The Department of National Defence
and Canadian Armed Forces

DATA STRATEGY

FOREWORD

It is our privilege to introduce the DND/CAF Data Strategy. This strategy reflects the increasing importance of data to meet our mandate of providing combat-effective, multi-purpose forces at home and abroad to protect Canada and Canadians.

Data are critical assets to modern organizations. Organizations that recognize the value of their data are better able to understand and engage with their stakeholders, generate insights that lead to the identification of opportunities, and improve their performance. However to achieve these benefits, data first needs to be managed and controlled. If we ignore the importance of data and data-driven approaches, the Defence Team will fall behind, and risks facing better-informed, more agile adversaries in conflict situations.

The DND/CAF Data Strategy was developed in consultation with representatives from across the organization through interviews and workshops. As a result of this collaboration, we are now better able to understand the magnitude of data available, collected, and used across the Defence enterprise. Advances in technology have made our ships, land vehicles, and aircraft into data platforms, and can now put data at the fingertips of our people to enable them to make real-time operational decisions. While we have significant work to do to fully exploit the value in our data, we are already exploring how to use data-driven technologies such as artificial intelligence and augmented reality to improve the efficiency and effectiveness of Defence programs.

The execution of this strategy will enable the Defence Team to collect and use data to the benefit of the DND/CAF, enable a transition to digitally-enabled tools and services, and support the implementation of *Strong, Secure, Engaged*. However, the objectives of the data strategy cannot be achieved without the support of all parts of the organization. Success in implementation depends on the Defence CDO delivering this Data Strategy in full partnership with the Defence CIO's Information Strategy which will provide us with the tools and technology we need. Further, leaders at all levels will have to engage with each other to reimagine the way we defend Canada and Canadians in the era of data and digital services.

We look forward to engaging the entire Defence Team as we advance this important agenda.

Jody Thomas
Deputy Minister
Department of National Defence

General J.H. Vance
Chief of the Defence Staff
Canadian Armed Forces

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INTRODUCTION

BACKGROUND

In June 2017, DND/CAF released its new defence policy *Strong, Secure, Engaged* (SSE). It acknowledges that much of Canada's tactical advantage is due to "agile information management and technology tools to aggregate and manipulate large quantities of data", and that the future of defence will place a "greater emphasis on information technologies, data analytics, deep learning, autonomous systems, advancements in the electromagnetic and cyber domains". SSE outlines a number of priority areas and initiatives, including several that have dependencies on the availability of quality data, such as modernizing the business of defence, and prioritizing joint intelligence, surveillance and reconnaissance.

In July 2017, the *CDS/DM Joint Directive to Develop and Operationalize a Defence Program Analytics Capability* was released, with the objectives of creating an analytics capability, driving digital transformation, and establishing data management as a core capability. The directive also created the position of a Chief Data Officer (CDO) for DND/CAF, and in July 2018 the ADM of Data, Innovation, Analytics (ADM (DIA)) was officially stood up. ADM (DIA) has a mandate to foster a data-driven culture within DND/CAF, provide guidance and direction on the acceptable use of data, encourage the use of analytics in decision-making and continuous improvement, and support initiatives to standardize data and create value from data.

These DND/CAF initiatives align with Government of Canada (GC) direction, which has begun to embrace the potential of data held within its departments. In November 2018 the *Report to the Clerk of the Privy Council: A Data Strategy Roadmap for the Public Service* was published, with a long-term vision of increasing data literacy, managing data as an asset, creating a data-driven culture, and governing data. An umbrella *Digital Government* policy has been released with a focus on improving service delivery to citizens through digital transformation. Other policies are being reviewed and updated to reflect the change to digital.

> *"I need end-to-end digital now. I can't wait 10 years to get it."*
>
> -Interview with CAF General/Flag Officer

WHY DO WE NEED A DATA STRATEGY?

This data strategy will:

- Provide direction and guidance to DND/CAF as it adopts data driven-approaches to decision-making and delivering the business of defence;

- Contribute to the delivery of the goals and priorities identified in SSE;

- Enable a transition to digital approaches, aligned with new GC direction and policy;

- Identify data gaps and the means to address those gaps; and

- Identify the structures, practices, and culture change required to become a data-driven organization.

SCOPE

The scope of DND/CAF Data Strategy includes all data held in any repository in any format, and at any point in the data lifecycle. This includes data created, collected, and/or used both in military operations and exercises, and in corporate administrative processes (e.g. HR, finance).

While related, Information management (IM) is covered in the Chief Information Officer's (CIO) Defence Information Strategy and is not included in the scope of this document.

WHAT IS DATA?

The following definition, based on the global industry standard Data Management Association (DAMA) Data Management Body of Knowledge (DMBOK), will be used:

Data is the representation of facts as text, numbers, graphics, images, sound, or video.

Figure 1: Data defined

Examples of data within DND/CAF include, amongst others, HR data (e.g. occupations, positions), financial data (e.g. costs, forecasts), materiel procurement and maintenance data (e.g. cycle time, stock outs), engineering data (e.g. road capacity, bridge classification), intelligence data (e.g. satellite images, voice prints), medical data (e.g. X-rays, prescriptions), and operations data (e.g. radar images, troop movement). Data is collected and used across all of DND/CAF in a wide variety of processes, and is stored in a large number of repositories.

"Data management should become part of the fabric of DND/CAF – it should be seen as basic work, not as extra work"

-Interview with CAF General/Flag Officer

At every point in its lifecycle from creation to destruction and through every use or manipulation, data has to be properly managed. ***Data Management*** is the development, execution, and supervision of plans, policies, programs, and practices that deliver, control, protect, and enhance the value of data assets, and it is critical to managing data throughout its lifecycle. The DAMA DMBOK includes 11 knowledge areas for data management: data architecture; data modeling; data storage and operations; data security; data integration and interoperability; document and content management; reference and master data management; data warehousing and business intelligence; metadata management; data quality; and data governance. These are explained in greater detail in ANNEX A.

