November 2023

Digital Engineering

PLANNING THE COMMON DATA MODEL

Preface

Standards Australia is committed to digital transformation of the built environment, through an innovative new program leading industry change and capability improvement.

In November 2022, Standards Australia released an initial discussion paper titled “Digital Engineering: Shifting the Paradigm in the Construction Sector”. This was coupled with an industry event, held at the Standards Australia head office in Sydney, to publicly launch this new initiative and to discuss the drivers and vision for industry change.

In April 2023, Standards Australia commenced the next phase of this program with the release of the paper “Digital Engineering: Introducing the Common Data Model”. This paper explored new opportunities for the engineering and construction sector through a step change in data management capabilities, that will enable organisations to build the digital thread of data and take digital twins to the next level. Central to this approach is the development of a Common Data Model, that will transform how critical metadata is specified, managed and exchanged over the complete asset lifecycle.

This latest paper, titled “Digital Engineering: Planning the Common Data Model”, dives deeper into this concept, and explores the practical steps necessary to bring this exciting vision into reality. Key topics include the importance of data modelling, the steps necessary for designing the digital thread and an overview of the program for building a sector-wide Common Data Model.

Key terms	Acronym	Definition
Building Information Modelling	BIM	Process of designing, constructing and maintaining a built asset using object-based 3D modelling
Common Data Model	CDM	A standardised data model, based on a top-down ontology, developed for a business sector to exchange data in a connected digital ecosystem
Common Data Environment	CDE	Agreed source of information for any given project or asset, for collecting, managing and disseminating each information container through a managed process (ISO 19650)
Connected Digital Ecosystem	CDE 2.0	Digital ecosystem of linked databases, that manages and exchanges datasets & metadata, using consistently structured data architecture, to ensure semantic interoperability over the asset lifecycle
Data architecture		A broad term used to describe the design of data models and associated artefacts that connect an enterprise strategy with its data management framework
Data management		The discipline of handling data as a valuable business resource, through a comprehensive collection of concepts, practices, systems and processes
Data model		A model of the users’ data requirements, typically expressed in terms of an entity-relationship model
Data modelling		Process of creating a specific data model for a determined problem domain
Database		Shared, integrated platform that stores an organized collection of related data
Digital Engineering	DE	A collaborative way of working, using semantic data management, to enable more productive methods of project delivery and asset management
Master data		Data that provides details and context for business activity. It uses uniform structure and entities to drive business processes, enable analytics and establish the golden thread of data (i.e. the digital asset lifecycle)
Metadata		Data about data that enables datasets to be structured, managed and federated
Semantic data management		Range of techniques that can be employed for storing, querying, manipulating, and integrating data based on its meaning

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ABOUT STANDARDS AUSTRALIA

Standards Australia is an independent, non-government, not for profit organisation. We are the nation's peak non-government standards development organisation.

The work of Standards Australia and our staff, stakeholders, members and contributors enhances the nation's economic efficiency, international competitiveness and contributes to a safe and sustainable environment for all Australians.

Standards Australia's vision is to be a global leader in trusted solutions that improve life – today and tomorrow.

1.0 Recap of the Previous Paper

1.1 Introduction

Standards Australia has commenced a new initiative that aims to shift the paradigm in the engineering and construction sector. Under the banner of Digital Engineering, this revolutionary approach to data management is now transforming the way the sector operates and exchanges valuable data over the complete asset lifecycle.

In the previous paper titled "Digital Engineering: Introducing the Common Data Model", we explored concepts centred on modern data management and the game-changing opportunities that they present for the engineering and construction sector. These included key concepts such as database design, its relevance to the built environment and how it may be harnessed to establish sector-wide change through the digital thread of data over the asset lifecycle.

Most importantly, we introduced the concept of a Common Data Model (CDM), which will enable a step change in how the engineering and construction sector manages project and asset data. The CDM will standardise the specification of metadata, which will enable development of the digital thread and is essential for building sector-wide digital twins.

In effect, the CDM will provide the new digital language of the built environment.

This next paper, titled "Digital Engineering: Planning the Common Data Model", explores the practical steps necessary to bring this exciting vision into reality. But first, a quick recap on the key points explored in the previous paper.

1.2 What is Data Management?

Data management may be described as the practice of collecting, organising, protecting, and storing an organisation's data so it may be reliably utilised to create value and support business decisions. This is why valuable data is now often referred to as the "new gold" of the business world.

Leading organisations in the modern business world rely on "data-driven decision making", through a combination of data mining, analytics, visualisation and reporting – these are collectively known as business intelligence (BI).

Properly managed data now plays a critical role in all activities throughout the built environment. All project and asset decisions, at all stages of the asset lifecycle, need efficient access to high quality, reliable data.

Historically however, the engineering and construction sector has demonstrated relatively low levels of digital maturity, with data generally being managed via a wide range of electronic files in proprietary formats or in tabular form using Microsoft Excel. The limitations of this approach include a lack of sophistication, automation, interoperability and/or seamless exchange. Collectively this results in much of the sector missing out on the benefits of modern BI to inform and drive business decisions.

A new approach is therefore required, which is based on more advanced forms of data management, called Digital Engineering.

1.3 What is Digital Engineering?

Digital Engineering (DE) is defined as a collaborative way of working, using semantic data management, to enable more productive methods of project delivery and asset management.

It represents an entirely new approach to managing data in the built environment, enabled through a convergence of master data management, business process optimization and emerging digital technologies.

It is important to recognise that DE is not centred on visualisation tools or data-rich 3D models – instead it works to create a complete digital ecosystem built on trusted and reliable metadata. This ecosystem supports an entirely new end-to-end vision, otherwise described as the “digital thread” of data, which extends well beyond current methodologies such as Building Information Modelling (BIM) and Geographic Information Systems (GIS).

1.4 Why do we need the digital thread?

Major engineering and construction projects are frequently very large and complex. They typically involve a wide range of specialist roles employed to provide specialist services for clients, consultants, and contractors. A selection of the various roles that appear over the lifecycle are represented below in Figure 1.1.

Figure 1.1: Various specialist roles engaged over the asset lifecycle

These roles typically work in collaboration, to produce deliverables and achieve real-world outcomes over incremental stages of the asset lifecycle. Most roles are engaged to provide specific services for single stages of the lifecycle only (e.g. planning, design, construction etc), before leaving the project with a handover for others to proceed. Some roles may be engaged for longer, providing continuity and oversight over multiple lifecycle stages. Very few roles, however, are engaged continuously over the complete lifecycle i.e. managing asset-related activities from cradle-to-grave.

