurs, textures et détails.



Crochet de support de missile *Evolved Sea Sparrow*

### Close-range photogrammetry



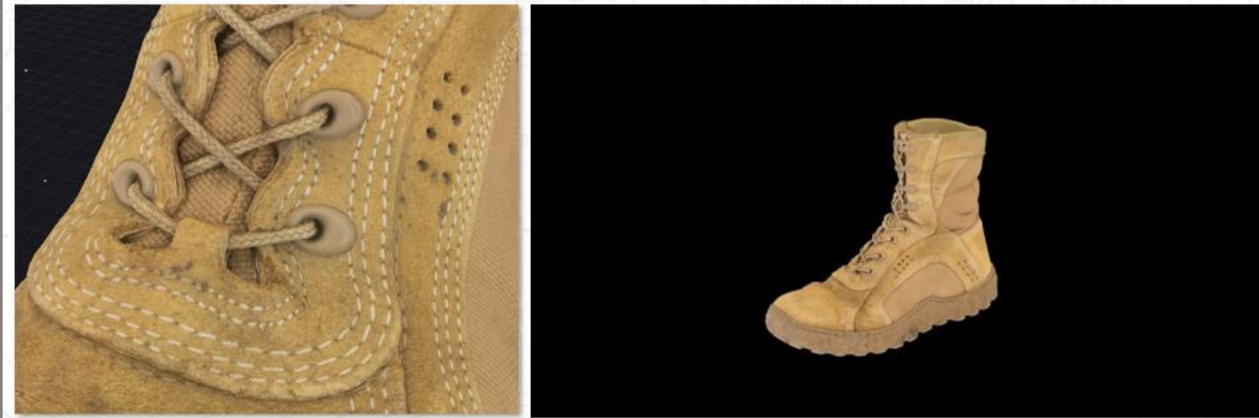
### Photogrammétrie rapprochée



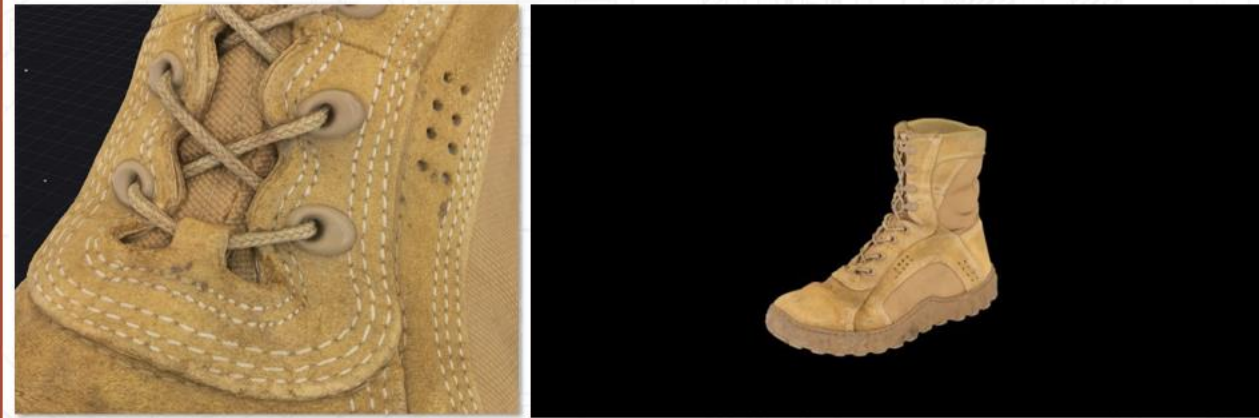




## Close-range photogrammetry

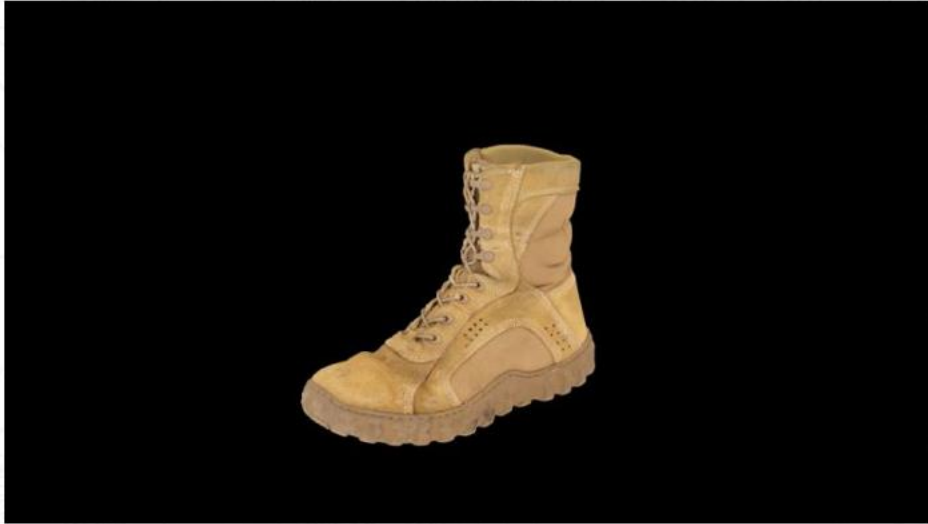


## Photogrammétrie rapprochée

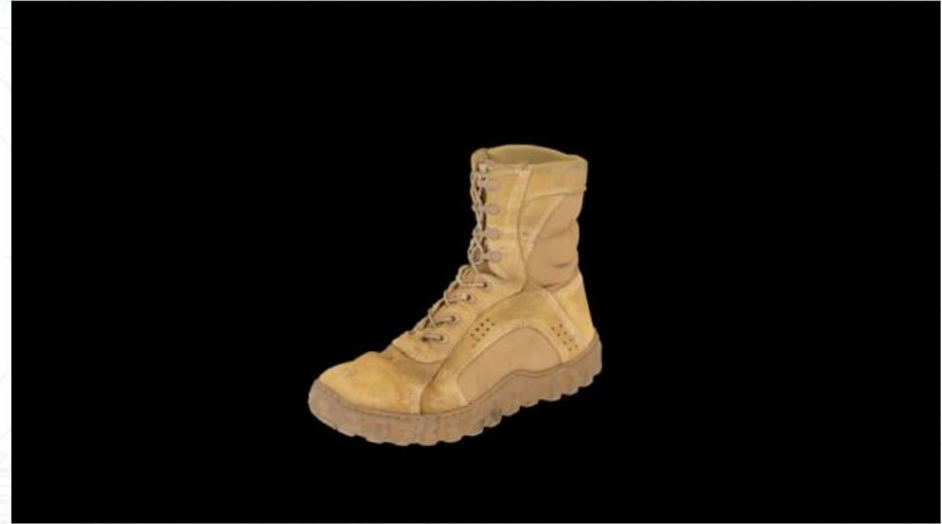




Video – Photogrammetry – Boot  
Animation.mp4



Video – Photogrammetry – Boot  
Animation.mp4



## Structures and spaces



Photogrammetry drone application can fully automate acquisition and processing of photos to create accurate 3D maps and models.



## Structures et espaces



Certaines applications de photogrammétrie pour drone peuvent automatiser entièrement l'acquisition et le traitement des photos pour créer des cartes et des modèles 3D précis.





## Applications of Photogrammetry

- Immersive way of studying an object or space
- Accident and failure investigations
- Mapping, Surveying and Inspections
- Measurement of volumes and distances
- Communication & situational awareness



3D models can be viewed on DWAN with Windows 3D Viewer



## Utilité de la photogrammétrie

- Manière immersive d'étudier un objet ou un espace
- Enquêtes sur les accidents et les pannes
- Cartographie, arpentage et inspections
- Mesure de volumes et de distances
- Outils de Communication



Les modèles 3D peuvent être visualisés sur DWAN avec Windows 3D Viewer



## Limitations

- Shiny or clear surfaces
- Weather / Environment
- Image qualities
- Flexible objects & Movements
- Time consuming (complex site or object)



## Limitations

- Surfaces brillantes ou claires
- Météo / Environnement
- Qualités des images
- Objets flexibles et mouvements
- Temps (site ou objet complexe)





## Photogrammetry and Laser Scanning

Laser scanning can be used to create extremely accurate mesh model.



Photos are combined with laser scan to add texture and accurate colors to the model.



## Photogrammétrie et numérisation laser

La numérisation laser peut être utilisée pour créer un modèle extrêmement précis.



Les photos sont combinées avec la numérisation laser pour ajouter de la texture et des couleurs précises au modèle.

Video – Photogrammetry – Vehicle  
Animation.wmv



Video – Photogrammetry – Vehicle  
Animation.wmv



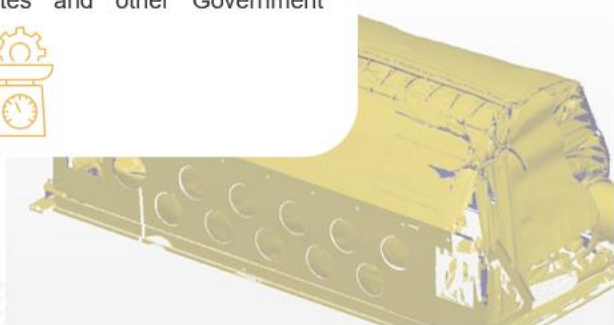


TESTIMONICS



## QETE MEASUREMENT SCIENCES

Measurement Sciences provides specialized metrology support to projects, procurements, accident investigations, failure analysis, and specialized tests and evaluations to tri-service DND/CAF directorates and other Government departments.

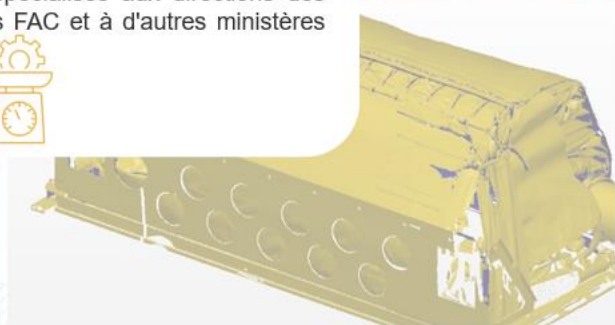


TESTIMONICS



## SCIENCES DES MESURES DU CETQ

Sciences des mesures fournit un soutien métrologique spécialisé aux projets, aux approvisionnements, aux enquêtes sur les accidents, à l'analyse des défaillances ainsi qu'aux tests et évaluations spécialisés aux directions des trois services du MDN et des FAC et à d'autres ministères gouvernementaux.







## CONTACTLESS MEASUREMENT CAPABILITIES



**ScanArm:** Highly accurate scanning or contact measurement. Objects up to 100kg can be mounted on the 8<sup>th</sup> Axis turntable.

**Tracker:** High accuracy CMM with 80m measurement radius. Locates the ScanArm for accurate measurements/scanning sites far apart but with high relative distance accuracy.



**Laser Scanner:** Up to 350m radius (spherical) measurements. Adjustable resolution and scan quality to maintain desired file size and scan time. Line-of-sight scanning of large objects/environments.



**Hand-Held Scanner:** Enables scanning in tight spaces where the ScanArm is not practical. Uses adhesive targets as positional reference. Flexible option for small to medium scanning tasks.



## CAPACITÉS DE MESURE SANS CONTACT



**ScanArm:** Numérisation ou mesure de contact très précise. Des objets pesant jusqu'à 100 kg peuvent être montés sur le plateau tournant du 8<sup>ème</sup> axe.

**Traqueur:** MMT de haute précision avec un rayon de mesure de 80 m. Localise le ScanArm pour des mesures/numérisation précises des sites éloignés les uns des autres mais avec une précision de distance relative élevée.



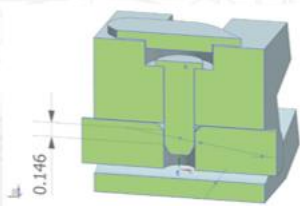
**Scanner Laser:** Mesures jusqu'à 350 m de rayon (sphérique). Résolution et qualité de numérisation réglables pour maintenir la taille de fichier et la durée de numérisation souhaitées. Numérisation en ligne de mire de grands objets/environnements.



**Scanner à main:** Permet de numériser dans des espaces restreints où le ScanArm n'est pas pratique. Utilise des cibles adhésives comme référence de position. Option flexible pour les tâches de numérisation petites à moyennes.

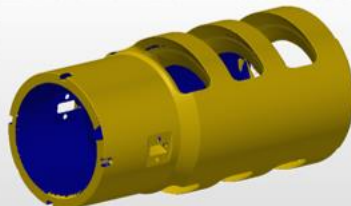


## EXAMPLES - REVERSE ENGINEERING



### Cormorant Helicopter Crash:

Crash during low-altitude hovering when pilot seat unexpectedly dropped. CAD modeling of parts stack-up to evaluate pin engagement into seat height adjustment slide.



### 105mm Muzzle Break Cracks:

Grinding away cracks forming on muzzle brake vents. Surface measurements were taken before/after grinding for FEA analysis to determine any critical loss of strength.

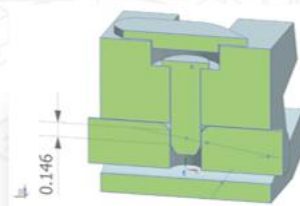


### Airbus A310 Evacuation Slide:

Interference between the slide pack and its cover was causing the cover to jam in the exit door, preventing evacuation. Interference study identified issues with inconsistently packed slides not meeting specifications.

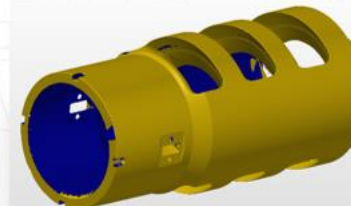


## EXEMPLES - INGÉNIERIE INVERSÉ



### Accident d'hélicoptère - Cormorant:

Crash en vol stationnaire à basse altitude lorsque le siège du pilote est tombé de manière inattendue. Modélisation CAO de l'empilement de pièces pour évaluer l'engagement des broches dans la glissière de réglage de la hauteur du siège.



### Fissures de rupture de bouche de 105 mm:

Élimine les fissures qui se forment sur les événements des freins de bouche. Des mesures de surface ont été prises avant/après le meulage pour une analyse FEA afin de déterminer toute perte critique de résistance.