CASE FOR CHANGE

DRIVERS

The following factors are driving the need for a DND/CAF data strategy:

- **Strong, Secure, Engaged:** The defence policy, released in 2017, outlines a number of initiatives to modernize the CAF as well as the business of Defence. Many of these initiatives have a strong association with data, either through the capture of data or through the use of data. A strategy is needed to put in place the structures and processes to better manage and leverage data to achieve these objectives;

- **Changing nature of conflict:** Conflict is no longer limited to the traditional domains of sea, land, air (and more recently, space). Nations are increasingly including a new domain of conflict: cyber. This new domain can have impacts over broad geographic areas with minimal resource expenditure. In recent years, social media has been used to spread misinformation and shape perception and public opinion on current and potential conflict. Data becomes important not only to identify threats, but also to respond to those threats. Additionally, conflict is increasingly becoming multi-domain, with threats from multiple domains at the same time. DND/CAF needs to be able to respond across multiple domains, maintaining interoperability internally and with partners such as NATO allies;

- **Variety and volume of data:** Traditional military platforms like ships, tanks, and planes are now data platforms, full of sensors and systems that capture, create, and use data in large volumes. Social media and the internet provide a wealth of data. Additionally, the line between structured and unstructured data is becoming blurred, forcing the organization to adapt to new ways of storing, finding, and using data;

- **Data-driven advanced technologies:** There has been rapid proliferation of new and maturing technologies (e.g. analytics, artificial intelligence, robotics, and virtual reality) that industry and government are exploiting to create value and advantage for their organizations. There is value in these technologies to DND/CAF, and many of these rely heavily on access to high quality data. Further descriptions of how data and advanced technologies are intertwined can be found in ANNEX C;

"I want to be able to ask big questions and address policy constraints"

-Interview with CAF General/Flag Officer

- **Requirement to measure and report on outcomes:** The *Policy on Results* states that all government departments must develop and report on a Departmental Results Framework (DRF) and their Program Inventory (PI). To effectively and efficiently report on the outcomes delivered by DND/CAF, the organization must have the tools and skills to find and analyze data, while also ensuring that the underlying data are of sufficient quality;

- **Open Government:** The *Directive on Open Government* states that DND/CAF must make data openly available. To meet this mandate, DND/CAF must have processes in place to evaluate data for sensitivity that may prevent sharing, and identify candidate data for sharing; and

- **The requirement to optimize defence spending:** Canada has a mid-size military force, and cannot compete based on amount of materiel, or on numbers of military personnel. Instead we must be better prepared, better trained, and more agile and responsive than our adversaries. As a consequence, DND/CAF must find ways of delivering effective and efficient military capabilities using all the tools available, including better use of data.

CHALLENGES

The data strategy is an opportunity to address a number of data-related challenges that DND/CAF faces, including:

- **Lack of awareness of DND/CAF data:** As an enterprise, there is little coordinated and consolidated knowledge or awareness of the data that is collected, used, and maintained in the organization. This limits the ability to generate insights from data;

- **Inability to make decisions about data:** DND/CAF does not have a comprehensive, agreed upon data governance framework. This lack of decision-making framework affects the organization's ability to share, integrate, aggregate, and otherwise use data;

> *"We are data rich and information hungry"*
>
> *-Interview with CAF General/Flag Officer*

- **Ineffective data management practices:** DND/CAF does not have effective data management practices, and data are not well-managed throughout their lifecycle;

- **Unwillingness to share data:** Data within DND/CAF is typically held in silos, and personnel are reluctant to share or provide access to that data internally. This limits the organization's ability to obtain value from data through aggregation and enhancement, and also prevents the organization from meeting its open data commitment;

- **Lack of trust in data:** DND/CAF has limited tools and abilities to evaluate the quality of data and trace the data from capture through to use. As a result, personnel perceive data as unreliable and are reluctant to use data for decision-making;

- **Inflexible legacy systems and processes:** DND/CAF has many source systems that capture and use data, which in some cases were heavily customized to accommodate specific processes. This limits DND/CAF's ability to adopt industry practices, address data integrity issues, explore innovative approaches, and change business processes;

- **Relatively low data literacy:** Collectively, Defence Team members have lower levels of data literacy, lacking competency to evaluate the quality of data, to understand the limitations of data, and to envision potential uses and their value;

- **Lack of a data culture:** The culture of DND/CAF must change to embrace data as an asset that requires effort to manage, and to allow for risk so that they can use data in new and different ways.

DATA STRATEGY

OBJECTIVES AND OUTCOMES

The objectives of the data strategy are to:

- Manage data as an enterprise asset and institutionalize data governance;

- Provide the tools and environment to allow all Defence Team members access to data they need;

- Build data literacy so that Defence Team members can use data to create value for DND/CAF; and

- Create a culture where data are leveraged in all decisions, and all personnel are held accountable for their role in managing data.

The implementation of the data strategy will deliver the following outcomes:

- Increased information advantage for Defence Team members, allowing them to operate effectively and safely around the world;

- Improved ability of Defence Team members to evaluate, understand, and use data including for decision-making;

- Increased agility in providing new and enhanced data-driven capabilities; and

- Improved ability to report on the results, effectiveness, and efficiency of DND/CAF programs.

GUIDING PRINCIPLES

The following guiding principles have been identified to help DND/CAF implement the data strategy:

- *Data are a shared asset:* DND/CAF are stewards of the data, ensuring that data are created, collected, managed, and used to the benefit of DND/CAF, the Government of Canada, and Canadians;

- *Data are accessible:* DND/CAF's data holdings are accessible and available to those who need them;

- *Data are secure:* DND/CAF's data holdings are identified and secured based on sensitivity, privacy, and releasability;

- *Data are trusted:* Data are governed to improve data quality; and

- *Data are managed ethically:* Data are managed throughout their lifecycle to eliminate bias, ensure fitness for use, and adhere to the *Code of Ethics*.

The guiding principles will be used to evaluate decisions about investments in data, and how to collect, share, and use data.

VISION

The vision statement for DND/CAF data is:

Data are leveraged in all aspects of Defence programs, enhancing our defence capabilities and decision-making, and providing an information advantage during military operations.
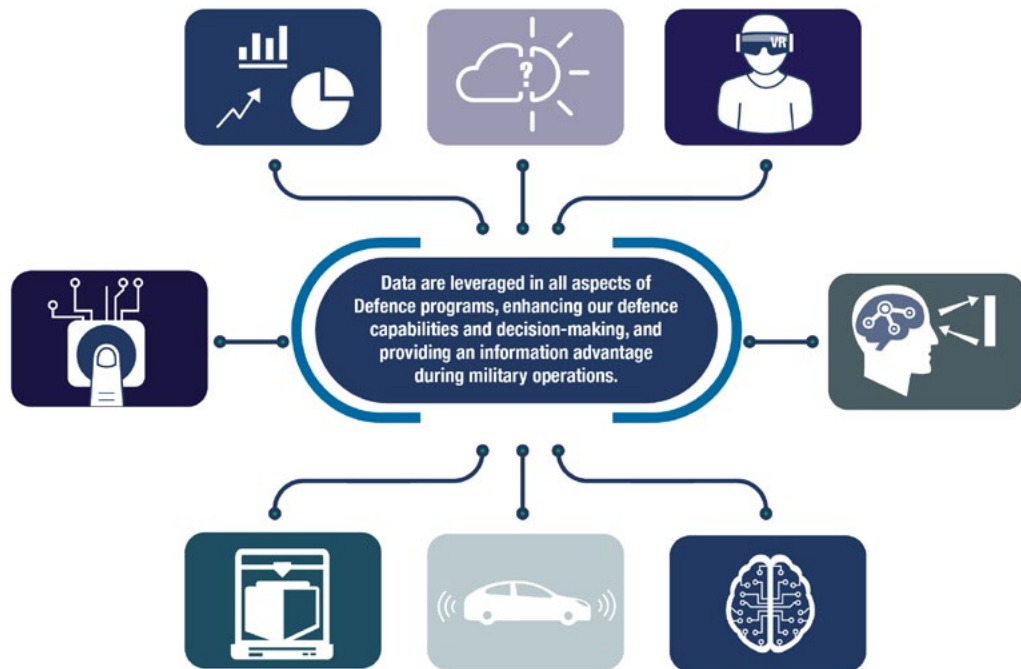
Figure 2: The vision for data within DND/CAF

