Toward a
Digital Construction Platform

The Digitalization of National Construction Codes &

The Development of a National Common Data Framework

Executive Summary

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Executive Summary

The National Research Council of Canada (NRC) has introduced the Platform to Decarbonize the Construction Sector at Scale (PDCSS) to help the Canadian built asset industry overcome the significant challenges it faces, namely those around sustainability and productivity. Among other things, the platform aims to reduce greenhouse gas (GHG) emissions in construction by developing new low-carbon requirements, incorporating low-carbon solutions into key NRC resources, and supporting their digitalization, thereby supporting the development and deployment of low-carbon construction solutions across the country.

The PDCSS is delivered through two thrusts aimed at fostering a low-carbon industry: (1) The Low Carbon Built Environment Challenge program (LCBE), and (2) The Construction Sector Digitalization and Productivity Challenge program (CSDP). Both thrusts aim to support a low-carbon regulatory context, and ultimately, help the Canadian built asset industry improve its productivity while delivering low-carbon, sustainable built assets.

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To operationalize the PDCSS and implement the solutions developed through the program, the NRC aims to leverage the rapid digitalization occurring within the global built asset industry. Accordingly, the NRC aims to develop a digital ecosystem designed to enhance productivity and support the delivery of more sustainable, low-carbon assets within the Canadian built asset industry. More specifically, the NRC aims to promote digitalization in support of decarbonization and productivity increase in the Canadian built asset industry through its three key resource areas for the construction sector: the National Model Construction Codes (NMCC), the National Master Specifications (NMS), and the evaluations and other resources produced by the Canadian Construction Materials Centre (CCMC).

The NRC will therefore develop a Digital Construction Platform (DCP) which aims to digitalize processes and offer services to Canadian built asset industry stakeholders by providing standardized frameworks to facilitate desired outcomes and identify essential services and resources to support them. The NRC DCP will serve as a central repository for these key resources, including the NMS, the CCMC database, and the NMCC. By digitizing these resources and making them accessible through a user-friendly interface, the NRC aims to streamline workflows, facilitate automated compliance checking, improve collaboration tools, and accelerate project delivery.

The objective of the research project presented in this report was to define the NRC DCP and develop a research and development (R&D) roadmap to deliver it.

The primary objectives of the NRC DCP project are:

To develop a robust digital infrastructure that supports the management and dissemination of construction codes, standards, and specifications in digital and machine-readable formats.

To enhance interoperability among various digital tools and platforms used by industry professionals, regulatory bodies, and government agencies.

To promote sustainability through the integration of decarbonization strategies within the construction sector.

To streamline regulatory compliance processes using automated tools and enhanced collaboration features

To promote and enable collaboration across NRC departments while centralizing and ensuring access to key resources.

To establish a foundational architecture and resource pool for the development of interoperable platforms and software tools within the Canadian built asset industry.

To deliver the project, NRC collaborated with buildingSMART Canada (bSC) and researchers from École de Technology Supérieure (ÉTS) to deliver the NRC DCP R&D Roadmap with a specific focus on the digitalization of the NMCC and the establishment of a National Common Data Framework. The project scope included developing a comprehensive framework as well as an overarching architecture for the NRC DCP. Following the creation of the framework and architecture (the "what"), an R&D roadmap was developed to outline the key actions required to be undertaken by NRC and its collaborators to deliver the NRC DCP (the "how").

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To achieve the project objectives, a collaborative and iterative methodology was employed over a 9-month period to develop the NRC DCP and the R&D roadmap.

The key components of the methodology include:

Contextual Analysis:
- Review of Existing Infrastructure: Analyzed NRC's resources, IT infrastructure, platforms, and applications to understand the current state and identify areas for improvement.
- Stakeholder Mapping: Identified and engaged key stakeholders to understand their needs and contributions.