### Toboggan d'évacuation de l'Airbus A310:

Une interférence entre le toboggan et son couvercle provoquait le blocage du couvercle dans la porte de sortie, empêchant ainsi l'évacuation. L'étude sur les interférences a identifié des problèmes liés à des toboggans mal emballés qui ne répondaient pas aux spécifications.



## HMCS REGINA DECK SCANS



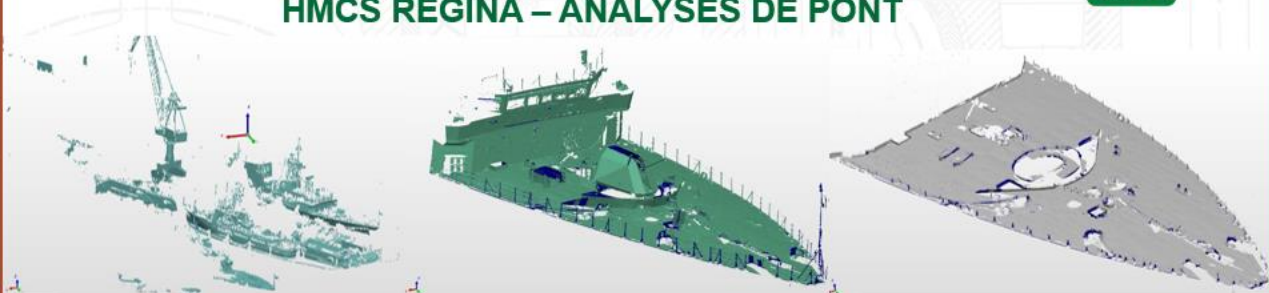
The bow of the Regina is seen at the bottom of the image. In the background is a Coast Guard vessel and another HFX Class ship docked at the neighboring pier, and the crane.

Total of 9 scans aligned and converted into a Polygonal Model. There must be enough overlapping data captured with enough detail to ensure a successful alignment.

Polygonal Model exported to the Modeler application and all unnecessary superstructure removed. Client files (STL, IGES, etc.) are generated from this data.



## HMCS REGINA – ANALYSES DE PONT



La proue de la REGINA est visible au bas de l'image. À l'arrière-plan se trouvent un navire de la Garde côtière américaine et un autre navire de classe HFX amarrés au quai voisin, ainsi que la grue.

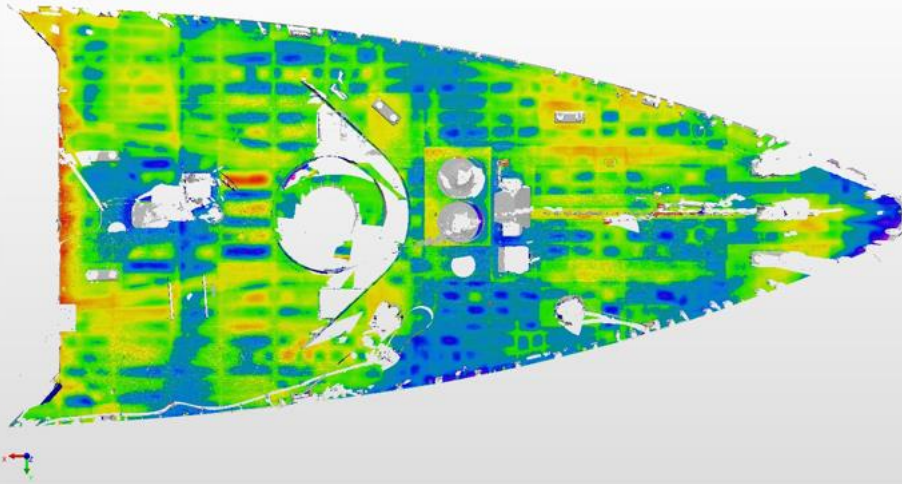
Total de 9 scans alignés et convertis en un modèle polygonal. Il doit y avoir suffisamment de données superposées capturées avec suffisamment de détails pour garantir un alignement réussi.

Polygonal Model exported to the Modeler Modèle polygonal exporté vers l'application Modeler et toutes les superstructures inutiles supprimées. Des fichiers clients (STL, IGES, etc.) sont générés à partir de ces données.



## HMCS REGINA BOW DECK SCAN

Measurement scale set to +/-25mm



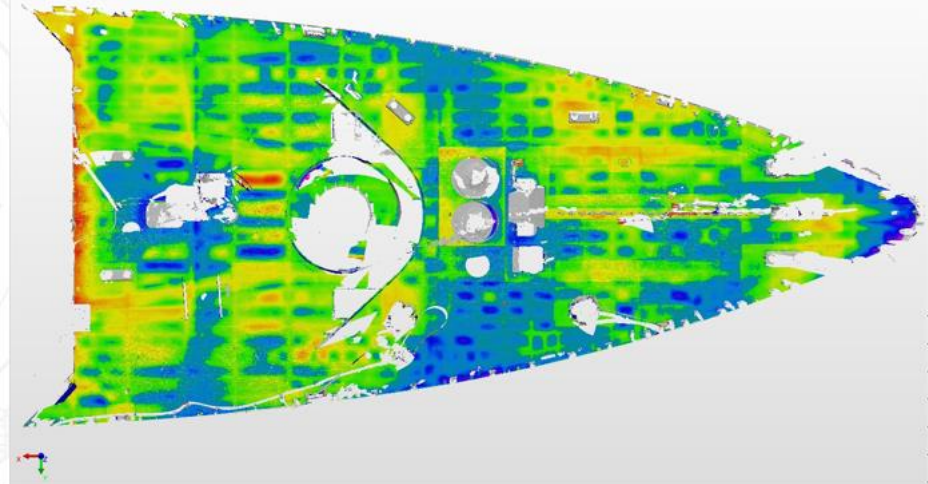
Polygonal model is "best fit" to the nominal deck geometry and deviations are color mapped. The scale is set to +/- 25mm. Any geometry shown in grey is outside of the scale range.

Color mapping makes spotting trouble areas very easy and intuitive.



## HMCS REGINA – SCAN DE PONT AVANT

Echelle de mesure réglée sur +/-25mm



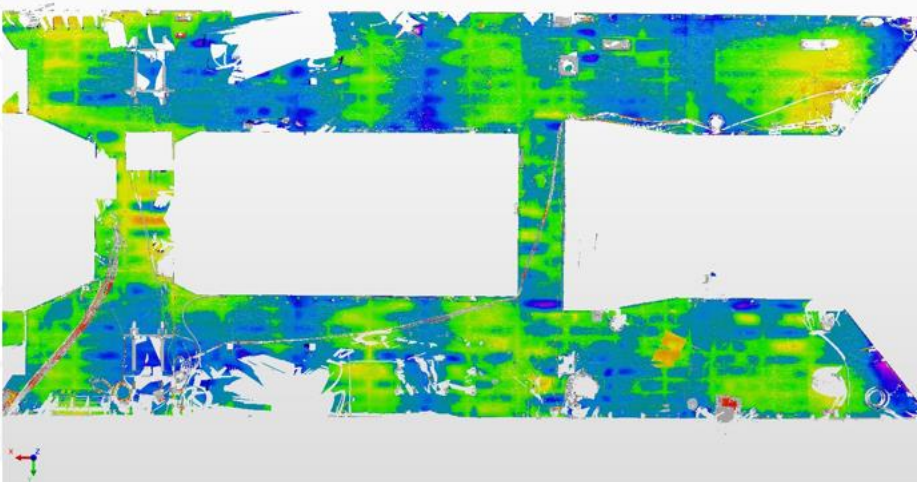
Le modèle polygonal est « le mieux adapté » à la géométrie nominale du pont et les écarts sont cartographiés en couleurs. L'échelle est réglée à +/- 25 mm. Toute géométrie affichée en gris se situe en dehors de la plage d'échelle.

La cartographie des couleurs rend la détection des zones problématiques très simple et intuitive.



## HMCS REGINA MID DECK SCAN

Measurement scale set to +/-25mm



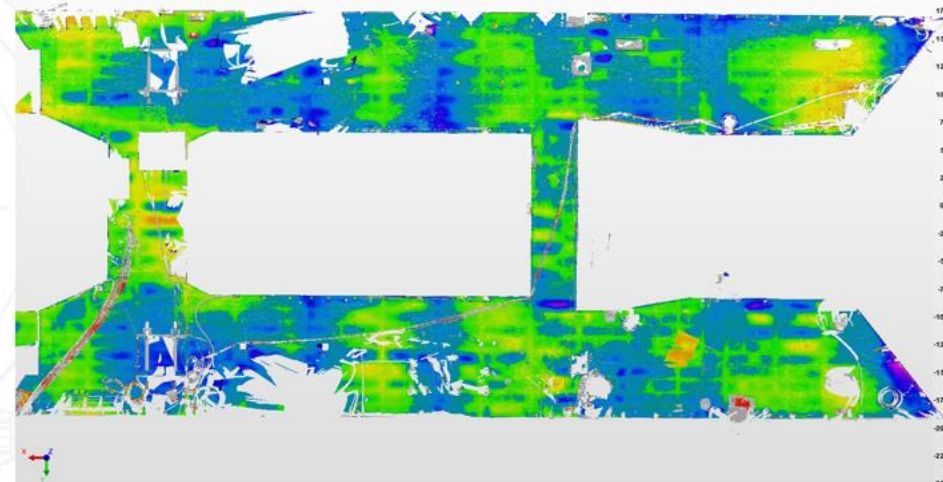
Mid deck scan demonstrates challenges associated with installed equipment, cables and other obstructions on the deck surface. Scanners operate on line of sight, making it difficult to work around some areas.

Creative approaches to locating the scanner (magnetic mount, various tripods) are being investigated.



## HMCS REGINA – SCAN DE PONT CENTRALE

Echelle de mesure réglée sur +/-25mm



L'analyse du milieu du pont démontre les défis associés aux équipements installés, aux câbles et autres obstructions sur la surface du pont. Les scanners fonctionnent en visibilité directe, ce qui rend difficile le travail dans certaines zones.

Des approches créatives pour localiser le scanner (support magnétique, divers trépieds) sont à l'étude.



## HMCS REGINA DECK SCANNING - FUTURE POTENTIAL



With additional scanning from the top of superstructures, all three main deck areas could be scanned and combined into one data file.

Axial twist, longitudinal bending, and localized deck condition could be evaluated for the deck as a whole, or individually as is displayed in this presentation.

Assessment of the deck form from bow to stern and compared across the entire fleet would allow tracking of damage from operations and prioritization of repairs.



## HMCS REGINA ANALYSES DE PONT – POTENTIEL FUTUR



Grâce à une numérisation supplémentaire depuis le haut des superstructures, les trois zones du pont principal pourraient être numérisées et combinées en un seul fichier de données.

La torsion axiale, la flexion longitudinale et l'état localisé du tablier peuvent être évalués pour le tablier dans son ensemble ou individuellement, comme indiqué dans cette présentation.

L'évaluation de la forme du pont de la proue à la poupe et sa comparaison sur l'ensemble de la flotte permettraient de suivre les dommages causés par les opérations et de prioriser les réparations.



### Conclusion

- QETE innovates on a continuous basis to improve test and evaluation capabilities in our technical specialty areas
- The innovations presented today can be leveraged to serve many different client needs
- QETE looks forward to continuing to support the needs of the Mat Group ENG community



### Conclusion

- Le CETQ innove de façon continue pour améliorer les capacités de tests et d'évaluation dans nos domaines de spécialités techniques
- Les innovations présentées aujourd'hui peuvent être exploitées pour répondre à de nombreux besoins différents des clients
- Le CETQ a hâte de continuer à répondre aux besoins de la communauté ENG de Mat Group





ANDRÉ LEDUC

# Amazon's Culture of Innovation

Canada Public Sector  
Amazon Web Services

# La culture d'innovation chez Amazon

André Leduc  
Responsable principal du développement des affaires  
Amazon Web Services



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**Our mission:**  
**to be Earth's most  
customer-centric company**



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**Notre mission :**  
**Être l'entreprise la plus centrée sur le client  
de la planète**



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**Where innovation begins:  
start with the customer and work  
backwards**



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**Où l'innovation commence :  
placer le client au premier plan et  
travailler en ce sens.**



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“There are many advantages to a customer-centric approach, but here’s the big one: **Customers are always beautifully, wonderfully dissatisfied**, even when they report being happy and business is great. Even when they don’t yet know it, **customers want something better, and your desire to delight customers will drive you to invent on their behalf.**”

- Jeff Bezos, Founder and Executive Chair,  
Amazon.com, Inc. 2016 letter to shareholders

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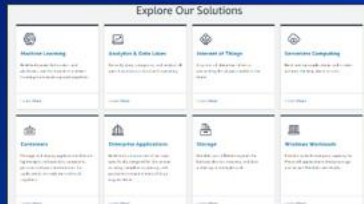
« L’approche centrée sur le client présente de nombreux avantages, dont voici le plus important : **Les clients sont toujours merveilleusement insatisfaits**, même lorsqu’ils se disent heureux et que les affaires vont bien. Même s’ils ne le savent pas encore, vos clients veulent toujours ce qui est le mieux, et votre désir de les satisfaire vous incitera à innover pour eux. »

- Jeff Bezos, fondateur et Président Exécutif, Amazon.com, Inc.  
Lettre aux actionnaires de 2016

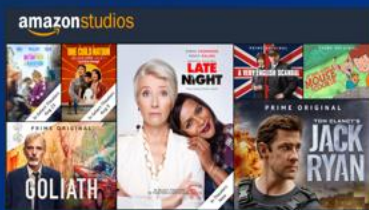
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E-commerce