Each of these specialised roles is responsible for providing specific services and associated deliverables. These days most information deliverables are in a digital form, however the precise quality and reliability of these can be highly variable. As such information deliverables are commonly produced in accordance with various specialised software platforms, standards, processes, coding structures and data formats. This results in a patchwork chain of information deliverables that are stored across multiple systems, with little-to-no consideration for duplication, semantics, interoperability, federation or analysis.

Plain language questions about specific assets can also be difficult to answer reliably, as critical information is typically stored across numerous files, formats and software platforms – as represented below in Figure 1.2. This lack of interoperability directly impacts how the engineering and construction sector can access, share and exchange project and asset data. It also introduces further degrees of uncertainty and generally hinders productivity. Most critically, this impacts the ability for the sector to run automated queries, utilise advanced data analytics and achieve more advanced BI capabilities.

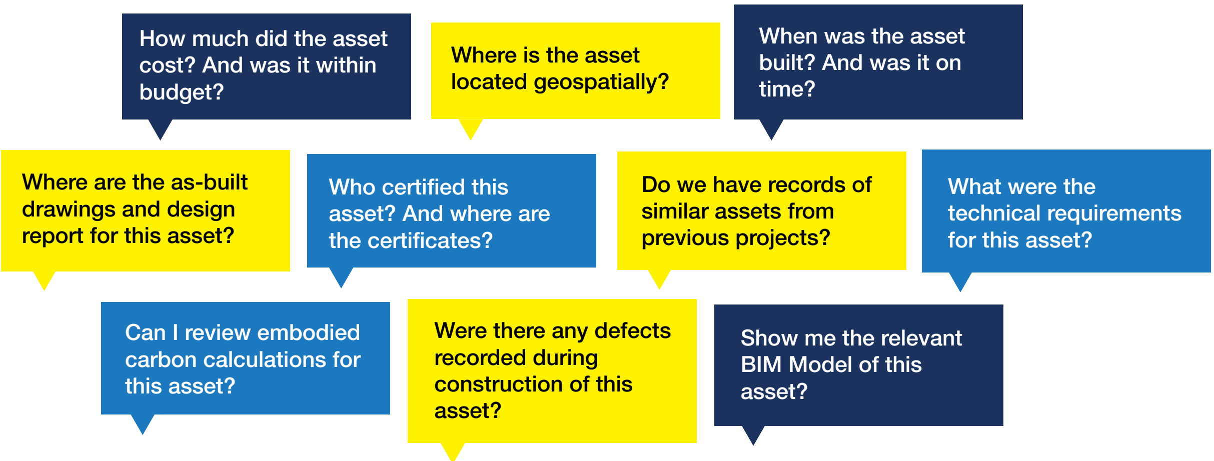


Figure 1.2: At present, it can be challenging to answer plain language questions about assets

Leading organisations are becoming more agile, powered by a core that is end-to-end digital over the complete asset lifecycle – otherwise known as the "digital thread" of data. This concept is a more than broad-scale adoption of new digital technologies. It represents the complete re-invention of business processes and data architecture – aligning all specialist roles and activities over the asset lifecycle, with a seamless pipeline of consistent, reliable and interoperable metadata.

As represented below Figure 1.3, the digital thread supports federation, query and analysis of interoperable data over the complete asset lifecycle. This enables full recall and traceability of related datasets in a controlled ecosystem.

This will drive significant efficiencies by avoiding data-loss, automating manual processes and minimising the need for information to be reassured or recreated repeatedly at each lifecycle stage.

Figure 1.3: Digital thread (or digital asset lifecycle) objectives

2.0 How Do We Design the Digital Thread?

2.1 Overview

Emerging technologies have a significant role to play in designing the digital thread, however this alone will not be enough to solve this challenge. Prior to exploring new technologies, this paper recommends that the engineering and construction sector adopt a new approach based on the following three key stages – represented below in Figure 2.1.

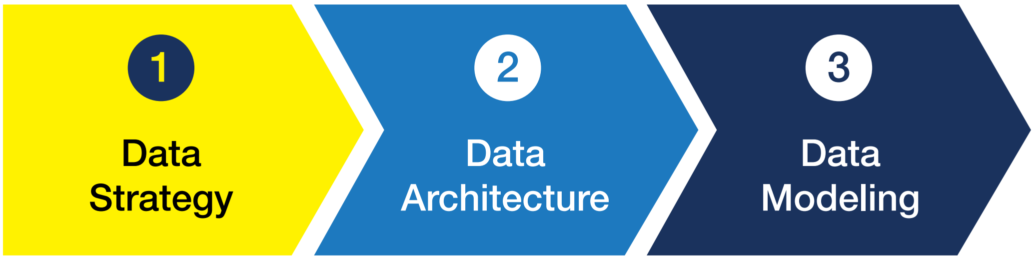


Figure 2.1: Creating the digital thread in three stages

1. Data strategy

As noted earlier, the engineering and construction sector is diverse, with a broad range of specialist roles and data needs. The first step is to develop a comprehensive strategy that will establish an overarching set of principles and technical requirements, and will define how data is expected to flow over the complete lifecycle. This initial strategy will be relatively high-level, specifying how all relevant parties, responsible for producing project and asset deliverables, will be expected to create, manage and exchange reliable metadata.

2. Data architecture

Once the strategy is agreed and documented, the sector can then commence development of a standardised data architecture. The data architecture will effectively produce an agreed lifecycle model for buildings and infrastructure, based on global standards, that will eventually be translated into the digital thread. This stage will define how data will flow through payloads of consistently managed metadata, and database queries are supported across all handover points. This new data architecture will represent the complete value chain over the asset lifecycle, and will enable all relevant parties to collaborate more effectively through aligned business processes.

3. Data modeling

The final step is to develop a standardised or Common Data Model (CDM), that will essentially form the backbone of the digital thread. This data model will provide a consistent database template, that enables all parties seeking to create, exchange and rely on consistent data over the complete asset lifecycle. It will be truly open-source, providing a non-proprietary ecosystem for everyone seeking to collaborate and exchange related data throughout the built environment.

The concept of a shared or standardised data model, coupled with an agreed data dictionary, is essential to achieving sector-wide digital transformation. The introduction of a Common Data Model will provide a new digital language of the built environment – and will support efficient data exchange, analysis, collaboration and recall over the complete digital thread.