This means that:

- Defence Team members have an information advantage in military operations, built through the integration and aggregation of high quality data from a wide variety of internal and external sources;

- Defence Team members have access to the data they need to identify and act upon opportunities to improve efficiency and effectiveness of Defence programs;

- Defence Team members have the skills to find, critique, analyze, and interpret data;

- DND/CAF has a culture where people are expected to use data; and

- DND/CAF explores and implements data-driven approaches to expand and enhance operational capabilities, such as:

  - Business intelligence and analytics for planning, reporting, and support to decision-making;

  - Advanced (i.e. predictive and prescriptive) analytics to provide foresight and recommendation, for example for predictive materiel maintenance and policy creation;

- Virtual reality and simulation, for example in training;

- Artificial intelligence, for example to automate low-value and repetitive tasks, such as summarizing searches or comparisons;

- Augmented reality, for example for navigation during operations;

- Autonomous vehicles (e.g. drones) and robotics, for example for surveillance or warehousing;

- Additive manufacturing (i.e. 3D printing), for example to manufacture parts on demand; and

- Biometrics, for example in intelligence.

The vision is detailed further in four pillars, described in the sections below: data management, data tools and environment, data literacy and skills, and data culture.

Data Management

GOAL	CURRENT STATE	FUTURE STATE
Manage data as an enterprise asset using well defined plans and processes throughout the data lifecycle	• Informal data governance – "ownership" • No data quality framework, ad-hoc data quality initiatives • Rigid security practices, low risk mindset • Lack of enterprise data model and inventory • Limited master, metadata management practices	• Formal data governance – "stewardship" • Data are regularly assessed against established framework, formal data quality initiatives • Master, reference, and metadata practices implemented • Flexible risk-based security approach • Documented enterprise data model, flows, inventory

Figure 3: The Data Management pillar

The data management pillar focuses on managing data as an enterprise asset. In the future state:

- Data governance is formalized, with data stewardship roles well defined and a network of data stewards established;

- Data are regularly assessed against an established data quality framework, and formal data quality initiatives will be planned and implemented;

- Master and reference data frameworks are implemented to improve data quality and interoperability;

- A metadata framework is implemented, and metadata repositories are managed, integrated, and searchable;

- Data security is managed through a flexible risk-based approach that secures data based on data sensitivities, user roles (including need to know), and classification; and

- An enterprise data model and data flows are documented, and a data inventory maintained.

To get to that future state, DND/CAF will have to:

- *Implement data governance:* Design and implement a data governance framework, including data stewardship;

- *Implement data quality approach:* Design and implement a data quality framework, including quality assessment criteria;

- *Model DND/CAF data:* Develop and maintain an Enterprise Data Model and data flows;

- *Evaluate data impacts:* Embed data architecture in the Architecture Review Board and review initiatives against data principles;

- *Appropriately secure data:* Develop and implement a risk-based data security approach that limits or grants access to data based on sensitivity and user roles (including need to know);

- *Implement a master data approach:* Develop and implement a master data management approach;

- *Implement a metadata approach:* Develop and implement a metadata management approach; and

- *Provide integrated data:* Develop and implement a data integration framework and approach, covering operational data sources, administrative / corporate data sources, and open data sources.

Data Tools and Environment

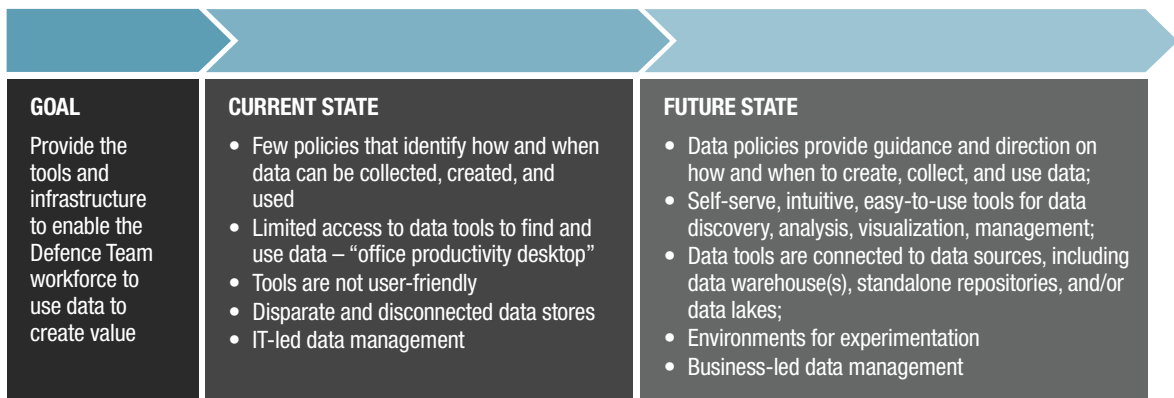| GOAL	CURRENT STATE	FUTURE STATE
Provide the tools and infrastructure to enable the Defence Team workforce to use data to create value	• Few policies that identify how and when data can be collected, created, and used • Limited access to data tools to find and use data – "office productivity desktop" • Tools are not user-friendly • Disparate and disconnected data stores • IT-led data management	• Data policies provide guidance and direction on how and when to create, collect, and use data; • Self-serve, intuitive, easy-to-use tools for data discovery, analysis, visualization, management; • Data tools are connected to data sources, including data warehouse(s), standalone repositories, and/or data lakes; • Environments for experimentation • Business-led data management

Figure 4: The Data Tools and Environment pillar.

The data tools and environment pillar focuses on creating the conditions that allow Defence Team members to create, collect, use, and manage data. In the future state:

- Data policies provide guidance and direction on how and when to create, collect, and use data;

- Intuitive, easy-to-use tools for data discovery, analysis, visualization and management are provided to all Defence Team members to increase self-service capabilities;

- Data tools are connected to enterprise data repositories, including data warehouse(s), standalone repositories, and/or data lakes;

- Environments exist to allow personnel to experiment with using data, and to innovate using data; and

- Data management is led by business requirements, not IT requirements.