Devices



Streaming Content



Consumables



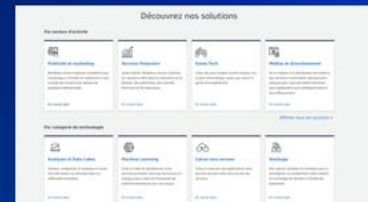
Physical Retail



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E-commerce



Appareils



Contenu en streaming



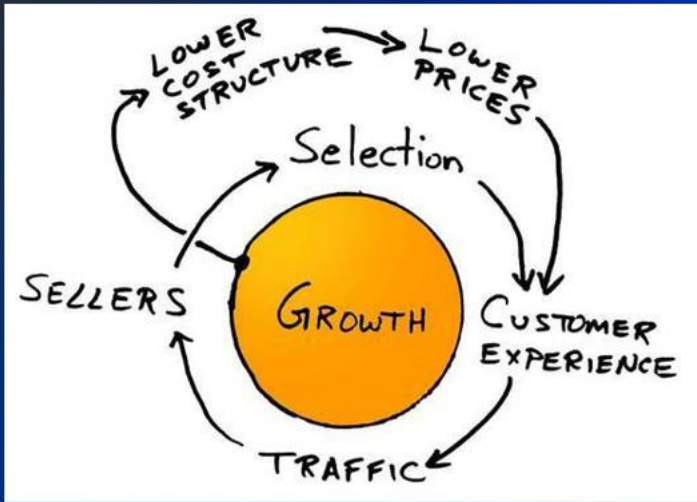
Produits de consommation



Vente au détail physique



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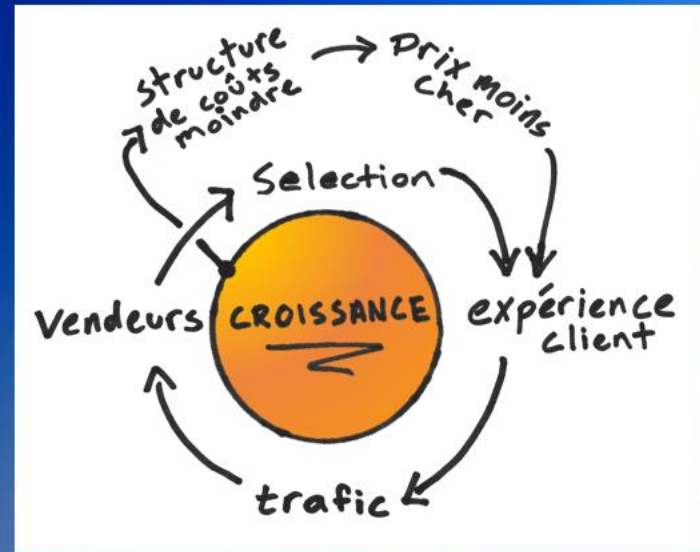


## Growth Flywheel

- Price
- Selection
- Convenience

## Volant de croissance

- Prix
- Choix
- Commodité



## How do we organize for Innovation?

### Culture

Customer obsession, hire builders, support them with a belief system

### Mechanisms

Encoded behaviors that facilitate innovative thinking

### Architecture

Technical structure and tools that support rapid growth and change

### Organization

Small, empowered teams that own what they create



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## Comment organiser l'innovation ?

### Culture

Obsession du client, embauche de créateurs, soutien avec un système de croyance

### Mécanismes

Comportement codé pour une pensée innovante

### Architecture

Structure technique et outils qui soutiennent la croissance et le changement rapides

### Organigramme

Petites équipes compétentes qui s'approprient ce qu'elles créent



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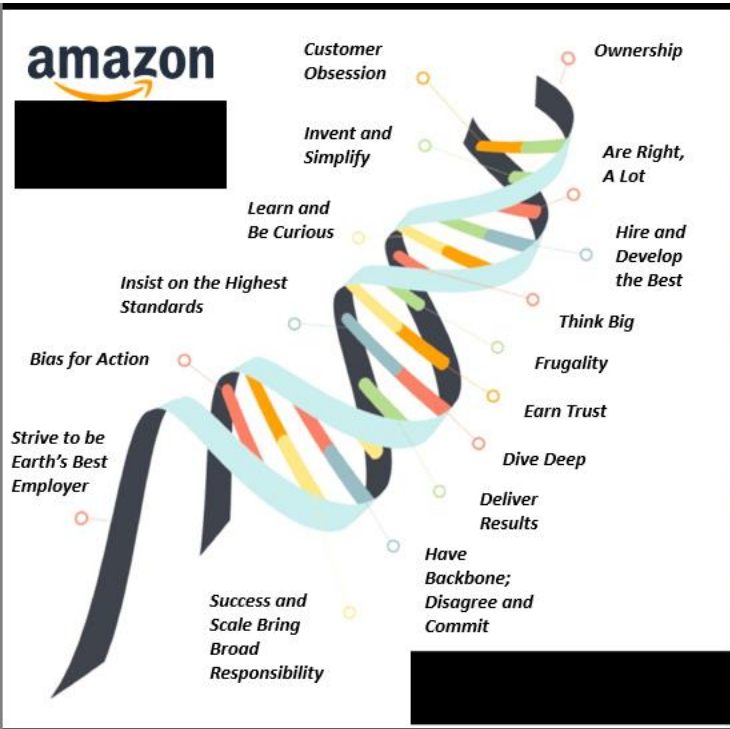
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## Our Leadership Principles

<https://www.aboutamazon.com/about-us/leadership-principles>

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## Nos principes de leadership

... à moins que vous n'en connaissiez de meilleurs. S'il vous plaît soyez un leader.

- L'obsession client
- Inventer et simplifier
- Apprendre et être curieux
- Placer le niveau d'exigence toujours plus haut
- S'investir personnellement
- Privilégier l'action
- Maîtriser et optimiser les coûts (frugalité)
- La réussite s'accompagne d'importantes responsabilités
- Avoir souvent raison
- Recruter et développer les meilleurs
- Voir grand
- Devenir le meilleur employeur au monde
- Obtenir des résultats
- Avoir du cran, s'opposer et s'engager
- Analyser en profondeur
- Gagner la confiance

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## Invent and Simplify

Leaders expect and require innovation and invention from their teams and always find ways to simplify. They are externally aware, look for new ideas from everywhere, and are not limited by “not invented here.” As we do new things, **we accept that we may be misunderstood** for long periods of time.



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## Inventer et simplifier

Les responsables attendent et exigent de leurs équipes qu'elles innover, inventent et trouvent toujours des moyens de simplifier. Ils gardent un œil sur l'extérieur, recherchent de nouvelles idées partout et ne sont pas limités par le syndrome du « pas inventé ici ». Lorsque nous innovons, **nous acceptons d'être incompris** pendant un certain temps.



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Willingness to be **misunderstood** for a long time



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Volonté d'être **incompris** pendant un certain temps



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129

Price Reductions (since '06)

200+

Fully featured services

Millions of

Active Customers Every Month



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129

baisses de prix (depuis 2006)

200+

services complets

Des millions

de clients actifs chaque mois



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## Bias for Action

Speed matters in business. **Many decisions and actions are reversible** and do not need extensive study. We value calculated risk taking.



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## Privilégier l'action

Dans le domaine des affaires, la rapidité est un aspect important. **De nombreuses décisions et actions sont réversibles** et n'ont pas besoin d'être étudiées en profondeur. Nous apprécions la prise de risques calculés.




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Is it a one-way or a two-way door?

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S'agit-il d'une porte à sens unique ou à double sens ?



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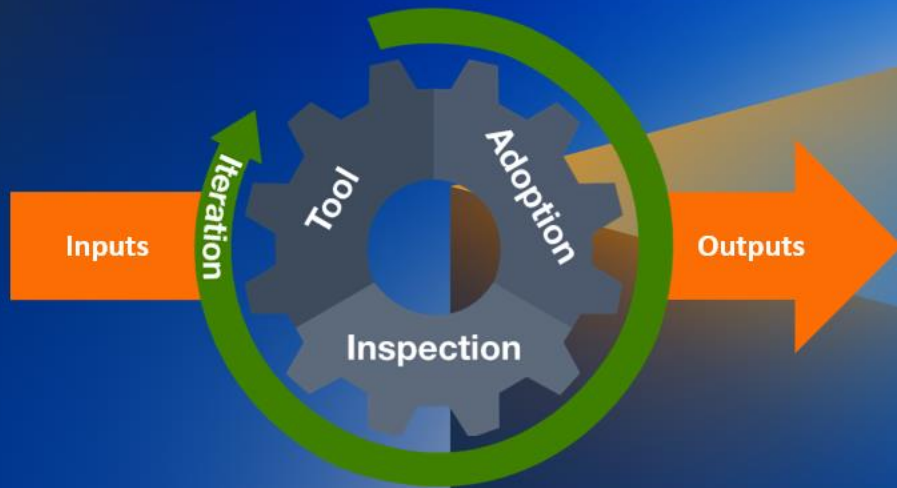
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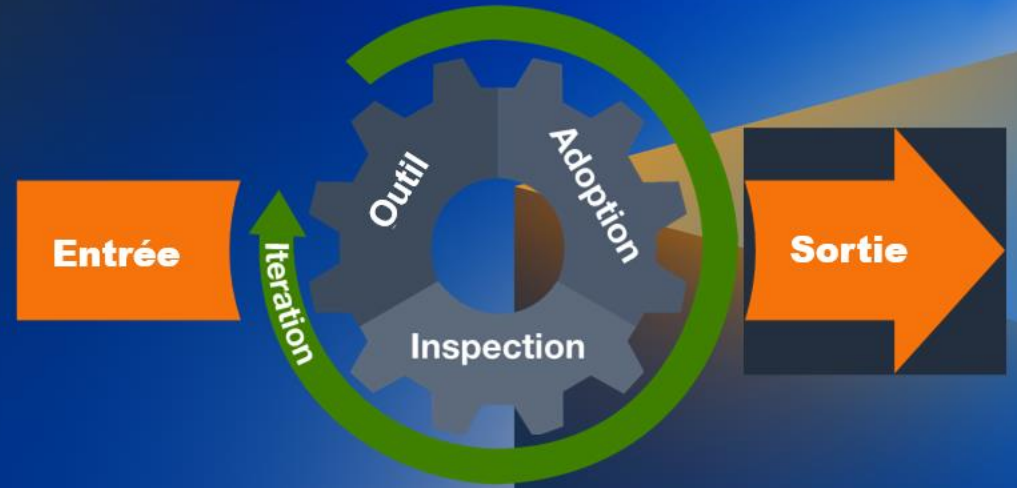
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A **mechanism** is a complete process



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Un **mécanisme** est un processus complet



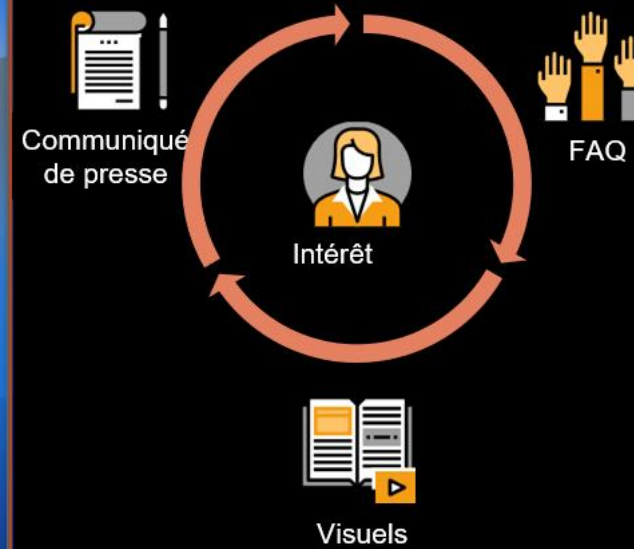
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## Working backwards: A mechanism for innovation

Use it to get clarity, not to  
document what you've  
already decided to do

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## Partir des besoins du client : Un mécanisme au service de l'innovation

Utilisez-le pour obtenir des  
informations claires plutôt  
que de documenter ce que  
vous avez décidé de faire.

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## Who is the customer?

Be specific about context and needs

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## Qui est le client ?

Soyez précis sur le contexte et les besoins

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## 5 Customer Questions



Working Backwards Questions

- Who is the **customer**?
- What is the customer problem or **opportunity**?
- Is the most important customer **benefit** clear?
- How do you know what customers **need** or **want**?
- What does the customer **experience** look like?

Wiki > Working Backwards

The graphic features a white tablet with a blue border, tilted at an angle. The top left corner of the tablet displays four orange icons: a gear, a clock, a satellite dish, and a house with an arrow pointing to it. The text is centered on the tablet's screen.

## 5 questions sur les clients



Questions de travail à rebours

- Qui est le **client**?
- Quel est le problème ou l'**opportunité**?
- Est-ce que le plus important **avantage** du client est clair?
- Comment savons-nous ce que le client **veut** ou a **besoin**?
- L'**expérience** du client ressemble à quoi?

Wiki > Working Backwards

The graphic features a white tablet with a blue border, tilted at an angle. The top left corner of the tablet displays four orange icons: a gear, a clock, a satellite dish, and a house with an arrow pointing to it. The text is centered on the tablet's screen.

# Working Backwards artifacts

## Press Release

Amazon Campus  
Amazon.com confidential

**Amazon Campus Launches First Multi-Channel Student Store at the University of California Berkeley**  
[www.amazon.com/Campus/Berkeleyamazon.com](http://www.amazon.com/Campus/Berkeleyamazon.com)

**SEATTLE (BUSINESS WIRE) – August 31st, 2014** – Since returning to school for the fall semester, 85 experienced a fresh take on the college bookstore as the new Berkeley Student Store opened at [berkeley.amazon.com](http://berkeley.amazon.com).

The Amazon-run online Student Store brings Amazon's broad selection, low prices, and convenient of Berkeley's campus and offers a number of additional student-focused features. With the launch students can now pay for any purchase on Amazon with their GiftCard, buy course materials in any Learning Management System or directly on Amazon.com, pick up orders at convenient locations, & One-Day Shipping on textbooks sent to the campus area. Amazon Student members at Berkeley are shipping to campus on millions of additional products plus FREE Two-Day shipping on millions more.

"I've been an Amazon Student member for two years," explained Senior Audrey Robinson. "Getting was huge. I've been ordering everything from Amazon since I got back to school. I may never have Students can access these campus-specific payment methods and shipping benefits, along with the textbooks - typically available only through the university's licensed bookstore - by activating the experience when they visit [berkeley.amazon.com](http://berkeley.amazon.com), sign up for Amazon Student and select Berkeley to Amazon within the Berkeley Learning Management System.

In place of a traditional campus bookstore, Amazon has deployed Lockers across campus and built a space that features a package pick up desk, technology showroom, and lounge area for students to hang out.