2.2 What is a data model?

Data models define the structure of relational databases that, in turn, are used to store an organised collection of related data. Data models play a key role in maintaining effective data management, by specifying metadata requirements for datasets. They ensure the integrity of metadata structures is maintained and supports semantic interoperability between information systems. In short, the combination of consistent metadata, stored in agreed data models creates structured data.

Data modelling is a fundamental activity for effective data management. Data modelling both enables and demands that an organisation understands its data architecture. It is the collective process of discovering, analysing, and scoping data requirements, and then visually representing and communicating these data requirements in the precise data model.

In the context of the built environment, data modelling is still a relatively new and uncommon capability, even within leading client and industry organisations. Over the past 10 years the engineering and construction sector has developed considerable skills with managing models, however these are typically in the form 3-dimensional graphical models for purposes such as visualisation, design coordination and stakeholder engagement. Examples of such models include laser scan point clouds, photogrammetry, GIS and BIM – as presented below in Figure 2.2.

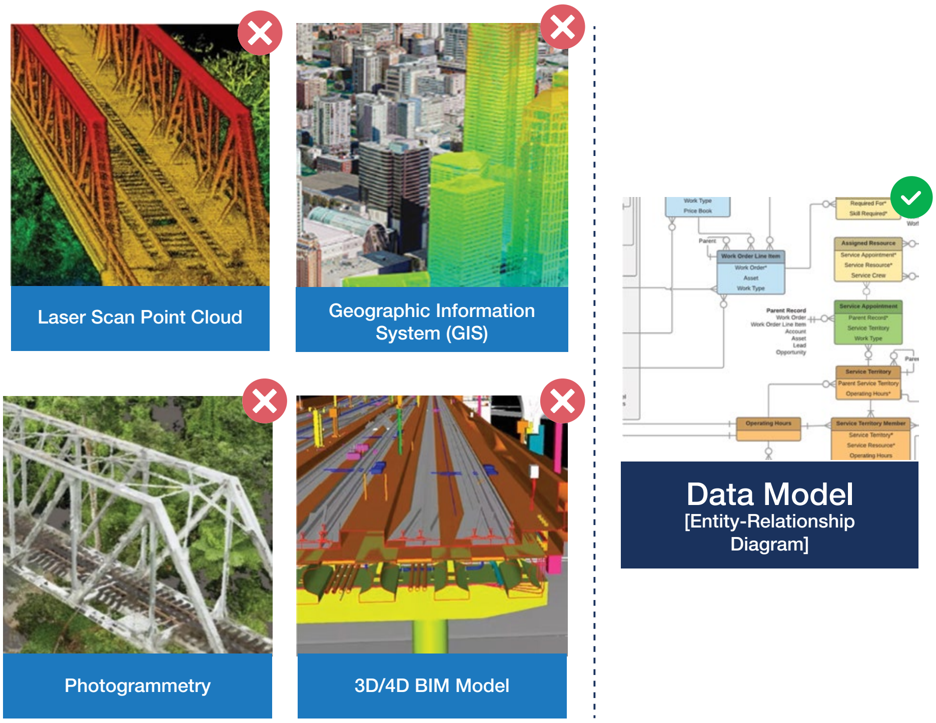


Figure 2.2: What is a data model?

While some may consider the above listed examples to be types of data models, this assumption is not entirely correct. Data modelling is a more abstract process used to create schematic diagrams, otherwise known as ‘entity-relationship’ diagrams (ERD) – as shown on the right of Figure 2.2. Data models allow users to represent and view the relationships and flow of data between defined entities (e.g. data tables, applications, data stores).

The conventions and techniques used to create ERDs date back almost 50 years and were first developed to design early relational databases in the mid-1970s. In the time since then, the techniques have been refined, however the basic concepts are still used today to design and build data warehouses, advanced software applications and online data storage systems.

2.3 What is the Common Data Model (CDM) and why is it important?

The engineering and construction sector needs a common digital language to share and exchange critical metadata about the built environment – by designing a data architecture that allows interconnected databases to talk.

The CDM, together with an associated data dictionary, will provide a novel solution for specifying, managing and exchanging structured data. It will apply “top-down” and “bottom-up” methodologies for data modelling, applicable for specification and production of information deliverables within the digital thread.

The overall structure and key components of the CDM will be designed to be universally applicable for the broadest range of organisations, for the broadest range of information deliverables, and for all stages of the asset lifecycle. It should be noted, however, that the CDM is not designed to capture all project and asset metadata, as this would be an impossible task to specify and administer successfully. Instead the CDM will identify the minimum set of entities and their relationships that are deemed essential for associating key datasets over the digital asset lifecycle.

This concept of standardised industry data models is not new, and numerous other sectors have benefited from using this approach for many years. For examples of some existing common data models, please refer to Appendix A.

2.4 How does this improve on current arrangements?

For many years, the engineering and construction sector has generally relied on BIM, administered within the Common Data Environment (CDE) as the leading method for project information management. Therefore, before we can explore future developments of the CDM, it is important to first discuss current arrangements with the CDE.

The CDE began life in the early 2000s as a CAD management process, providing advanced revision control and effective design coordination capabilities on multidisciplinary projects. Over time this definition has evolved into meaning file repositories, either as a single source of truth or a collection of related software platforms that exchange project information by manually importing and exporting files.

As noted earlier, engineering and construction projects typically involve numerous specialist roles, each responsible for specific tasks over the life of the asset. Each specialist typically requires their own forms of data, using specialist software packages in order to deliver services and produce deliverables e.g. Documents, CAD, GIS, BIM, schedule, cost estimate etc.

These specialist software packages are generally siloed, each having been developed for unique purposes and outcomes. The databases at the heart of these software packages are also siloed, and typically lack any common data entities, attributes or semantics across disciplines.

Referring below to Figure 2.3, this image represents eight common specialist roles, however projects often have many times this number – as per Figure 1.1. The lack of common (or master) data management across these various roles results in manual, lossy & administrative processes for data entry, management, export, exchange, association & query (i.e. analogue business processes).

If common metadata has actually been prescribed on a project, the lack of a master data repository often results in metadata being duplicated across numerous proprietary datasets which can only be accessed and retrieved through the specialist software, by specialist users. Project teams therefore remain siloed, with limited, inefficient and manual data entry/exchange – and generally poor collaboration overall.