To get to that future state, DND/CAF will have to:

- *Implement data policies:* Develop data policies and directives that conform to domestic and international legal obligations;

- *Resolve policy conflicts:* Evaluate current policies, directives, and legislation to identify and resolve conflicts and duplications;

- *Develop data management tools roadmap:* Identify requirements for, and develop a roadmap of, data management tools for data governance, data quality, data discovery, and data visualization;

- *Implement data management tools:* Procure, implement, and provide access to common data management tools for all personnel; and

- *Provide data environments:* Provide technical environments, such as sandboxes, where Defence Team members can explore and experiment with data.

Data Literacy and Skills

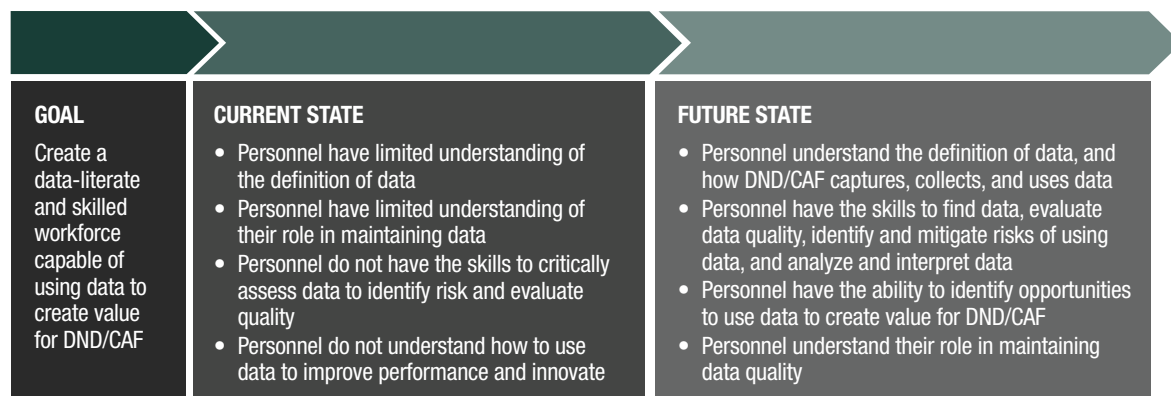| GOAL	CURRENT STATE	FUTURE STATE
Create a data-literate and skilled workforce capable of using data to create value for DND/CAF	• Personnel have limited understanding of the definition of data • Personnel have limited understanding of their role in maintaining data • Personnel do not have the skills to critically assess data to identify risk and evaluate quality • Personnel do not understand how to use data to improve performance and innovate	• Personnel understand the definition of data, and how DND/CAF captures, collects, and uses data • Personnel have the skills to find data, evaluate data quality, identify and mitigate risks of using data, and analyze and interpret data • Personnel have the ability to identify opportunities to use data to create value for DND/CAF • Personnel understand their role in maintaining data quality

Figure 5: The Data Literacy and Skills pillar

The data literacy and skills pillar focuses on creating a skilled workforce that not only understands data in all its forms and at all points in the lifecycle, but also has the skills to use data to make decisions, to innovate, and to create value through improved efficiency and effectiveness. In the desired future state, Defence Team members:

- Understand the definition of data, and how data are collected, captured, and used both within their L1 and across DND/CAF;

- Have the skills required to find data, evaluate its quality, identify and mitigate risks associated with using that data; and analyze and interpret data;

- Identify opportunities to use data in new reports and new ways to create value for DND/CAF; and

- Understand their role in managing data throughout its lifecycle, and across DND/CAF.

To get to that future state, DND/CAF will have to:

- ***Define data literacy:*** Define the skills and competencies required to be data literate, and develop a framework to evaluate data literacy;

- ***Evaluate data literacy:*** Define target data literacy levels for DND/CAF, and evaluate the level of data literacy throughout DND/CAF;

- ***Develop data literacy training:*** Develop training and tools to improve data literacy, both formally and informally;

- ***Develop data literacy plan:*** Develop and implement a plan to increase data literacy throughout DND/CAF;

- ***Develop data literacy staffing plan:*** Identify critical positions within DND/CAF that require higher data literacy, and identify opportunities to staff those positions through targeted hiring and other approaches such as job rotation; and

- ***Develop HR strategy:*** Identify opportunities to sustain data literacy such as through new career paths and work streams, career and succession planning, and new occupations/ job categories.

Data Culture

GOAL	CURRENT STATE	FUTURE STATE
Create a culture where data is valued, and the use of data is habitual	• The potential value of data is not well understood • The use of data in decision-making is not yet expected, nor is it trusted when it is used • Data are an after-thought in the design and delivery of programs and processes • The benefit of using data is not considered when assessing risk	• Data are recognized as an asset that requires effort to manage and maintain • Data are leveraged in decision-making • Data are considered during design of programs and processes • Data are trusted • Leadership and personnel have greater risk tolerance

Figure 6: The Data Culture pillar

The data culture pillar focuses on creating a culture where not only are Defence Team members encouraged and expected to use data, but also excited about its potential. In the desired future state:

- The time and resources required to manage data are considered part of doing business, and are planned and tracked accordingly;

- Data are leveraged in decision-making, and Defence Team members are held accountable for presenting data-based recommendations;

- Personnel are unafraid to present data-based reports, even if the results and conclusions are negative or run counter to known preferences;

- Personnel trust that DND/CAF has managed data appropriately, and therefore that the data are reliable; and

- Leadership and personnel are willing to tolerate and accept greater risk in using data if it generates enough benefit.

To get to that future state, DND/CAF will have to:

- **Develop change management approach:** Develop a change management approach plan to obtain buy-in, and increase readiness for a data-driven organization;

> *"Building skills and data literacy in the department will be a challenge – old habits die hard"*
>
> *-Interview with DND executive*

- **Perform stakeholder analyses:** Analyze stakeholders to identify both data champions and resistance to using data to further DND/CAF goals;

- **Prepare communications:** Develop and share compelling messaging and lessons learned to encourage and entice Defence Team members to use data;

- **Create accountability for data:** Identify ways to hold personnel at all levels in the organization accountable for managing data and maintaining data quality;

- **Reinforce data culture:** Reinforce and reward behaviours that lead to better quality data; and

- **Experiment with data:** Provide opportunities for personnel to experiment with data, and share ideas about how data can be used to create value for DND/CAF.

RESPONSIBILITIES FOR DATA MANAGEMENT

The Accountabilities, Responsibilities and Authorities (ARA) framework is being reviewed and updated to reflect the creation of ADM DIA, and new accountabilities and responsibilities for data management across the department. New and/or updated policies and directives, as well as the data governance framework, will formalize the responsibilities for data management within DND/CAF in support of the ARAs.