## FAQs

Amazon Campus  
Amazon.com confidential

**Student Customer FAQ**

**Q1: What do I get when Amazon is on my campus?** Students get a number of benefits when Amazon is on campus. By activating the co-branded experience on Amazon, students receive Free One-Day shipping on textbooks to campus address, textbook selection, the ability to pay with their university ID card, and the ability to pick up Amazon.com orders on campus. On campus, all students will have access to an Amazon Student Lounge.

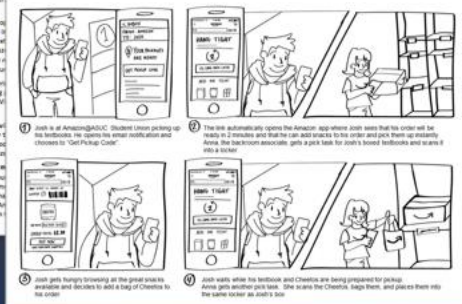
**Q2: How do I activate the co-branded experience?** Students at client universities will have four methods for activating the co-branded experience: 1) visiting the co-branded subdomain directly by typing the URL [berkeley.amazon.com](http://berkeley.amazon.com) in clicking an external link, 2) joining the Amazon Student program and selecting their school, 3) shopping for text their school's Learning Management System, 4) clicking on a Student Store merchandising placement on Amazon.com when they have opted in, they will see a persistent co-branded toolbar on the top of the page whenever they visit Amazon.com. Customers can turn the experience off at any time by navigating to the "Account Settings" menu in "Your Account."

**Q3: What do I get if sign up for Amazon Student when Amazon is on my campus?** Amazon Student members the standard benefits of the program plus Free One-Day shipping to the campus area on millions of top selling benefits include Free Two-Day shipping on Prime eligible items, unlimited instant streaming of Prime instant V access to the Kindle Owners' Lending Library. The cost of a Student membership will remain \$39/year.

**Q4: Why aren't there any 'grab and go' items available for purchase at the Student Lounge?** At launch, we will products to customers "on demand" at the Student Lounge because we do not have a Point of Sale system or inventory for sale on site. However, we intend to offer this in the future for a small selection of top-selling grab-and-go items, customers may order items displayed in the Lounge by using the bar code scan feature in the Amazon app.

**Q5: Why is Free One-Day shipping limited to campus addresses? Why don't I get Free One-Day shipping to my home address?** Amazon is able to reduce costs associated with shipping orders by campus to pass on to all students at the school via Free One-Day shipping for textbooks, and to our Amazon Student members on millions of other eligible products. However, in order to provide these benefits at no additional, the geography in which we offer this benefit to those zip codes served from our on-campus delivery station. All members always receive Free Two-Day shipping on Prime eligible items, to campus or most other addresses on Amazon.com.

## Visuals



# Artéfacts « Partir des besoins du client »

## Communiqué de presse

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Amazon.com confidential

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The Amazon-run online Student Store brings Amazon's broad selection, low prices, and convenient of Berkeley's campus and offers a number of additional student-focused features. With the launch students can now pay for any purchase on Amazon with their GiftCard, buy course materials in any Learning Management System or directly on Amazon.com, pick up orders at convenient locations, & One-Day Shipping on textbooks sent to the campus area. Amazon Student members at Berkeley are shipping to campus on millions of additional products plus FREE Two-Day shipping on millions more.

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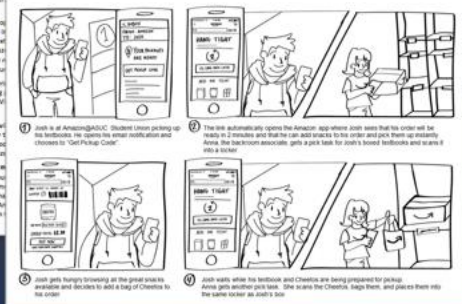
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## Visuels



By signing up for a single subscription, Amazon Family customers will have the peace of mind knowing that Amazon will send them the right sized diaper at the right time.

Babies need an average of about 3,600 disposable diapers across seven sizes in three years, and remain in a size anywhere between a few weeks to several months. A baby might need just one box of size 1 diapers but need as many as eight boxes of size 4 diapers. To complicate matters, weight – and not age – is the best predictor of a baby's diaper size.

With Amazon's Subscribe & Save program, customers previously created diaper subscriptions in a specific size which was replenished until the customer decided it was time to move up a size. This meant that parents needed to anticipate the change in diaper size and either cancel their existing subscription to create a new one, or go to the Manage Your Subscriptions page to update the existing diaper subscription with the new size. This caused endless frustration for parents, added to the stress of having a new baby, and the experience ran counter to the concept of a subscription that should run smoothly with minimal touch points.

With the introduction of the new auto-sizing feature, customers who subscribe to diapers will be asked to provide their child's weight, in addition to the existing child info. They will then be able to set up a single subscription that will take them through the various sizes at the right time. Customers will be notified before the next box of diapers is due to ship that it has automatically sized up – if it's too soon, there will be a simple one-click process to keep the current size.

"I love using Subscribe & Save. But for my older child, I have had to return boxes that were one size too small, which actually increased my work load," says Mara Steiner, who has used Subscribe & Save for her baby needs for several years. "As I expect my second child, I am very excited at the thought of having the right size diapers show up at my door each month. New parents have enough to do without having to keep calculating which size of diapers they should be buying for their baby."

"We want parents to always have the right sized diaper for their child at the right time," said Greg, director of Subscribe & Save. "This single subscription experience for diapers will ensure that customers can depend upon Subscribe & Save to do the work for them, and never have to worry about changing size as their children grow."

Amazon's Subscribe & Save ships thousands of items to their customers on a regular basis with additional discounts. With the diaper subscription service, the program has simplified the experience for new parents.

To learn more about Subscribe & Save's diaper subscriptions auto-sizing, go to [www.amazon.com/subscribe](http://www.amazon.com/subscribe)

What about mobile?

Customer Benefit?

Not a good name for this

Lead & Customer call to say this?

Customer Benefit?

Babies need an average of about 3,600 disposable diapers across seven sizes in three years, and remain in a size anywhere between a few weeks to several months. A baby might need just one box of size 1 diapers but need as many as eight boxes of size 4 diapers. To complicate matters, weight – and not age – is the best predictor of a baby's diaper size.

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What about mobile?

## How do we organize for Innovation?

### Culture

Customer obsession, hire builders, support them with a belief system

### Mechanisms

Encoded behaviors that facilitate innovative thinking

### Architecture

Technical structure and tools that support rapid growth and change

### Organization

Small, empowered teams that own what they create



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## Comment organiser l'innovation ?

### Culture

Obsession du client, embauche de créateurs, soutien avec un système de croyance

### Mécanismes

Comportement codé pour une pensée innovante

### Architecture

Structure technique et outils qui soutiennent la croissance et le changement rapides

### Organigramme

Petites équipes compétentes qui s'approprient ce qu'elles créent



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## A shift to **microservices**

- Decoupled architecture of single-purpose services
- Business logic and data only accessible through hardened APIs
- Increased speed, agility, and innovation

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## Le passage aux **microservices**

- Architecture découplée de services à usage unique
- Logique opérationnelle et données accessibles uniquement par des API renforcées
- Rapidité, agilité et innovation accrues





## Self-service without gatekeepers

Enable builders to  
use the right tool  
for the right job

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## Libre-service sans gardien

Permettre aux  
constructeurs  
d'utiliser le bon  
outil pour le bon  
travail

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## Accelerate the pace of innovation

### Our technical architecture:

- Allows for instant experimentation
- Lowers the cost of failure
- Enables rapid scale and iteration



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## Accélérer le rythme de l'innovation

### Notre architecture technique :

- Permet une expérimentation instantanée
- Réduit le coût de l'échec
- Permet une mise à l'échelle et une itération rapides



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“We like to say that there is no compression algorithm for **experience.**”

- Andy Jassy, CEO, Amazon.com, Inc



« Il n'existe pas d'algorithme de compression pour **l'expérience.** »

- Andy Jassy, PDG, Amazon.com, Inc.

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Amazon hires  
**builders** and lets  
them build

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Amazon embauche  
des **créateurs** et leur  
permet d'inventer

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Two-pizza teams are fast and agile, fostering **ownership** and **autonomy**



Small, decentralized, nimble teams



Own and run what you build



Les équipes réduites (« two-pizza teams ») sont rapides et agiles, ce qui encourage **l'investissement personnel** et **l'autonomie**.



Des petites équipes décentralisées et agiles



Appropriiez-vous et exécutez ce que vous avez construit

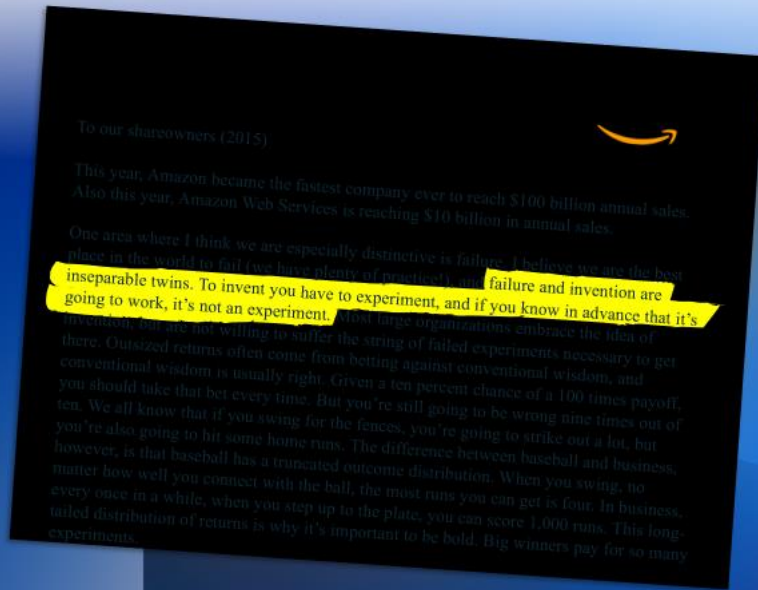
« Équipe pour **DEUX PIZZAS** »

“...failure and invention are inseparable twins. To invent you have to experiment, and if you know in advance that it's going to work, it's not an experiment.”

- Jeff Bezos, Founder and CEO, Amazon.com, Inc. 2015 letter to shareholders



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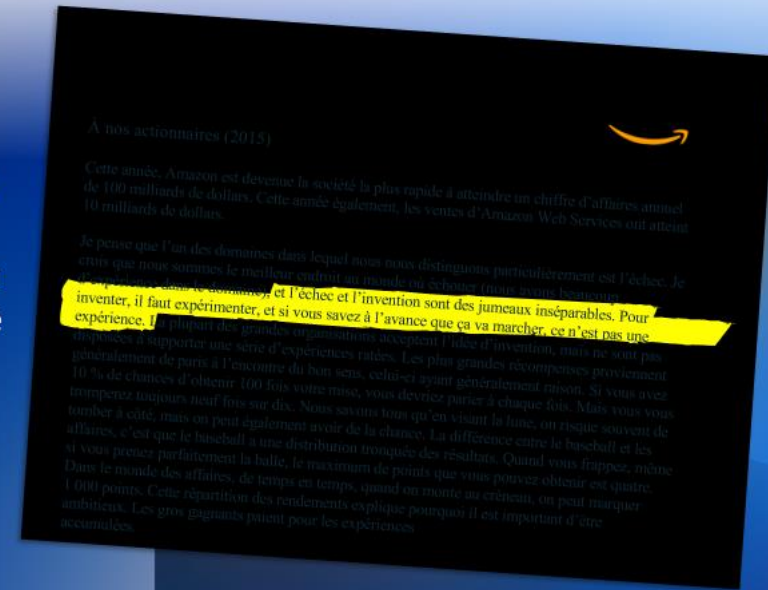


« ... l'échec et l'invention sont des jumeaux inséparables. Pour inventer, il faut expérimenter, et si vous savez à l'avance que ça va marcher, ce n'est pas une expérience. »

- Jeff Bezos, fondateur et PDG, Amazon.com, Inc. Lettre aux actionnaires de 2015



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## Learn from failures

Auctions, zShops, Marketplace



Fire Phone



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## Apprendre de ses échecs

Auctions, zShops, Marketplace



Fire Phone



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Thank You

Andre Leduc  
Sr Business Development and Capture Manager  
AWS Canada

Merci!