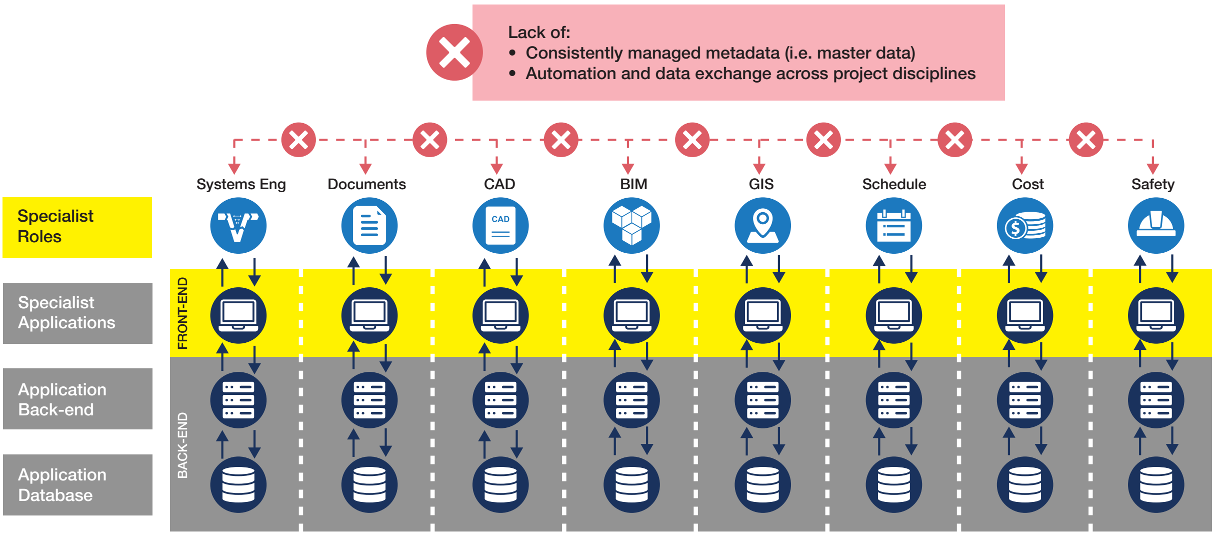


Figure 2.3: Current state: Lacking software integration and master data management across various specialist roles. Note: This diagram is representative of the overall sector. It is noted however that some organisations may have established bespoke links between specific systems.

2.5 The future of master data management

An alternative approach is to commence contract/project planning with consideration for the overall data and software architecture. By starting with the CDM, a common database may be established on commencement of a project, supporting master data management and providing a central repository for key data entities that are shared across all specialist roles.

Referring below to Figure 2.4, this approach supports effective collaboration, with open, reliable and automated data/entry exchange. This will drive consistent data management practices across all specialist roles, and support automated exchange, association & query using automated business processes. It also reduces the amount of metadata required within each specific software package, avoiding unnecessary manual entry and duplication of metadata across platforms – saving time and money on projects.

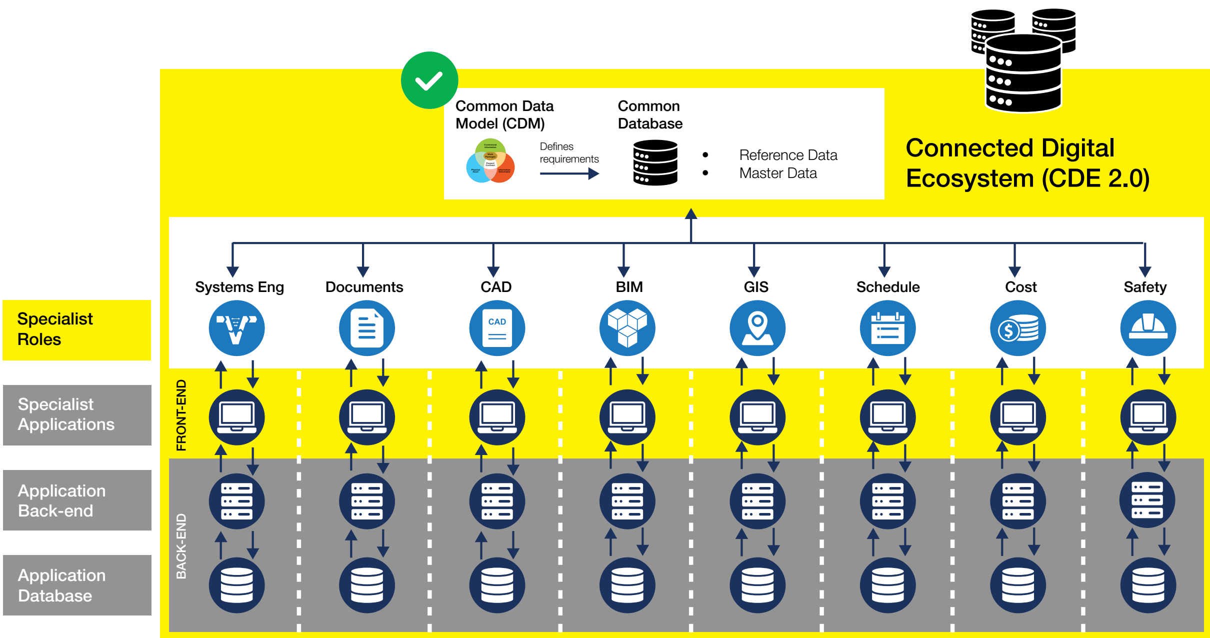


Figure 2.4: Future state: Master data management and improve collaboration across various specialist roles

The common database will initially form the primary store of two key types of data:

- Reference Data: standardised data used to identify, classify or reference other data e.g. asset lifecycle stages, asset classification,
- Master Data: contextual data about the business entities used for business transactions e.g. contracts, personnel, suppliers, work packages etc

The precise nature of the data stored in the common database will require research and collaboration with the engineering and construction sector, to determine the optimal set of data to support this framework.

In time, it is expected this will continue to evolve, with software improvements enabling more automated and streamlined processes e.g. through the development of new Application Programming Interfaces (APIs). Improvements of this nature may be considered more aspirational at this stage, however this demonstrates how further efficiencies and benefits may be unlocked through this approach.

2.6 CDM as the basis for a new data ecosystem

Master data management, enabled through the CDM, will provide a step change in data reliability and overall productivity throughout the engineering and construction sector. This approach also lays the groundwork for building the next evolution of the CDE.

The Connected Digital Ecosystem (or CDE 2.0) may be defined as a digital ecosystem of linked databases that manages and exchanges datasets & metadata using a common data model, to ensure semantic interoperability over the asset lifecycle.

The CDE 2.0 will create a network of secure and reliable databases within an organisation, which may be queried and analysed collectively. This will give rise to new data management capabilities and support new forms of business intelligence described in earlier sections of this paper.