Development and Refinement of Digitalization Scenarios:
- Scenario Development: Developed initial scenarios outlining potential future developments in digital tools and processes within the NRC's ecosystem. These scenarios illustrate how stakeholders might leverage innovative methods to enhance data management, compliance checking, and collaboration.
- Scenario Analysis and Improvement: Continuously analyzed and refined the scenarios based on stakeholder feedback, evolving needs, and new insights to ensure they are practical, relevant, and aligned with project goals.

Stakeholder Engagement and Collaboration:
- Workshops and Meetings: Conducted workshops and meetings with key decision-makers from the Codes, NMS, and CCMC, and other stakeholders to gather insights and validate requirements.
- Feedback Mechanisms: Established channels for ongoing feedback from stakeholders to further refine and improve the NRC DCP and its components.

Documentation and Reporting:
- Documentation: Collected and documented detailed information on digitization scenarios, stakeholder contributions, and system requirements.
- Reporting: Prepared the reports and supporting documents to present the findings, methodologies, and outcomes.

With this project, the NRC is undertaking the development of a digital ecosystem, the DCP, to enhance the efficiency, transparency, and sustainability of the Canadian built asset industry. The proposed DCP is designed to be modular and scalable, leveraging widely accepted resources, standards, and services to ensure a robust and interoperable ecosystem. In terms of architecture, the NRC's DCP is built upon a layered framework that is organized into three tiers, each addressing critical aspects of digitalization within the built asset industry. Figure A illustrates the layered framework which is explained below.
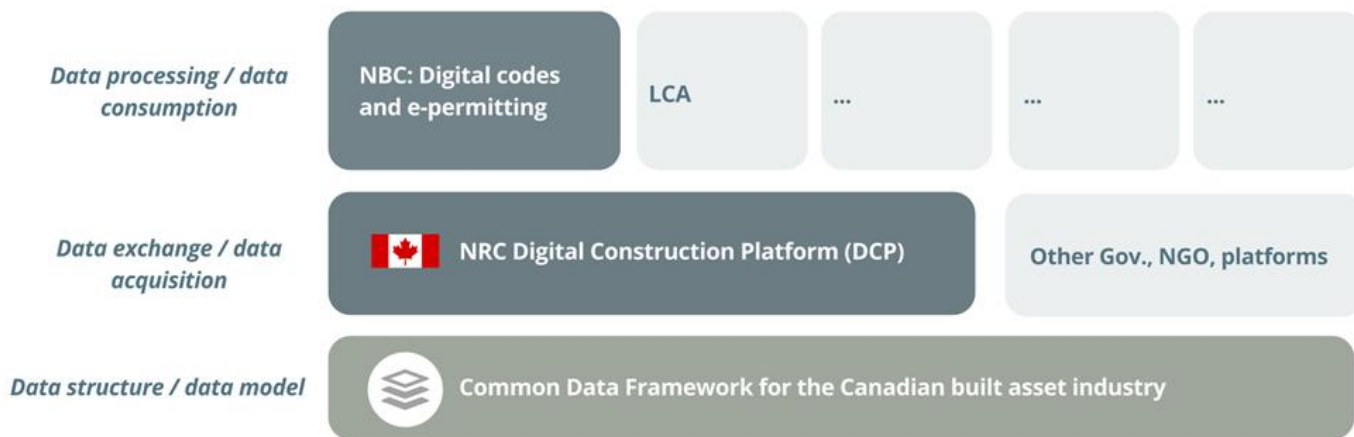

Figure A NRC's Digital Construction Platform layered framework

Tier 1: Common Data Framework (CDF)