André Leduc  
Responsable principal du développement des affaires  
leduandr@amazon.com



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National  
Défence

Défense  
nationale

ASSISTANT DEPUTY MINISTER (MATÉRIEL)



# Break

Canada



National  
Défence

Défense  
nationale

ASSISTANT DEPUTY MINISTER (MATÉRIEL)



# Repos

Canada

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# Ammunition Innovation

• June 7th 2024

**GENERAL DYNAMICS**  
Ordnance and Tactical Systems-Canada



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# Ammunition Innovation

• June 7th 2024

**GENERAL DYNAMICS**  
Ordnance and Tactical Systems-Canada



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General Dynamic OTS Canada

*Centre of excellence for ammunition*



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General Dynamic OTS Canada

*Centre of excellence for ammunition*



## General Dynamics–OTS Canada

- Centre of excellence for military ammunition in Canada
- World-class developer and manufacturer of ammunition and defense solutions adapted to the needs of the armed forces and law enforcement agencies
- Quality assurance standards (Management System certified to ISO 9001, ISO 14001 and ISO 45001)
- Structured Innovation Process (Lean Six Sigma + Stage Gate)
- Part of the National Technology and Industrial Base (NTIB)

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3

# Munition Supply Program - Canada

**GENERAL DYNAMICS**  
Ordnance and Tactical Systems-Canada



**GENERAL DYNAMICS**  
Ordnance and Tactical Systems-Canada

- **The Munitions Supply Program (MSP), since its inception in the mid 70's, is intended to establish a government-industry partnership that meets Canadian national policy objectives in two areas:**
  - Contributing to national security and defence by providing an assured domestic source of supply for high-volume-usage ammunition and small arms weapons for the Canadian Armed Forces (CAF) in both peace and war; and
  - Contributing to economic growth by maintaining and developing technologies and industrial capabilities that are globally competitive and sustain good jobs.
- **New MSP Guiding principles (after 2018 review)**
  - Value for money – transparency on cost, performance reporting and measurement of results
  - Improved governance supported by documentation
  - Evidence-based decision-making processes
  - Opportunity to foster greater innovation
  - Opportunity to re-examine exceptional contracting authorities

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# Capabilities

- Development and production of ammunition and related defence products
- Ammunition systems integration
- Extensive expertise in ammunition and weapon design
- Load, Assemble and Pack (LAP)
- Development of Insensitive Munitions (IM)
- Development, manufacture and transformation of energetic materials
- Propellant Manufacturing
- Conventional and low toxicity primers manufacturing
- Metal forming of components
- In-house proofing and testing for all calibers of ammunition (National NATO test centre)
- Over two hundred scientists, engineers and technicians working in R&D and system engineering
- Integrated configuration control system with customers



5

General Dynamics-OTS Canada Proprietary Information

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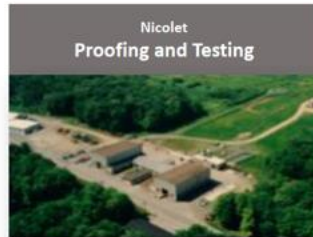
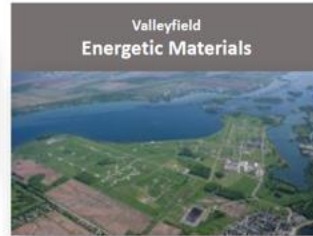
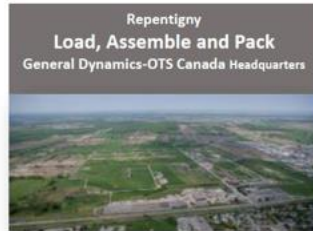


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General Dynamics-OTS Canada Proprietary Information

# Operational Structure – OTS Canada

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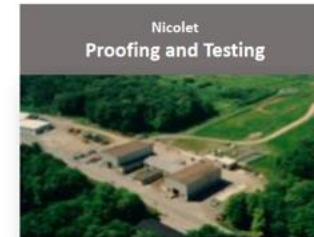
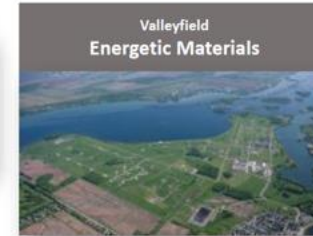
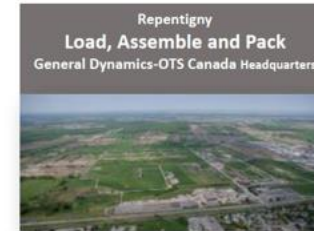


GENERAL DYNAMICS  
Ordnance and Tactical Systems-Canada

6

# Operational Structure – OTS Canada

// General Dynamics-OTS Canada PROPRIETARY //



GENERAL DYNAMICS  
Ordnance and Tactical Systems-Canada

6

# Repentigny Site (Le Gardeur)

Land: 4.09 km<sup>2</sup> (1.58 sq. mile)  
(1,010.5 acres)

Core activity

- Load, Assemble and Pack, more than 150 different ammunition products

Number of employees: 754

Building area : 946,100 sq. ft

Number of buildings : 143

Number of magazines : 21

## Infantry and Mortar Ammunition

- 66mm – 84mm Infantry
- 60mm, 81mm and 120mm Mortar



## Small Caliber Ammunition

- 9mm, 5.56mm, 7.62mm and 12.7mm
- Components and Cartridge Cases



## Medium Caliber Ammunition

- 20mm and 25mm
- 40mm LV/HV Grenades



## Pyrotechnics for:

- OMNITRAP
- Ground Burst
- Breaching Units
- Parachute/Trip Flares
- Smoke Hand Grenades
- Modular Practice bombs



## Tank Ammunition

- 120mm Tank Tactical and Training
- 105mm Tank Training



## Artillery & Naval Ammunition

- 105mm & 155mm Artillery
- Propelling Charges
- 57mm Target Practice



## Simunition Training Ammunition

- Lethal & Non-Lethal Training for Military & Law Enforcement



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7





## St-Augustin Site

### Cartridge Cases and Components

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8

Land: 15 acres

Core activity

- Metal forming of brass cartridge cases, projectiles and various metal components

Number of employees : 177

Building area : 127,800 sq. ft

Number of buildings : 3

## St-Augustin Site

### Cartridge Cases and Components

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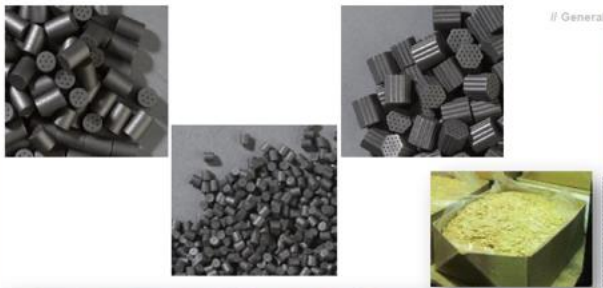
# Valleyfield Site

Land: 4.45 km<sup>2</sup>  
(1.74 sq. mile)  
(1,111.5 acres)

Core activity

- Development and manufacturing of extruded propellant and explosives

Number of employees : 491  
Number of buildings : 162  
Number of manufacturing buildings: 134  
Number of magazines : 28



// General



Manufacturer of IMR Product line  
property of Hodgdon Powder Company



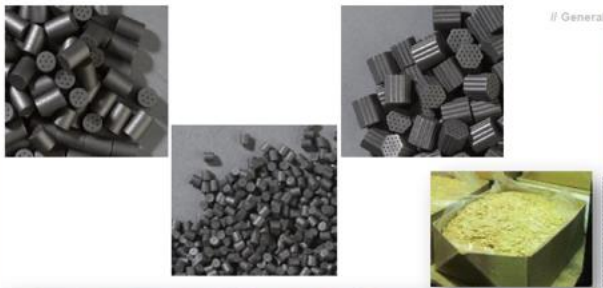
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# Nicolet Test Centre

Management contract  
(Government-Owned/  
Company-Operated)

Land: 7.72 sq. miles  
(4,950 acres)

Core activity

- Proofing and testing of small, medium and large, direct and indirect fire ammunition and components
- Weapon modification, repair and overhaul

Number of employees: 30

Number of buildings: 8



• Capabilities:

- Internal ballistics: Simulation, EPVAT, ACW, Blow-by, Flareback, Propellant residue analysis
- Intermediate ballistics: Metal parts break-up, Discarding sabot, Muzzle brake, Jump
- External/terminal ballistics: Spin, Yaw, Trajectory, Accuracy, Penetration, Functioning, Fuze safety, Dispersion, Detonation, IM testing, 1,000 meter range at Nicolet and long range at CFB Gagetown



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Innovation



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Innovation



## Innovation

- Novelty that fills a need
  - Threats
  - Adaptability
- Earth shattering
- Incremental
- Oops
  - Celebrate success and failures
- Spans a multitude of fields
  - Umbrella R&D Collaboration Agreement with DRDC



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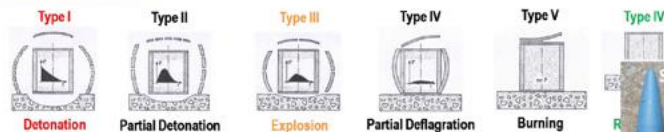


# In insensitive munitions

## Types of threats

- Shape Charge Jet Impact** - Shaped Charge Weapon attack
- Sympathetic Detonation** - Detonation in Magazine, Store, Aircraft or Vehicle
- Fast Cook Off** - Magazine, Store, Aircraft or Vehicle Fuel Fire
- Slow Cook Off** - Fire in Adjacent Magazine, Store, or Vehicle
- Bullet impact** - Small Arms Attack
- Fragment impact** - Fragmenting Munitions Attack

## Types of reactions

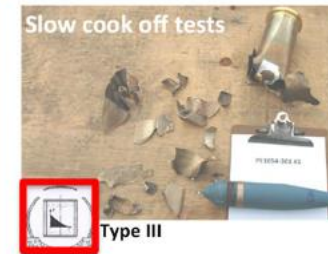
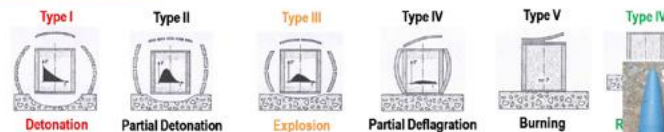


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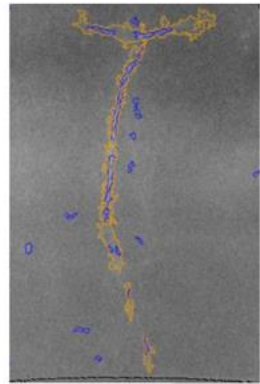
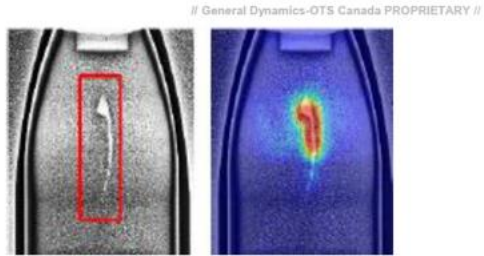
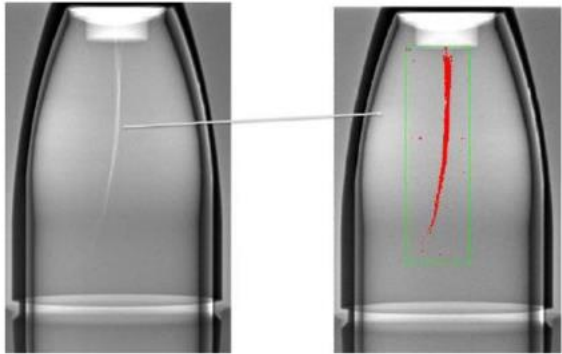
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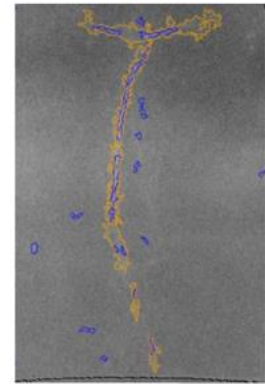
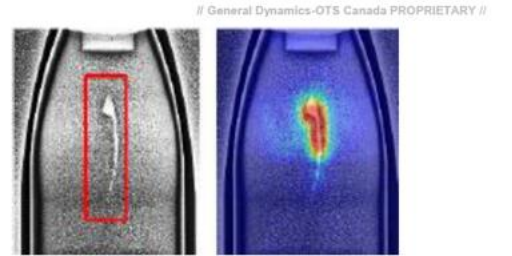
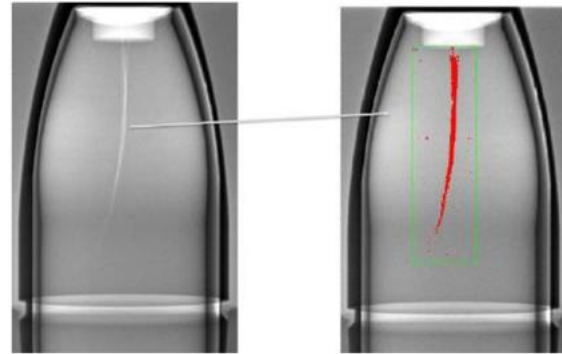
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# AI X-ray inspection

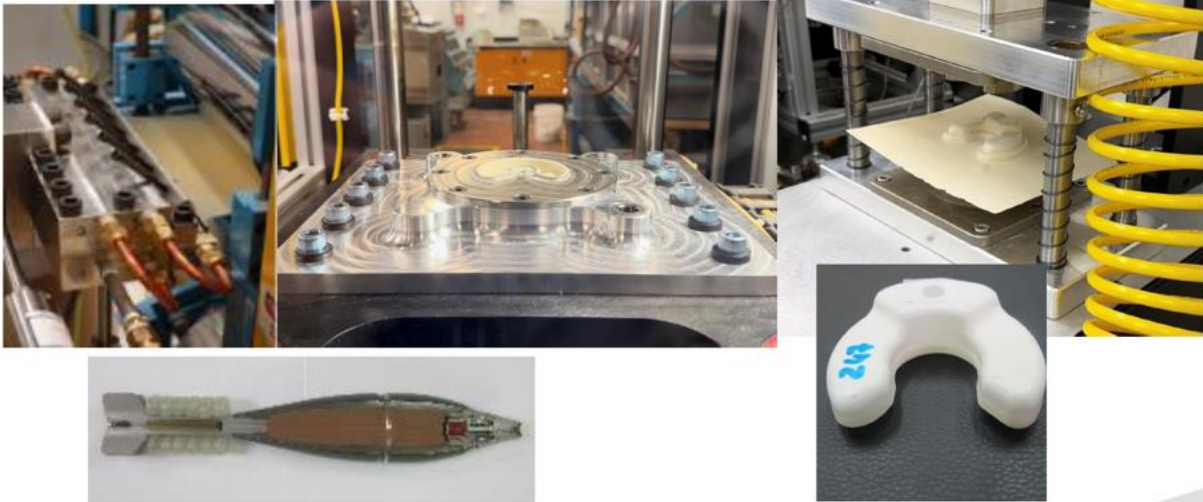


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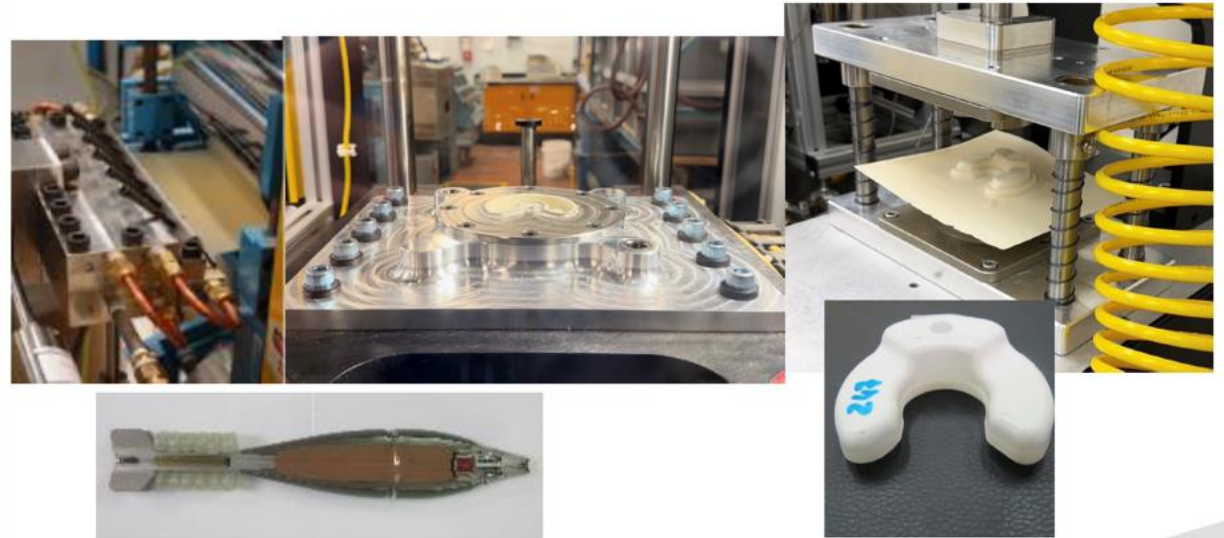
# Foamed Celluloid increments