Over time, as the number of projects and organisations begin to adopt the CDM, a greater ecosystem of CDE 2.0 will continue to flourish. This will enable exponentially greater efficiencies, supporting business intelligence for the overall sector, jurisdictions and the nation.

Summarised below in Figure 2.5, the CDE 2.0 is a scalable solution that:

- manages all datasets as discrete databases;
- builds a scalable ecosystem of databases; and
- enables a broader ecosystem of ecosystems.

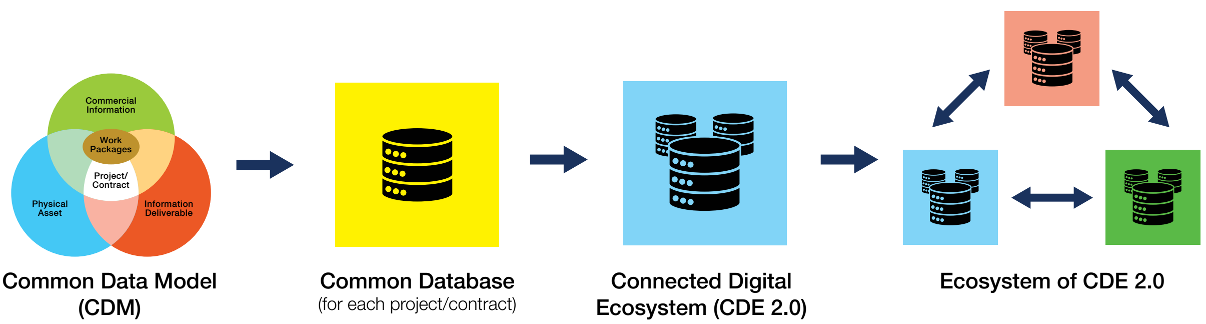


Figure 2.5: Formation of the Connected Digital Ecosystem (CDE 2.0)

Benefits of the of the CDM are wide ranging, with a selection of key benefits outlined in Appendix B of this paper.

3.0 Planning the Common Data Model

3.1 Taking a top-down/bottom-up approach

Given the broad and transformative nature of the CDM, its development will extend well beyond existing business or technological solutions. This will require extensive collaboration and expertise from across the engineering and construction sector, through a fusion of traditional technical skills, new standards and emerging digital capabilities. It is therefore recommended that the CDM is developed using a combination of "top-down" and "bottom-up" methodologies, as presented below in Figure 3.1.

This approach will support developing a complete framework, that streamlines processes, improves data management and recommends new tools and introduced capabilities for industry to adopt. These two approaches are explained in further detail below.

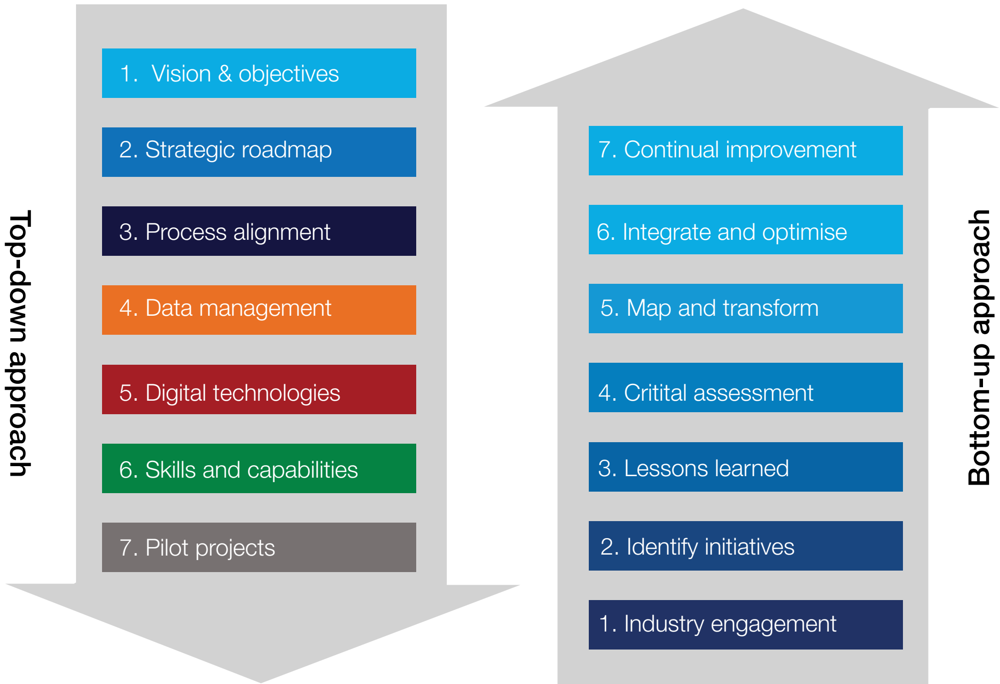


Figure 3.1: Top-down & bottom-up approaches for building for the CDM

3.2 Top-down approach

Working top-down, development of the CDM will first establish the vision and objectives of the initiative, to ensure all parties are clear on the direction and intended outcomes. This will articulate a clear set of principles that align objectives and define "what does good look like" along a series of incremental milestones.

This stage will also be important to not only define what is in scope, but also what is intentionally outside of the immediate scope – in order to prevent scope creep and set clear expectations within defined boundaries.

Once these are documented and agreed, the development team can then move onto addressing more technical components such as process, data, technologies and finally people – such as new roles, capabilities and skills gaps, as outlined in Table 3.2.

Component	Questions	Examples
1. Vision & objectives	What is the optimal future state for the sector?	Data as an asset, organisational intelligence, digital twin, industry 4.0 digital transformation, etc.
2. Strategic roadmap	What are the strategic targets to achieve the vision?	Strategic plans, roadmaps, inflight initiatives, working groups, resourcing, budget, etc.
3. Process alignment	How are business processes aligned over the end-to-end asset lifecycle?	Business architecture, collaborative information production and exchange, data flow, etc.
4. Data management	How will data be managed to support business processes?	Data architecture, data models, standards, requirements, specifications, accessibility, etc.
5. Digital technologies	How will technologies be applied to manage data?	Solutions architecture, data production, sharing, collaboration, integration, files/ databases, etc.
6. Skills and capabilities	What capabilities are required to maximise value from digital technologies?	Master data management, project data management, data custodians, data architects, etc.
7. Pilot projects	How can this be applied and proven on live projects?	Projects trials, industry collaboration, communities of practice, lessons learned, etc.