The CDF establishes a standardized approach to data management, encompassing semantics, syntax, concepts, processes, practices, and services. This foundational tier ensures coherent and consistent data organization, vital for achieving interoperability across diverse systems within the built asset industry, by clearly defining the resources supporting each key area. Figure B illustrates the key components of the CDF
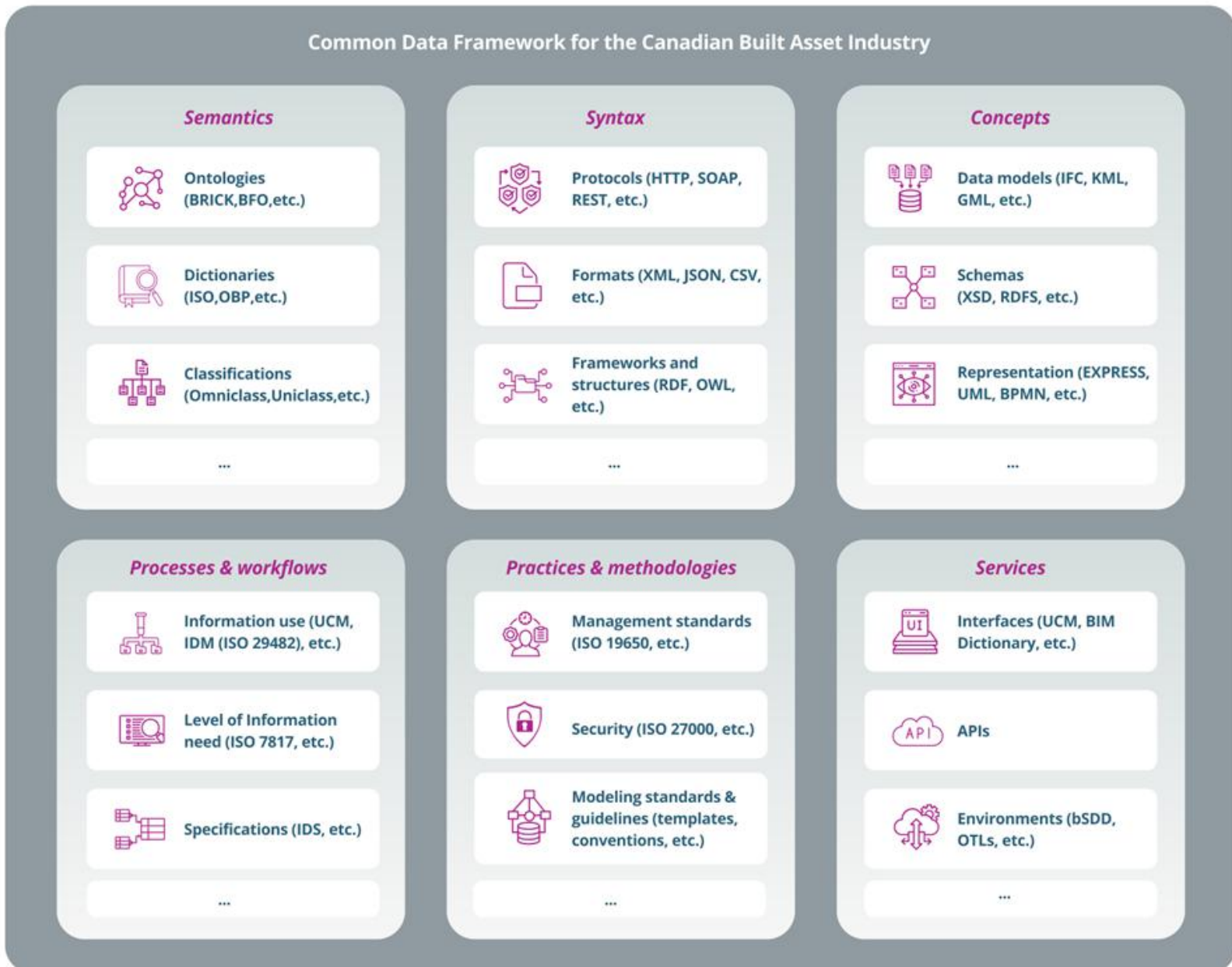