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# Foamed Celluloid increments

// General Dynamics-OTS Canada PROPRIETARY //





# LAP: One Way Luminescence

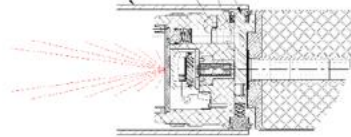
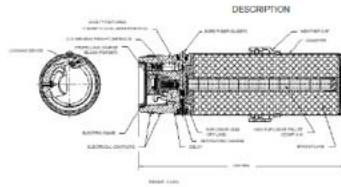
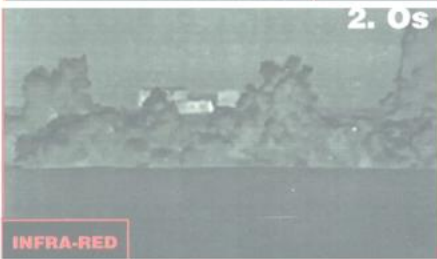


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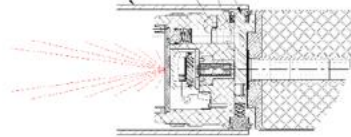
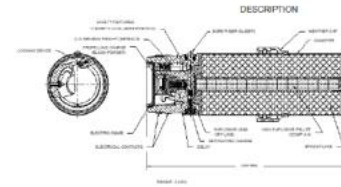
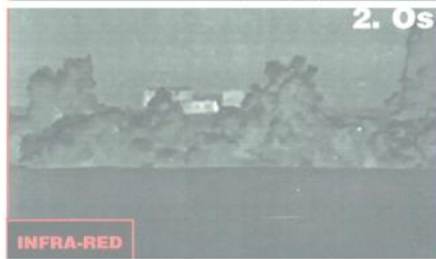
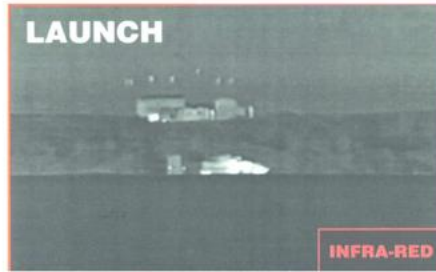
# VIRSS technology

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# VIRSS technology

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How to foster Innovation?



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How to foster Innovation?



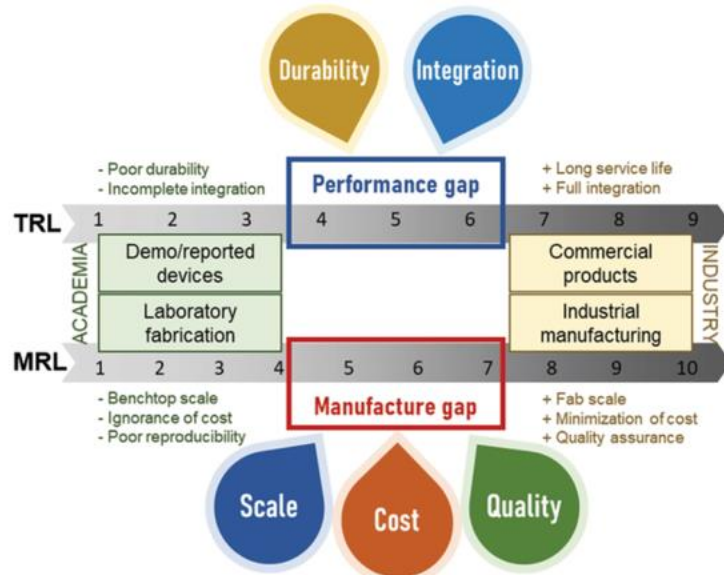


# Ideation → CAF

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**TRL**  
Technology  
Readiness Level

**MRL**  
Manufacturing  
Readiness Level

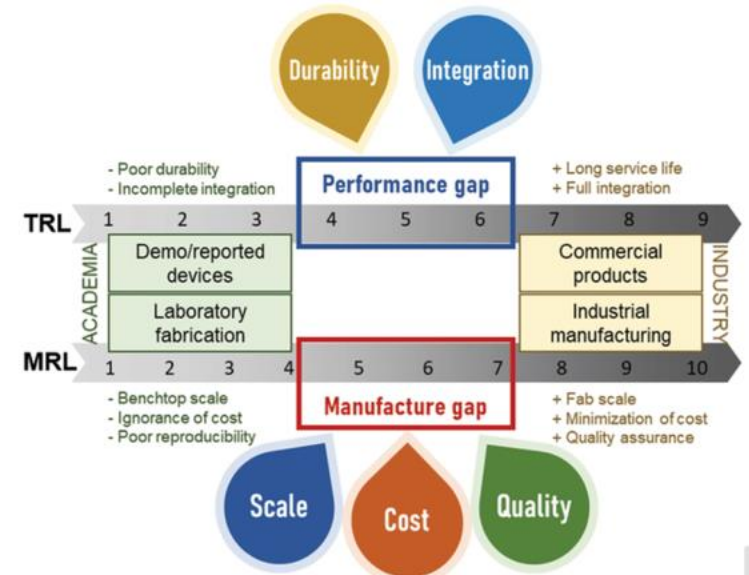


# Ideation → CAF

// General Dynamics-OTS Canada PROPRIETARY //

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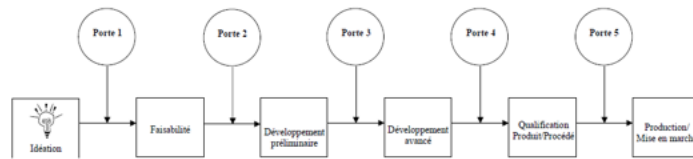


## Structure

- Product Development is done using the Stage-Gate approach

- Development is divided in six main stages

- Ideation
- Feasibility
- Preliminary Dev
- Advanced Dev
- Qualification
- Industrialization



- Lean Design For Six Sigma (LDFSS)

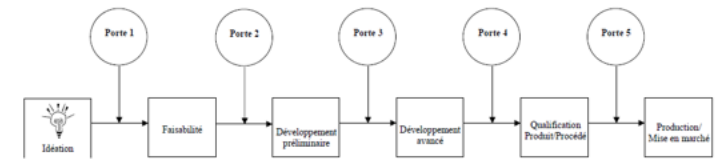
- Structured approach based on statistical tools (QFD, DOE, FMEA, etc.) is used to develop new products and new processes
- Emphasis on robustness

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## Teamwork

- Teamwork is critical
  - TRL
  - MRL
  - Stage-Gate
- Engage with us → Form an IPT (Integrated program team)
  - We are your centre of excellence in munitions
  - As early as possible
  - Share the needs, we have an Umbrella Agreement



**We are your centre of excellence in munitions and MSP partner, let's innovate together!**

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**GENERAL DYNAMICS**  
Ordnance and Tactical Systems–Canada

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QUESTIONS OR COMMENTS



**GENERAL DYNAMICS**  
Ordnance and Tactical Systems–Canada

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QUESTIONS OR COMMENTS







## Cybersecurity Update

Jason Furlong, CD, MASC, PEng

C4I Manager  
PMO CSC



## Mise à jour en Cybersécurité

Jason Furlong, CD, MASC, PEng

Gestionnaire de C4I  
projet de Navire de combat  
canadien



## INTRO - ATTACK ON BELARUS

Source: xkcd.com 17 August, 2020



## INTRO - ATTAQUE À BELARUS

Source: xkcd.com 17 August, 2020



## Outline

- Review of “the Problem”
- Software Supply Chain Attacks
- AI in Cyber Attacks



## Aperçu

- Quel est le problème?
- Attaques à la chaîne d’approvisionnement
- Attaques cybernétiques et l’intelligence artificielle



## The Problem

- Software and information systems will always have vulnerabilities
- Adversaries will always be actively looking to exploit these vulnerabilities
- As soon as we rectify an attack vector, they are moving onto the next attack



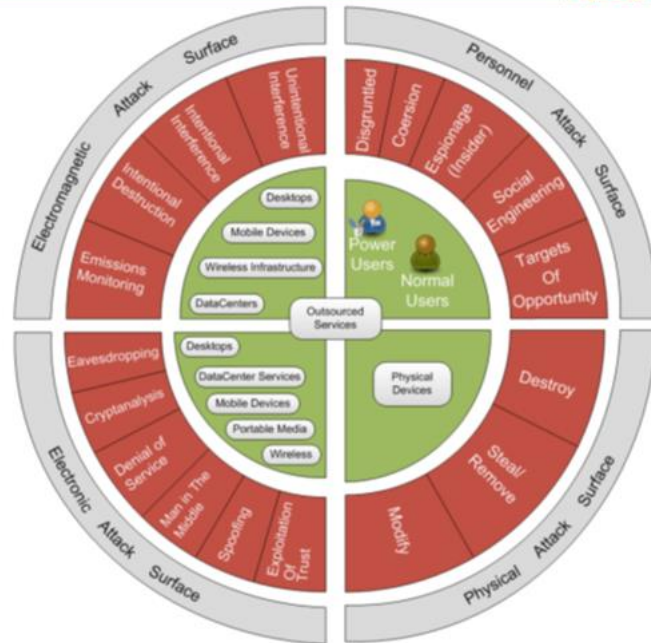
## Le problème

- Les logiciels et les systèmes d'information auront toujours des vulnérabilités
- Les adversaires chercheront toujours activement à exploiter ces vulnérabilités
- Dès que nous corrigeons un vecteur d'attaque, ils passent à l'attaque suivante

# Attack Surfaces / Surfaces d'attaque



The "Wheel of Doom"  
La « roue du destin »



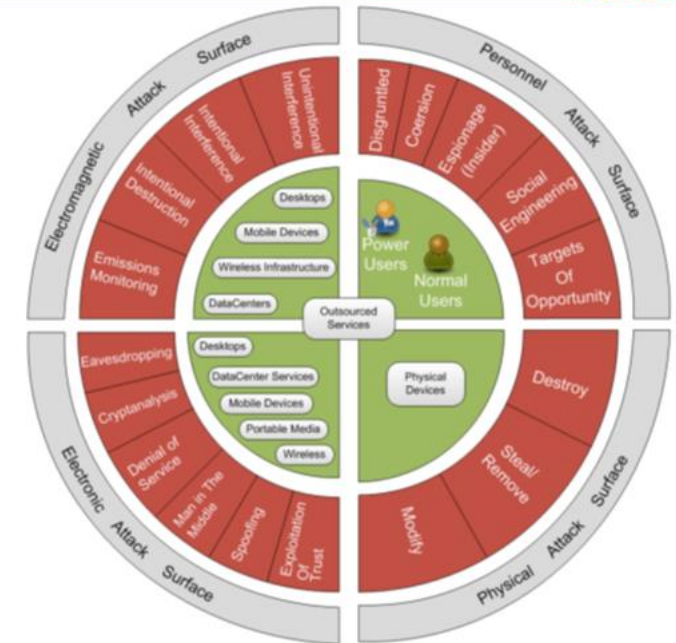
Source: "Enterprise Security Architecture (ESA) Enterprise Threat Assessment, Communications Security Establishment, March 2016

Source: Architecture de sécurité intégrée (ASI) contrôles de la sécurité organisationnelle, Centre de la sécurité des télécommunications, Mars 2016

# Surfaces d'attaque



La « roue du destin »



Source: Architecture de sécurité intégrée (ASI) contrôles de la sécurité organisationnelle, Centre de la sécurité des télécommunications, Mars 2016



## Current State of Cybersecurity in the World

- Russia, and China are the largest originators of internet-based attacks
- Ransomware and other network hijinks are a source of income for cash-starved North Korea
- Iran wages an ideological war online
- Pole Vaulting



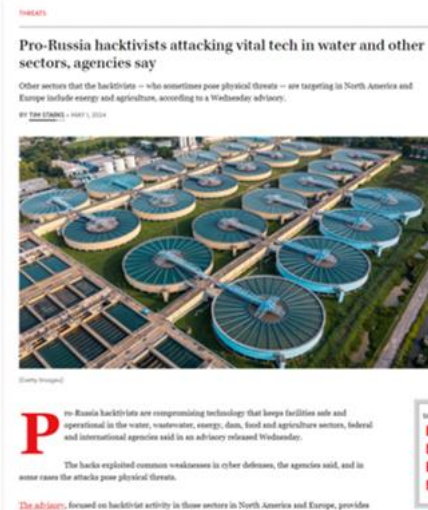
## État actuel de la cybersécurité dans le monde

- La Russie et la Chine sont les principaux auteurs d'attaques sur Internet.
- Les ransomwares et autres détournements de réseau sont une source de revenus pour la Corée du Nord en manque d'argent
- L'Iran mène une guerre idéologique en ligne
- Saut à la perche