Table 3.2: Top-down methodology for building for the CDM

3.3 Bottom-up approach

While the engineering and construction sector currently doesn't have a standardised approach to digital engineering, development of the CDM does not have to start from scratch. Over the past 10 years, there have been numerous initiatives relating to digital engineering that have been led by industry organisations, leading asset owners and academia.

The bottom-up approach will work concurrently with the top-down strategy, to identify and reference current bodies of work that are already underway within the engineering and construction sector. This will promote cross-sector collaboration with organisations that share similar objectives to the CDM in order to avoid reinventing the wheel. Examples may include systems and processes sourced from cross-sector digital innovation, major infrastructure projects and leading global sources.

Detailed analysis of existing bodies of work will be undertaken to review and critically assess the merits, limitations and lessons of current approaches to digital engineering. This will help to further accelerate development of CDM and the associated data dictionary, based on current practice developed both locally and from around the globe.

3.4 Preliminary CDM data domains

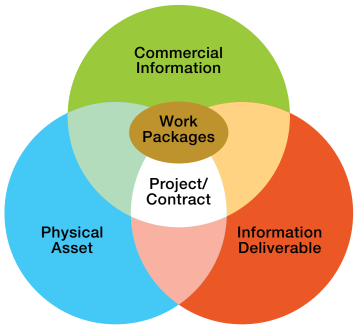
The key objective of the CDM is to support development of the digital thread over the asset lifecycle, as the foundation for digital twins, smart infrastructure and broader industry 4.0 objectives. With this in mind, preliminary planning of the CDM has identified the following key data domains as represented below in Figure 3.3.

Commercial Information

Key details relating to the commercial data entities for the project or contract.

Physical Assets

Key details relating to physical asset and location breakdown, based on standardised global asset classification systems e.g. Uniclass, Omniclass, ICMS etc.



Work Packages

Temporary contract-based labelling of physical works, grouped into project (or contract) based work packages and zones.

Information Deliverables

Key project datasets catalogued as geometric or non-geometric information deliverables e.g. CAD, BIM, GIS etc.

Figure 3.3: Preliminary CDM data domains

3.5 The Next Phase

The next phase of this program proposes the development of a new publication (e.g. Standard, Technical Specification or other publication) that outlines the CDM and associated data dictionary.

Early planning has identified the following potential scope of work (note this is still TBC):

1. Overview of CDM concepts: including vision, principles, concepts, (e.g. digital thread, digital twin etc) benefits etc
2. Data management basics: based on global best practice (DAMA DMBoK), to introduce and explain key concepts e.g. semantic interoperability, data dictionaries, data modelling using Information Engineering (IE) notation
3. Fundamental details: including references to relevant standards e.g. ISO 12006.2-2015 and the need for common approach to asset classification, common asset lifecycle etc
4. CDM components: broken into key data domains (i.e. Commercial Info, Asset Info, Info deliverables and Work Packaging)
5. Technical details: of the CDM inc. overview and detailed descriptions of key entities, relationships, semantic data tables etc
6. General instructions: on how an organisation may integrate the CDM within their business processes.

NB: All new work proposals adhere to [Standardisation Guide 001: Preparing Standards].

For any enquiries on Standards Australia's Digital Engineering Initiative, please email SI@standards.org.au.

Appendix A: Examples of Common Data Models From Other Sectors

- **Aerospace:** SX000i is a specification developed jointly by the Aerospace and Defence Industries Association of Europe (ASD) and the American Aerospace Industries Association (AIA) to provide information, guidance and instructions to ensure compatibility and coordination of logistics activities. This initiative has developed a suite of interoperable specifications comprising standardised terminologies, guidance and a common data model.

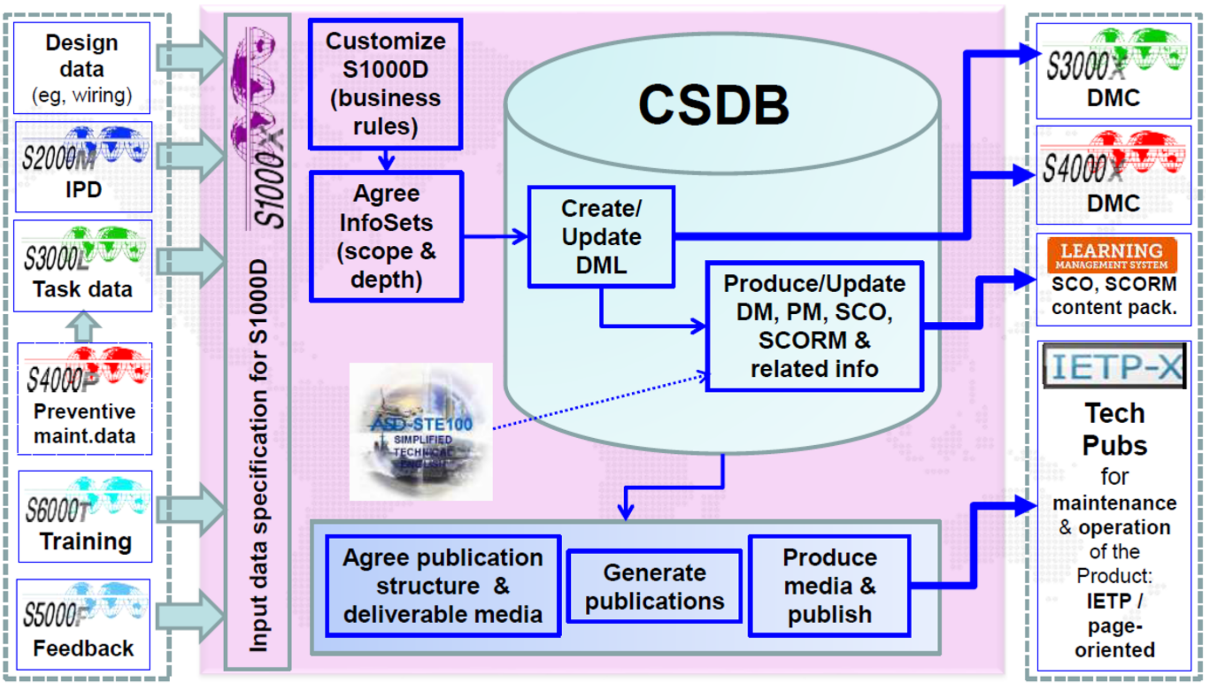


Figure A.1: SX000i framework and associated documentation (source: IPS 2021 Report)

- **Airline Industry:** The [Airline Industry Data Model (AIDM)] has been developed by the International Air Transport Association (IATA), which represents some 300 airlines or 83% of total air traffic. The AIDM provides a common point of reference to store industry-agreed vocabulary, data definitions and their relationships – in order to generate interoperable, faster and easier messaging between parties.