Figure B Common Data Framework for the Canadian built asset industry

Tier 2: Data Exchange / Data Acquisition

Building on the CDF, Tier 2 focuses on the development of the NRC DCP, a digital "ecosystem" predicated upon the key resources identified in Tier 1 and emphasizing the integration and exchange of data across different Common Data Environments (CDEs). This tier is designed to ensure that the platform supports seamless data flow and communication among stakeholders. It aims to create a scalable and functional platform that centralizes information and enhances collaboration, benefiting NRC as well as other governmental and non-governmental sectors and their platforms. Figure C illustrates the conceptual architecture for the DCP.
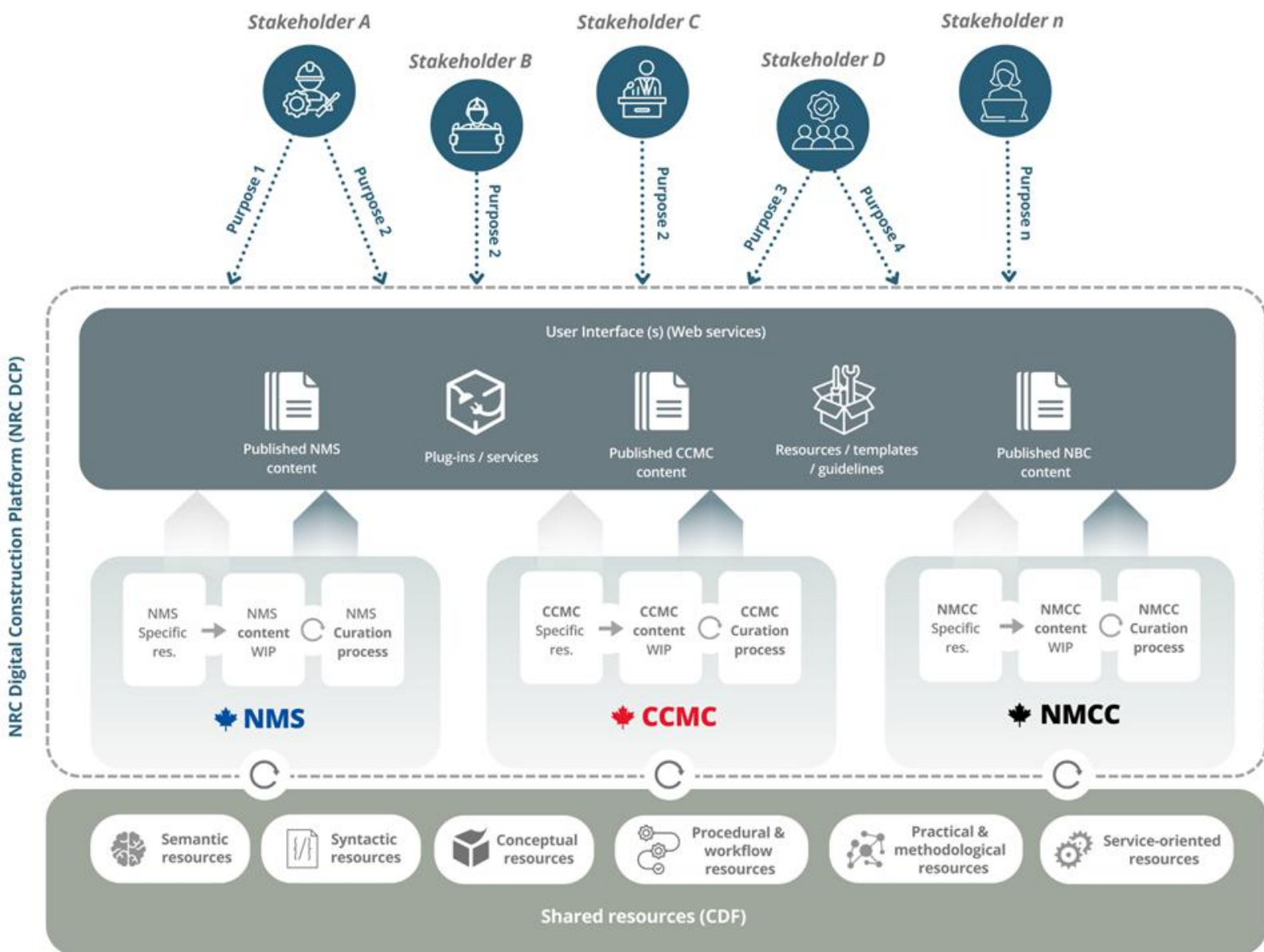