HIGH-LEVEL ROADMAP

To deliver on the Data Strategy described in the document, there are a number of activities and/or initiatives that must be undertaken as identified in the pillars. All parts of the organization, and Defence Team members, are expected to support the activities and initiatives as required. The table below describes the activities and initiatives required to deliver the DND/CAF data strategy. The table includes:

- Activity / Initiative: A brief description of the activity or initiative;

- Sponsor: The sponsor accountable for the activity / initiative; and

- Level of Effort (LOE): An estimated, relative level of effort to complete the activity / initiative. It may be low, medium, or high.

Activity / Initiative	Sponsor	LOE
Data Management		
Implement data governance	ADM (DIA)	L
Implement data quality approach	ADM (DIA)	L
Evaluate data impacts	ADM (IM)	L
Model DND/CAF data	ADM (DIA)	M
Implement a master data approach	ADM (DIA)	M
Implement a metadata approach	ADM (DIA)	H
Appropriately secure data	ADM (IM)	H
Provide integrated data	ADM (IM)	M
Data Tools and Environment		
Implement data policies	ADM (DIA)	M
Develop data management tools roadmap	ADM (DIA)	L
Provide data environments	ADM (IM)	M
Resolve policy conflicts	ADM (DIA)	H
Implement data management tools	ADM (IM)	M
Data Literacy and skills		
Define data literacy	ADM (DIA)	L
Evaluate data literacy	ADM (DIA)	L
Develop data literacy plan	ADM (DIA)	L
Develop data literacy training	ADM (DIA)	L
Develop data literacy staffing plan	ADM (HR-Civ)/CMP	M
Develop HR strategy	ADM (HR-Civ)/CMP	M
Data Culture		
Develop change management approach	ADM (DIA)	L
Perform stakeholder analyses	All L1s	M
Prepare communications	ADM (DIA)	L
Create accountability for data	ADM (HR-Civ)/CMP	M
Reinforce data culture	All L1s	H
Experiment with data	ADM (DIA)	M

The roadmap provides a description of what needs to be delivered, but does not address how these initiatives will be delivered. A more detailed implementation plan that identifies the scope, approach, sequencing, dependencies, and high-level estimates of the resources required for these initiatives will be developed to support this roadmap; however, the timelines will be dependent on the funding and resources allocated to delivering the initiatives. The implementation plan will also identify the expectations for L1 participation in the initiatives. At this time, the highest priority activities in the roadmap are:

- Implement data governance;

- Implement data quality approach;

- Implement data policies; and

- Define data literacy.

Performance indicators will be identified to track benefits of implementing the data strategy, and progress will be tracked and reported to senior management committees. Additionally, as progress is made, new opportunities to leverage data may arise, and new data-related initiatives may be launched.

IMPLEMENTATION CONSIDERATIONS

The following are critical success factors that impact the ability to implement the roadmap:

- *Leadership sponsorship:* Changing the DND/CAF culture to one that uses data routinely requires constant and consistent reinforcement of key messages to all Defence Team members. It also requires the will and desire to invest in the capabilities. Both of these require the Defence Team leaders to engage with, and prioritize, data-related initiatives;

- *Readiness to accept change:* Defence Team members must be ready and willing to apply new data management practices, acquire new data literacy skills, and use data in new ways;

"Becoming a data-driven organization requires significant culture change"

-Interview with DND executive

- *Willingness and ability to commit resources:* As with any transformation, the success depends on the ability of the organization to commit people and money. The transformation requires personnel who understand data, are capable of analyzing and presenting data, and who understand the technical challenges of working with data. With many competing demands for money and resources, DND/CAF's pace of change will be reflective of the resources committed and when they are committed;

- *Implementation plan design:* Initiatives in the implementation plan will have to be designed such that they accommodate the varying needs of DND/CAF, providing adequate support to those who need it while not imposing limitations on those who are investigating more complex uses of data.

CONCLUSION

The potential benefits of better managing data within DND/CAF are significant. Given the volume of data that are already being used to generate insight, if data can be managed such that they are accessible and trusted, then the organization can generate even more insights that lead to new opportunities to improve DND/CAF processes and increase operational readiness. At the same time, there are new data-driven technologies that open up possibilities for the use of data to change the way the business of defence is delivered.

The data strategy sets out ambitious targets for the management of data, and for a change in culture and mindset that views and treats data as an asset. These targets set expectations for DND/CAF at the enterprise level, and require the support of all parts of DND/CAF to achieve the objectives. To manage the expectations of the enterprise, an implementation plan will set out estimated timelines and milestones that will be dependent on the allocated budget and resources. The data strategy will be periodically reviewed and updated, aligned with governance cycles and policy refreshes.