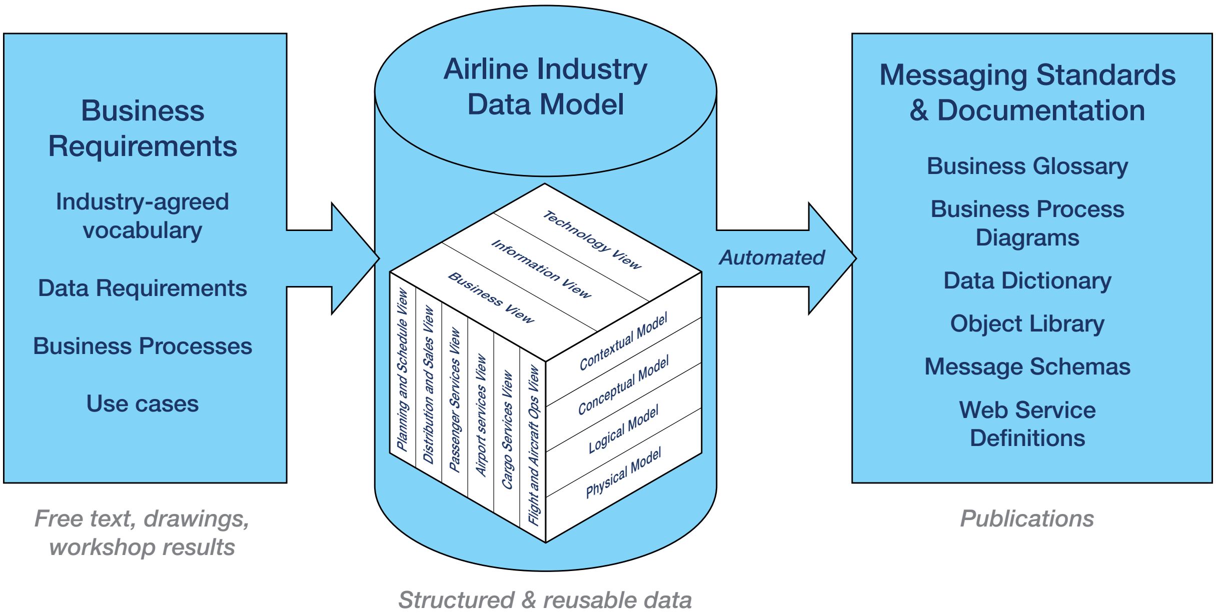


Figure A.2 Airline Industry Data Model (AIDM) (Source: IATA)

- **High Voltage Power Systems:** The [Common Information Model (CIM)] is defined by the IEC as "an abstract model that represents all the major objects in an electric utility enterprise typically involved in utility operations." This is applied across three IEC standards (IEC 61970, IEC 61968, IEC 62325) for control centre applications, and provides a standard way of representing power system resources as object classes and attributes, along with their relationships. The CIM sits alongside a second data model (IEC 61850) for substation automation and other device level applications – as represented below in Figure A.3.

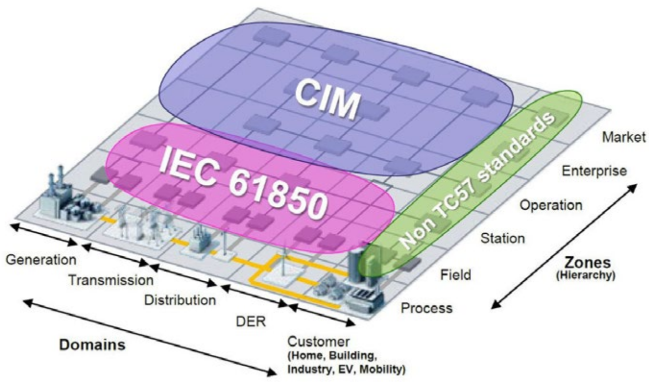


Figure A.3: Smart Grid Architecture Model incorporating CIM and IEC 61850 (source: paper)

- **Oil and Gas:** The Capital Facilities Information Handover Specification (CFIHOS) is an initiative that has emerged out of the International Association of Oil and Gas Producers (IOGP). This aims to provide practical standardised specifications for information handover that work for anyone involved in making, operating, maintaining or decommissioning industrial facilities everyone in the information supply chain – operators, contractors and equipment manufacturers and suppliers.

  The data model and associated data dictionary are both complex pieces of work that have been constantly developed and refined over a 10-year period. The resulting suite of documentation are comprehensive, with screenshots provided over page.

Figure A.4: Capital Facilities Information Handover Specification (source: CFIHOS)

- **Medical Analysis**: The Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM) is an open community data standard, designed to standardize the structure and content of observational data and to enable efficient analyses that can produce reliable evidence. A central component of the OMOP CDM is the Observational Health Data Sciences and Informatics (OHDSI) standardized vocabularies. The OHDSI vocabularies allow organization and standardization of medical terms to be used across the various clinical domains of the OMOP common data model and enable standardized analytics that leverage the knowledge base when constructing exposure and outcome phenotypes and other features within characterization, population-level effect estimation, and patient-level prediction studies.

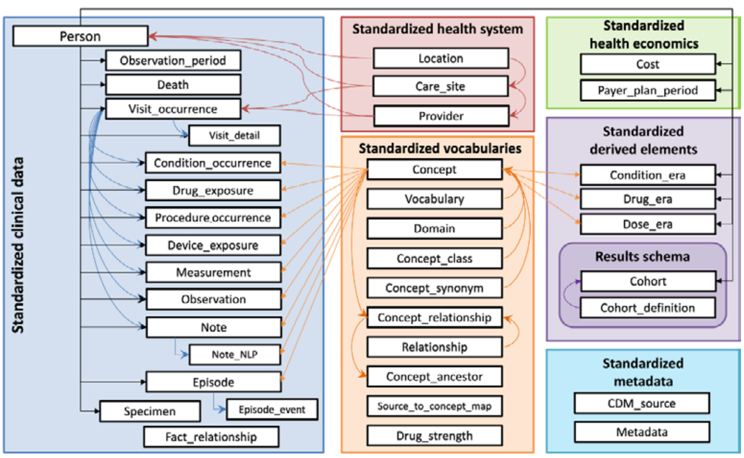


Figure A.5: Observational Health Data Sciences and Informatics (OHDSI) OMOP CDM

- **Microsoft Dataverse:** The Microsoft Common Data Model is a collection of many standardised extensible data schemas with entities, attributes, semantic metadata, and relationships, which represent commonly used concepts and activities in various businesses areas such as automotive, banking, commerce, educational, healthcare, marketing, sales, legal and non-profit institutions.