Figure C NRC DCP Conceptual architecture

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Tier 3: Data Processing / Data Consumption

Tier 3 addresses the advanced processing and use of data. It involves digital codes, e-permitting processes, and analytical methods like Life Cycle Assessment (LCA) and develops the specific services offered by the DCP. These services are primarily articulated around the three NRC resources being digitalized: the NMCC, the NMS and the CCMC database. Each service is explained, and user scenarios are developed to detail how the DCP should operate. By leveraging the data structures from Tier 1 and the integration capabilities from Tier 2, this tier aims to facilitate comprehensive data analysis and decision-making. It focuses on providing advanced tools for data visualization, reporting, and validation.

The development and implementation of the NRC DCP are guided by a roadmap, articulating 198 activities spanning a six-year period, from 2024 to 2030, and organized into three main streams:

Digital Resources
This stream involves digitizing NRC's resources including NMS, CCMC evaluations, and NMCCs, developing supporting tools, and formalizing digital processes. It ensures that all resources are available and usable throughout the asset lifecycle.

Digital Platform
This includes developing essential functions and services, establishing data exchange standards and integrations, and implementing repositories for data storage and management.

Platform Delivery
This stream covers project governance, capability development, and communication strategies. It ensures effective project management, stakeholder engagement, and the development of necessary training and support materials.
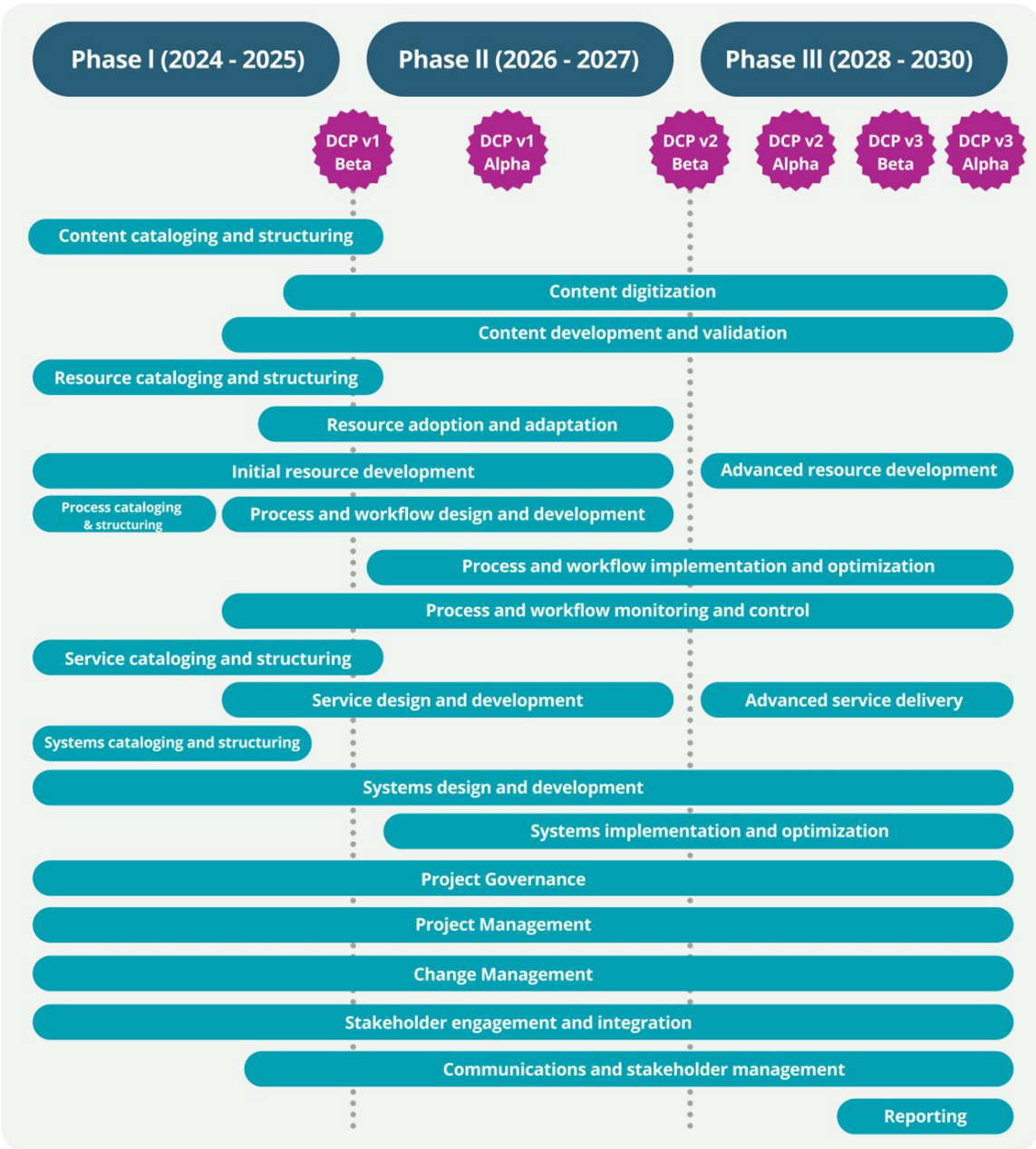
The Roadmap