ANNEX A — DEFINITIONS
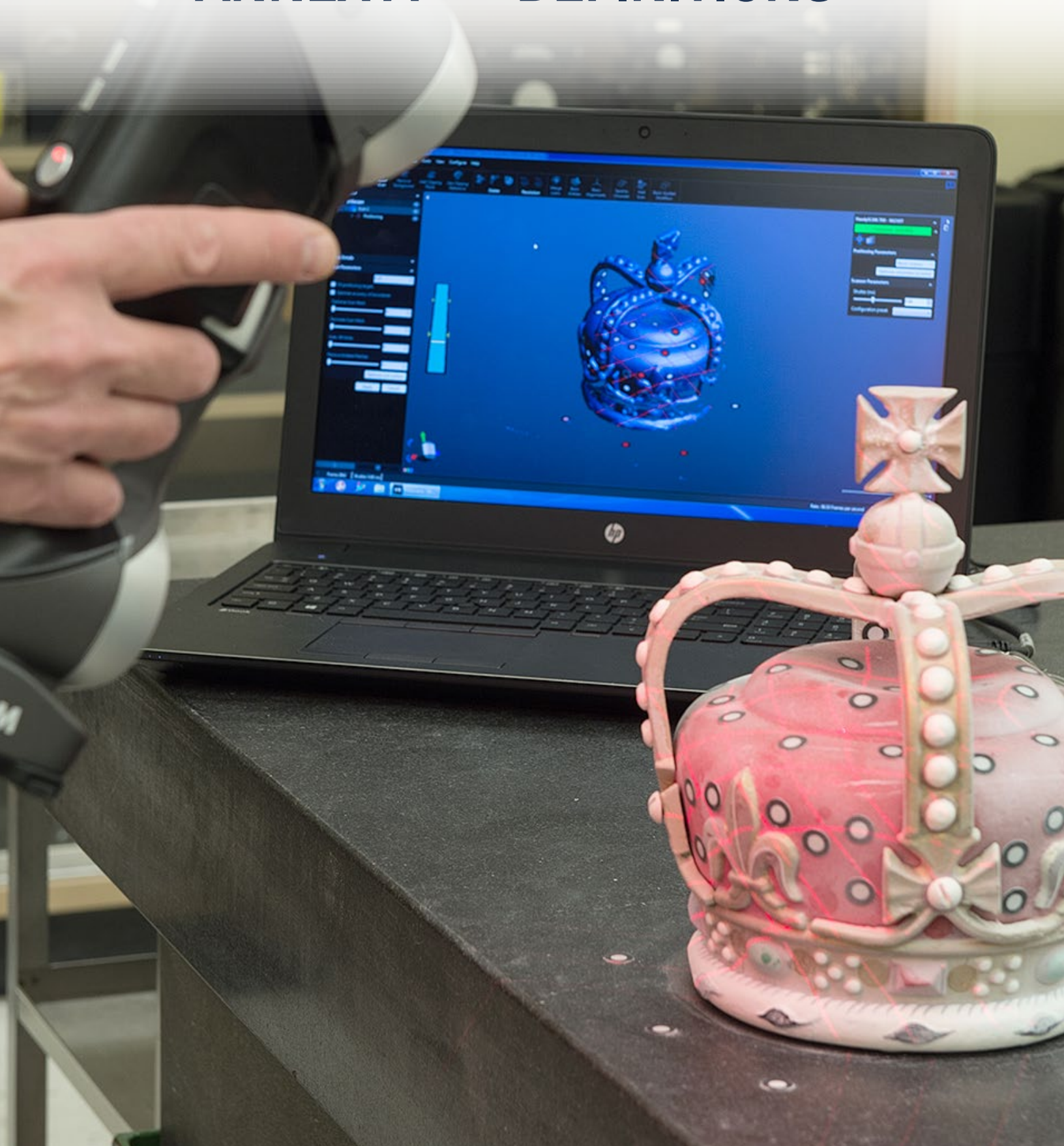
A.1. DATA

As mentioned earlier, the definition of data used in this document is "the representation of facts as text, numbers, graphics, images, sound, or video". This definition of data can be further categorized and typed to include:

- **_Structured data:_** Data that uses a data model to define relationships between data fields. Within DND/CAF, DRMIS, HRMS are examples of systems that create and use structured data.

- **_Unstructured/semi-structured data:_** Data that is stored without a data model to understand how it is organized, or its content, such as email, web pages, social media, reports, pictures, and audio. Examples of unstructured or semi-structured data within DND/CAF include "combat camera" images, or Defence Team news videos.

- **_Master data:_** Data that provides context for the business in the form of common and abstract concepts. For DND/CAF, master data might include employees, materiel, assets, vendors / suppliers, G/L, and cost centres.

- **_Reference data:_** Data that is used to relate data beyond the boundaries of an organization, or to characterize other data. Examples include province codes, postal codes, and status codes.

- **_Metadata:_** Often described as data about data, it can include data rules, constraints, concepts, relationships with other data, and many other things. The last updated field, or author field, are common examples of metadata.

- **_Big data:_** Semi-structured and unstructured data in a wide variety of formats, in large volumes, and produced at high speed. "Big" data, by virtue of their volume, velocity, or variety cannot be easily stored or analyzed with traditional methods. Things like sensors, Internet of Things (IoT) devices, and social media all create "big" data.

- **_Open data:_** Data that can be freely used, shared and built-on by anyone, anywhere, for any purpose.

- **_Dark data:_** Data that has been collected, created, processed, and stored but that isn't used to make decisions or derive insight.

- **_Operational data:_** Data used in an operational setting to address an operational objective.[1]

- **_Corporate data:_** Data used in an administrative setting to address a legislative, regulated requirement, or as part of an internal process.

- **_Transactional data:_** Data that describes an event, or a change to an entity.

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[1] In industry, operational data is data generated through the operations of the organization, what is termed corporate data within DND/CAF

A.2. DATA FLOWS

The movement of data across business processes, locations, business roles, and technical components including databases, applications, platforms, and networks. Data flows are used to describe where data originates, where it is stored and used, and how it moves between processes and systems.

A.3. DATA LIFECYCLE

Data has a lifecycle, which includes:

Figure 7: The Data Lifecycle, adapted from the DAMA DMBOK

- *Plan:* Identifying what data the business needs, and planning for its capture, storage, and use;

- *Design and Enable:* Designing the processes and systems to capture, manage, and govern data;

- *Create and/or Obtain:* Creating data through operational processes, or obtaining the data through data exchange or acquisition from another organization;

- *Store and Maintain:* Processing data (e.g. integration, warehousing, scrubbing) and storing data;

- *Use:* Using data to support the organization's objectives;

- *Enhance:* Adding new data to existing data to support new requirements; and

- *Dispose:* Archiving data that is not currently being used, and purging data that is no longer required to minimize the consumption of resources.

A.4. DATA LITERACY

Literacy broadly means having competency in a particular area. Data literacy includes the skills necessary to discover and access data, manipulate data, evaluate data quality, conduct analysis using data, interpret results of analyses, and understand the ethics of using data.

A.5. DATA MANAGEMENT

Data management[2] is the development, execution, and supervision of plans, policies, programs, and practices that deliver, control, protect, and enhance the value of data assets throughout its lifecycle. This includes the following knowledge areas:

- *Data architecture:* identifying the data needs of the enterprise (regardless of structure), and designing and maintaining the master blueprints to meet those needs. It is used to align data investments with business strategy;

- *Data modeling and design:* discovering, analyzing, and scoping data requirements, and then representing and communicating these data requirements in a data model. Data models can include conceptual, logical, and physical models;

- *Data storage and operations:* designing, implementing, and supporting stored data to maximize its value;

- *Data security:* planning, developing, and executing security policies and procedures to provide proper authentication, authorization, access, and auditing of data assets. The goal is to protect data and information assets in alignment with privacy and confidentiality regulations, contractual agreements, and business requirements;

- *Data integration and interoperability:* moving and consolidating data within and between data stores, applications, and organizations (integration consolidates data into consistent forms, either physical or virtual; interoperability allows multiple systems to communicate);

- *Document and content management:* controlling the capture, storage, access, and use of data stored outside relational databases;

- *Reference and master data management:* managing shared data to meet organizational goals, reduce risks associated with data redundancy, ensure higher quality, and reduce the costs of data integration;

- *Data warehousing and business intelligence:* the planning, implementation, and control processes to provide decision support data and support knowledge workers engaged in reporting, query, and analysis;

- *Metadata management:* the planning, implementation and control activities to enable access to high quality, integrated metadata;

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[2]   Adapted from the DAMA DMBOK v2

- ***Data quality management:*** the planning, implementation and control activities that apply quality management techniques to data to assure the data are fit for consumption and meets the needs of consumers; and