## Some interesting recent Hacks



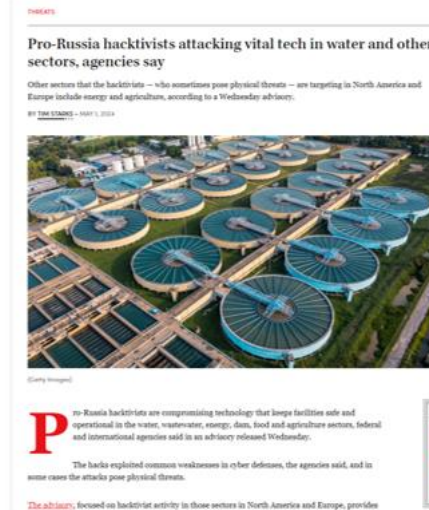
- Sweden being hacked prior to the accession to NATO
- Driver information displays in the US being hacked
- Espionage from China on dissident organizations outside of China
- Public Infrastructure (Operational Technology) attacks are on the rise
  - Water
  - Gas
  - electricity



## Quelques hacks récents intéressants



- La Suède piratée avant son adhésion à l'OTAN
- Aux États-Unis, les affichages d'informations sur le conducteur sont piratés
- Espionnage depuis la Chine contre des organisations dissidentes en dehors de la Chine
- Les attaques sur les infrastructures publiques (technologies opérationnelles) sont en hausse
  - Eau
  - Gaz
  - électricité





## The War in Ukraine

- Russia relentlessly cyber attacking Ukraine
- Modern war isn't contained within a border



## La guerre en Ukraine

- La Russie attaque sans relâche l'Ukraine
- La guerre moderne ne se limite pas à une frontière





## Show me the money...

- Ransomware
- Hijack systems to mine crypto currencies
- IP theft
- Corporate and National espionage
- Digital guns for Hire
  - Foreign state actors
  - Sale of hacking tools and services



## montre moi l'argent...

- Rançongiciel
- Détourner des systèmes pour exploiter des crypto-monnaies
- Vol de propriété intellectuelle
- Espionnage d'entreprise et national
- Pistolets numériques à louer
  - Acteurs étatiques étrangers
  - Vente d'outils et de services de hacking



## The Cyber Families

- Information Technology
- Operational Technology
- Platform Technology



## Les cyber-familles

- Technologie de l'information
- Technologie opérationnelle
- Technologie de plate-forme



## So what:

- We are more reliant on IT than ever before
- Modern militaries need deployed IT to function
  - DRMIS
  - Digital tools
  - Public Infrastructure



## So what:

- Nous dépendons plus que jamais de l'informatique
- Les armées modernes ont besoin d'une informatique déployée pour fonctionner
  - DRMIS
  - Outils numériques
  - Infrastructures publiques



## Software Supply Chain Attacks

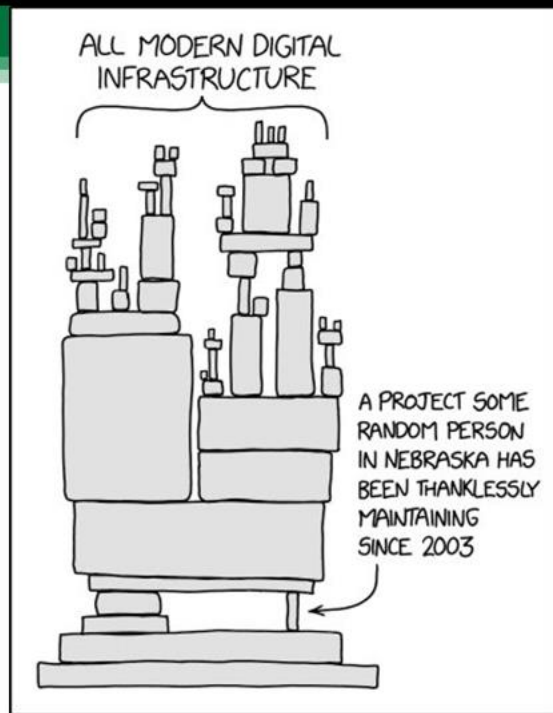


## Attaques de la chaîne d'approvisionnement logicielle

## Modern Digital Infrastructure

- Extensive and interconnected

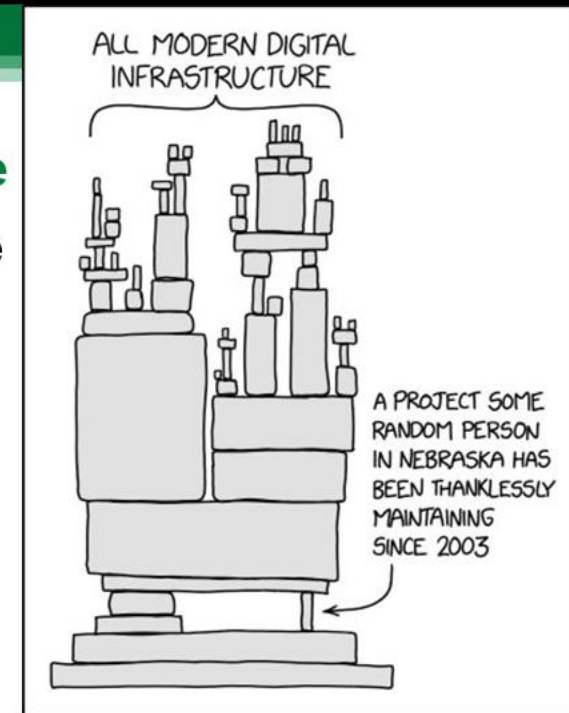
Source: xkcd.com 17 August, 2020



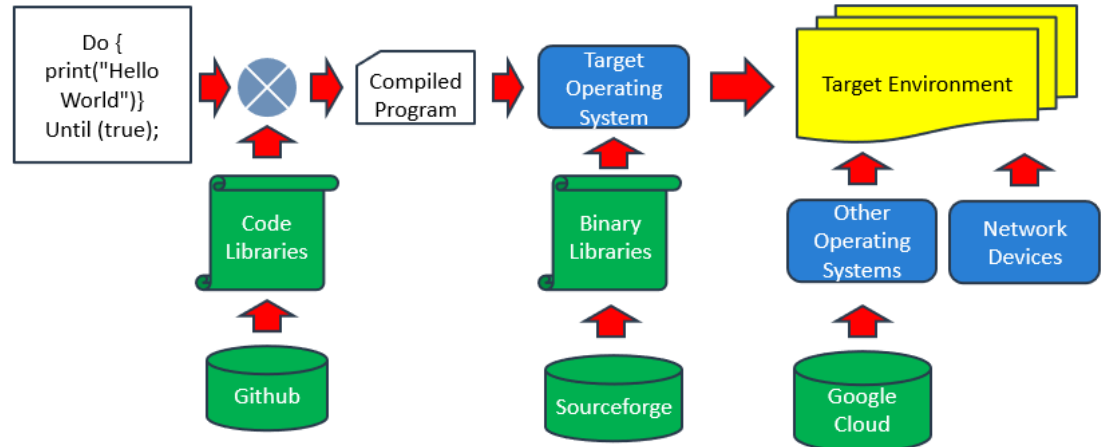
## Modern Digital Infrastructure

- Infrastructure numérique moderne

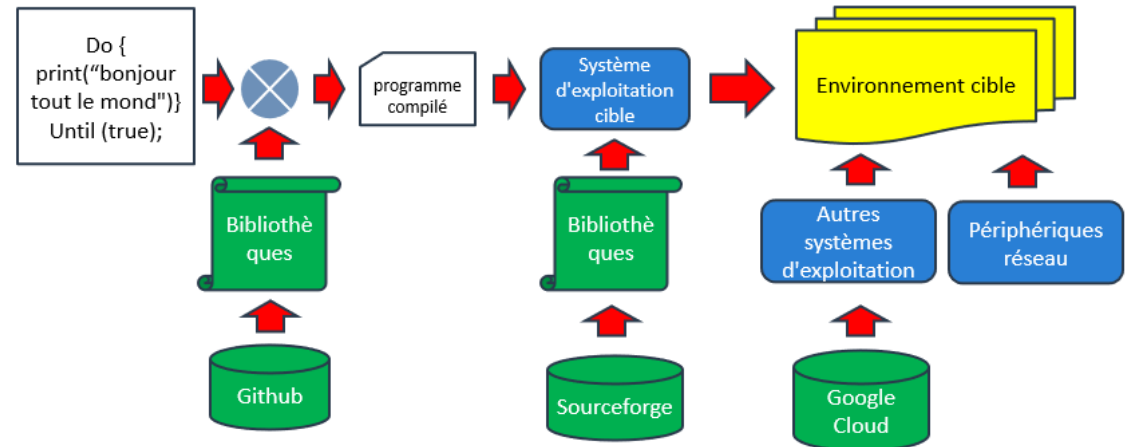
Source: xkcd.com 17 aout , 2020



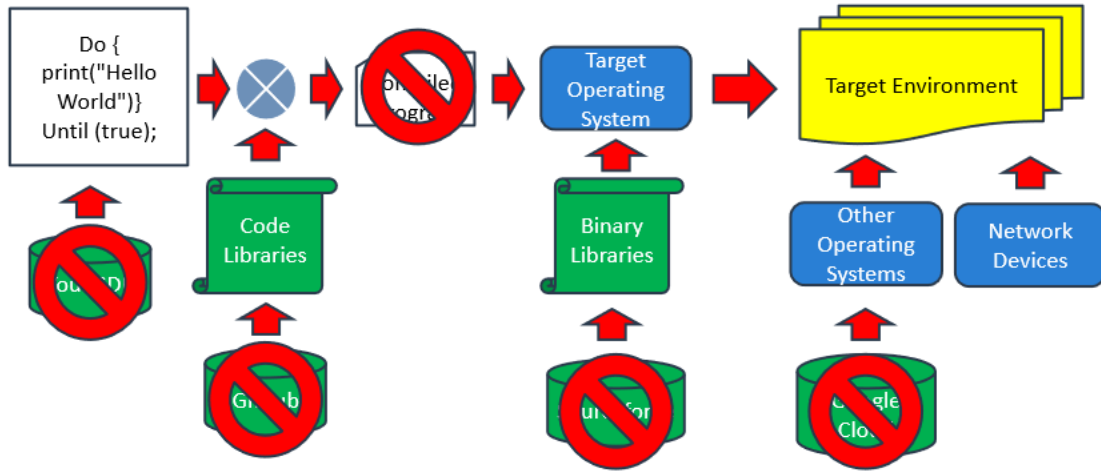
# Software is Sausage Making



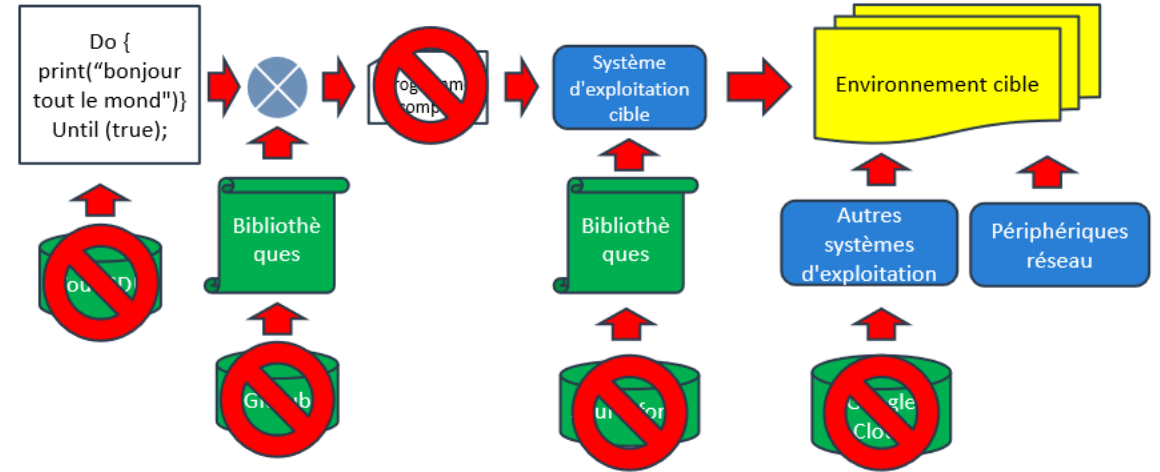
# Construction du logiciel



## Software is Sausage Making



## Construction du logiciel





## Software DNA is recursive

- Every time you create a new piece of software it is built using tools and components from existing and prior software.
- All our software can be traced back to the 1950s



## L'ADN du logiciel est récursif

- Chaque fois que vous créez un nouveau logiciel, il est construit à l'aide d'outils et de composants de logiciels existants et antérieurs.
- Tous nos logiciels remontent aux années 1950







## What is the Software Supply Chain?

- Sources of Software
  - 1<sup>st</sup> party
  - 2<sup>nd</sup> Party
  - 3<sup>rd</sup> Party
  - Legacy
  - Open Source
  - Commercially



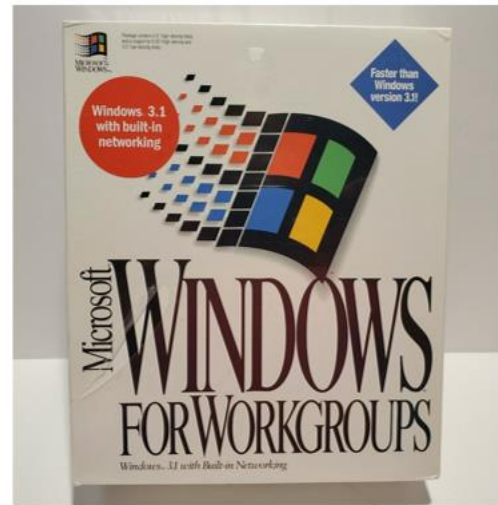
## Qu'est-ce que la Supply Chain Logicielle ?