Figure D Proposed High-level DCP R&D Roadmap

The Digital Construction Platform

The NRC DCP initiative involves setting the foundation for improved data and information management, enhancing interoperability of information systems, including Common Data Environments (CDE), and enabling seamless information exchanges among the different stakeholders within the Canadian built asset industry.

The DCP is designed to

Increase productivity and efficiency through streamlined workflows, automated processes, and improved data management.

Improve decision-making by providing access to real-time data and analytics for informed decision-making.

Ensure sustainability by supporting low-carbon construction practices and lifecycle assessment.

Enhance regulatory compliance with simplified building permit processes and automated compliance checks.

Once deployed, it is expected that the NRC DCP will enhance the efficiency, transparency, and sustainability of the Canadian built asset industry. Key outcomes of the DCP include the successful integration of digital specifications, automated compliance checking, and improved data management practices. The DCP will facilitate better stakeholder collaboration and support the decarbonization goals of the construction sector. Additionally, the DCP will be modular and scalable, leveraging widely accepted resources, standards, and services to ensure a robust and interoperable ecosystem.

Full Report

The full report includes a high-level overview of current work in digital ecosystems for the built asset industry, as well as machine-readable building codes, automated code compliance checking, and e-permitting. A current state analysis of NRC's three key resource areas for the construction sector: the NMCC, the NMS, and the CCMC evaluations, focusing on their development and dissemination processes.

The report presents the NRC DCP's target state across its three tiers: the CDF, the Digital Ecosystem, and the Digital Services and Functions, illustrated through specific user scenarios. The platform's requirements are discussed throughout. Finally, the report outlines and discusses the R&D roadmap and implementation plan.

By digitizing these resources and making them accessible through a user-friendly interface, the NRC aims to streamline workflows, facilitate automated compliance checking, improve collaboration tools, and accelerate project delivery.

buildingSMART Canada is committed to supporting the digitalization of Canada's built asset industry by developing and helping promote the adoption of open, international standards and solutions.

buildingSMART Canada is the community for visionaries working to transform the design, construction, operation, and maintenance of Canada's built environment.

As a Canadian federally incorporated Not-for-Profit Corporation, the Canadian chapter of buildingSMART International provides the appropriate body and home for Canadian BIM and digital project and asset lifecycle delivery Standards and best practices development.

It exists to support the implementation of BIM in a way and at a pace that enables industry to successfully achieve its objectives and deliver value to Canadians.

Canada and Canadian professionals have a long history and reputation of collaboration and communication between countries and regions. The chapter continues to fulfill this role, supporting the development and application of standards from high-level to practical use.

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