- ***Data governance:*** exercising authority and control (planning, monitoring, and enforcement) over the management of data assets.
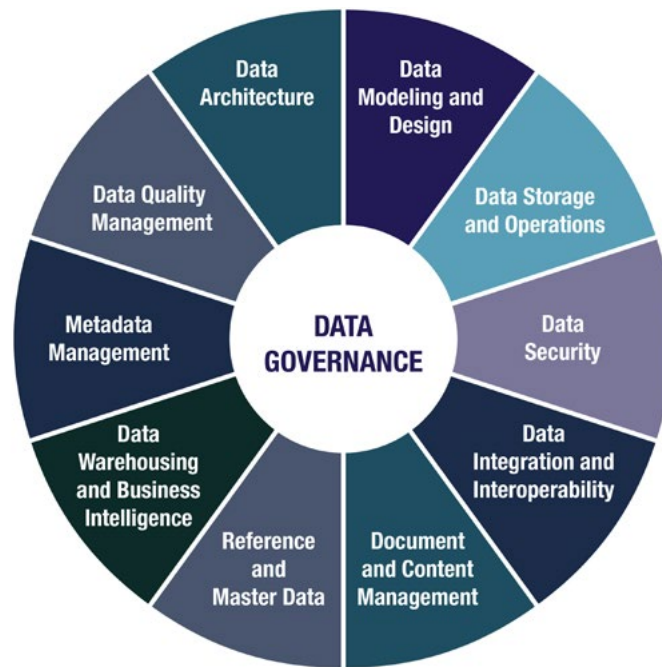

Figure 8: Data Management knowledge areas (i.e. DAMA Wheel)

A.6. DATA VALUE CHAIN

A value chain (sometimes known as a value stream) is the set of activities that an organization uses to create value for its stakeholders; at each stage, incremental value is created. For data, the value chain is linked to the business processes that create and use data. A data value chain takes into consideration how data are collected, disseminated, shared, used, and enhanced.

A.7. INFORMATION

Information is defined as data in context. Data and information are intertwined, and the policies and processes that govern and manage them should be aligned.

ANNEX B —
ORGANIZATION CONTEXT
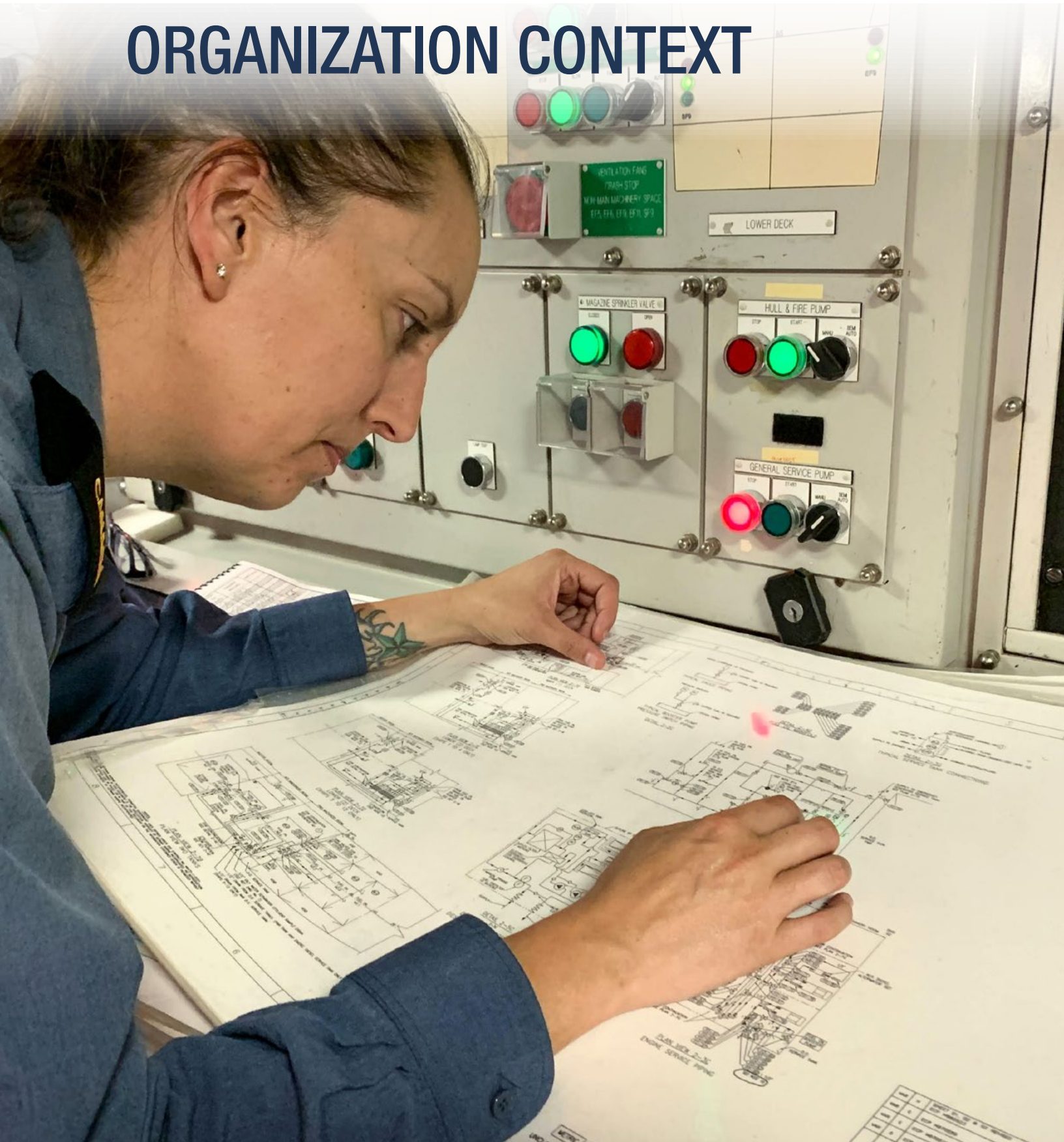
B.1. INTERNAL CONTEXT

DND/CAF is a complex organization comprised of two separate entities that collectively form the Defence Team: the Canadian Armed Forces (CAF), and the Department of National Defence. As the only military organization in Canada, CAF fulfills a unique role in serving and protecting Canada and its citizens, and projects military force through the three environments: the Royal Canadian Navy (RCN), Canadian Army (CA), and the Royal Canadian Air Force (RCAF). From a corporate perspective, DND provides administrative and support services to the members of the CAF. Both the CAF and DND are responsive to the Minister of National Defence through their respective leaders, the Chief of the Defence Staff (CDS) and the Deputy Minister (DM).

DND/CAF operates as federated L1s, with some parts of the organization being responsive to the DM, some responsive to the CDS, and some responsive to both the CDS and DM. These L1s are semi-autonomous, and frequently have independent business processes, different data requirements, and separate IT systems and applications. However, there are several L1s whose core processes touch all parts of the organization, for example finance, HR (both military and civilian), materiel, and real property. These different modes creates challenges for governance, standardization, interoperability, and data sharing.