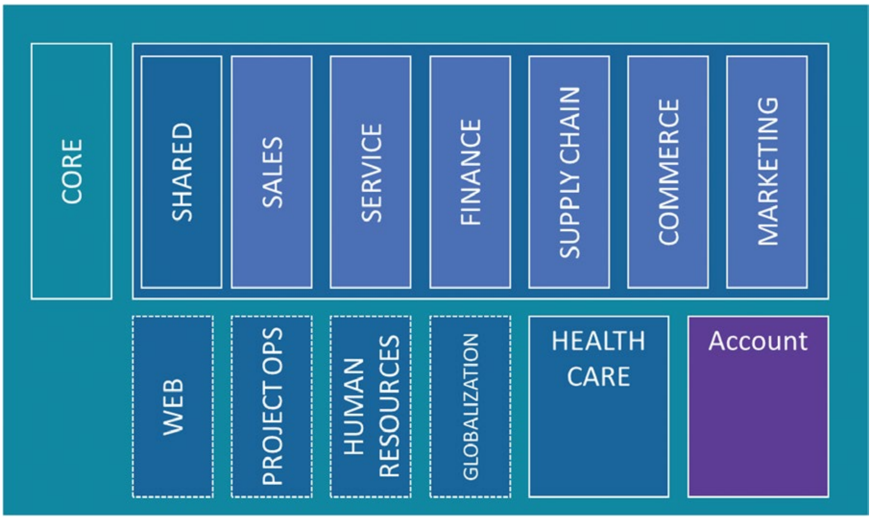


Figure A.6: Microsoft Common Data Model Schema (based on source: Microsoft)

Appendix B: Net Benefit of the Common Data Model

This section explores some of the key net benefits of the CDM, in terms of the following:

B.1 Health and Safety

The engineering and construction sector has the potential to cause significant risks to public health and safety. If communication breaks down on a construction project, poor decisions can lead to dire consequences such as worksite injuries, various forms of environmental pollution (e.g. air, dust, noise etc), stress to individuals, mental health issues and much more. In the long-term, once the new building or facility commences operation, further unforeseen issues arise, which can lead to more long-term health and safety issues.

Poor data management has been identified as a leading cause of poor communication and decision-making on projects. This standard will address this issue by standardising the sector's overall data architecture. The aim is to specifically target and improve how project and asset data is created, managed and exchanged.

The CDM will streamline how project teams share and re-use data, thereby improving communication and the flow of information throughout the engineering and construction sector. This in turn will improve coordination and collaboration between all parties working within the built environment – improving planning and oversight of all construction works. This will help to ensure that projects are delivered safely, and new facilities are safer for the public.

B.2 Community

The engineering and construction sector plays a significant role in the well-being of communities. Successful engineering projects can provide positive outcomes for communities over many generations, helping cities to grow and societies to flourish.

On the flipside, poor project decisions can have major consequences to the success of communities – both in short-term project delivery and long-term project outcomes. It is therefore important for the engineering and construction sector to engage with local communities, through clear and effective methods of communication. This helps to ensure stakeholders can voice their concerns, projects gain feedback from local communities and that overall project goals are aligned.

At present, the effectiveness of community consultation can often be impacted due to a lack of timely access to reliable project data. This in turn negatively impacts community expectations, and damages overall trust in the long-term success of new projects. It is therefore imperative that projects share and gather reliable project data with communities, ensuring clear and effective communication every step of the way.

The CDM will improve data management capabilities for all parties working within the built environment, enabling positive social and community impacts over the complete project and asset lifecycle.

B.3 Environment

The engineering and construction sector plays a significant role the current wellbeing of our environment and more broadly the sustainability of our society. It is estimated that globally this sector currently accounts for approx. 39% of global carbon emissions, meaning that reducing carbon emissions in construction will have a pivotal impact around the world.

In recent years, projects have become more focussed on environmental and sustainability outcomes, particularly with regard to carbon. Much of this requires detailed estimation and analysis of embodied carbon, to identify and compare options for reduced carbon output. This is currently challenging however, due to inconsistent and unreliable data currently available on physical assets and project activities.

By standardising the data architecture of the engineering and construction sector, all parties will have access to reliable project and asset data. The CDM will enable a step change in how carbon is calculated and managed throughout the built environment. Carbon estimates may be calculated and reported based on standardised asset breakdowns, resulting in more reliable data on the sector overall.

This will put the sector in a better position to manage and reduce carbon emissions, unlocking positive environmental outcomes for the industry and society overall.

B.4 Competition

It is well known that the engineering and construction sector has a poor track record when it comes to digital transformation. It is one of the least digital sectors and is consistently ranked towards the bottom when compared with other industries. In Australia, the sector lags behind other comparable sectors, with research identifying the current lack of digital leadership and poor data literacy being two major concerns (out of many) negatively impacting industry performance.

There is now an opportunity to shift this paradigm, using digital engineering and more contemporary forms of data management. This proposed standard will provide clear instructions for how organisations (both public and private) can improve their data management capability by using a common data model. This will enable a step change in data management and exchange throughout the sector, and will lower the bar of entry for less “digitally mature” organisations.

The development of the CDM will also drive sector-wide digital transformation, which will position the Australian sector to be a global leader in this space. This will improve the global competitiveness of Australian organisations, when competing on major projects, both locally and abroad.

B.5 Economy

Engineering and construction projects are some of the largest investments that governments make. Major transport projects are particularly significant, due to both their positive impact to society and their associated costs (which are now frequently in the 10's of billions). When major projects are not delivered to plan, this can often result in time and cost overruns with substantial economic impacts to society. Poor quality project data, and the lack of data driven decisions have been identified as some of the leading causes of project overruns.

Digital engineering aims to address the root causes of these project overruns, by improving how project and asset data is created, managed and exchanged. This will ensure all parties working on projects will have access to high-quality, reliable data for more informed data driven decision-making. It also helps to develop predictive analytics and improve project insights, providing controls and early warning well before project issues arise.

The proposed CDM will build digital engineering capability across the sector. This will have a positive impact on project economics and will help to mitigate the risk of overruns on major infrastructure projects.

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