Digital Technology Leaps and Artificial Intelligence are transforming the Aerospace & Defense Industry. New open R&D and business models and value generation strategies, from Hardware to Software to Process, will largely impact all Aerospace and Defense Industries alongside Governments, Academia and SMEs acting in that space.

Digital and AI Technology Impacts on Aerospace and Defense

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Core Theme: It is a wake-up call - Digital Technology Leaps and Artificial Intelligence are transforming the Aerospace & Defense Industry. New open R&D and business models and value generation strategies, from Hardware to Software to Process, will largely impact all Aerospace and Defense Industries alongside Governments, Academia and SMEs acting in that space.

1. Digital Transformation is at the confluence of the current challenges that Aerospace & Defense community is facing

2. AI will irrigate soon all sensors grids and supervision platforms

3. Digital environment and new technology streams and ecosystems will transform the generation chain of aerospace and defense capabilities

Tight defense budgets, growing and diversified threat and soaring defense equipment’s costs, that is not the perfect scenario to maintain superiority over pacing competitors

Back in the 70’s, American aerospace businessman and former Undersecretary of the Army Norman Augustine predicted that in the year 2054, the entire US defense budget will purchase just one tactical aircraft to be shared between Air Force, Navy and the Marine.

Well the good news is that he was wrong, but the actual numbers speak for themselves: we may have reached the turning point to balance quantity with quality.

The US’ 3rd offset strategy announced 2 years ago by former US Defense Secretary Chuck Hagel, that aims at addressing these military challenges, involves the revival of the defense innovation similar to the major nuclear-related innovation of the 50’s, and later digital interconnected battlespace era led by the US
The French Defense Minister’s most recent testimony ahead of the French Parliament cited Artificial Intelligence as the third rupture technology that will drive a new defense paradigm to ensure superiority over our adversaries.

The quest for competitive technology is not new to most of the Defense & Aerospace stakeholders.

What has changed dramatically is that these key digital technologies mainly come from the civil sector such Big Data Analytics and Machine Learning, Connected objects or Augmented Reality,

This new paradigm forces the Defense industry to now draw from civil R&D.

Unlike Internet that was derived from the US DoD ARPAnet, the 21st century will see leading Aerospace & Defense Industries prevailing only if they transform their R&D model, their products and services lines, their Procurement, Supply Chain and Business Model to become fast adapters of commercial technologies, otherwise they will be condemned to drag behind.

There is probably a tremendous opportunity for Canada and Québec to adequately position themselves vis-à-vis Aerospace and Defense OEMs, building on the technology super clusters policy and assets like the AI ecosystem in Montreal that are not yet privatized, and neither bought out by the GAFAs

But what exactly are we talking about?

A little bit of AI 101...

Artificial Intelligence is not new; it was first brought up as a terminology and a science by John McCarthy in 1955. It is a branch of computer science that refers to systems that can allegedly think and learn as intelligent humans would. Artificial intelligence is in fact a programmed ability to process information...period!
The first wave of AI models (early 2000s) were human rules driven, it is the reasoning model. The machine would explore the specifics based on causality or logic (the human defined rules). This AI capability is scoring well in reasoning over narrowly defined problems (such autonomous driving in a segregated area) but has no learning capability and poor handling of uncertainty.

The second wave of AI is the learning model. Engineers create statistical models for specific problem domains and train them on big data to make predictions. This was this type of AI used by IBM deep Blue beating on Kasparov on a chess game...but that kind AI cannot plan and make decision (reasoning) and is not able to play checkers or any other board game by itself unless reprogrammed for such new application.

The third up-coming wave of AI is the self-learning model that will allow the machine to adapt to different contexts and environment to a certain extent to better deal with real world phenomena. Deep Learning is the disruptive breakthrough because it provides self-learning technology that can then reproduce its own set of data and rules.

So what does it mean in the context of Aerospace & Defense?

Terminator and Skynet?

Probably not, but rather an increase in augmented intelligence and autonomy features injected into the defense & aerospace systems, products, services and platforms to assist operators, pilots and any other decisions makers, leading to new Human-Machine collaboration CONOPS.
Benefits of AI will bring new human capabilities and capacity like extended reach to more dangerous or lengthy tasks, quicker decision processes, delegation for repetitive specific tasks dealing with large and complex data sets, persistence, resilience and reliability against fatigue and behavioral bias, while Human judgement, Intuition and Emotion will remain essential to supervise the system because the machine will never get there. You will not see AI but you will exploit its output like when you talk to Siri on your smartphone. AI can easily synchronize with existing systems, ensuring more efficient and reliable information that human will act upon.

Take the example of Air Traffic. As the Air transport Traffic will double globally by 2035 (even triple in the region of South Asia), while unmanned vehicles will be inserted into the Traffic Management network, Big Data and Artificial Intelligence will become essential to run sensor grids and supervision platforms in a secured and efficient, way better than by doubling the networks capabilities and air traffic controllers.