Geographically, DND/CAF operates globally. While the majority of personnel are located within Canada, DND/CAF maintains personnel in a variety of permanent postings in the United States, Europe, and elsewhere. Additionally, deployed personnel can be located anywhere. These personnel also have varied access to DND/CAF data and systems: in some locations they will have full access, but in others (e.g. on ships during an extended period at sea) they will have limited access to data and systems other than those integral to the platform.

B.2. EXTERNAL CONTEXT

There are a number of external influences on DND/CAF that must be factored into the data strategy. Perhaps most importantly for a military organization, the nature of conflict is changing. Conflict is increasingly becoming cyber-centric, where having data becomes critical in responding to threats. At the same time, data are frequently the target of cyber-attacks, and can be used to advantage by Canada's adversaries. Additionally, Canada's partners and adversaries alike have access to data at their fingertips using mobile devices, and are using social media to not only gather data but also to spread disinformation and shape perception. With technology becoming commoditized, adversaries are rapidly gaining on Canada's perceived information advantage, which increases the risk to CAF members in military operations.

The CAF must also be interoperable with its partners, including NATO and UN, both while on deployment and in general. Canada has also committed to sharing data with a variety of partners, such as the Five Eyes, and in these cases DND/CAF must comply with common data exchange standards and platforms that exist among these partners. The CAF must also be responsive to parliamentary oversight.

Another external influence is the advances in technology. The rise Internet of Things (IoT) and its connected devices and sensors is creating opportunities to capture data in scenarios where it was not possible before, resulting in large volumes of data. The rise of social media provides many opportunities to mine data to create advantage. Storage solutions are changing to accommodate the large volumes of data, with cloud and hybrid-cloud solutions growing in popularity, and converged architectures appearing. The number of applications for data continues to grow, with artificial intelligence, robotics, virtual reality and simulation all increasing in importance and popularity.

DND, as a public sector organization, also has to comply with GC policies and direction. The GC has released, or plans to release, new and updated policies and directives around digital approaches to government, digital exchange, and automated decision approaches such as artificial intelligence. The GC data strategy was released in November 2018. There are working groups established to, amongst others, document requirements for common reference data, share lessons-learned and best practices on data governance, and gather requirements for data cataloguing. All of these may have an impact on what DND/CAF can and should do.

ANNEX C — DATA-DRIVEN ADVANCED TECHNOLOGIES

There are a number of advanced technologies that are quickly transforming industry and government and have the potential to provide value to DND/CAF. These technologies are often highly reliant on access to high-quality, voluminous data to operate at maximum effectiveness. In many cases, DND/CAF is already exploring that potential, such as in autonomous vehicles (i.e. drones); however, to truly exploit the potential of these technologies, DND/CAF needs to provide high-quality, well-defined data as an input:

- **Artificial intelligence (AI):** A system, or component of a system, which emulates aspects of human cognition such as perception, reasoning, planning, and learning such that it can enable actions either digitally or through the powering of physical systems. A subset of AI, machine learning, uses programs that can teach themselves to learn and act. To realize the benefits of artificial intelligence, large datasets that are largely removed of bias are required; the data can be structured or unstructured, depending on the particular need.

- **Autonomous vehicles:** Sometimes known as drones, autonomous vehicles can be anything from cars to small quadcopters that can operate in air, in water, on land, and underground either semi-autonomously (using remote controls) or autonomously (using onboard computers). DND/CAF is already exploring the use of air-based drones and water-based drones as targets in training, and as platforms for surveillance. To realize the benefits of autonomous vehicles, unstructured geospatial data and metadata needs to be of high quality, easily accessible, and readily available.

- **Augmented reality (AR):** In augmented reality, the real world is blended with the virtual world using audio or visual overlays of contextual data. In effect, a user wearing AR-enabled smart glasses would be able to see the real world with an additional overlay of data to help make real-time decisions. Examples where it might be used in DND/CAF are in warehouses to help pick relevant items, or on deployment to provide directions to personnel. To realize the benefits of augmented reality, metadata (e.g. geospatial data) and master data need to be of high quality, easily accessible, and readily available.

- **Virtual reality / simulation:** In virtual reality and simulations, specialized equipment allows users to interact with three-dimensional environments or images. DND/CAF is already using simulation to train pilots, but there is additional potential to train DND/CAF personnel in a variety of maneuvers and techniques such as materiel repair and explosive detonation using virtual reality. To realize the benefits of virtual reality and simulation, metadata (e.g. geospatial data) and master data need to be of high quality, easily accessible, and readily available.

- **Robotics:** Robots are machines that have enhanced sensing and control that are used to automate or augment activities. Once used primarily in manufacturing, robots are increasingly being used for other applications. DND/CAF already uses robots for explosive detonation, but there is also the potential to use them in warehouses for stowing and picking. To realize the benefits of robotics, master data, transactional data, and geospatial data need to be of high quality, easily accessible, and readily available.

- **Additive manufacturing:** Sometimes known as 3D printing, additive manufacturing creates three-dimensional objects by "printing" successive layers of materials. The layering is based on detailed digital models, and now can use a variety of materials including plastic, metal, and even glass. DND/CAF is exploring using additive

manufacturing to create just-in-time and on-demand materiel replacement parts. To realize the benefits of additive manufacturing, detailed digital representations of the desired output using unstructured data images are required.

- *Biometrics:* Biometrics uses physical characteristics (such as fingerprints, retina prints, voice prints) to uniquely identify and authenticate individuals. CAF already uses some biometrics to identify members, and DND/CAF uses biometrics such as facial recognition in intelligence. To realize the benefits of biometrics, easily accessible and readily available large repositories of unstructured data (e.g. of fingerprints, voice prints, pictures of faces) is required.

- *Intelligence Mission Data (IMD):* Future military platforms will have tremendous data requirements to enable the full capability of the platform's offensive and defensive weapon systems. Geographic, Order of Battle, Electronic Warfare, Technical characteristics, and Signature intelligence are all required so that these platforms can navigate, detect, identify, evade, and engage the enemy. The CAF/DND is exploring how to collect, store, and share the associated complex data sets as they pertain to potential foreign threat systems, but also our own data and those of friendly or non-combatants in order to optimize the performance of our future systems. This IMD effort effects all environments and will not only require a data governance structure but also a new capability by which we reprogram Canadian Military platforms with operationally critical data.

- *Internet of Things (IoT):* The IoT is a network of connected devices such as sensors, vehicles, appliances, that have the capability to collect, exchange and act on data. Sensors in particular provide additional data gathering opportunities in locations where it is difficult to place larger devices, such as inside engines. DND/CAF is already exploring the greater use of sensors and connected devices in materiel preventative maintenance.

- *Blockchain:* A blockchain is a distributed ledger that maintains a record of all transactions using hashing to authenticate and validate transactions reliably and anonymously. The resulting blockchain is considered a single version of the truth. There is potential for DND/CAF to use blockchain approaches to manage its supply chain, or certify the airworthiness of its planes.