- Sources of Software
  - 1<sup>ere</sup> parti
  - 2<sup>iem</sup> Parti
  - 3<sup>iem</sup> Parti
  - héritage
  - Open Source
  - Commercialement



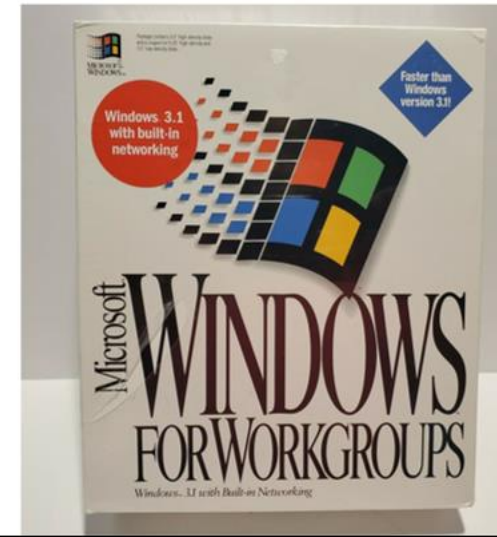
## Where does software come from?

- What is a package manager?



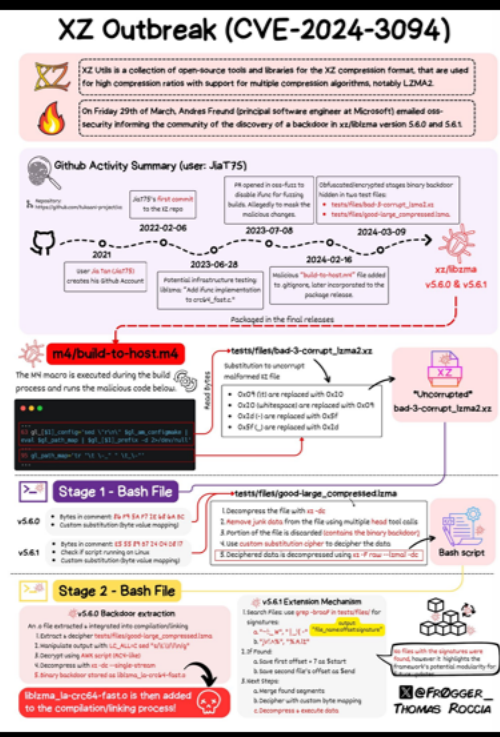
## D'où vient le logiciel?

- Qu'est-ce qu'un gestionnaire de paquets?



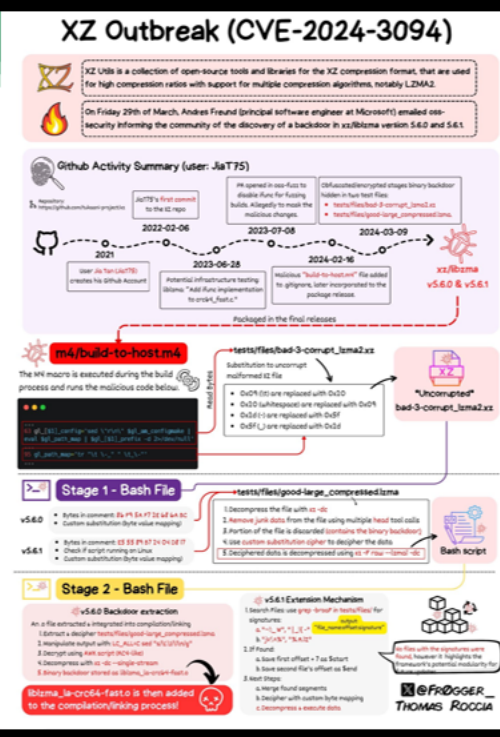
# The XZ Utils attack

- Likely a foreign agent
- Long-term plant (~2 years)



# L'attaque au XZ Utils

- Probablement un agent étranger
- Quelqu'un mis en place depuis 2 années.







## SBOMS

- Software Bill of Materials
  - List of all Software Components
  - Standardized formats
    - SPDX
    - Cyclose DX



## LCL

- Liste de composants logicielle (LCL)
  - Liste de tous les composants logiciels
  - Formats standardizes
    - SPDX
    - Cyclose DX

## Vulnerability Exploitability eXchange (VEX)



- Provides Users info about a product being vulnerable
- Not every vulnerability in a software component will affect you
- Status report:
  - Not affected
  - Affected
  - Fixed
  - Under Investigation

Source: National Telecommunications and Information Administration  
US Dept of Commerce.

## Vulnérabilité Exploitabilité eXchange (VEX)



- Fournit aux utilisateurs des informations sur un produit vulnérable
- Toutes les vulnérabilités d'un composant logiciel ne vous affecteront pas
- Rapport de situation:
  - Pas affecté
  - Affecté
  - Fixé
  - Sous enquête

Source: National Telecommunications and Information Administration  
US Dept of Commerce.

## SBOM Issues



1. Standardization
2. Incomplete or inaccurate data from SBOM Tools
3. Inadequate SBOM Resources an automation
4. Making Sense of Data
5. Enriching SBOMs (VEXs aren't easy)
6. Operationalization SBOMs
7. Building the Village: Culture Clash

Source: App Sec & Supply Chain  
Security, 16 May, 2023

## SBOM Issues



1. Standardisation
2. Données incomplètes ou inexactes des outils SBOM
3. Ressources SBOM inadéquates et automatisation
4. Donner du sens aux données
5. Enrichir les SBOM (les VEX ne sont pas faciles)
6. Opérationnalisation des SBOM
7. Construire le village : choc des cultures

Source: App Sec & Supply Chain  
Security, 16 May, 2023



## Implications for ADM(Mat)

- You will need to specify the requirement for an SBOM repository.
- Something else for LCMMs to worry about
  - Example Log4J
- Make it into the procurement process as early as possible so your suppliers aren't surprised.



## Pour ADM(Mat) ca veut dire:

- Vous devrez préciser les exigences relatives à un référentiel LCL.
- Autre chose dont les gestionnaires de matériel doivent s'inquiéter
  - Example Log4J
- Insérez-le dans le processus d'approvisionnement le plus tôt possible afin que vos fournisseurs ne soient pas surpris.





## **Other Interesting Cyber Items**



## **Autres cyber-articles intéressants**

## AI in Attacks

- Some limited use in crafting scripts for attacks.

### Malicious PowerShell script pushing malware looks AI-written

By Ionut Ilicu April 10, 2024 12:12 PM



A threat actor is using a PowerShell script that was likely created with the help of an artificial intelligence system such as OpenAI's ChatGPT, Google's Gemini, or Microsoft's CoPilot.

The adversary used the script in an email campaign in March that targeted tens of organizations in Germany to deliver the Rhadamanthys information stealer.

#### AI-based PowerShell deploys infostealer

Microsoft researchers identified the attack as a threat actor

## L'intelligence artificielle dans les

- Une certaine utilisation limitée dans la création de scripts pour les attaques.

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## Self-modifying Worms

- What are they?
- SSH-snake attack



## Vers auto-modifiables

- Quels sont-ils?
- SSH-snake attaque



## Navwar (Navigation Warfare)

- Russia behind a massive GPS denial attack in the Baltic Sea
- (yes, I know this isn't technically a Cyber topic)



Source: New Scientist



## Navwar (Guerre de navigation)

- La Russie est à l'origine d'une attaque massive par déni de GPS en mer Baltique
- (oui, je sais que ce n'est techniquement pas un sujet Cyber)



Source: New Scientist



## Summary

- Cyber attacks increasing
- SBOM is now everyone's issue
- Attackers are leveraging the latest tech



## Résumé

- Les cyberattaques se multiplient
- Le SBOM est désormais l'affaire de tous
- Les attaquants exploitent les dernières technologies



## Conclusion

- Cybersecurity is continuous throughout the life of your system
- Cyber is everyone's problem.



## Conclusion

- La cybersécurité est constante tout au long de la durée de vie de votre système
- La cybersécurité, c'est comme la sécurité aérienne : c'est le problème de tout le monde.





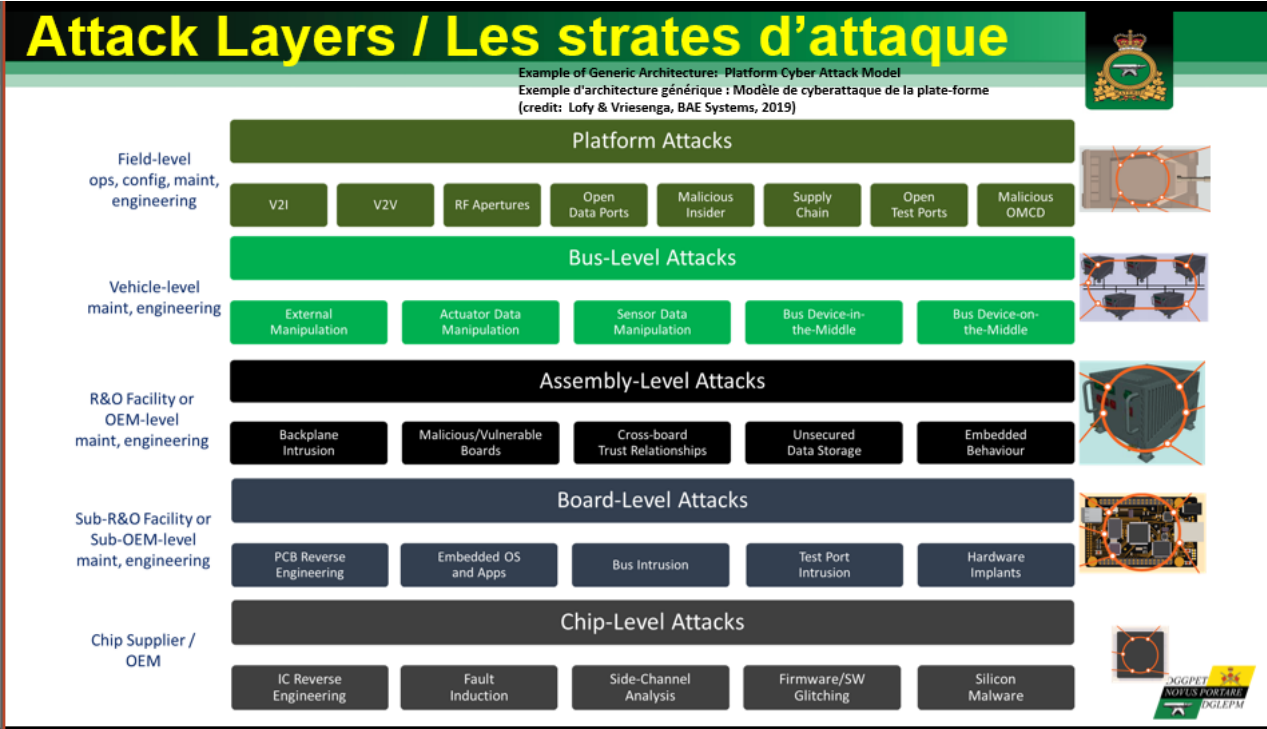
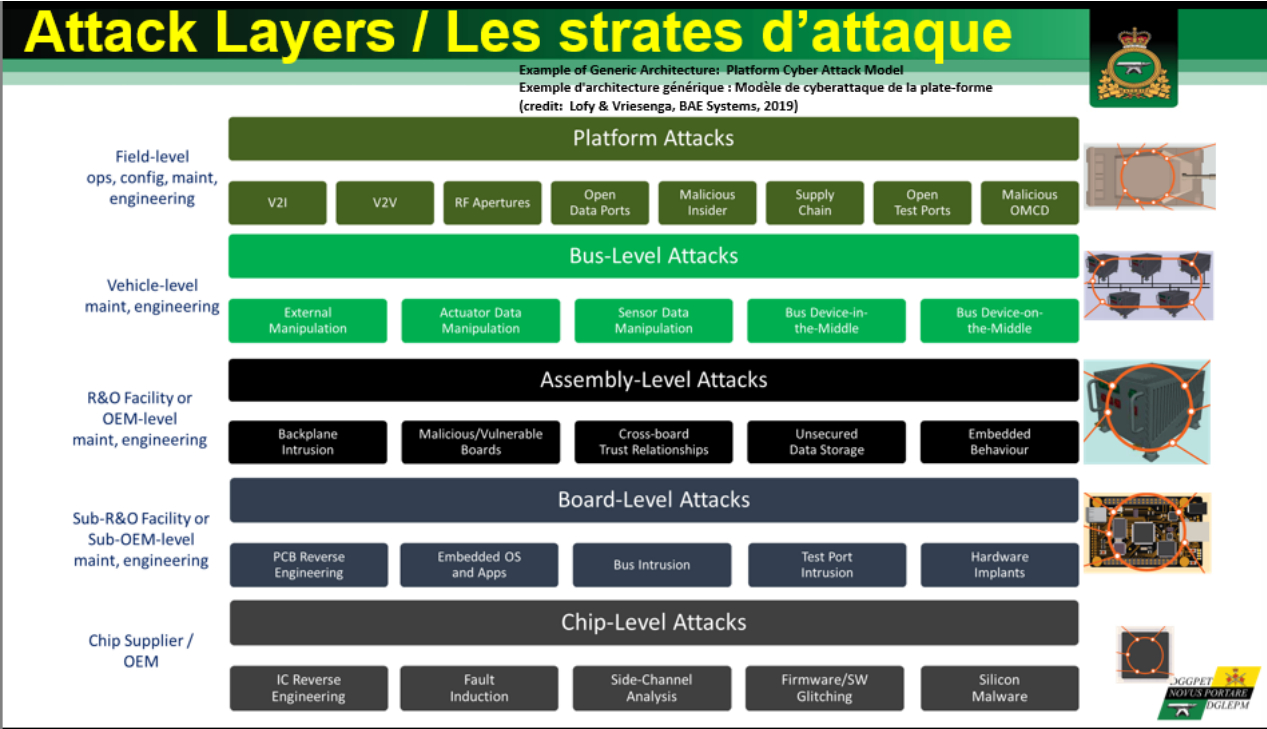
# Questions?

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Jason Furlong  
PMO CSC  
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National  
Defence

Défense  
nationale



# Assistant Deputy Minister Associate (Materiel) (ADMA Mat) /

**Nancy Tremblay**

Canada



National  
Defence

Défense  
nationale



# Sous-ministre adjointe déléguée (Matériels) (SMAD Mat)

**Nancy Tremblay**

Canada



National Defence / Défense nationale

ASSISTANT DEPUTY MINISTER (MATÉRIEL)



# CLOSING REMARKS

*Thank you!*



National Defence / Défense nationale

ASSISTANT DEPUTY MINISTER (MATÉRIEL)



# REMARQUES FINALES

*Merci!*