Rather than developing new radars and aircrafts, trends show a gradual shift from Hardware to Software and then to Processes where true efficiencies, increased safety and performances will
be leveraged by computing techniques and untapped huge data sets, supported by enhanced visualization tools.

Softwarization of everything and machine learning is already happening in our day-to-day life like in your smartphone or car. The same phenomena is already driving the development of new features into legacy platforms and equipment such as Software Defined Radios that provide enhanced capabilities beyond voice transmission such as, data, geo-localization, images or videos all in one, with adaptive waveforms to cope with hostile radio frequency spectrum...and in a distributed mode obviously!

Processing capabilities and outputs is where the value lies. Computing hardware has never been so cheap and miniaturized, while CPU performances are growing exponentially. Data generation and collection are being managed wisely by insiders to feed computing tools and platforms in order to extract the golden substance.

It comes with a premium, but at the same time infrastructure, hardware and maintenance costs are dramatically decreasing, as depicted on this slide that portrays current user terminals SAR ground station fitted with ESA antennas, as part of the MEOSAR satellite constellation.
Is it the end of new platforms developments? Probably not, but expect legacy ones to be upgraded with digital and AI features while disruptive new ones may arise at cost effective such as the one on the following slide.

Stratobus is a space based sensor & communication platform R&D program that intends to fill some gaps in the Communication and Observation Grid when power supply, persistence, flexibility and low cost are the customer drivers. Half a drone, half a satellite, fully autonomous for 1 year long, this disruptive platform could arise numerously as the Augustine Law 16, i.e Quantity is Quality, resonates even louder nowadays.

Over several decades Thales has partnered with Canadian governments and Academia to create different consortia and S&T - R&D clusters in various civil domains, as depicted on this slide. Beyond the production of hundreds of Canadian patents, this has led to the commercialization and deployment of pioneer technologies and solutions, such as the fully automated driverless urban rail system SELTRAC, of 35 years ago back in Vancouver, that is today the world technology standard. Or, the first ever North American Business Jet equipped with digital flight controls made in Thales, the Gulfstream 650. This is all 100% Canadian Technology that is exported worldwide in Trains and Jets.
The upcoming consortia in Urban Sciences, Cybersecurity, Artificial Intelligence and 5G Broadband all anchored in Quebec are the next enabling springboards to make Canada a front runner in the digital era and Thales is proud to be founding member of all of them.

So to conclude let’s look at 5 years down the road

The Defense & Aerospace Industry is undergoing profound digital transformation to better capture this announced disruption. The Canadian R&D cluster policy is the necessary condition to implement digital S&T framework. Integrated assets such as the Universities, labs and SMEs, like the Montreal AI Cluster led by the IVADO, must be now leveraged by the Industry in a push-pull mode.

The aerospace & Defense OEMs can set clear R&D application roadmaps that must be harnessed with the Digital ecosystems. On their end, the S&T Community must spark and trigger the Industry to generate value with the brightest minds and technologies.

Hardware SMEs must evolve towards more digital friendly models to become compatible with digital players. This involves Industry 4.0 model, meaning digitizing their own practices such as Cloud based processes and IoT compatibility, Cybersecurity and Data protection, Proprietary Data collection, not to mention, Additive manufacturing, Robotics or augmented reality in order to supply digital optimized components.

On the software side of the house where the value is dramatically shifting, decision making, virtual assistant and data optimization will be the key drivers.

In house technology superiority is no longer a done deal for Defense OEMs!

New digital platforms are being developed or acquired by major Defense players. They are designed right off the bat as open architecture to benefit top notched technologies and expertise generated by dynamic star-ups and SMEs that are generally not very far from the S&T
clusters. OEMs are in a very active mode to partnering and teaming up with them while anchoring within those S&T clusters to cycle in the best of breed fast tracking science.

10 years from now, in the Defense world, the 80% solution could be available off the shelf from companies that will never bother, nor will they be organized to develop the military applications of their superior technologies.

As regards public organizations, I guess this is fair to say that we can expect a strong impact of formal writing of requirements, procurement processes and linkage with R&D generation and collaboration. The Defense OEMs are fast adapting new operating & HR models to adopt open innovation and run dual and mixed R&D assets, external and internal, with agility and flexibility. Similarly, Defense Procurement will have to evolve to stay relevant while supporting the development of a true innovation value chain that is economically successful.

With regards to Artificial Intelligence, the challenge is even greater as the learning pace is exponential. US and French DoD have already implemented co-located labs within AI ecosystem. The former with Defense Innovation Unit Experimental (DUIx) in the Silicon Valley and the latter with the Intelligence Campus in Paris, but this is another story...secret defense!

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For those that are not aware yet, I hope you’ll take this as a wake-up call!

Thank you.